

KINROSS

Great Bear

Great Bear Gold Project Impact Statement

Appendix N-1:

Human Health and Ecological Risk Assessment



GREAT BEAR RESOURCES

GREAT BEAR PROJECT

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

MARCH 2026





GREAT BEAR PROJECT

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

GREAT BEAR RESOURCES

FINAL

PROJECT NO.: OMEMA2303
MARCH 2026

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ABBREVIATIONS

ADAF	Age-dependent adjustment factors
ALCM	Additional Lung cancer Mortality
AEX	Advanced Exploration
ANA	Asubpeeschoseewagong Netum Anishinabek First Nation
BAF	Bioaccumulation factor
B(a)P	Benzo(a)pyrene
B(a)P TPE	Benzo(a)pyrene total potency equivalent
BC MWLRS	British Columbia Ministry of Water, Land and Resource Stewardship
BCF	Bioconcentration factor
Cal EPA	California Environmental Protection Agency
Cal OEHHA	California Office of Environmental Health Hazard Assessment
CAP	Criteria air parameters
CAAQS	Canadian Ambient Air Quality Standards
CCME	Canadian Council of Ministers of the Environment
DPM	Diesel particulate matter
DOC	Dissolved organic carbon
ECCC	Environment and Climate Change Canada
EPC	Exposure point concentration
ERA	Ecological Risk Assessment
FCSAP	Federal Contaminated Sites Action Plan
FNFNES	First Nations Food, Nutrition, and Environment Study
FWQG	Federal Water Quality Guideline
fVC	Federal valued component
HHERA	Human Health and Ecological Risk Assessment
HHRA	Human Health Risk Assessment
HQ	Hazard quotient
IAAC	Impact Assessment Agency of Canada
IACR	Index of Additive Cancer Risk
IK	Indigenous Knowledge
ILCR	Incremental lifetime cancer risk
IUR	Inhalation unit risk
LAF	Life adjustment factor
LCR	Lifetime cancer risk
LOAEL	Lowest observed adverse effect level
LOE	Line of evidence
LSA	Local study area
LSFN	Lac Seul First Nation
MECP	Ministry of the Environment, Conservation and Parks
MPOI	Maximum point of impingement
NO ₂	Nitrogen dioxide
NOAEL	No observed adverse effect level
NWMOC	Northwestern Ontario Métis Community
OTR98	Ontario Typical Range Soil Chemistry
PA	Project area
PAH	Polycyclic aromatic hydrocarbon
PEF	Potency equivalence factor
PM _{2.5}	Particulate matter less than 2.5 micron in diameter
POD	Point of departure
POPC	Parameter of potential concern
POR	Point of reception
PQRA	Preliminary quantitative risk assessment
pVC	Pathway valued component

RAF	Relative absorption factor
RfC	Reference concentration
RfD	Reference dose
RLEF	Indigenous people in Red Lake and Ear Falls
ROC	Receptors of concern
RSA	Regional study area
RSL	Regional Screening Levels
SAR	Species at Risk
SCS	Site condition standards
SQG	Canadian Soil Quality Guidelines
TISG	Tailored Impact Statement Guidelines
TKLUS	Traditional Knowledge Land Use Study
TPE	Total potency equivalents
TRV	Toxicity reference value
UCLM	Upper confidence limit of the mean
US EPA	United States Environmental Protection Agency
VOC	Volatile organic compound
VMF	Viggo management facility
WFN	Wabauskang First Nation
WQG	Water quality guideline



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ATTACHMENTS

- A BASELINE DATA
- B PREDICTED ENVIRONMENTAL MEDIA CONCENTRATIONS
- C IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN
- D HHRA INHALATION MODEL DESCRIPTION
- E HHRA MULTI-MEDIA MODEL DESCRIPTION
- F ERA MODEL DESCRIPTION

1 INTRODUCTION

Great Bear Resources Ltd. (Great Bear Resources), a wholly owned subsidiary of Kinross Gold Corp., is planning to develop, operate and eventually reclaim a new gold mine on the Great Bear Property (the Property) located east of Red Lake, Ontario (Figure 1-1). The Property was acquired by Kinross Gold Corp. in 2022 in support of an objective to re-establish a long-term presence in Ontario. The Great Bear Gold Project (Project) is a proposed underground and open pit mine and process plant with related facilities.

The Property is located in the unorganized townships of Faulkenham Lake, South of Byshe, Dixie Lake and Bruce Lake near Highway 105, approximately 25 kilometres (km) southeast of the Municipality of Red Lake and 37 km northwest of the Township of Ear Falls (cross country distances; Figure 1-1).

The Impact Assessment Agency of Canada (IAAC) determined that a federal Impact Assessment pursuant to the *Impact Assessment Act*, 2019 (S.C. 2019, c. 28, s. 1) for the development of an Impact Statement is required to be completed for the Project. This report is one of a series of modeling reports prepared by WSP Canada Inc. (WSP) on behalf of Great Bear Resources to support the Impact Statement for the Project.

The construction and operation of the Project may emit parameter constituents into air (through fugitive dust, vehicle exhaust and direct facility emissions) and water (through permitted emissions and runoff). These parameters of potential concern (POPCs) include criteria air parameters (CAPs), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), diesel particulate matter (DPM) and / or metals / metalloids (hereinafter referred to collectively as metals). Emissions from the Project may result in changes in environmental quality (air, soil, water and food). Human and ecological receptors (i.e., terrestrial plants and invertebrates, wildlife and aquatic life) around the Project may be exposed to these POPCs in site media through various potential exposure pathways. For people, food includes traditional foods (i.e., vegetation, fish and wild game) and garden produce and, for wildlife, food includes plants and prey. The human health and ecological risk assessment (HHERA), which consists of a human health risk assessment (HHRA) and an ecological risk assessment (ERA; including both a terrestrial and aquatic ERA), evaluates exposure to media and food to determine potential health risks from the proposed Project.

1.1 PURPOSE AND OBJECTIVE OF THE REPORT

This HHERA has been prepared to:

- Evaluate Project-related health effects on human and ecological receptors.
- Determine the exposures and associated risks under existing conditions (baseline) as well as those that are predicted to occur from Project-related POPCs under Project alone and baseline plus Project scenarios for each of the Project phases (i.e., construction, operations and closure).
- Evaluate and summarize the predicted Project-related changes in human and ecological health risks for each of the Project phases and compare the changes between baseline and Project contributions.

This HHERA was prepared in accordance with industry best practices and to address the Tailored Impact Statement Guidelines (TISG) for the Project as issued by IAAC, dated August 1, 2024. There are three health-specific technical appendices that inform the assessment of Indigenous health in the Impact Statement for the Project, the:

- HHERA
- HIA Report (WSP 2026b)
- Mercury Bioaccumulation Study for Downstream English River to Wabigoon System Waterbodies (IS Appendix T; WSP 2026a)

Collectively these sources contribute to the inputs, assumptions, approaches and methods (quantitative and qualitative) applied in support of assessing Project effects on Indigenous health, which are also assessed in federal valued component (fVC) subsections for Indigenous Peoples health (Section 10 to Section 14 of the Impact Statement under separate cover) for Lac Seul First Nation (LSFN), Wabauskang First Nation (WFN), Asubpeeschoseewagong Netum Anishinabek (ANA,) Northwestern Ontario Métis Community (NWOMC) and Indigenous people in Red Lake and Ear Falls (RLEF), respectively.

1.2 PROJECT OVERVIEW

Great Bear Resources is planning to develop, operate and eventually reclaim a new gold mine on the Property, comprised of underground workings and two open pits with associated processing facilities and infrastructure (Figure 1-2). The Project layout places the required mine-related facilities near the underground ore deposit on lands held by Great Bear Resources and will re-use and expand on facilities developed as part of the Advanced Exploration (AEX) Program as reasonable.

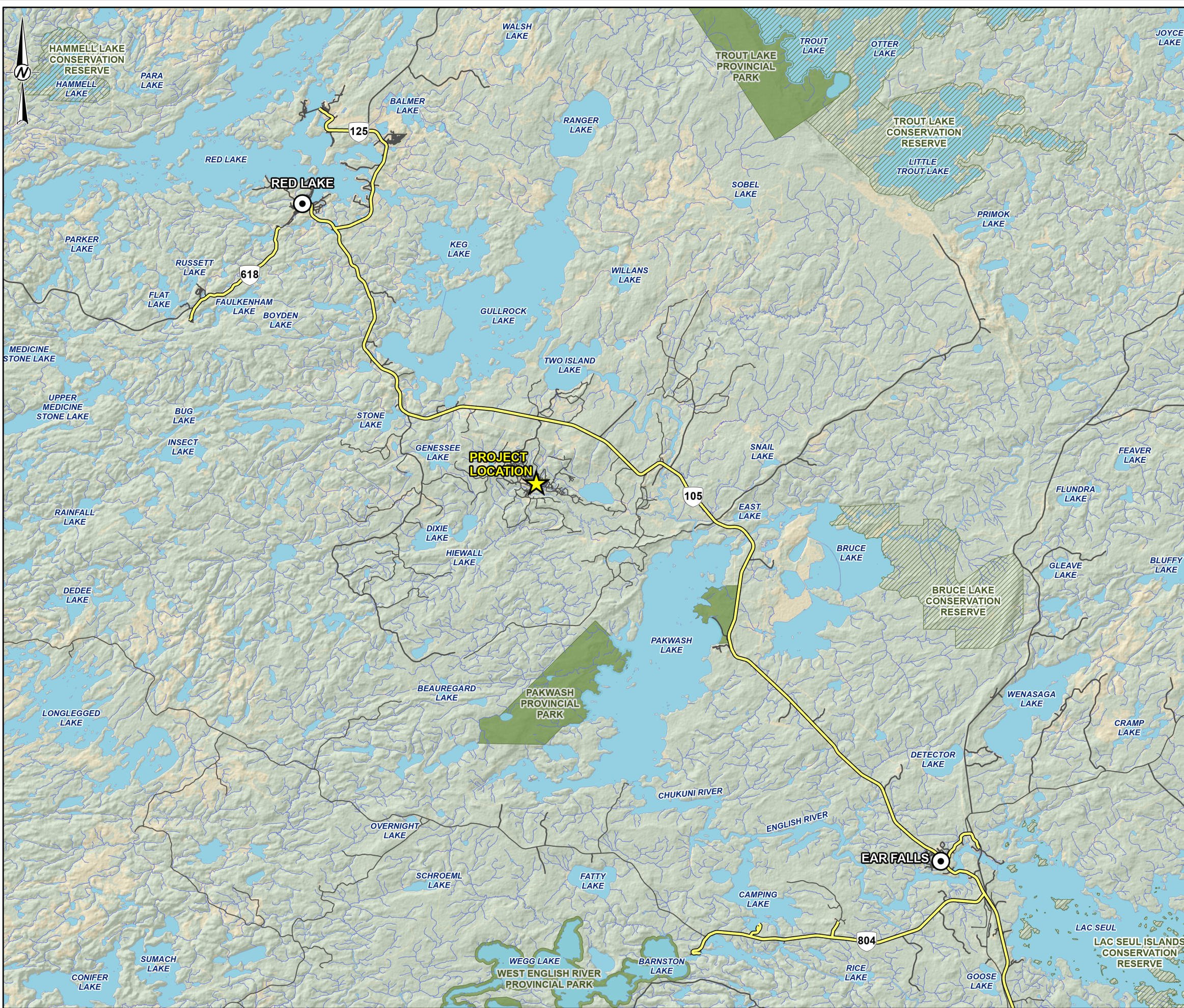
The site is accessible by Tuzyk's Road, which connects the Property to Highway 105. Access south of the commercial aggregate operations is proposed to be restricted, for security and safety reasons. A security checkpoint will be established at that location, and the road to the south will be repurposed as the mine access road.

The major components of the Project include:

- Underground mine.
- Open pits (two): LP Central pit and Viggo pit.
- Surface stockpiles: overburden stockpile, mine rock stockpile, low grade ore stockpile and run of mine ore stockpile).
- Ore process plant.
- Facilities to manage tailings from the processing of ore: tailings management facility and Viggo management facility (VMF; after construction phase).
- Water management and treatment works.
- Dedicated aggregate operations to produce aggregate for onsite use.
- Other onsite buildings, facilities, areas and infrastructure.

In addition to the mine site footprint, the Project Area (PA) includes the area between proposed facilities and provides a buffer around the proposed mine site footprint to accommodate potential Project optimizations (Figure 1-3).

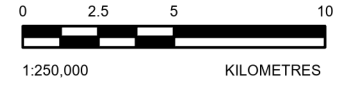
The Project is expected to be developed over a three-year construction period (Years -3 to -1). The operations phase is anticipated to last approximately 26 years (Years 1 to 26) during which overburden, ore and mine rock will be extracted from the underground mine workings and LP Central pit, then transported and processed to recover gold and silver to produce doré bars. Closure of the Project will be completed in accordance with the *Ontario Mining Act* and its associated Regulations and Codes. The decommissioning and closure period will include a three-year active closure period (Years 27 to 29), followed by a one-year passive closure period (Year 30), followed by a final closure period where removal of water management and infrastructure will occur (Year 31). The decommissioning and closure period will be followed by a period of post-closure environmental monitoring (Years 32+).



SCALE: 1:30,000,000

LEGEND

- PROJECT LOCATION
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- RESOURCE / RECREATION ROAD
- WATERCOURSE
- WATERBODY



NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. WATERCOURSES AND WATERBODY ACQUIRED FROM LAND INFORMATION ONTARIO (MNR) AND MODIFIED TO MATCH AERIAL IMAGERY AND LIDAR.
3. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT

GREAT BEAR RESOURCES

PROJECT

GREAT BEAR PROJECT

TITLE

PROJECT LOCATION

CONSULTANT



YYYY-MM-DD	2025-09-17
DESIGNED	----
PREPARED	MD
REVIEWED	----
APPROVED	----

PROJECT NO.
CA0031272

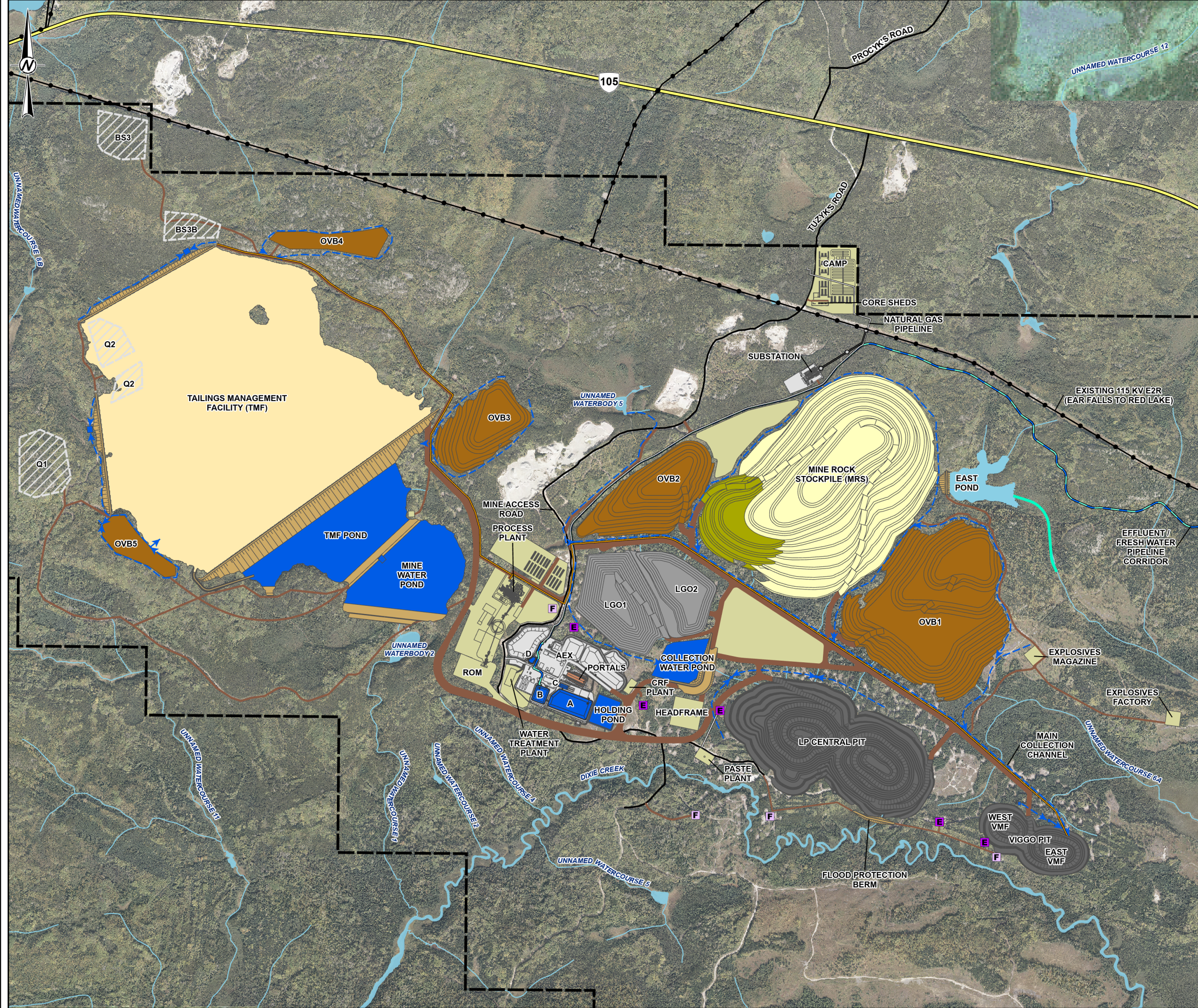
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FIGURE
1-1

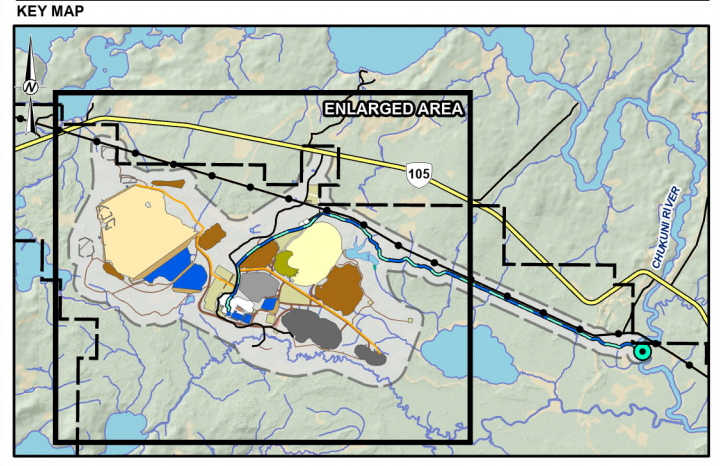
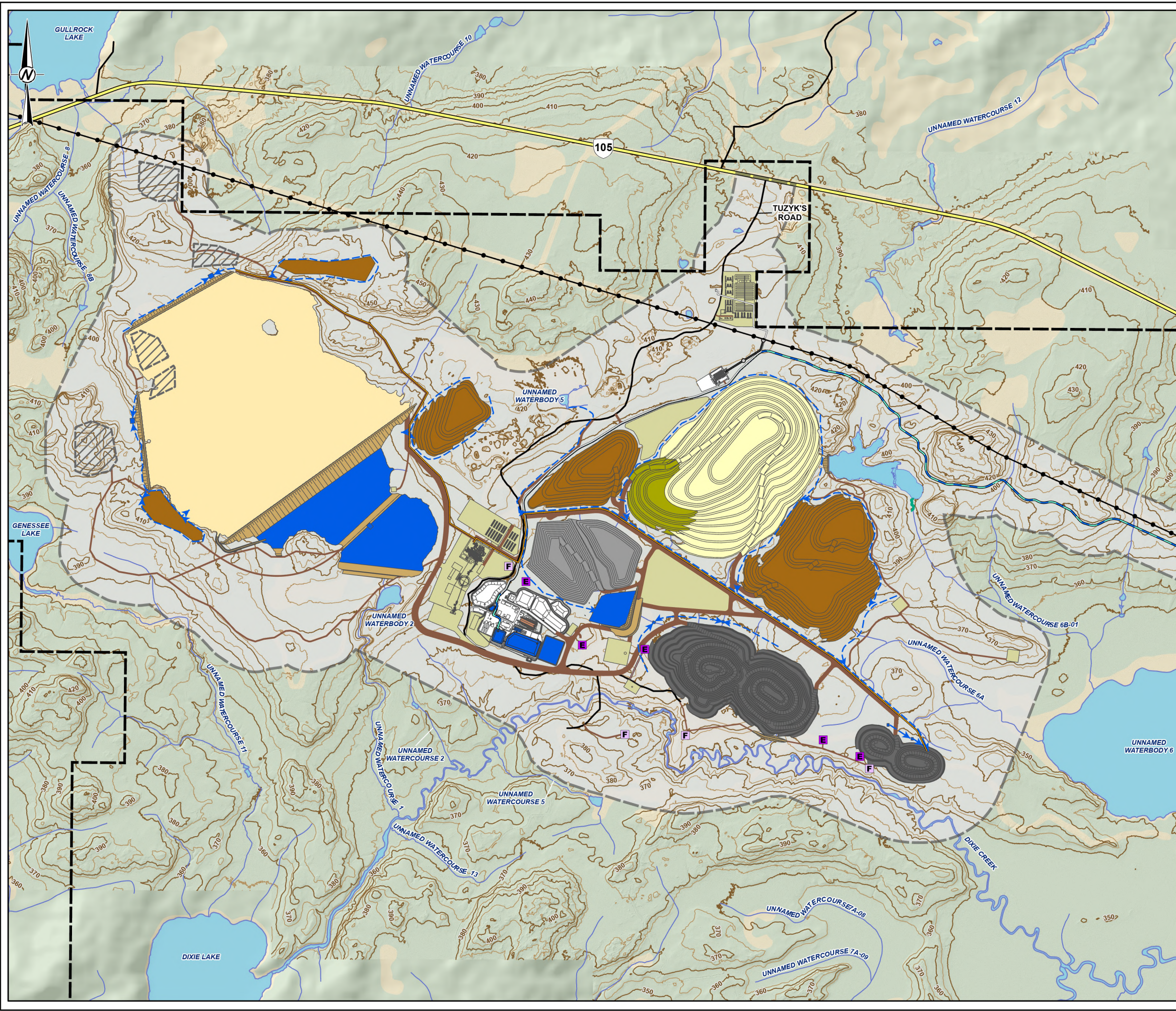
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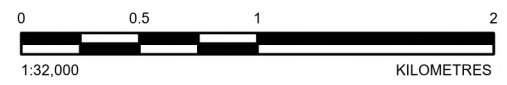


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- LEGEND**
- PROPERTY BOUNDARY
 - PROJECT AREA (PA)
 - HIGHWAY (INCLUDING ENBRIDGE PIPELINE)
 - LOCAL ROAD
 - EXISTING TRANSMISSION LINE
 - WATERCOURSE
 - WATERBODY
 - MAJOR CONTOURS (10 M INTERVAL)
 - MINOR CONTOURS (5 M INTERVAL)
- PROPOSED MINE FEATURE**
- OPEN PIT
 - MINE ROCK STOCKPILE (NPAG)
 - MINE ROCK STOCKPILE (PAG)
 - LOW GRADE ORE STOCKPILE (LGO)
 - OVERBURDEN STOCKPILE (OVB)
 - TAILINGS MANAGEMENT FACILITY (TMF)
 - DAM
 - POND
 - COLLECTION DITCH
 - MINE FACILITIES / INFRASTRUCTURE
 - ROAD
 - PORTAL
 - ADVANCED EXPLORATION SITE (AEX)
 - ROCK QUARRY (Q) / SAND AND GRAVEL PIT (B)
 - DIVERSION CHANNEL
 - EXHAUST VENT RAISE
 - FRESH AIR VENT RAISE
 - TRANSMISSION LINE
 - TAILINGS PIPELINE
 - PASTE PLANT PIPELINE
 - EFFLUENT / FRESH WATER PIPELINE CORRIDOR
 - EFFLUENT DISCHARGE LOCATION



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. CONTOURS ACQUIRED FROM 2022 LIDAR SURVEY.
 3. PROPERTY BOUNDARY PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2024.
 4. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 5. SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025.
 6. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
PROJECT AREA

CONSULTANT	YYYY-MM-DD	2026-03-31
	DESIGNED	---
	PREPARED	MD
	REVIEWED	---
	APPROVED	---



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2 OVERVIEW OF THE RISK ASSESSMENT PROCESS

An HHRA is the process of estimating the nature and probability of adverse health effects in humans who may be exposed to POPCs in environmental media, now or in the future. Similarly, an ERA assesses potential health risk to ecological receptors who may be exposed to POPCs in environmental media. All parameters (from both anthropogenic and natural sources) have the potential to cause adverse effects. However, the magnitude of effect (risk) depends on the receptor being exposed, the route, magnitude and duration of exposure and the inherent toxicity of the POPC. If all three components (receptor, exposure and hazard) are present (i.e., where the three circles in Figure 2-1 intersect) the possibility of risk exists. If one or more of the three components is missing, then there would be no risk.

The HHRA and ERA process involves the following four fundamental steps, which will be discussed in the sections below:

- Problem formulation
- Exposure assessment
- Toxicity / effects assessment
- Risk characterization.

The HHRA and ERA followed Federal guidance recommended by Health Canada (2023a) and Canadian Council of Ministers of the Environment (CCME 2020), respectively.

2.1 PROBLEM FORMULATION

The problem formulation is the initial screening and decision-making step. Its purpose is to distinguish between receptor-POPC-exposure pathways for which further quantitative analysis is warranted and those that do not warrant further analysis either because the potential for risk is negligible or because a simple solution for mitigating the potential exposure exists.

The problem formulation includes three key aspects: identification of POPCs, characterization of receptors that could be exposed to the POPCs and characterizing the exposure pathways by which exposure to the POPCs may occur.

The POPCs are identified by comparing the concentrations in the application media (i.e., air, soil, surface water and sediment) to screening values protective of human health and ecological receptors.

Receptors within the HHRA are people in the Local Study Area (LSA) (Figure 2-2) and Regional Study Area (RSA) (Figure 2-3) who have a high potential for exposure to POPCs. Within the ERA, receptors are any non-human individual, species, population, community, habitat or ecosystem that may potentially be exposed to POPCs in the LSA and RSA. These commonly include terrestrial and / or aquatic plants, invertebrates, birds, mammals and fish.

The problem formulation evaluates which exposure pathways are considered complete to the human or ecological receptors. The exposure pathways may be direct (e.g., ingestion of surface water) or indirect (e.g., ingestion of fish exposed to surface water).

2.2 EXPOSURE ASSESSMENT

The exposure assessment is conducted for all relevant parameters, exposure pathways and receptors identified in the problem formulation. For some pathways, the exposure assessment involves the estimation of the intake of POPCs by human and ecological receptors. The total estimated intake of POPCs is calculated via the sum of intakes from each exposure pathway identified in the problem

formulation. This step involves the determination of exposure point concentrations (EPCs) for each parameter in the various environmental media, either by direct measurement or predictive modelling. The exposure assessment also includes the intake rate of each environmental media by the relevant receptors.

2.3 TOXICITY/ EFFECTS ASSESSMENT

The toxicity / effects assessment is completed for all relevant POPCs identified in the problem formulation and involves the identification of the toxic endpoints for each. It involves the determination of either: a) a maximum dose or concentration of each parameter to which a receptor can be exposed without an appreciable amount of adverse health effect occurring (threshold dose or concentration); or b) the relationship between dose and incidence or severity of adverse effect (dose-response identification). In most cases the toxicity assessment involves the selection of a benchmark or toxicity reference value (TRV) recommended by an appropriate regulatory agency (such as Health Canada, Environment and Climate Change Canada, the Ministry of the Environment, Conservation and Parks; MECP, or the CCME). In cases where a regulatory published TRV is not available, a TRV is identified from an evaluation of the most current state of science, based on a review of peer-reviewed study manuscripts presenting scientific data. Both the type of health effect (e.g., cancer and non-cancer) and the pathway by which a receptor is exposed to the parameter (e.g., ingestion and inhalation) will be considered when selecting appropriate toxicity reference values.

2.4 RISK CHARACTERIZATION

The risk characterization step involves qualitatively and / or quantitatively evaluating the potential risks to receptors resulting from exposure to each parameter. The risk characterization step is done for all parameters and exposure pathway / receptor combinations identified in the problem formulation step. The risk characterization involves the following:

- Integration of exposure and toxicity assessments to calculate a risk value; and comparison of the risk value to a regulatory target of risk to determine the level of acceptability. Uncertainty is an inherent aspect of the risk assessment process due to necessary assumptions regarding the Project site, receptor characteristics and mathematical modelling. Uncertainties may arise from a number of areas due to some inherent lack of precision about the true value of a parameter (e.g., body weight, inhalation rate, ingestion rate). Uncertainties are accounted for by assuming conservative receptor and exposure scenarios to exaggerate exposures to help ensure that risks are not underestimated. In the framework for the HHERA specific to the Impact Assessment process, potential risks are discussed in the context of the assessment scenarios. That is, the potential risks identified for the combination of baseline and Project (i.e., baseline plus Project) are evaluated for each phase of the Project. The risks identified for the construction, operations and closure phases and post-closure are discussed relative to the baseline conditions that would occur in the absence of the Project, wherever appropriate. A more detailed description of the assessment scenarios is provided in Section 3.4. For human and ecological receptors, a potential adverse effect is defined when the risk for the Project (i.e., Project plus baseline) via the sum of all exposure pathways, is greater than the acceptable risk target and the estimated potential risk for the baseline scenario.

Human health exposure to CAPs is only operable via the inhalation of air pathway and therefore potential adverse effects were characterized based on the inhalation pathway alone. Whereas, for parameters that can contribute to increased concentrations in other media through deposition, such as inorganic metals (including mercury), human and ecological exposure may be exposed via several pathways, including inhalation, direct contact with soil, and ingestion of water, sediment and food. Therefore, potential adverse effects are characterized based on the sum of all exposure pathways in a multi-media assessment.

2.5 REGULATORY CONTEXT

The HHERA has been conducted according to industry accepted risk assessment practices and methodologies and follows guidance published and endorsed by government agencies. This approach is consistent with previous projects in Ontario that have been reviewed by IAAC. The following guidance documents were relied upon in the HHERA:

- Guidance for Evaluating Human Health Impacts in Impact Assessment: Human Health Risk Assessment (Health Canada 2023a)
- Guidance for Evaluating Human Health Impacts in Impact Assessment: Air Quality (Health Canada 2023b)
- Guidance for Evaluating Human Health Impacts in Impact Assessment: Country Foods (Health Canada 2023c)
- Guidance for Evaluating Human Health Impacts in Impact Assessment: Drinking and Recreational Water Quality (Health Canada 2023d)
- Federal Contaminated Site Risk Assessment in Canada: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA) Version 4.0 (Health Canada 2024)
- Federal Contaminated Site Risk Assessment in Canada: Toxicological Reference Values (TRVs) and Chemical-Specific Factors Version 3.0 (Health Canada 2025a)
- Federal Contaminated Site Risk Assessment in Canada: Supplemental Guidance on Human Health Risk Assessment for Oral Bioavailability of Substances in Soil and Soil-Like Media (Health Canada 2017a)
- Federal Contaminated Site Risk Assessment in Canada: Supplemental Guidance on Human Health Risk Assessment for Air Quality (Health Canada 2017b)
- Federal Contaminated Site Risk Assessment in Canada: Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals (DQRACHEM) (Health Canada 2010)
- CCME Ecological Risk Assessment Guidance (CCME 2020)
- Federal Contaminated Sites Action Plan: Ecological Risk Assessment Guidance (FCSAP 2012a)
- Federal Contaminated Sites Action Plan: Ecological risk assessment guidance - Module 6: ecological risk assessment for amphibians on federal contaminated sites. (ECCC 2019)
- Rationale for the Development of Soil and Ground Water Standards for Use at Contaminated Sites in Ontario (MECP 2011).

2.6 INCORPORATION OF INDIGENOUS KNOWLEDGE

The Project lies within Treaty 3 territory, on the traditional territories of LSFN, WFN, ANA and the NWOMC, and therefore these four communities were considered in the HHERA. As identified in Section 1.1, RLEF were considered as a fifth community in the HHERA, as Indigenous people make up 24% and 19% of the populations of the Municipality of Red Lake and the Township of Ear Falls, respectively..

As part of the Project, LSFN, WFN, ANA, NWOMC and RLEF, were engaged by Great Bear Resources to participate in the Impact Statement process. LSFN, WFN ANA, and NWOMC were invited to provide Indigenous knowledge (IK) and Traditional Knowledge Land Use Study (TKLUS) information, as described in the Impact Statement Section 3 (Participation and Engagement) and detailed in WSP (2026a). It is understood that the IK / TKLUS reports received are confidential; however, IK considerations and information have been considered throughout the Impact Statement.

Each confidential report provided by Indigenous communities was systematically reviewed to identify and extract information relevant to the HHERA. This included both mapping and documenting reported areas of cultural importance and traditional land use activities occurring within the LSA and RSA to help identify areas where people are expected to spend time and identifying species of cultural significance and those commonly consumed as part of traditional food diets.

It is noted that at the time of producing this report, ANA is currently undertaking a Land Use and Occupancy Study. At the time of producing this report, the results of the study were not available. Therefore, it is acknowledged that the species described as being identified by ANA below in this section were not explicitly identified by the community but rather their consumption by ANA community members was assumed based on publicly available secondary sources, for the purposes of the multi-media HHRA model development. The secondary sources used to inform which species are potentially consumed by ANA are included in the Impact Statement Section 3 (Participation and Engagement) and detailed in the Impact Statement Appendix C (Record of Consultation).

Similarly, there was no confidential report available explicitly for the RLEF. For the development of the multi-media HHRA model, the species identified within confidential reports from LSFN, WFN and NWOMC were considered applicable to the RLEF.

The confidential reports and secondary sources were reviewed to identify traditional foods and species of cultural significance for further consideration in the HHRA (Section 4) and the ERA (Section 5).

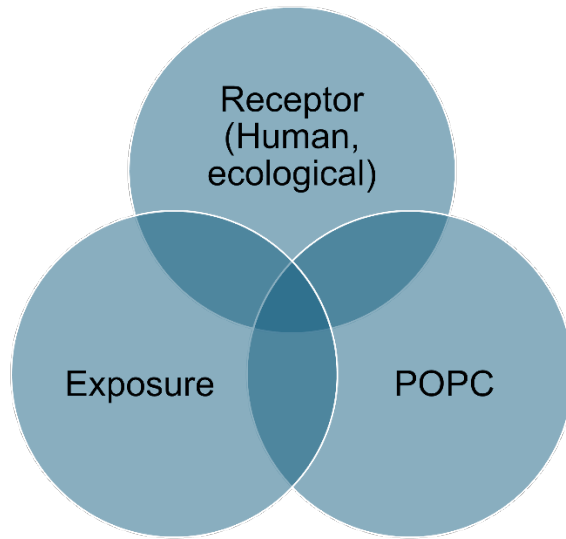
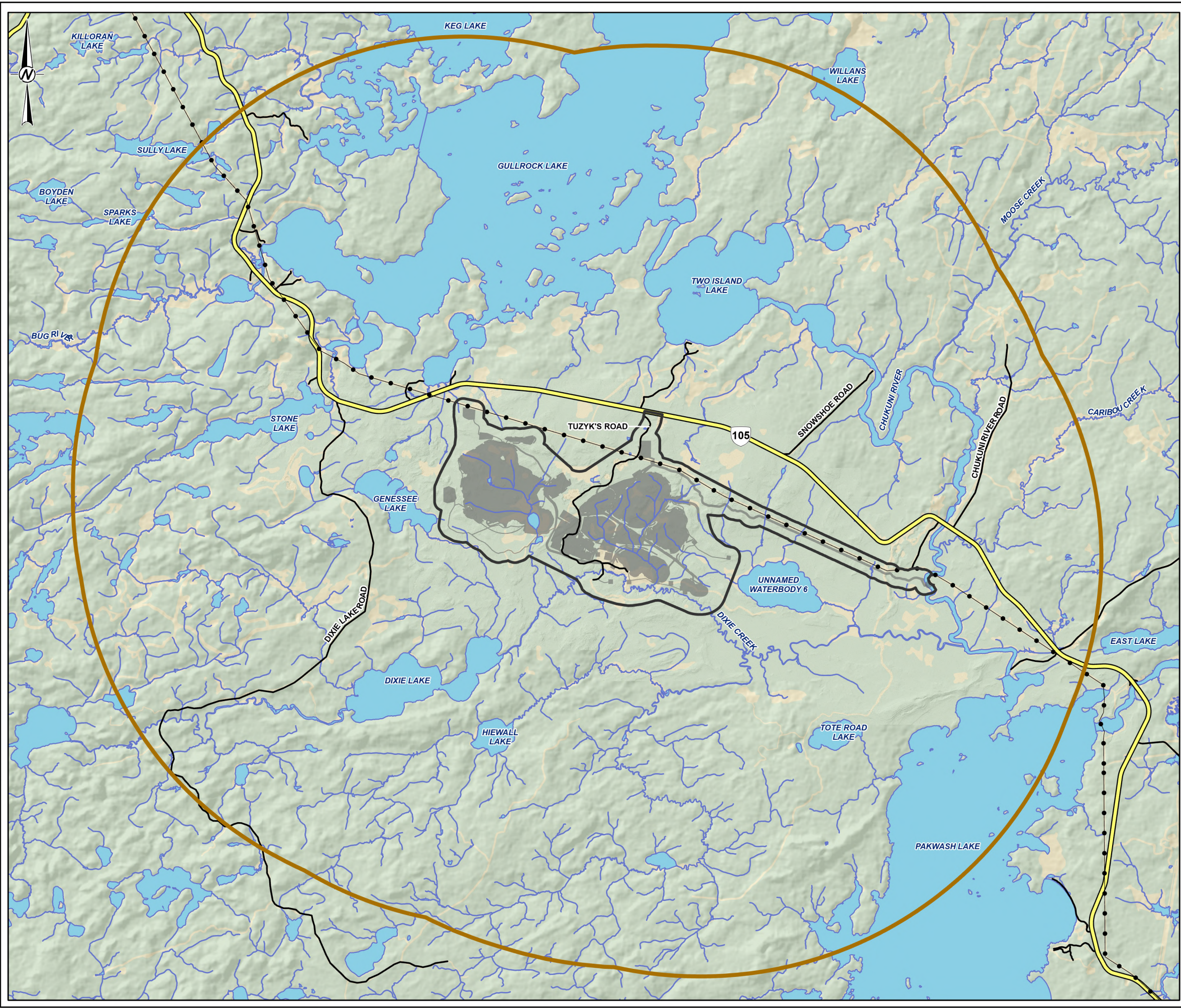
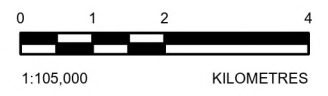


Figure 2-1: Risk Assessment Components



LEGEND

- GREAT BEAR PROJECT FOOTPRINT
- PROJECT AREA
- LOCAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
- HIGHWAY
- LOCAL ROAD
- EXISTING TRANSMISSION LINE
- WATERCOURSE
- WATERBODY



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 3. SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025.
 4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
LOCAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

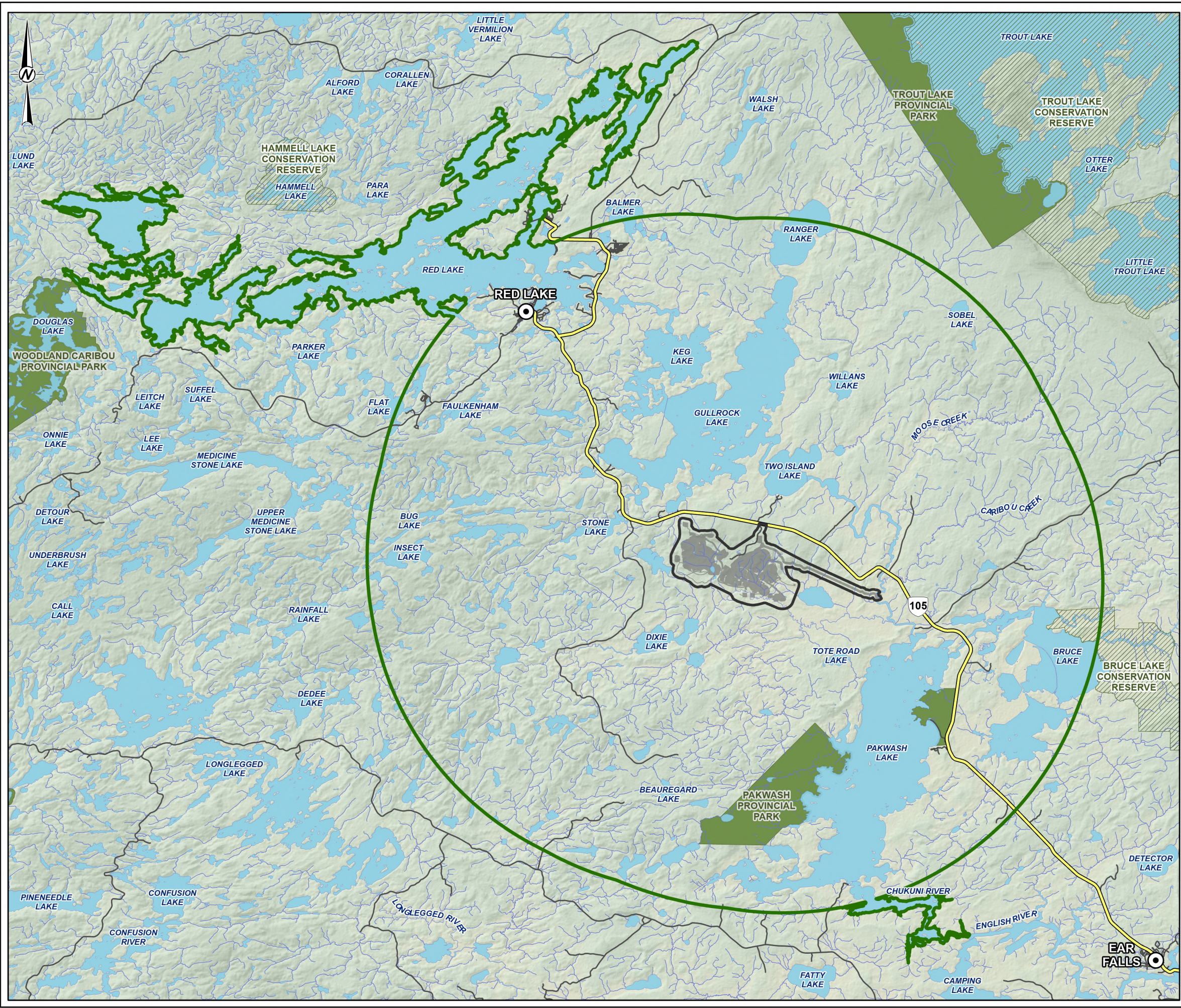
CONSULTANT	YYYY-MM-DD	2026-02-24
	DESIGNED	---
	PREPARED	MD
	REVIEWED	---
	APPROVED	---



PROJECT NO. CA0031271	CONTROL 0001	REV. A	FIGURE 2-2
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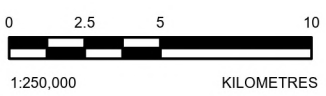
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LEGEND

- GREAT BEAR PROJECT FOOTPRINT
- PROJECT AREA
- REGIONAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 3. SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025.
 4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
REGIONAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

CONSULTANT	YYYY-MM-DD	2026-02-24
	DESIGNED	----
	PREPARED	MD
	REVIEWED	----
	APPROVED	----

PROJECT NO. CA0031271	CONTROL 0001	REV. A	FIGURE 2-3
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3 STUDY AREAS AND ASSESSMENT SCENARIOS FOR THE HHERA

3.1 VALUED COMPONENTS

Valued components are aspects of the natural and human environment that may be affected by the Project and were identified as being of particular concern or value to participants. The selected valued components evaluated in the Impact Statement were characterized as fVCs, which are valued components within federal jurisdiction, or pVCS, which are valued components that provide a pathway through which the Project may directly or indirectly affect fVCs. The full list of valued components assessed in the Impact Statement and rationale for selection is provided in Section 6.3 of the Impact Statement. The valued components informed the identification of human and ecological receptors as summarized in Table 3-1 and discussed in Section 4 and 5 for the HHRA and ERA, respectively.

3.2 SPATIAL BOUNDARIES

The spatial boundaries considered for the assessment of human and ecological health are shown in Figure 2-2 and Figure 2-3 and defined as follows:

- PA: The Project footprint, illustrated in Figure 1-3, Figure 2-2 and Figure 2-3 including all temporary and permanent areas associated with the mine site development, as well as an outside buffer to allow flexibility for design optimizations prior to construction and over the mine life.
- LSA: The LSA is illustrated in Figure 2-2 and extends beyond the PA and is intended to capture potential direct effects from the Project (such as emissions, discharges and habitat loss) and indirect effects resulting from the Project. The HHERA LSA is a combination of both the air quality and surface water system LSAs. The LSA for human and ecological health encompasses the area adjacent to the PA to capture the maximum predicted ground-level concentrations due to the Project and where air quality can be predicted or measured with a reasonable degree of accuracy. This zone includes the leased claims boundary and extends approximately 10 km from the main area of the PA (excluding a buffer for the Chukuni River pipelines or pump house). For surface water, the LSA includes sub-watersheds of Dixie Creek that intersect with the PA, as well as the Chukuni River (the receiving environment). It also includes the Chukuni River upstream to the Snowshoe Rapids Dam, and downstream to the outlet of Pakwash Lake.
- RSA: The RSA is illustrated in Figure 2-3 and encompasses the PA and LSA and, where appropriate, extends further to support a regional context in the assessment of potential Project effects. It is the maximum geographical extent or zone of influence in which potential effects from the Project are assessed. The RSA for human and ecological health is a combination of both the air quality RSA, which is 10 km further than the LSA, and surface water system RSA, which encompasses the LSA and extends into the Dixie Creek watershed, encompassing Dixie Lake and Hiewall Lake. Upstream, it follows the Chukuni River to include Two-Island Lake, Gullrock Lake, Keg Lake and Red Lake. Downstream, the RSA continues through Pakwash Lake and along the Chukuni River to its confluence with the English River.

3.3 TEMPORAL BOUNDARIES

The temporal boundaries used in the HHERA were selected to be consistent with those used in evaluating the effects of the Project:

- Construction phase (3 years): Years -3 to -1, representing the construction period for the Project. Mining of the Viggo pit will be completed during this phase. Development in the LP Central pit will be initiated in the last year of construction.
- Operations phase (26 years): Years 1 to 26, with the first year representing the transition from construction into operations where the mine will not be at full capacity. Underground mine and ore processing will occur over the entire period; open pit mining in the LP Central pit will be completed in about nine years.
- Closure phase (5 years):
 - Years 27 to 29 represent the active closure period when the majority of the decommissioning and reclamation of the PA is completed (water treatment infrastructure will remain in place).
 - Year 30 is a passive closure period while the site is on care and maintenance as filling of the mine workings with water is completed and excess water is treated.
 - Year 31 is the final closure period after the LP Central pit is filled with water, the water treatment infrastructure is removed, and site waters are acceptable for passive release to the environment, and the filled LP Central pit lake will be reconnected to the natural water system.

The construction, operations and closure phases (estimated duration of 32 years) are deemed suitable to capture all of the environmental effects associated with the Project. The HHERA evaluation at post-closure will reflect predicted exposures from conditions after closure is complete.

3.4 ASSESSMENT SCENARIOS

Baseline Scenario

The baseline scenario (i.e., existing conditions) considers potential risk to human and ecological health associated with present, pre-Project conditions, including ambient environmental conditions and existing sources of potential risk (including parameter concentrations in soil, sediment, water, air and food). The baseline assessment scenario represents the level of risk that would be experienced in the vicinity of the Project should the Project not proceed.

The baseline scenario incorporates existing parameter concentrations in exposure media (e.g., soil, sediment, water, air, traditional foods), obtained from the results of baseline sampling completed. The use of existing measured data is supplemented by estimated concentrations where data gaps have been identified (e.g., estimated baseline parameter concentrations in traditional foods and food items consumed by wildlife, based on published uptake equations and factors).

Project Alone Scenario

The Project alone scenario evaluates potential human or ecological health risks from predicted incremental changes to parameter concentrations in the environment associated with the Project, including construction, operations and closure phases, and post-closure (i.e., concentrations that do not consider the contribution that baseline scenario concentrations make to overall exposure). The effects of this scenario on human and ecological health are calculated to help inform the Impact Statement decision and provide an estimate of the Project's contribution to overall health effects.

Baseline Plus Project Scenario

The baseline plus Project scenario includes the consideration of the anticipated Project alone scenario conditions in combination with the baseline scenario. This assessment scenario evaluates the contributions of the Project in addition to baseline conditions for all phases of the Project defined above:

construction, operations and closure. The baseline plus Project scenario represents the levels of exposure that would be experienced in the vicinity of the Project should the Project proceed.

Cumulative Effects Scenario

The cumulative effects scenario evaluates the potential effects of the baseline plus Project scenario in combination with effects from reasonably foreseeable future activities within the RSA, where applicable. In Section 15 of the Impact Statement (Cumulative Effects Assessment), the cumulative effects assessments for air quality and water quality indicated that, as the potential changes identified for other existing or reasonably foreseeable projects will not overlap spatially or temporally with the Project, or were already included in the assessment of changes to air quality and water quality from the Project, a cumulative effects assessment is not required. Therefore, the cumulative effects scenario was not assessed within the HHERA.

3.5 PROJECT SETTING

The objective of this section is to provide an overview of parameter emissions and releases (i.e., exposure pathways), receptors and risk management measures incorporated into the design of the Project for each of the temporal boundaries of the HHERA. A more detailed description of exposure pathways and receptors relevant to the HHRA and ERA are discussed within those respective subsections.

3.5.1 PROPERTY INFORMATION

The Project site is an active mineral exploration area and there are no historic buildings or facilities present on the Property from the grassroots exploration work. Core storage is present on the Property from the ongoing drilling programs of Great Bear Resources.

There is a long history of documented exploration work on the Property beginning in 1945 to present day. Grass roots exploration has included mapping, prospecting, surface diamond drilling and geophysical work. Great Bear Resources is continuing surface exploration to assess the mineral potential of the Property and has initiated an AEX Program near the centre of the Property to extract a bulk ore sample. The objective of the AEX Program and the ongoing surface exploration drilling is to collect information to assist with engineering design. The Project site is accessible from the provincial road network by means of a local unpaved road (Tuzyk's Road), which is connected to Highway 105. A dedicated airstrip is not proposed for the Project. A helipad will be maintained near the services and administration area to support medical evacuations and field investigations. The location of the PA centroid is Universal Transverse Mercator 5633910 Northing, 455665 Easting (NAD83, Zone 15N).

3.5.2 PROJECT DESCRIPTION SUMMARY

This section provides an overview of the proposed Project phases, components and undertakings. Additional details are provided in Section 5 of the Impact Statement.

Ore extraction from the open pit and / or underground mine and onsite ore processing is planned to occur at a nominal combined rate up to 15,000 tonnes per day or less. Unconsolidated surface materials (overburden) and mine rock will also need to be removed from the open pits and underground workings to access the ore. There may be periods when the rate of mining ore is higher when only ore is being extracted. Overburden and mine rock will be re-used in Project construction and reclamation as appropriate or stored in surface facilities on the Property.

Processing of mined ore to produce gold and silver (doré) bars will occur on the Property in a conventional process plant designed with a high level of water recycle. Tailings resulting from processing the ore in the process plant will be treated and stored in tailings management facilities on the Property. Contact water within the PA will be collected and managed. Excess water from the PA will be treated to meet all regulatory requirements prior to discharge to the Chukuni River.

Mining and processing operations will be supported by other onsite buildings including: mine office and maintenance complex, cold and warm storage buildings, laydown areas and accommodations camp. These will be supported by related roads, power, tankage and piping infrastructure as needed. Solid and liquid wastes will be collected and managed in accordance with regulatory requirements. Hazardous wastes will be transported to existing facilities off site.

Great Bear Resources has focused on designing a compact and highly efficient mine footprint, supported by extensive engineering and environmental studies. The main components of the Project have been listed in Section 1.2 and are shown in Figure 1-2.

3.5.3 DESCRIPTION OF PROJECT PHASES

3.5.3.1 CONSTRUCTION PHASE

Construction can begin once the impact assessment process is completed and initial environmental approvals are received. The construction phase is expected to take approximately three years.

Primary construction phase activities are expected to include:

- Refinement of environmental management planning and documentation to support construction activities.
- Development of construction camp, associated infrastructure and staging areas (the camp is designed to accommodate 1,000 people on a temporary basis during construction and then be scaled down during operations).
- Site preparation activities including clearing, grubbing and bulk earthworks.
- Onsite haul and access road construction.
- Establishment and operation of water management and treatment facilities.
- Completion of stripping of overburden, and extraction of mine rock and ore from Viggo pit, and initiation of these activities in the LP Central pit.
- Expansion of the AEX underground workings including production mining with stockpiling of ore on surface.
- Management of stripped overburden including storage in designated stockpiles and re-use in construction.
- Management of extracted mine rock according to the metal leaching and acid rock drainage management plan.
- Stockpiling of ore for future processing.
- Onsite quarry, and sand and gravel (aggregate) resource development and operation.
- Construction of diversions, dams and berms for water collection and management, and associated with for future tailings storage.
- Establishment of offsetting and compensation-related features.
- Construction of permanent buildings and infrastructure.
- Establishment and operation of waste management facilities.
- Initiation of the environmental monitoring and reporting required by construction phase environmental approvals.
- Ongoing engagement and consultation with Indigenous Nations and stakeholders.

3.5.3.2 OPERATIONS PHASE

During the operations phase, overburden, ore and mine rock will be extracted from the underground mine workings and LP Central pit for stockpiling or transport directly to the primary crusher for sizing. Sized ore will be processed to recover the gold and silver, and to produce doré bars for periodic shipment off site, approximately twice per month. The operations phase is anticipated to last approximately 26 years and will include the following primary activities:

- Extraction and transport of ore and mine rock to surface via ramps, supplemented by a shaft to underground later in mine life.
- Operation of the LP Central pit for up to 9 years, including periodic stripping of surface overburden as needed.
- Operation of the underground mine for approximately 26 years.
- Processing of ore from the run of mine and low grade ore stockpiles in the process plant.
- Management of overburden, mine rock, tailings and ore in designated facilities, including according to the metal leaching and acid rock drainage management plan as applicable.
- Operation of water management and treatment facilities, including temporary storage of membrane filtration reject solution on surface.
- Camp complex operations (approximate capacity of 300 persons).
- Operation of waste management facilities.
- Progressive reclamation of stockpiles, facilities and yards as practical.
- Environmental monitoring and reporting required by construction phase and operations phase.
- Ongoing engagement and consultation with Indigenous Nations and stakeholders.

3.5.3.3 CLOSURE PHASE

The decommissioning and closure phase is anticipated to include an active closure phase and a passive maintenance and monitoring phase. The integrated closure approach which is a required element of the Great Bear Resources social performance management system, requires planning for the end of mine life prior to construction, considering both environmental and social impacts. This holistic strategy encompasses physical and environmental activities like reclamation and monitoring, as well as social aspects like employee transition and community engagement. The goal is to create a positive legacy for host communities and ensure long-term benefits beyond the mine's operational lifespan. Closure of the Project will be governed primarily by the *Ontario Mining Act* and its associated Regulations and Codes.

During the initial active closure period, the following activities will be completed which will take up to three years after operations cease:

- Continuation of environmental monitoring and compliance reporting required by environmental approvals, as applicable.
- Execution of closure plan measures for final reclamation of facilities and site.
- Removal of assets that can be salvaged for re-sale or re-use.
- Initiate re-filling of the LP Central pit with water if not started during operations.
- Pumping of contact water treatment (membrane filtration) reject solution into the underground mine for permanent storage, and re-filling of the underground mine and VMF with water.
- Demolition and recycling and / or disposal of remaining materials in approved facilities.
- Reclamation of affected areas, such as by re-grading, placement of an appropriate cover as needed and revegetation.
- Ongoing engagement and consultation with Indigenous Nations and stakeholders.

A passive closure period is proposed to follow, during which the site will be on care and maintenance. The following activities will continue:

- Continuation of environmental monitoring and compliance reporting required by retained environmental approvals.
- Completion of filling of the VMF, underground workings and LP Central pit with water.
- Maintaining the water level below surface in the VMF and LP Central pit until water quality is acceptable for passive discharge to the environment.
- Ongoing engagement and consultation with Indigenous Nations and stakeholders.

After site waters are suitable for passive discharge to the environment, the water treatment system and remaining site facilities will be decommissioned during a final closure period, and this will be completed in less than one year.

3.6 DATA RELIED UPON IN THE HHERA

The HHERA relied on measured (baseline) and predicted data for various environmental media (i.e., air, soil, sediment, surface water and traditional foods). Details regarding measured baseline data are provided in Attachment A and predicted data used in the HHERA are provided in Attachment B. Supporting documents are listed in the references in Section 7 and Attachments A and B.

3.7 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN

Activities associated with each Project phase are expected to emit CAPs along with inorganic POPCs such as metals, as well as PAHs and VOCs associated with diesel emissions. Where environmental conditions are suitable (such as in an aquatic environment), the natural biotransformation of mercury to methylmercury may also occur.

Baseline parameter concentrations in environmental media including air, soil, surface water, sediment, fish and some traditional foods were measured for use in the HHERA. Baseline conditions in various media were obtained from the various disciplines supporting the Impact Statement, as discussed in the sections below. A summary of all baseline data considered in support of the HHERA is provided in Attachment A of this report.

POPC concentrations in Project-specific media, including ore and mine rock were also considered for the HHERA, by incorporating the chemical speciation in the mine rock combined with predicted particulate matter concentrations to estimate dustfall parameter concentrations modelled in the Air Quality Assessment Report (WSP 2025a).

Parameter concentrations of selected inorganic POPCs in air, soil, water or sediment were then modelled into plants and soil organisms, mammals and birds, and aquatic receptors, including fish, for use in the traditional foods component of the HHRA, and for use in the ERA. Modelled concentrations are also summarized in Attachment B.

To identify POPCs for the HHERA, maximum or statistical concentrations of all parameters analyzed in applicable environmental media were first compared against health-based screening criteria protective of both human and ecological receptors in a Tier 1 screening. The identified POPC greater than these Tier 1 screening criteria were carried forward for further assessment in the HHRA and / or ERA as discussed in Sections 4 and 5, respectively. POPCs that were below the Tier 1 screening criteria were not carried forward for further assessment unless they were considered to be a bioaccumulation concern or of specific concern to the communities in the region. If POPCs were carried forward for further assessment in the HHRA and / or ERA, additional Tier 2 screening was completed, as appropriate, as outlined in Section 4 and 5, respectively. Figure 3-1 below illustrates this screening process.

The Tier 1 screening for the different environmental media is described in detail in Attachment C and summarised in the following sections (Section 3.7.1 to 3.7.5). The Tier 2 screening process, where applicable, is described in detail in Attachment C and summarized in Sections 4.1.1 and 5.2.1 for the HHRA and ERA, respectively.

3.7.1 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN IN AIR

Air quality data representative of baseline conditions as well as the Project phases were obtained from the Air Quality Baseline Report (WSP 2025b), the Air Quality Assessment Report (WSP 2025a), and the Greenhouse Gas Assessment (WSP 2025c). In addition, the HHERA also relied on air quality concentrations predicted for the Project phases (construction, operations and closure) for 1-hour, 24-hour, and annual averaging periods, described in Air Quality Assessment Report (WSP 2025a) and Attachment B.

The air quality assessment focused, appropriately, on the maximum predicted concentrations at the Project Leased Claims Boundary, as well as potential points of reception (PORs). In addition, Health Canada in its Guidance Document for Evaluation of Human Health Effects in Impact Assessment: Air Quality (Health Canada 2023b) requires that the predicted or estimated POPC concentrations for the maximally exposed population, for the most sensitive receptors and at the point of maximum impingement (MPOI) be provided. For the Project, the MPOI is consistent with the O. Reg. 419/05: Air Pollution – Local Air Quality definition. A point of impingement is defined in Section 2 of O. Reg. 419/05 and includes the following:

- Any point off site.
- Any point on site that is on a childcare facility or on a structure that serves primarily as a health care facility, a senior citizens' residence and/or long-term care facility, or an educational facility.
- Any point on the same structure as the source of a parameter that does not belong to the facility.

Given that there are no childcare, health care or senior citizens' facilities within the Project Leased Claims Boundary, the MPOI was appropriately considered for the identification of POPCs. Evaluation of the MPOI is a typical conservative approach to air quality assessments where the maximum off site concentration is compared to air quality criteria, regardless of whether receptors are expected to be present at this location.

Data from baseline measurements, chemical assays and predictive modelling are provided in the respective air quality assessment reports and are summarized Attachment A and B. Maximum predicted air concentrations were provided for each POR for the construction and operations Project phase plus baseline, as presented in Attachment B, Table B1-1 and Table B1-2 and in the Air Quality Assessment Report (WSP 2025a).

For the purposes of the HHERA, only those parameters that are currently known or suspected to have potential toxicity to humans or ecological receptors are presented here and considered for a quantitative and / or qualitative assessment of potential risk. Details regarding parameters excluded from consideration in the screening of POPCs are provided in Attachment C. Baseline air quality data were collected from monitoring stations in the LSA, as reported in the Ambient Air Quality Baseline Monitoring Report (WSP 2025b), and summarized in Attachment A. For the purposes of screening and POPC identification, the following air quality concentration statistics were compared to health-based air quality criteria:

- 1-hour averaging period: 90th percentile of measured (baseline) plus predicted (Project phases) 1-hour average concentrations.
- 24-hours averaging period: 90th percentile of measured (baseline) plus predicted (Project phases) 24-hours average concentrations.
- Annual averaging period: Average of maximum measured (baseline) plus predicted (Project phases) annual average concentrations.

It was assumed that predicted air concentrations and deposition rates from Project activities would be the same during construction and closure phases, therefore the screening of the construction phase in the context of air quality is representative of both construction (three years) and active closure (three years). It was assumed that no deposition occurred under baseline conditions and during the passive closure phase or during post-closure as there would be no Project activities occurring under baseline conditions, and notable sources of air emissions that would warrant an air quality assessment are not expected to occur passive closure or post-closure (WSP 2025a).

Additionally, a total exposure concentration calculated as the maximum measured baseline concentration summed with the maximum predicted concentration for each Project phase was also compared to health-based air quality criteria (i.e., baseline plus construction, baseline plus operations). This screening was completed for all parameters for which both measured baseline and predicted Project concentrations were available.

It is noted that for carbon monoxide, an 8-hour averaging period was assessed rather than a 24-hour averaging period.

A parameter was identified as a POPC if its maximum predicted concentration for the construction phase, operations phase, baseline plus construction phase, or baseline plus operations phase exceeded the selected health-based air criterion applicable for that parameter. POPCs were individually screened and identified for each averaging period. The results of the air POPC screening process, including a detailed screening approach, description of the air criteria selection, comparison of parameters to selected air criteria, and identification of air POPCs, are presented in Attachment C. Air quality criteria were selected from primary and secondary sources, as described in detail in Attachment C. The health-based air criteria selected for screening were based on the following hierarchy, with the more conservative criterion (i.e., lower) of the criteria available from primary sources:

- MECP (2020; 2023) - Ambient Air Quality Criteria or Air Contaminant Benchmarks.
- CCME (1999a, 2025) — Canadian Ambient Air Quality Standards (CAAQS) or National Ambient Air Quality Objectives.
- If multiple criteria were available for MECP or CCME, the available criteria were reviewed based on relevance to human health effects prior to selecting a screening criterion.
- It is noted that for the assessment of DPM, Health Canada (2016) criteria were selected in the absence of MECP or CCME criteria.

In the absence of air quality criteria from primary sources, available criteria from secondary sources were reviewed. Criteria with supporting documentation available, criteria based on more current studies, or criteria based on studies which are more relevant to human health (i.e., human studies) were preferentially selected. The hierarchy expands upon the hierarchy of the Air Quality Assessment Report (WSP 2025a), which considered MECP and CCME air quality criteria in their assessment. Air quality criteria reviewed from secondary sources included:

- World Health Organization (2000, 2021a) - Air Quality Guidelines.
- United States Environmental Protection Agency (US EPA 2025a) - National Ambient Air Quality Standards.
- US EPA (2024) - Regional Screening Levels (RSLs).
- California Office of Environmental Health Hazard Assessment (2025) - Reference Exposure Levels.
- British Columbia Ministry of the Environment and Climate Change (2021) - Ambient Air Quality Objectives and Standards.
- Texas Commission on Environmental Quality (2025) - Effects Screening Levels, Reference Values, or Air Monitoring Comparison Values.

The details of the agencies considered, the available air criteria and the selection approach are provided in Attachment C. The selected acute and chronic inhalation air criteria and the results of the air quality screening are provided in Attachment C, Tables C-1-3 to C-1-5 for the 1-hour, 24-hour and annual exposure duration, respectively.

The POPCs identified for the 1-hour and 24-hour averaging times will be evaluated in the acute inhalation HHRA. The POPCs identified for the annual averaging time will be evaluated in the chronic inhalation HHRA. The chronic inhalation HHRA considered both non-carcinogenic and carcinogenic exposures to POPCs in air.

A summary of the available air quality criteria from each agency and the selected air quality criteria for the 1-hour, 24-hour and annual averaging periods is presented in Attachment C, Tables C1-3, C1-4, and C1-5, respectively.

A summary of results of the air quality screening for the 1-hour, 24-hour and annual exposure periods are presented in Attachment C, Tables C1-6 (1-hour), C1-7 (24-hour) and C1-8 (annual). The following parameters were retained as POPCs in the inhalation assessment:

- 1-hour: Nitrogen Dioxide (NO₂) and DPM.
- 24-hour: No predicted project phase concentrations, or baseline plus predicted project phase concentrations were above selected screening criteria, therefore, no POPCs were identified for the 24-hour averaging period.
- Annual: DPM.

Note that annual DPM predicted concentrations were above the carcinogenic criteria only, therefore DPM was retained as a POPC for more detailed inhalation assessment of carcinogenic risk. No predicted Project phase concentrations, or baseline plus predicted Project phase concentrations were above non-carcinogenic air quality criteria for DPM.

Based on the screening process, DPM and NO₂ were retained as POPCs, wherein DPM and NO₂ are evaluated in the acute inhalation assessment for the 1-hour averaging period and DPM is evaluated in the chronic inhalation for the annual averaging period. Further details regarding the Tier 1 screening used to identify POPCs in air is provided in Attachment C.

DPM consists of fine and ultrafine particulate matter released directly from fuel combustion in diesel engines or is formed by secondary particulates in the exhaust. Particulate matter less than 2.5 microns in diameter (Health Canada 2016) from combustion processes (including blasting) were considered in the air dispersion modelling as a surrogate for DPM (WSP 2025a). DPM is specifically assessed for carcinogenic risks from inhalation in the chronic assessment and is relevant to the HHRA.

3.7.2 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN IN SOIL

Baseline metal concentrations in soil were established as part of the soil and traditional food sampling program completed in support of the HHERA and are presented in Attachment A. Soil samples (co-located with vegetation samples) were collected and analyzed from 21 locations and were analyzed for metals and PAHs. Further details on baseline soil data can be found in Attachment A, where details regarding sampling methodology and sampling locations for the soil and traditional foods sampling program are presented in Attachment A.

The maximum measured concentration in soil was used to represent the baseline soil concentration in the Tier 1 screening to identify POPCs in the HHERA.

Soil concentrations for the Project phases (i.e., construction, operations and closure) were calculated based on deposition rates of airborne emissions from Project activities, which were generated through quantitative modeling presented in the Air Quality Assessment Report (WSP 2025a). The calculation of incremental changes to soil quality as a result of deposition is presented in Attachment B. It was assumed that deposition would not occur under baseline conditions or during the post-closure phase as there would be no Project activities occurring, and notable sources of air emissions that would warrant an air quality assessment were not expected to occur (WSP 2025a). Therefore, soil quality predictions were not

calculated for baseline and post-closure. It was conservatively assumed that POPC losses (e.g., via degradation, leaching or erosion) would not occur in soil. Therefore, soil conditions during post closure were assumed to be equivalent to the conditions predicted during closure.

For PAHs, deposition rates were only provided for benzo(a)pyrene for the construction, operations and closure phases. As such, predicted soil concentrations for other carcinogenic PAHs considered as part of the benzo(a)pyrene total potency equivalent (B(a)P TPE) calculation (see details in Attachment C) were estimated based on the Project-related incremental change for benzo(a)pyrene. B(a)P TPE is the sum of all carcinogenic PAH concentrations estimated based on their potency equivalency factor (PEF) relative to benzo(a)pyrene. PEFs for the carcinogenic PAHs in the soil quality guidelines (CCME 2010) are provided in Attachment C. It was assumed that the ratio of the predicted incremental change in the soil concentration of benzo(a)pyrene relative to its baseline concentration could be applied equivalently to all the other carcinogenic PAHs. The ratio of change in concentration for benzo(a)pyrene was multiplied by each carcinogenic PAH's respective baseline concentration to predict its respective Project-related incremental change. The predicted soil concentration for a given carcinogenic PAH was then calculated by adding the baseline soil concentration and the predicted incremental change. Further details, including sample calculations, are provided in Attachment C.

For the purposes of screening, both the maximum measured baseline concentration and the maximum overall predicted soil concentration across all applicable Project phases (i.e., construction, operations and closure) for each parameter was selected for screening.

Soil screening criteria considered for the HHERA are based on land use. The Project is located in an area of Ontario on the traditional territories of multiple Indigenous Nations, and in proximity to the Municipality of Red Lake and the Township of Ear Falls within the District of Kenora. The region offers many opportunities for Indigenous traditional land use activities, as well as recreation (i.e., hiking, camping, fishing) for residents and visitors.

Agricultural criteria were applied for the purpose of Tier 1 soil screening as it is recommended by CCME (2006) when considering natural use areas, that includes consumption of country foods by local residents, that agricultural guidelines should be used. The agricultural soil screening criteria were considered applicable as they are protective of edible plants in the LSA / RSA and take into account the protection of birds and mammals. The soil screening criteria used to identify POPCs were selected according to the following hierarchy:

- The more conservative criterion (i.e., lower) available from the primary sources.
- CCME (1999b, current to 2025) Canadian Soil Quality Guidelines (SQG) for the Protection of Environmental and Human Health for agricultural land use; for PAHs, CCME SQGs are provided in the Scientific Supporting Document (CCME 2010).
- MECP (MOE 2011a) Table 2 Full Depth Generic Site Condition Standards (SCS) in a Potable Ground Water Condition, Agricultural Land Use, Coarse-textured soil.

In the absence of soil criteria from primary sources, soil quality criteria from secondary sources were selected according to the following order of preference:

- British Columbia Contaminated Sites Regulation Schedule 3.1 Numerical Soil Standards for intake of contaminated soil (human health), toxicity to soil invertebrates (ecological health), livestock ingesting soil and fodder (ecological health) pathway-specific or generic soil quality guideline.
 - Where pathway specific criteria were available, the lowest of the available values was selected as it would be protective of both human and ecological health.
 - Where only generic soil criteria were available, these values were only considered to be protective of human health.
- Alberta Environment and Protected Areas Tier 1 Soil and Groundwater Remediation Guidelines for Coarse-textured soil, Agricultural Land Use (Alberta Environment and Protected Areas 2024).
- US EPA (2024) RSLs for Resident Soil (applicable to human health only).

The Tier 1 soil quality criteria from the above agencies and the selected human health criteria are presented in Attachment C, Table C1-1. Background concentrations were also considered in the screening of soil quality. Ontario background concentrations for soil are available from MECF, Table 1 Full Depth Background SCS (MOE 2011a). In the absence of an available Table 1 SCS, Ontario Typical Range Soil Chemistry (OTR98) for Rural Parks (Region 6 - Northern Ontario, or All Regions, as available) were selected as background concentrations (MOE 2011b). In the absence of a soil screening criteria, the Ontario background was selected as the screening criteria (i.e., Table 1 SCS, or OTR98 in the absence of Table 1 SCS). If the Ontario background concentration was higher than the selected primary or secondary criterion, the Ontario background value was selected as the screening criterion.

For PAHs, B(a)P TPE is the sum of estimated cancer potency relative to benzo(a)pyrene for carcinogenic unsubstituted PAHs. The baseline soil B(a)P TPE concentration and the predicted Project phase B(a)P TPE concentrations were calculated by multiplying the maximum (measured or predicted) concentration of each PAH by its B(a)P PEF and summing the products. PEFs are as follows for a target cancer risk of 1×10^{-5} : benzo(a)anthracene, 0.1; benzo(a)pyrene, 1; benzo(b+j+k)fluoranthene, 0.1; benzo(g,h,i)perylene, 0.01; chrysene, 0.01; dibenzo(a,h)anthracene, 1; indeno(1,2,3-c,d)pyrene, 0.1. The index of additive cancer risk (IACR) was also calculated for PAHs to ensure that potable water resources are protected. It was calculated by dividing the maximum (measured or predicted) soil concentration of each carcinogenic PAH by its soil quality guideline for protection of potable water component value to calculate a hazard index for each PAH and then summing the hazard indices for the entire PAH mixture. Soil quality guideline for protection of potable water component values are as follows: benz(a)anthracene, 0.33 milligrams per kilogram (mg/kg); benzo(b+j+k)fluoranthene, 0.16 mg/kg; benzo(g,h,i)perylene, 6.8 mg/kg; benzo(a)pyrene, 0.37 mg/kg; chrysene, 2.1 mg/kg; dibenz(a,h)anthracene, 0.23 mg/kg; indeno(1,2,3-c,d)pyrene, 2.7 mg/kg. For both the calculation of B(a)P TPE and IACR, half the detection limit was used for non-detect concentrations (CCME 2010).

While the maximum predicted mercury concentration was below its selected soil screening criterion, mercury is considered a highly bioaccumulative substance and was identified as a parameter of concern by Indigenous communities in the area of the Project. Therefore, mercury was carried forward for further consideration in both the HHRA and ERA. Similarly, while the maximum predicted selenium concentration was below its selected soil screening criterion, it is considered a bioaccumulative substance in the aquatic environment and can bioaccumulate in fish consumed by humans, for which there are no screening guidelines available. Although it is not considered a POPC in soil, selenium is carried forward to the multi-media assessment for the HHRA. Selenium was not carried forward as a POPC in the ERA because predicted surface water concentrations were below surface water criteria protective of the bioaccumulation pathway for ecological receptors.

For the purposes of screening, both the maximum measured baseline concentration and the maximum overall predicted soil concentration across all applicable Project phases (i.e., construction, operations, closure) for each parameter was selected for screening. The results Tier 1 screening for soil are presented in Attachment C, Table C1-1. A parameter was identified as a POPC if its maximum predicted concentration (Project plus baseline) exceeded the selected health-based soil quality criterion applicable for that parameter. The maximum predicted concentration of arsenic exceeded its selected soil criterion; therefore, arsenic was retained as a POPC in soil for human and ecological health.

Health Canada Impact Assessment Guidance (2023a) identified arsenic, cadmium, chromium, cyanide, mercury and PAHs as parameters of potential concern related to gold mining (not including smelting). These parameters were specifically considered in the HHERA Tier 1 screening for soil. PAHs, cadmium, chromium and cyanide did not exceed human health-based criteria in soil and, as such, they were not retained as POPCs for human health. As discussed above, arsenic was retained as a POPC based on soil concentrations above human health-based screening criteria.

3.7.3 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN IN SEDIMENT

Baseline metal concentrations in sediment were measured as part of the sampling program completed in support of the Fisheries Resources Baseline Report (WSP 2025d). Surficial sediment samples were collected from sampling locations at Dixie Creek, Genessee Lake, Chukuni River, and nearby unnamed watercourses and waterbodies. Further details on the baseline sediment data can be found in the Fisheries Resources Baseline Report (WSP 2025d) and Attachment A.

Project activities which could potentially indirectly impact sediment quality include the discharge of mine contact water into the surrounding aquatic environments, or erosion of soil which has accumulated Project POPCs from deposition of airborne emissions. However, sediment concentrations are not anticipated to change substantially as a result of the Project as the majority of predicted surface water quality concentrations during construction and operations phases are within baseline ranges, with all predicted surface water quality concentrations within baseline ranges during the post-closure phase (details presented in the Receiver Water Quality Modelling Report; WSP 2025e). Further, runoff is being controlled, collected and treated throughout the Project to mitigate changes to the surrounding aquatic environment. As such, sediment quality is not anticipated to be impacted by the Project and sediment predictions were not modelled (i.e., it was assumed that there would not be a material change in sediment quality and the incremental change from the Project was assumed to be zero). The assessment of potential Project impacts to soil and surface water are considered to be protective of Project-related changes to sediment quality.

Based on the recreational activities anticipated within the LSA and RSA (e.g., wading along the shoreline or swimming), sediment exposure is expected to be minimal because lakes in the region are generally deep, particularly in areas close to waterfront cabins, lodges or residences. While some small lakes and creeks located within the vicinity of the Project may be shallow enough or have near-shore areas where people could come into contact with sediment while wading, fishing or boating, any such contact during these activities is expected to be minimal as it is expected people would be wearing footwear during these types of activities. Swimming may occur off docks at personal waterfront cabins, lodges or residences where limited and infrequent sediment contact is expected due to water depths. Bathing within recreational waters is not expected within the LSA or RSA. If bathing were to occur in lakes in the region, sediment exposure is expected to be for small periods of time and limited to contact with the soles of the feet (i.e., standing for bathing). Therefore, dermal contact with and indirect ingestion of sediment is most likely to occur with suspended sediments in surface water or with intertidal sediment as people enter and leave the water for swimming and / or bathing. Dermal contact with sediment that is submerged under water is expected to result in lower exposure than a typical soil exposure scenario as overlying water causes removal of sediment from the exposed areas of the body when exiting the water. Potential sediment exposure from recreational activities at the shoreline (e.g., beach exposure at Pakwash Lake Provincial Park) were assessed through the soil exposure pathway. The assessment of potential human health risks from potential Project impacts to soil and surface water are considered to be protective of potential human exposure to sediment. Therefore, baseline sediment concentrations were not screened against human health-based guidelines and sediment contact / ingestion was not assessed in the HHRA.

The ERA used baseline sediment quality concentrations, for POPCs identified in screening for other media, as an input for the ERA multi-media (food chain) model to account for total exposure by wildlife receptors. Baseline sediment quality used for the ERA is presented in Attachment A, Table A1-3. It was assumed that the Project will have no material effect on the POPC concentrations in sediment, therefore baseline sediment concentrations were used to model exposure to wildlife receptors for all Project phases (see Attachment E).

The ERA did not evaluate exposure to sediment by aquatic life because the Project will have no material effect on the POPC concentrations in sediment and predicted sediment quality changes were not modelled. Therefore, a Tier 1 screening of sediment quality was not completed for the ERA. The assessment of potential Project impacts to surface water and exposure by aquatic life was considered the primary and most relevant exposure pathway to be protective of Project-related changes to aquatic life.

3.7.4 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN IN SURFACE WATER

Project activities were potentially anticipated to impact surface water quality through the discharge of treated mine contact water to the surrounding aquatic environment.

Existing conditions (i.e., baseline) for surface water quality for incorporation into the HHERA are based on model baseline condition presented in the Receiver Water Quality Modelling Report (WSP 2025e). Existing conditions of Project area watercourses and waterbodies, including the Chukuni River (the receiving environment) are equivalent to monthly median (or average) baseline concentrations, where the number of samples available for each month were greater than three. In cases where only one or two baseline data samples were available for that month (e.g., winter months when monitoring locations could not be safely accessed during the baseline sampling program), source term inputs for unnamed watercourses were instead developed as seasonal inputs (i.e. quarterly grouping: November to January, February to April, May to July, August to October). For unnamed waterbodies, if less than three datapoints per month were available, source terms were developed for under ice versus open water seasons (November to April and May to October). Model source terms for existing conditions are provided in Appendix A of WSP 2025e. Surface water concentrations were also predicted for each Project phase on a monthly time scale (i.e., construction, operations, closure) and water quality node. Details regarding surface water quality modelling is presented under separate cover in the Receiver Water Quality Modelling Report (WSP 2025e). The predicted concentrations for applicable water quality nodes used in the HHERA along with supporting details (e.g., selection of water modelled nodes included, model description, and modelled results) are provided in Attachment B. The water quality nodes are shown on Figure 3-2 and water quality node UN-1, UN-2 and UN-4 will be compensated for and UN-6 was determined to not be materially affected by the Project. The maximum monthly modelled concentrations across all applicable water quality nodes for baseline, construction, operations, closure and post-closure were selected as the predicted concentrations for screening.

Generic screening criteria for surface water protective of both human and ecological health were unavailable from primary or secondary sources. As such, separate screening criteria were selected for human health and ecological health screening.

For human health, surface water quality was screened for the protection of human health from exposure to surface water via ingestion as drinking water. The following sources were considered for selecting surface water screening criteria:

- The more conservative criterion (i.e., lower) available from the primary sources:
 - Health Canada (2025b) Guidelines for Canadian Drinking Water Quality
 - MECP (MOECC 2016) Groundwater Components for Potable Water Scenario, GW1 Human Health Component Value
- In the absence of criteria from primary sources, surface water quality criteria from secondary sources were selected according to the following order of preference:
 - British Columbia Contaminated Sites Regulation (2025a) Schedule 3.2 Generic Numerical Water Standards for Drinking Water.
 - US EPA (2024) RSL for Resident Tap Water.

For ecological health, surface water quality was screened for the protection of freshwater aquatic life exposed to surface water via direct contact. Surface water quality criteria protective of aquatic life are typically lower than criteria protective of drinking water consumed by wildlife and were considered conservative to use as Tier 1 screening criteria. The following sources were considered for selecting surface water screening criteria for ecological health:

- The more conservative criterion (i.e., lower) available from the primary sources:

- CCME (1999c, current to 2025) Canadian Water Quality Guideline (WQG) for the Protection of Aquatic Life, freshwater, long-term.
- Environmental and Climate Change Canada (ECCC 2025) Federal Environmental Quality Guidelines.
- MECP (MOEE 1994) Provincial Water Quality Objective.
- In the absence of criteria from primary sources, surface water quality criteria from secondary sources were selected: British Columbia Ministry of Water, Land and Resource Stewardship (BC MWLRS 2025b) Approved Water Quality Guideline for Freshwater Aquatic Life, long-term chronic.

The surface water quality criteria from the above agencies and the selected screening criteria are presented in Attachment C, Table C1-2. The selected surface water screening criteria for human health are considered protective of both potable and recreational (e.g., dermal contact) use.

A parameter was retained as a POPC for human health or ecological health if the maximum monthly predicted surface water concentration was greater than the selected screening criteria for human health or ecological health, respectively. The screening results for surface water quality are presented in Attachment C, Table C1-2.

For human health, the maximum predicted concentration of arsenic exceeded its selected surface water criterion; therefore, arsenic was retained as a POPC in surface water for human health. While the maximum predicted mercury concentration was below its selected surface water screening criterion, mercury is considered a highly bioaccumulative substance, particularly in aquatic environments, and was identified as a parameter of concern for the Project by Indigenous communities. Therefore, mercury was carried forward to the multi-media assessment for the HHRA. Similarly, while the maximum predicted selenium concentration was below its selected surface water screening criterion, it is considered a bioaccumulative substance in the aquatic environment and can bioaccumulate in fish consumed by humans; therefore, selenium was carried forward to the multi-media assessment for the HHRA.

Parameters associated with gold mining operations identified by Health Canada (2023a), arsenic, cadmium, chromium, cyanide, mercury and PAHs, were specifically considered in the HHERA Tier 1 screening. Cadmium, chromium and cyanide were not above human health-based criteria in surface water, as such they were not retained as POPCs for human health. Arsenic was retained as a POPC based on surface water concentrations above Tier 1 human health-based screening criteria. PAHs were screened in soil only.

For ecological health, the maximum predicted concentrations of total phosphorus, aluminum, arsenic, chromium, copper, iron and lead exceeded their respective selected surface water screening criteria and were retained as POPCs in surface water for ecological health. Additionally, as stated above for human health, while the maximum predicted concentrations of mercury and selenium were below their respective screening criteria, these parameters are considered to be bioaccumulative in the aquatic ecosystem. The selected ecological screening criteria are protective of aquatic life (e.g., plants, invertebrates and fish) but not aquatic-feeding mammals and birds. As such, mercury and selenium were carried forward to the ERA Tier 2 screening for surface water.

3.7.5 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN IN TRADITIONAL FOODS

Project activities are anticipated to impact soil and surface water quality through the deposition of airborne emissions and / or discharge of mine contact water into the surrounding aquatic environment. Vegetation may uptake parameters from soil or surface water. Wildlife may also uptake parameters directly from environmental media (e.g., soil, sediment, surface water) through ingestion or incidental ingestion, or through the ingestion of food items (i.e., vegetation, invertebrates, fish, other wildlife). Humans may be exposed from the subsequent consumption of vegetation and wild game.

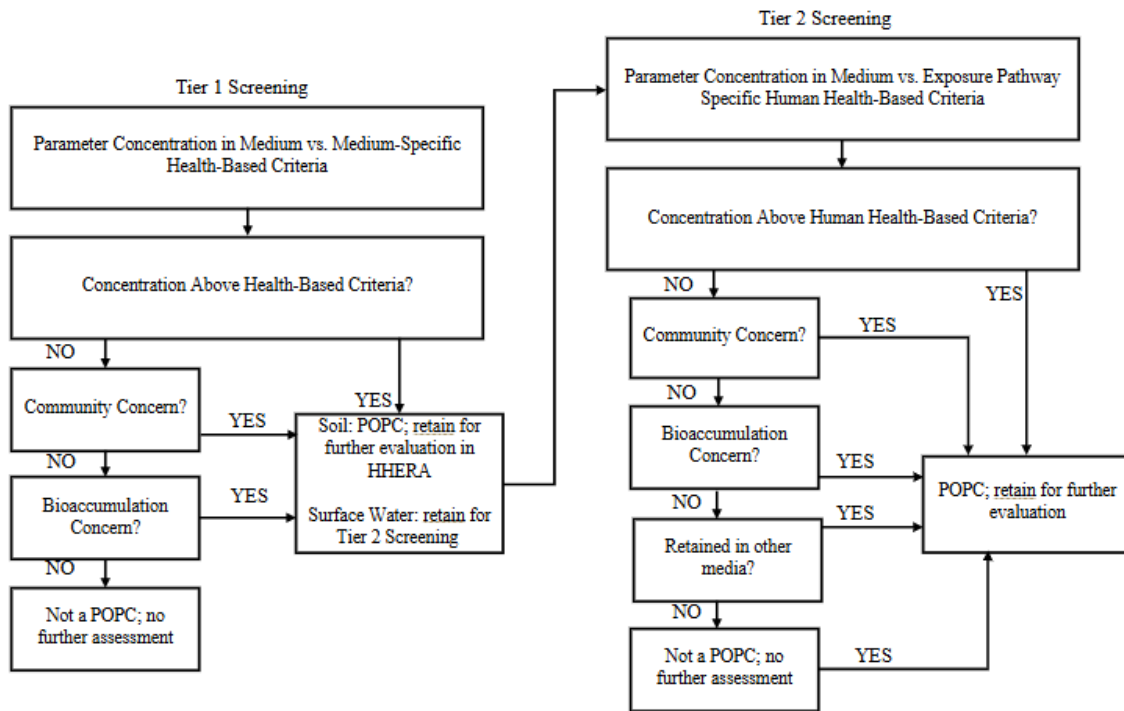
Vegetation (traditional plants, berries) and wild game tissue were collected as part the soil and traditional food sampling program completed in support of the HHERA and presented in Attachment A. Fish tissue

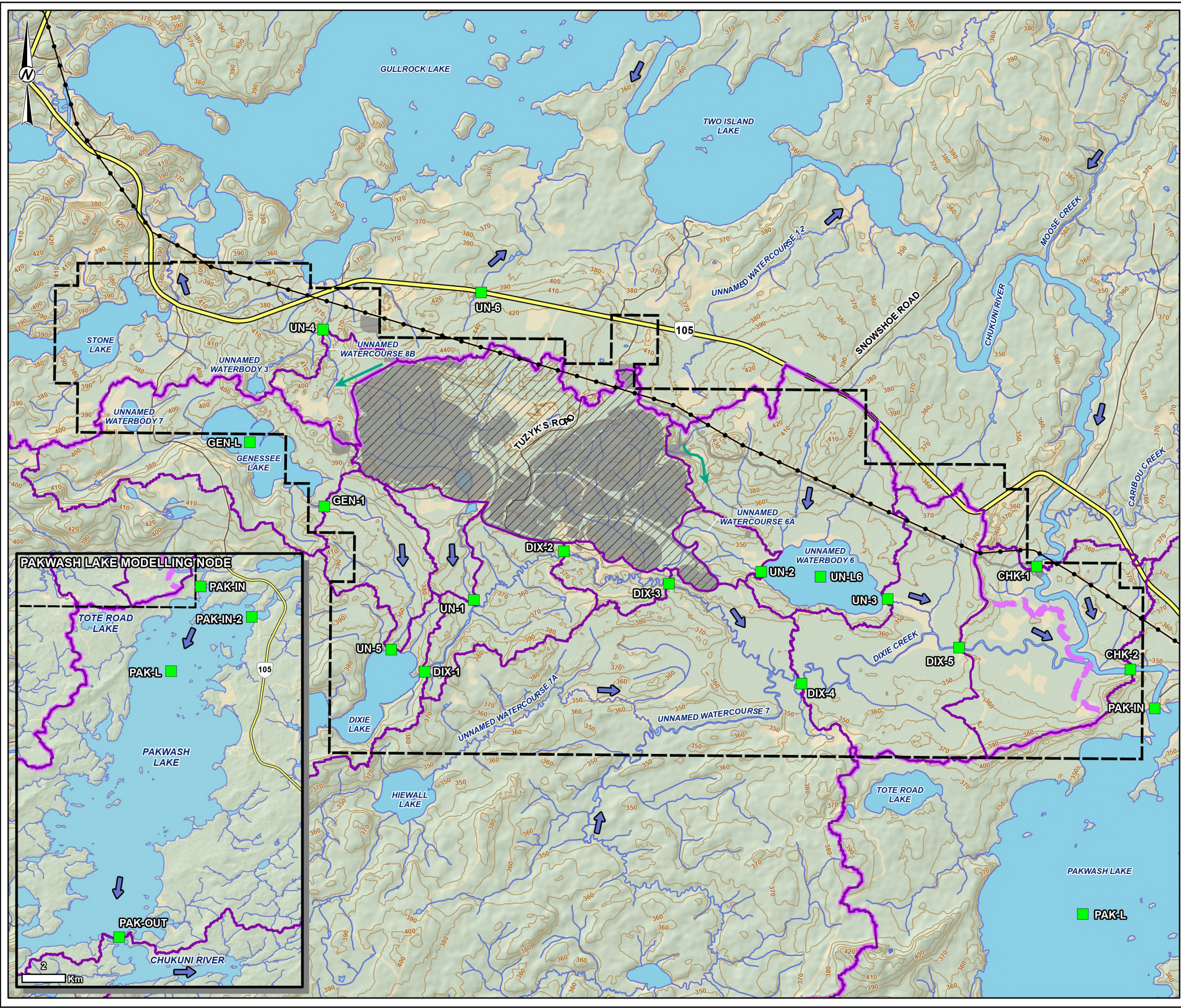
sampling was conducted and described in the Fisheries Resources Baseline Report (WSP 2025d). Generic screening criteria protective of human and ecological health are generally not available for these media. As such, a Tier 1 screening was not completed for fish, vegetation or wild game tissue. However, these measured concentrations were incorporated into the multi-media assessments of both the HHRA and ERA components of the HHERA. Details regarding the application of fish, vegetation, and wild game tissue data in the HHERA are provided in Attachments E (Human Health Multi-Media Model) and F (Ecological Health Multi-Media Model).

3.7.6 *SUMMARY OF POPCS*

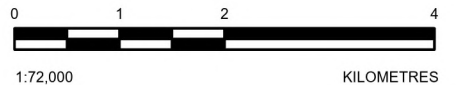
Table 3-2 summarizes the POPC identified in the screening completed in Section 3.7 to be considered further in the HHRA (Section 4) and the ERA (Section 5).

Figure 3-1: Screening Process for the HHERA





- LEGEND**
- PROPERTY BOUNDARY
 - GREAT BEAR PROJECT FOOTPRINT
 - CLEAN WATER DIVERSION
 - SURFACE WATER QUALITY MODELLING NODE
 - DIXIE CREEK WATERSHED (NOT USED FOR NODE AREAS)
 - MODELLING NODE WATERSHED
 - PROJECT WATERSHED
 - HIGHWAY
 - LOCAL ROAD
 - EXISTING TRANSMISSION LINE
 - CONTOURS (10 M INTERVAL)
 - WATERCOURSE
 - WATERBODY
 - FLOW DIRECTION



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

- REFERENCE(S)**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. WATERCOURSES AND WATERBODY ACQUIRED FROM LAND INFORMATION ONTARIO (MNR) AND MODIFIED TO MATCH AERIAL IMAGERY AND LIDAR.
 3. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 4. PROPERTY BOUNDARY PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2024.
 5. CONTOURS ACQUIRED FROM LAND INFORMATION ONTARIO (MNR), 2022 AND DERIVED FROM 2022 LIDAR PROVIDED BY GREAT BEAR RESOURCES.
 6. SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025.
 7. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
 GREAT BEAR RESOURCES

PROJECT
 GREAT BEAR PROJECT

TITLE
 OPERATIONS / CLOSURE SURFACE WATER QUALITY MODELLING NODES

CONSULTANT	YYYY-MM-DD	2025-11-17
DESIGNED	----	
PREPARED	MD	
REVIEWED	----	
APPROVED	----	



PROJECT NO. CA0031271 CONTROL 0001 REV. A FIGURE 3-2

PATH: X:\CA\CA0031271\Projects\2025\Operations_Closure_Surface_Water_Quality_Modelling_Report\WQO_Modelling_Report.mxd PRINTED ON: AT 0:41:17 AM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Table 3-1: Valued Components Relevant to the HHRA

Valued Component	Description
Federal Valued Components (fVC)	
Indigenous Peoples	Inclusive of community services and infrastructure; current use of lands and resources for traditional purposes; physical and cultural, heritage, structures, sites or things; community well-being; and health. The HHRA was prepared to address the biophysical determinants of health aspect of this fVC (Section 4).
Fish and Fish Habitat	The ERA evaluated effects to aquatic life, including fish, as a result of changes to water and sediment quality (Section 5). The HHRA evaluated effects to human health from consumption of fish (Section 4).
Migratory Birds	The ERA evaluated effects to wildlife, including migratory birds, as a result of changes to air and water quality. Specific avian receptors of concern assessed in the ERA are described in Section 5. The HHRA evaluated effects to human health from consumption of wild game including birds (Section 4).
Pathway Valued Components (pVC)	
Vegetation communities	The ERA evaluated effects to vegetation communities as a result of changes to air, soil and water quality (Section 5). The HHRA evaluated effects to human health from consumption of vegetation (Section 4).
Wild Rice	The ERA evaluated effects to wild rice as a result of changes to air, soil and water quality (Section 5). The HHRA evaluated effects to human health from consumption of wild rice (Section 4).
Moose	The ERA will evaluate effects to wildlife, including moose, as a result of changes to air and water quality (Section 5). The HHRA evaluated effects to human health from consumption of moose (Section 4).
Species at Risk	The ERA will evaluate effects to species at risk as a result of changes to air and water quality (Section 5).
Other Wildlife	The ERA will evaluate effects to wildlife as a result of changes to air and water quality. Specific wildlife receptors of concern assessed in the ERA are described in Section 5. The HHRA evaluated effects to human health from consumption of wild game (Section 4).

Notes:

ERA = ecological risk assessment; fVC = federal valued component; HHRA = human health risk assessment; pVC = pathway valued component.

Table 3-2: Summary of POPCs identified following Tier 1 Screening

Media	Human Health		Ecological Health
Air	Averaging Period	1-Hour – Nitrogen Dioxide (NO ₂), Diesel Particulate Matter (DPM)	Not applicable
		24-Hours – None	
		Annual – DPM	
Soil	Arsenic Mercury ⁽¹⁾ Selenium ⁽²⁾		Arsenic Mercury ⁽¹⁾ Selenium ⁽²⁾
Surface Water	Arsenic Mercury ⁽¹⁾ Selenium ⁽²⁾		Total phosphorus Aluminum Arsenic Chromium Copper Iron Lead Mercury ⁽¹⁾ Selenium ⁽²⁾

Notes:

ERA = ecological risk assessment; HHRA = human health risk assessment; POPC= parameter of potential concern.

1. Mercury concentrations were not above the selected screening criteria, but the parameter was retained as a POPC due to both community concerns and its bioaccumulation potential.
2. Selenium concentrations were not above the selected criteria, but the parameter was retained as a POPC due to its bioaccumulation potential in the aquatic ecosystem (applicable to the ERA) and due to its bioaccumulation potential (applicable to the HHRA).

4 HUMAN HEALTH RISK ASSESSMENT

The HHRA is a process used to assess the potential risk to human receptors resulting from one or more environmental stressors. In so doing, the HHRA takes into account the concentrations of the parameters to be evaluated, their toxicity and the manner in which receptors may be exposed.

The objective of the HHRA was to assess potential human health risks associated with the identified POPCs in the RSA and LSA for each Project phase. Potential health risks to human receptors were determined by completing a qualitative and / or quantitative assessment using site specific conditions, where available, and generic assumptions provided by Health Canada or the MECP.

The HHRA was conducted according to industry accepted risk assessment practices and methodologies and followed guidance published and endorsed by government agencies. This approach is consistent with previous projects in Ontario that have been reviewed by IAAC. Guidance documents were relied upon in the HHRA are identified in Section 2.5.

4.1 PROBLEM FORMULATION

The problem formulation includes three key aspects: identification of POPCs, characterization of receptors that could be exposed to the POPCs and characterizing the exposure pathways by which exposure to the POPCs may occur. Considerations included the people (i.e., human receptors) who may be exposed, the fate and behaviour of the parameters in the environment, and the toxicological potency based on various pathways of exposure (i.e., air, soil, sediment, water and food) and routes of exposure (i.e., inhalation, ingestion and dermal contact) to the human receptor. In addition, the problem formulation evaluated which exposure pathways were considered complete from the source of risk leading directly or indirectly to the sensitive human receptors. Incomplete pathways (i.e., no exposure route, absence of toxicity or insufficient concentration) were excluded from the assessment. For example, if a parameter was considered toxic, the risk may still remain nonexistent if the concentration of the parameter in the media was low or there was no possibility that a receptor can be exposed to the parameter.

POPC concentrations that are greater than their respective human health screening values (Section 4.1.1) are carried forward for a quantitative assessment of potential risk. Receptors included in the assessment are conservatively considered to potentially include all human receptor ages defined by Health Canada (i.e., infant, toddler, child, teen and adult) who may spend time in the RSA and LSA (Section 4.1.2). Where exposure pathways can be reasonably assumed to be complete (Section 4.1.4), they are carried forward for a detailed examination of potential risks conducted via quantitative approach. The detailed quantitative assessment involves the remaining steps of the HHRA framework, including the exposure assessment, toxicity assessment and risk characterization.

4.1.1 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN

In Section 3.7, POPCs were identified through a Tier 1 screening which consisted of the comparison of maximum or statistical concentrations of all parameters analyzed in various media against health-based screening criteria. In general, a Tier 1 screening process involves the comparison of analytical data to screening criteria protective of both human and ecological health. As such, a secondary screening process, herein referred to as the Tier 2 screening, is required to identify POPCs based on human-health based screening criteria, and/or refinement of screening criteria to be specific for human-health exposure pathways.

The Tier 1 screening in Section 3.7 (full details provided in Attachment C) identified the following POPCs for further evaluation in the HHRA:

Inhalation Assessment

- Air: NO₂ (1-hour averaging period), DPM (1-hour and annual averaging periods).
 - For the chronic assessment (i.e., annual averaging period), DPM is assessed for carcinogenic risks only since there were no concentrations above non-carcinogenic screening criteria.

Multi-media Assessment

- Soil: Arsenic, mercury, and selenium.
- Sediment: None; pathway is excluded from the assessment (see details in Section 4.1.4).
- Surface Water: Arsenic, mercury, and selenium.

POPCs identified in the Tier 1 screening were then further evaluated through Tier 2 screening for the HHRA. Tier 2 screening involves the comparison of maximum or statistical concentrations of POPCs identified through the Tier 2 screening against human health-based screening criteria. Details of the Tier 2 screening for each media, if completed, are provided below.

4.1.1.1 INHALATION ASSESSMENT – TIER 2 SCREENING

No Tier 2 screening was required for the inhalation assessment, as the screening criteria applied in the Tier 1 screening of air quality concentrations were human health-based criteria. POPCs identified for air in the Tier 1 screening were evaluated in the inhalation assessment.

4.1.1.2 MULTI-MEDIA ASSESSMENT – TIER 2 SCREENING

4.1.1.3 SOIL – TIER 2 SCREENING

No Tier 2 screening was required for soil since Tier 1 screening values for POPCs carried forward were human health-based criteria, as outlined below.

Arsenic was retained as a POPC in soil as the maximum measured baseline and maximum predicted Project phase soil concentrations were elevated above Tier 1 soil quality screening criteria. The selected Tier 1 soil quality screening criteria for arsenic, as presented in Table C1-1, was 11 mg/kg and selected from the MECP Table 2 SCS, which is equal to the Ontario background concentration of arsenic in soil (Table 1 SCS; MOE 2011a). As detailed in Section 3.7.2 and Attachment C, where the Ontario background concentration was higher than selected screening criteria, the Ontario background concentration was selected (i.e., did not select screening criteria lower than established Ontario background concentrations). For Tier 2 screening, based on the current and future land use in the RSA, the applicable human health-based screening criteria for soil is the MECP Table 2 S1 soil component value for agricultural land use (MOECC 2016). As defined in MOE 2011b, a component value is developed to provide a receptor or group of receptors protection from a contaminant via a specific pathway. The S1 component value is a high-frequency, high-intensity, human health exposure scenario equivalent to that of a surface soil at a residential/parkland/institutional or agricultural/other site (children and pregnant women are present). The soil value is calculated using toxicity reference values (TRVs) and a soil ingestion and dermal exposure model. The S1 component value, 0.95 mg/kg, is lower than the Ontario background concentration, therefore the Ontario background would be selected for screening. As the Ontario background concentration is equal to the Tier 1 screening criteria, no additional screening is required.

As detailed in Section 3.7.2, maximum measured and predicted soil concentrations of mercury and selenium were below generic Tier 1 screening criteria. Mercury was retained as a POPC for the multi-media assessment due to its bioaccumulative potential and as it was identified as a parameter of concern by Indigenous communities. Similarly, selenium was retained as a POPC for the multi-media assessment due to its bioaccumulative potential in the aquatic environment. As these parameters were retained independently of screening results, no Tier 2 screening was required.

Arsenic was retained as POPC in soil. Mercury and selenium were retained due to their bioaccumulation potential. Arsenic, mercury and selenium were further evaluated through the multi-media assessment.

4.1.1.4 SURFACE WATER – TIER 2 SCREENING

As discussed in Section 3.7.4 and Attachment C, generic surface water screening criteria protective of both human and ecological health were not available from primary and secondary sources. As such, Tier 1 screening of surface water quality was completed with the use of drinking water criteria protective of human health.

For the Tier 1 screening, drinking water criteria were compared to the overall maximum monthly concentration of all applicable water quality nodes for each Project phase (full details provided in Attachment B). For Tier 2 screening, drinking water criteria were compared to the maximum annual average concentration at each water quality node for each Project phase in order to identify which specific water bodies, if any, should be further evaluated in the HHRA. Details of the water quality nodes considered in the HHRA are presented in Attachment B.

Additionally, screening against incidental ingestion of surface water criteria was completed in the Tier 2 screening to represent potential incidental ingestion which may occur during recreational activities (i.e., swimming) or bathing. Incidental ingestion of surface water screening criteria was calculated as drinking water criteria adjusted by a factor of 20. The adjustment factor of 20 was selected based on the ratio of ingestion rates used to derive the drinking water criteria and the amount of water ingested when swimming (World Health Organization 2021b).

The Tier 2 screening for surface water is presented in Tables C1-9 and C1-10 in Attachment C. Based on the screening outlined above, all concentrations of arsenic, mercury and selenium were below drinking water criteria and incidental ingestion of surface water criteria at all water quality nodes for all Project phases. However, based on the identification of arsenic as a POPC in soil, it was also retained as a POPC in surface water to allow for evaluation of total Project-related exposure to arsenic from all exposure pathways in the multi-media assessment. As discussed above, mercury was retained as a POPC due to its bioaccumulative potential and because it was identified as a parameter of concern by Indigenous communities. Similarly, selenium was retained as a POPC due to its bioaccumulative potential in the aquatic environment.

The following POPCs were retained for further assessment in the multi-media HHRA following Tier 2 screening:

- Arsenic: Retained based on soil concentrations above human health screening criteria.
- Mercury and Methylmercury: Retained due to bioaccumulation potential and identified as parameters of concern to the public / community; no surface water concentrations above human health screening criteria were identified.
- Selenium: Retained due to bioaccumulation potential; no surface water concentrations above human health screening criteria were identified.

4.1.2 IDENTIFICATION AND CHARACTERIZATION OF HUMAN RECEPTORS

Receptors were selected based on the identification of persons with the greatest potential to be impacted by exposures to parameters sourced from Project activities. Human receptors who may be exposed to the Project-related emissions include Indigenous and non-Indigenous community members who live in residences located in communities surrounding the Project (primarily outside the LSA and RSA) and / or spend part of their time in cabins, lodges, camps or residences located within the LSA / RSA, and / or who visit the area within the LSA / RSA to practise traditional or recreational land use (including fishing, hunting, traditional food harvesting and spiritual practices). The receptors selected for evaluation are based on current and future use of the area around the Project and are intended to represent a range of possible exposure scenarios.

For the purposes of the Air Quality Assessment (WSP 2025a), 29 PORs were selected to represent areas with human activity within the LSA and RSA, which may include traditional land and resources uses (Figure 4-1). These PORs consist of residences and potential recreational use cabins, lodges and camp sites identified through field work and a review of the Ministry of Natural Resources Geospatial Ontario (formerly Land Information Ontario) geospatial datasets. In some cases where a land use covered a large area, representative points were selected. For the purposes of the HHRA, additional PORs were added to this initial list (for a total of 41 PORs; Figure 4-1), in part based on review of available traditional knowledge and land use studies to represent areas of potential short and long term human activity within the RSA, as further discussed in Section 4.1.4. Section 3 (Participation and Engagement) of the Impact Statement provides more detail on the extensive consultation and engagement process to date, and Impact Statement Appendix C (Record of Consultation) provides the record of consultation including detailed comments received, and responses provided, during the development of the Impact Statement.

While on the Project site, the health of workers is protected by occupational health and safety standards, codes and regulations established by various provincial and federal bodies; thus, potential risks to on site Project workers associated with Project-related POPCs is not addressed in the scope of this assessment.

The receptors selected for the HHRA identified to represent realistic yet conservative receptors within the LSA and RSA are as follows:

- **Indigenous Resident:** As discussed in Section 2.6, the Project lies within Treaty 3 territory, on the traditional territories of ANA, LSFN, WFN, the NWOMC, and these four communities were considered in the HHRA. The Municipality of Red Lake and the Township of Ear Falls were jointly considered as a fifth community in the HHRA, as a large population of Indigenous people reside in these communities. Members of Indigenous communities may use land and resources for traditional purposes and thus may experience higher levels of exposure than members of the general population (e.g., higher rates of traditional foods ingestion, or more time spent outdoors). An Indigenous community member may also include the other critical subgroups noted (e.g., a toddler and / or pregnant female). Several PORs were identified within the LSA and RSA where both Indigenous- and non-Indigenous people could spend substantial time on a long term basis (such as cabins, residences, camps or lodges). It is not known that these areas are frequently used by Indigenous residents, however, it was conservatively assumed that they could. Several other locations (PORs) were identified where both indigenous- and non-indigenous people could spend time on a shorter-term basis (such as fishing, hunting, cultural or recreation areas). As such, an Indigenous resident was conservatively selected as the main receptor group for the HHRA. This receptor is representative of Indigenous individuals who are conservatively assumed to reside in the LSA or RSA year-round for their entire lifetime and are potentially exposed to POPCs in soil, surface water and foods through direct soil contact (ingestion, dermal contact and particulate inhalation), consumption of traditional foods (fish, wild game, berries, traditional plants), consumption of backyard below- and above-ground garden produce, ingestion of surface water as a drinking water source, and direct surface water contact while swimming or bathing. This is considered a highly conservative assumption since most of the POR locations within the LSA and RSA where chronic (long term) exposure was assumed are cabins, lodges or camps that are not known to be used as full time residences, and most Indigenous people in the area reside outside the LSA and RSA. All life stages prescribed by Health Canada (2024) were modelled for this receptor. This includes an infant, toddler (the most sensitive life stage due to their exposure rates relative to body weight), child, teen, and adult (or Elder). A woman of childbearing age was also specifically evaluated for mercury given it is considered a developmental toxicant.

Two types of Indigenous residents were assessed to capture exposures from varying levels of traditional foods consumption (e.g., berries, traditional plants, fish, and game), including the following:

- **Indigenous Resident (Heavy Consumer):** The heavy consumer Indigenous resident was based on a receptor that consumes high amounts of traditional foods (i.e., 95th percentile consumption rates).
- **Indigenous Resident (Average Consumer):** The average consumer Indigenous resident was based on a receptor that consumes average amounts of traditional foods (i.e., mean consumption rates). The average consumer Indigenous resident was considered to represent the general Indigenous population.

The assessment of Indigenous resident receptors is considered to be protective of non-Indigenous residents that may live or spend extended periods within the LSA and RSA given that Indigenous residents are assumed to have greater potential for exposure to traditional foods. For instance, it was assumed that all traditional food consumed by an Indigenous resident is from the LSA or RSA, this receptor is continuously exposed to POPCs originating from the Project throughout their entire lifetime, and 95th percentile traditional food consumption rates (further details in Attachment E) were assumed for the heavy consumer Indigenous resident. Similarly, the assessment of Indigenous resident receptors is considered to be protective of Indigenous and non-Indigenous people who reside outside the LSA and RSA and who may visit the LSA and RSA to take part in various traditional land use or recreational activities such as hunting, fishing, gathering, cultural practices, camping, hiking, swimming and / or boating.

Further details regarding human receptors including receptor characteristics used in the HHRA, are provided in Attachment E.

4.1.3 TRADITIONAL FOOD SPECIES AND CONSUMPTION RATES ASSUMPTIONS

As stated in Section 2.6, the Project lies within, or is in proximity to, several traditional territories including ANA, LSFN and WFN. NWOMC and Indigenous people living in Red Lake, Ear Falls and within the District of Kenora, are also residing in proximity of the Project.

Therefore, the HHRA considered the specialized diets and lifestyles of Indigenous populations, including the reliance on wild plants and animals as food sources. Health Canada (2024) recommends using site-specific food ingestion rates whenever possible. A traditional food study specifically related to the Project was not available for the Indigenous groups considered in the HHRA; however, Indigenous food ingestion rates of traditional foods are available for the region of the Project (Ecozone 1 – Boreal Shield) from the First Nations Food, Nutrition, and Environment Study (FNFNES) conducted for Ontario (Chan et al. 2014, 2021). The goal of the FNFNES was to gather information on the food consumed by various Indigenous groups across Canada to provide a comprehensive compilation of traditional foods consumed by Indigenous people. Chan et al. (2014) completed a food survey with 18 Indigenous communities throughout Ontario in 2011 and 2012. Some of the survey results are presented by ecozone: Boreal Shield / Subarctic (Ecozone 1), Boreal Shield / Northeast (Ecozone 2), Hudson Plains / Subarctic (Ecozone 3), and Mixedwood Plains / Northwest (Ecozone 4) in Ontario. Chan et al. (2014) provides the mean and 95th percentile of the amount of traditional foods consumed per day, for traditional food consumers only, broken down by ecozone. The LSA and RSA fall within the Boreal Shield / Subarctic (Ecozone 1). As such, food survey results for the Boreal Shield / Subarctic (Ecozone 1) in Ontario were considered representative of local Indigenous people and will be presented in the subsequent sections.

Chan et al. (2021) additionally developed a supplemental data report, which provides consumption rates for mean and 95th percentile of the amount of traditional foods consumed per day in the broader Boreal Shield region, not specific to Ecozone 1. Where Ecozone 1 consumption rates were lacking, Boreal Shield consumption rates were applied, as further discussed below.

Chan et al. (2014) provides consumption rates for the top three species reported to be consumed within Ecozone 1 in Ontario, based on data collected through the FNFNES, for each of the following categories: fish, game meat, game organs, birds and plants. In Ecozone 1, the most consumed species identified by the FNFNES are:

- Fish: Walleye, Lake Whitefish, Northern Pike
- Game meat: Moose, Deer, Rabbit
- Game organs: Moose liver, Moose kidney, Caribou liver
- Birds: Canada Goose, Partridge, Ducks
- Plants: Blueberries, Raspberries, Wild Rice

4.1.3.1 INCORPORATION OF INDIGENOUS AND TRADITIONAL KNOWLEDGE

As discussed in Section 2.6 above, LSFN, WFN, ANA and NWOMC were invited to provide IK and TKLUS reports, as described in Section 3 of the Impact Statement (Participation and Engagement) and detailed in the Record of Consultation (Impact Statement Appendix C). It is understood that the IK / TKLUS reports received are confidential; however, IK has been considered throughout the Impact Statement.

Each TKLUS report provided by Indigenous communities was systematically reviewed to identify and extract information relevant to the HHRA. This included both mapping and documenting reported areas of cultural importance and traditional land use activities occurring within the LSA and RSA to help with selection of POR locations and identifying species of cultural significance and those commonly consumed as part of traditional food diets to help validate the important species as presented in Chan et al. (2014) and listed above. The IK / TKLUS reports reviewed are detailed in Section 2.6.

The TKLUS reports and secondary sources were compared to the Chan et al. (2014) data to validate the food species for inclusion in the HHRA, as summarized below.

- All five communities (LSFN, WFN, ANA, NWMOC and RLEF) identified Walleye (Pickerel), Lake Whitefish, Northern Pike (Jackfish), Moose, Deer, Rabbit, Blueberries, Raspberries and Wild Rice (manoomin) as frequently consumed species. As these were also identified by the FNFNES as top three consumed species in their respective food type categories for Ecozone 1 with available consumption rates (Chan et al. 2014), they were selected for inclusion in the HHRA.
- For birds, four of the five communities identified Goose, Duck and Grouse / Partridge as frequently consumed, which aligns with the bird species identified in the FNFNES for Ecozone 1 with available consumption rates, therefore they were included in the HHRA. The partridge ingestion rates for Ecozone 1 from Chan et al. (2014) were considered to be applicable for Grouse and Partridge given that these species are both ground nesting, insectivorous birds (Carroll et al. 2020, Schroeder et al. 2021).
- For berries, all five communities additionally identified Chokecherry / Pin Cherry and Cranberry as frequently consumed species. No consumption rates for Ecozone 1 were available for Chokecherry / Pin Cherry and Cranberry. Boreal Shield consumption rates were available in the Chan et al. (2021) Supplemental Data report, and a comparison of Chokecherry / Pin Cherry and Cranberry Boreal Shield consumption rates to Ecozone 1 consumption rates for Blueberries and Raspberries showed that Ecozone 1 consumption rates for Blueberries and Raspberries were higher and therefore protective of consumption rates for Chokecherry / Pin Cherry and Cranberry. Therefore, only Blueberry and Raspberry Ecozone 1 consumption rates were considered in the HHRA.
- For traditional plants, all five communities identified Labrador Tea and four communities identified Mint as frequently consumed. Ecozone 1 consumption data is not available for these species, however Chan et al. (2021) provides Boreal Shield consumption rates for Labrador Tea and Mint. The Boreal Shield consumption rates were selected for use in the HHRA in the absence of Ecozone 1 consumption rates for an appropriate surrogate species for traditional plants.
- For wild game, Caribou were also identified by three communities as frequently consumed. No Ecozone 1 consumption data is available for Caribou, however Chan et al. (2021) provides Boreal Shield consumption rates for Caribou. Given the unique diet of Caribou which would not be appropriately reflected by selection of a surrogate species, Boreal Shield Caribou consumption rates were selected for the HHRA. Beaver and Muskrat were additional wildlife species identified by three communities as species which were hunted and / or trapped, however based on the information available in the TKLUS reports these species are consumed less frequently than other wild game such as Moose, Deer, Rabbit, which were identified as top consumed species by both the TKLUS reports and Chan et al. (2014). Given the lower reported frequency of consumption and the lack of Ecozone 1 consumption rates for these species, Beaver and Muskrat were not considered in the HHRA. It is noted that these species were evaluated in the ERA, detailed in Section 5 and Appendix F.

It is recognized that the traditional foods evaluated in the HHRA do not represent the full range of species ingested by Indigenous people in the area of the Project. However, through consideration of both species reported as most frequently consumed in the TKLUS reports and top consumed species identified based on the FNFNES report (Chan et al. 2014), the HHRA provides a reasonable evaluation of potential exposure to Project-related POPCs through ingestion of traditional foods. For evaluation of the potential consumption of wildlife species (i.e., mammals and birds), the multi-media model considered small and large wildlife species categories representing different trophic levels and dietary preferences. These species categories are based on the consumption of game meat and / or game organs and include small mammals (game meat), large mammals (game meat), large mammals (organ meat), and birds.

A summary of the species selected for the multi-media model, informed by the FNFNES (Chan et al., 2014, 2021) and TKLUS reports, is provided in Table 4-1 below. It is noted that these are specific to traditional food items, and do not include other food items considered in the multi-media model (e.g., garden produce).

4.1.4 EXPOSURE PATHWAYS IDENTIFICATION

Exposure scenarios are developed to identify reasonable yet conservative cases that consider how each of the receptors identified for assessment in the HHRA may be exposed to emissions from the Project. Exposure pathways refer to the method by which the POPC could reach the various receptors. Pathways could either be direct, in which POPC could travel directly from the source to the receptor, or indirect, in which POPC could be carried through multiple environmental media (e.g., air, soil, water, food) before reaching the human receptor. For example, a parameter released into the air could reach a receptor through a direct pathway if it was directly inhaled. Alternatively, a POPC may travel through an indirect pathway if it deposits from the air onto the soil and, consequently, enters the food chain due to the uptake by plants and animals that might then be ingested by humans.

The potential exposure media in the LSA and RSA are ambient air, surface water, fish, vegetation and wildlife. The Project will emit POPC into the air, primarily from fugitive dust emissions, and potentially discharge POPC through effluent directed to surface water. The emission of parameters may affect the regional and local air quality and water quality. In addition, the deposition of parameters from the air onto the ground surfaces may affect the regional soil and water quality. Parameters in the soil could be incidentally ingested by humans or could accumulate in plant tissues and move up the food chain when the plants are consumed by humans or by wild game. The same mechanism applies to surface water that may be consumed by wildlife or uptake in fish tissue from surface water.

The following operable exposure pathways were included in the HHRA:

- **Air:** People may be exposed to POPCs in air through inhalation. Each of the receptors were assumed to be exposed to air while accessing the study area.
- **Soil:** Airborne parameters emitted by the mine may deposit onto soil. People may subsequently be exposed to POPCs in soil through direct contact (e.g., incidental ingestion, dermal contact, soil dust inhalation) due to baseline conditions plus aerial deposition from Project activities. Each of the receptors were assumed to be exposed to soil while accessing the study area.
- **Surface water:** People may be exposed to POPCs in surface water through ingestion as a drinking water due to baseline conditions plus accumulation of POPCs from aerial deposition from Project activities and discharge from Project contact water. The Indigenous resident was assumed to use surface water as a drinking water source while conducting traditional land use activities. People may also be exposed to POPCs in surface water through incidental ingestion of, and dermal contact with, POPCs in surface water while swimming and bathing due to baseline conditions plus aerial deposition from Project activities and discharge from Project contact water.
- **Vegetation** (berries and traditional plants): Airborne constituents emitted by the mine may deposit onto berries and traditional plants. Berries and traditional plants may also take up constituents from atmospheric deposition to soil and subsequent uptake via roots. People may subsequently be exposed to POPCs through ingestion of berries and traditional plants (i.e., Labrador Tea, Mint, Wild Rice) that have bioaccumulated POPCs from soil due to baseline conditions plus and aerial deposition from Project activities. The Indigenous resident may collect berries for consumption.
- **Backyard Garden:** Above and below ground plants in backyard gardens may take up POPCs from atmospheric deposition to soil and subsequent uptake via roots. People may subsequently be exposed to POPCs through ingestion of garden produce (above and below ground plants) that have bioaccumulated POPCs from soil due to baseline conditions plus and aerial deposition from Project activities. The Indigenous resident was assumed to harvest and consume above and below ground plants from their backyard garden.
- **Fish:** Fish in waterbodies and watercourses in the LSA and RSA may have take up and bioaccumulate POPCs from surface water that contain POPCs due to baseline conditions plus aerial deposition from Project activities and discharge from Project contact water. People may be exposed to POPCs through ingestion of fish harvested from watercourse and water bodies in the LSA and RSA. The Indigenous resident was assumed to consume fish meat (Walleye, Northern Pike and Lake Whitefish filets) from the study area.

- **Wild game** (meat and organs): Game may take up and bioaccumulate POPCs from exposure to from soil, surface water and dietary items (i.e., plants, other animals) that contain POPCs due to baseline conditions plus aerial deposition and discharge from Project contact water. People may subsequently be exposed to POPCs in game harvested from the study area. The Indigenous resident were assumed to consume wild game meat from the study area, including Moose, Caribou, Deer, Rabbit, Grouse / Partridge, Duck, Canada Goose. Indigenous residents were also assumed to consume wild game organs, including Moose liver, Moose kidney, Caribou liver, and Caribou kidney.

Sediment and groundwater were not considered operable pathways in the multi-media assessment.

While sediment is present within waterbodies in the LSA and RSA, Project related changes to these waterbodies are assessed through receiver surface water quality modelling and changes to sediment are considered insignificant in comparison. The majority of predicted surface water quality concentrations during construction and operations phases are within baseline ranges, with all predicted surface water quality concentrations within baseline ranges during post-closure phase (WSP 2025e). Further, runoff is being controlled, collected and treated throughout the Project to mitigate changes to the surrounding aquatic environment. As such, sediment quality is not anticipated to be impacted by the Project and sediment projections were not modelled (i.e., it was assumed that there would not be a material change in sediment quality and the incremental change from the Project was assumed to be zero). While several nearby lakes and creeks located within the vicinity of the Project may be accessed by people during fishing, swimming or boating, the larger lakes are deep reducing the likelihood for sediment contact. Swimming may occur off docks at personal waterfront residences (e.g., lodges, cabins), and limited sediment contact is expected. Although some smaller lakes and creeks may be shallow enough or have near-shore areas where people could contact sediment while wading or fishing, any such contact during these activities is expected to be minimal and it is anticipated that shoes would be worn during these activities. There is a beach present along Pakwash Lake Provincial Park within the RSA where sediment exposure can occur along the shore, however this exposure potential can be considered through the soil exposure assessment. The assessment of potential Project impacts to soil and surface water are considered to be protective of Project-related change to sediment quality. Sediment exposure pathways were therefore not considered in the HHRA multi-media model.

It was assumed in the HHRA that an Indigenous resident would only have access to groundwater via groundwater wells. Figure 4-3 illustrates the locations of 10 potential water supply wells, including those of unknown use, based on a search of available water well records from the online Water Well Information System. As discussed in Section 7.5 of the Impact Statement, there are no groundwater water wells (including drinking water wells) present within the LSA and RSA which will be affected by the Project. All of the water supply wells are north of the Property, to the northwest, close to Boyden Creek, or north and northeast close to Gullrock Lake, and lie on far sides of groundwater divides (represented by local watershed boundaries illustrated in Figure 4-43) from aspects of the Project that are likely to affect groundwater (Impact Statement Section 7.5.4, WSP 2025g). In addition, Section 7.1 of the Hydrogeology Baseline Report (WSP 2025g) indicates that “To date, no discrete natural springs have been located at the property. This is likely due to hydrogeology not being conducive to spring development due to the widespread presence of low permeability surficial clay and deeper layers in the subsurface that would generally preclude the formation of discrete conduits for groundwater flow that could express on surface as identifiable springs.” Groundwater exposure pathways were therefore considered to be incomplete for the Project, and groundwater was not considered in the HHRA multi-media model.

Exposure pathways applicable to each receptor retained for the multi-media HHRA are presented in Table 4-2. Further details regarding the exposure pathways included in the HHRA are provided in Attachment E.

4.1.4.1 POINTS OF RECEPTION LOCATIONS FOR AIR QUALITY EXPOSURE

In order to develop the exposure scenarios, several potential PORs were identified to represent air emissions at locations where individuals may reasonably be found spending time outside of the PA of the Project, but within the LSA and RSA. While on the Project site, the health of workers is protected by occupational health and safety standards, codes and regulations established by various provincial and federal governments; thus, occupational health and safety is not addressed in the scope of this assessment.

The PORs evaluated for air quality exposure in the HHRA include:

- Initial Air Quality PORs: PORs 1 to 29 consist of primarily long-term stay locations (e.g., cottage, cabin, lodge, camp), with the exception of POR1, which is a short-term stay storage area.
- Additional PORs: PORs 30 to 41 were selected by the HHRA team to represent additional areas that were either identified in available confidential TKLUS reports, or were identified to account for the potential for exposure on water bodies not otherwise identified in TKLUS reports. PORs 30 to 38 and 40, which consist of primarily short-term stay TKLUS locations (e.g., fishing area, gathering area, cultural area) identified through TKLUS reports or chosen to represent exposure on water bodies. POR 39 is an overnight stay location. Following consultation, POR 41 was added near the Municipality of Red Lake as a long term stay location within the RSA.
- Additionally, a non-static location called the MPOI was assessed, which represents the highest predicted ground level air concentrations anticipated to along the Leased Claims Boundary of the PA. It is noted that human receptors in the LSA are not expected to spend an appreciable amount of time at the MPOI and, therefore, the short-term and long-term stay and TLKUS locations more accurately represent potential exposure.

Note that many initial air quality PORs also overlap with TKLUS areas. TKLUS-specific PORs represent locations identified through TKLUS reports for which PORs were not previously assigned.

Both measured and predicted concentrations were used in the inhalation assessment, where concentrations were either directly measured or predicted using models. Measured data were available for baseline air quality as presented in the Air Quality Assessment (WSP 2025a) and summarized in Attachment A of the HHERA. Predicted air concentrations were modelled for the MPOI and PORs for each project phase (construction, operations, and closure) and used for the HHRA (WSP 2025a). Furthermore, each POR was classified based on where people would be at the locations long-term (i.e., chronic) or short-term (i.e., acute). It is conservatively assumed that the receptor at each POR is an Indigenous Resident, who is present 100% of the time at each chronic POR and up to 24-hours at acute PORs.

The PORs selected for consideration in the HHRA are listed in Table 4-3 and illustrated in Figure 4-1. Details regarding the air quality predictions used in the HHERA are provided in Attachment B.

4.1.5 HUMAN HEALTH CONCEPTUAL SITE MODEL

The information collected in the problem formulation is depicted on the human health conceptual site model; it illustrates the source media for POPCs, identifies the receptors at each of the study areas and shows operable exposure pathways by which receptors may be exposed to the POPCs.

The overall conceptual site model for human receptors is provided in Figure 4-2.

4.2 EXPOSURE ASSESSMENT

The exposure assessment component of the HHRA is intended to estimate potential exposures for the receptors that could be expected to come into contact with POPCs at the site. It describes the receptors and the exposure pathways that could contribute to exposure and uses this information to estimate the potential exposure for each type of receptor. The exposure assessment can be summarized by these basic components:

- Characterization of POPC exposure concentrations in each relevant media including considerations towards bioavailability and speciation of POPCs.
- Characterization of potential receptors.
- Quantitative exposure estimates for each parameter exposure media and receptor combination.
- Multi-media assessment- Total exposure from all exposure pathways, routes and media for which determination of potential adverse effects may be based.

The exposure assessment is considered for the baseline and Project phases (construction, operations, closure). A quantitative estimation of exposure is only calculated for those pathways determined to be complete as per the HHRA problem formulation described in the previous section. Details regarding the exposure assessment, including description of exposure concentrations used, characterization of potential receptor exposure, and exposure estimates, are provided in Attachment D for the inhalation assessment and Attachment E for the multi-media assessment.

4.2.1 ACUTE INHALATION

For the acute inhalation assessment, the estimated acute exposure from inhalation of ambient air is assumed to be the predicted 1-hour air concentration (in milligrams per cubic metre).

$$\text{Exposure Estimate (EE)} = \text{Concentration in air (C}_{air}\text{)}$$

The air quality predictions for 1-hour include consideration of the MPOI location, which is not a fixed location and may vary slightly based on the specific constituent and averaging period.

For the one-hour averaging period, the maximum of the one-hour concentrations was used as the exposure concentration. Acute exposure estimates (i.e., EPCs) for POPCs assessed in the inhalation HHRA are presented Table D1-1 in Attachment D. All PORs and MPOI were assessed for the acute inhalation assessment. Further details regarding the exposure assessment for the acute inhalation assessment, including description PORs and EPCs used, are provided in Attachment D.

4.2.2 CHRONIC INHALATION

For the chronic inhalation assessment, which relies on annual air quality predictions, exposure assessment involves estimating the amount of time that people might spend at a receptor location where they may be exposed to POPCs in air. For chronic PORs, it was conservatively assumed that the Indigenous resident receptor was present in the LSA or RSA continuously throughout their entire lifetime. As such, no adjustment to exposure time based on time spent outside of the LSA or RSA) was made. Therefore, as with the acute assessment, the EPCs in air were assumed to be the exposure estimate.

$$\text{Exposure Estimate (EE)} = \text{Concentration in air (C}_{air}\text{)}$$

For the annual averaging period, the maximum annual average of measured annual concentrations were selected as the EPCs for baseline conditions and the maximum annual average of predicted annual concentrations were selected as the EPC for Project phases. Chronic exposure estimates (i.e., EPCs) for POPCs assessed in the inhalation HHRA are presented Table D1-1, in Attachment D. Only PORs listed as Chronic in Table 4-3 (i.e., PORs 2 to 29 and POR 39 to 41) were assessed for the chronic inhalation assessment. Acute PORs and the MPOI were excluded as people are unlikely to be at those locations for extended durations of time. The chronic assessment of PORs 2 to 29 and 39 is also considered to be protective of acute inhalation exposure at these PORs.

4.2.3 MULTI-MEDIA ASSESSMENT

An exposure assessment was conducted for each POPC identified in the problem formulation for the multi-media assessment. Human exposure from all relevant pathways was evaluated in a multi-media evaluation that considered the ingestion of dietary items, ingestion of soil and surface water, dermal contact with soil and surface water, and inhalation of soil dust. Exposure was estimated in terms of a daily dose for each POPC. This value is called the estimated daily intake and is typically expressed as milligrams of a parameter per kilogram of body weight per day (mg/kg bw/day). The estimated daily intake was calculated with the following considerations:

- Receptor group-specific characteristics (e.g., body weight, ingestion rates, and dietary assumptions and preferences).
- The amount of time a person would spend at a receptor location.

- EPCs of POPCs in environmental media (i.e., soil, surface water, vegetation, fish, and / or wild game).

Details regarding the parameters considered for calculating the estimated daily intake (i.e., receptor characteristics, exposure durations, and EPCs) and the derivation of human exposure estimates are provided in Attachment E.

General receptor characteristics such as body weights, incidental soil ingestion rates, and skin surface areas were obtained from Health Canada (2024) and from literature when they were not available from the regulatory agencies. Ingestion rates for traditional foods were obtained from Chan et al. (2014; 2021). Details on receptor characterization are provided in Attachment E.

For estimating non-cancer health risks, the toddler was evaluated for the assessment of exposure and risks due to non-carcinogenic POPCs to be consistent with HHRA Guidance (Health Canada 2024). The toddler life stage (i.e., 7 months to 4 years) was chosen as the most sensitive life stage for the assessment of non-carcinogens because toddlers are considered to be more susceptible to non-cancer health effects from parameter exposures relative to adults as they typically have a greater intake rate to body weight ratio and certain behavioural activities may expose them to larger quantities of parameters (e.g., playing in soil). In addition, some parameters have been shown to be more toxic to toddlers than adults. Non-carcinogenic exposure and risks were also calculated for the adult (age 20+ years) life stage considered representative of the general population, and for an adult female considered representative of sensitive populations for exposure to developmental toxicants.

A composite receptor was used to evaluate cancer risk across life stages combined over a lifetime. Cumulative incremental cancer risks were calculated for the five life stages defined by Health Canada (2024), infant, toddler, child, teen and adult.

For the multi-media assessment, exposure durations were established for each receptor based on the pathways outlined in Section 4.1.4. The receptor exposure durations are discussed in detail in Attachment E.

Exposure concentrations of various media used in the multi-media assessment were based on measured data (i.e., existing data collected for the Mine), data obtained directly from other disciplines (e.g., modelled air quality and surface water quality) or were estimated from existing data and modelled deposition and / or uptake factors. Details regarding baseline data are provided in Attachment A. Details regarding predicted data used in the HHRA are provided in Attachment B. Details regarding the EPCs used for calculating the estimated daily intake are provided in Attachment E.

For the Project phases (construction, operations and closure), predicted concentrations were estimated as follows:

- Soil: POPC concentrations were estimated from measured soil exposure concentrations (i.e., 95% upper confidence limit of the mean; UCLM; measured soil exposure concentrations) and predicted dust deposition rates to predict soil EPCs. Incremental changes to soil concentrations due to airborne emissions during the Project phases were calculated from annual deposition rates (WSP 2025a). The details are provided in Attachment E.
- Surface water: predicted concentrations of arsenic in surface water were provided in the Receiver Water Quality Modelling Report (WSP 2025e). The modeled surface water data are provided in Attachment B. For inorganic and methylmercury, surface water exposure point concentrations were obtained from the Mercury Bioaccumulation Study (WSP 2026a). These estimates considered the influence of sulphate emissions from the Project on mercury methylation rates.
- Air: Predicted concentrations of POPCs in air were provided in the Air Quality Assessment (WSP 2025a). The predicted air quality data are provided in Attachment B.
- Berries and traditional plants: POPC concentrations were estimated using site-specific bioaccumulation factors (BAFs), predicted soil concentrations and predicted dust deposition rates using a deposition model (US EPA 1999, 2005a) provided in Attachment E.
- Fish tissue: POPC concentrations were estimated using site-specific BAFs and predicted surface water concentrations. Details on the selected BAFs are provided in Attachment E. Mercury concentrations in fish tissues were calculated in the Mercury Bioaccumulation Study (WSP 2026a) to

accurately estimate the uptake of inorganic and methylmercury from surface water that is influenced by sulphate emissions.

- Wild game: POPC concentrations were estimated using wildlife exposure modelling following US EPA (2005a) methodology. Details on the derivation of wildlife POPC concentrations are provided in Attachment E.

For certain POPC chemical speciation was incorporated into the HHRA, such as the following:

- Arsenic speciation: Dietary arsenic exposure in the HHRA focused the assessment on the more toxic form of arsenic, which is inorganic. Organic forms of arsenic are relatively non-toxic (Schoof et al. 1999). Further details regarding the assumed inorganic speciation for each media are presented in Attachment E.
- Mercury speciation: Mercury was identified as a POPC but total mercury can be speciated into inorganic and organic forms. Methylmercury was identified as a POPC in fish tissues but was not measured in media other than fish (e.g., soil, surface water, groundwater, sediment, vegetation, or wild game tissues). Therefore, a literature search was conducted to estimate the amount of methylmercury (organic) relative to the amount of (inorganic) mercury that was measured in soil, sediment, terrestrial plants, surface water, and wild game tissues. Further details regarding the assumed mercury speciation for each media are presented in Attachment E.

To estimate exposure doses and calculate risk estimates for people, a Microsoft Office Excel-based multi-media exposure model was developed. A description of the multi-media exposure model is provided in Attachment E.

4.3 TOXICITY ASSESSMENT

Toxicity assessment involves the classification of the toxic effects of parameters and identifying appropriate TRVs to quantitatively estimate human health risk for the HHRA. TRVs are an estimation of the amounts of parameters that an individual can be exposed to over a given time period without experiencing adverse health effects. For each POPC, a TRV was determined based on a reported mode of action (i.e., threshold or non-threshold) and exposure pathway (e.g., oral).

For threshold acting parameters (i.e., non-carcinogens), TRVs are expressed as reference doses (RfDs) for the oral pathway and as reference concentrations (RfCs) for the inhalation pathway. A reference dose is an estimate of daily oral exposure for the human population (including susceptible subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. An RfC is an estimate of continuous inhalation exposure to a parameter by the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects over a lifetime. Reference doses and RfCs are generally derived for chronic exposure periods (i.e., many years to a lifetime).

For non-threshold acting parameters (i.e., carcinogenic parameters), the TRVs are slope factors for the oral pathway and inhalation unit risks (IURs) for the inhalation pathway. A slope factor is the upper-bound increased cancer risk from a lifetime exposure to a parameter. An IUR is the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) in air.

Details regarding the selection of TRVs are provided in Attachment D for the inhalation assessment and Attachment E for the multi-media assessment.

4.3.1 INHALATION ASSESSMENT

For the acute inhalation assessment, the 1-hour air quality screening criteria applied for the Tier 1 screening (detailed in Attachment C of the HHERA) were used as the acute TRVs (i.e., RfCs) for the POPCs (i.e., DPM and NO_2). Note there were no POPCs for the 24-hour exposure durations, therefore, acute TRVs were selected for the 1-hour exposure duration only. Details regarding the selected 1-hour TRVs are presented in Attachment C. For the chronic inhalation assessment, the non-carcinogenic annual air quality screening criteria applied for the Tier 1 screening (detailed in Attachment C of the

HHRA) were used as the chronic TRV for the non-carcinogenic assessment. For the carcinogenic assessment, the California Office of Environmental Health Hazard Assessment (Cal OEHHA) IUR of 0.0003 (µg/m³)⁻¹ was selected as the carcinogenic TRV following a review of available primary and secondary sources (Cal OEHHA 2011). Details regarding the selection of chronic TRVs for the inhalation assessment is provided in Attachment D. The selected TRVs for the inhalation assessment are presented in Table 4-4 and Table 4-5, below.

4.3.2 MULTI-MEDIA ASSESSMENT

TRVs are based on critical effect levels or no-effect levels observed from studies in exposed human populations or animal species. For the multi-media assessment, the toxicity assessment focused on TRVs for oral or dermal exposure, where available.

TRVs were obtained preferentially from Health Canada (2025a). Where Health Canada (2025a) did not provide TRVs, the US EPA's Integrated Risk Information System (US EPA 2025b) was referenced. Consideration was also given to study subjects (e.g., human versus animal study), the study duration, and whether the critical endpoint was based on a no-observed-adverse-effect level (NOAEL).

TRVs typically do not exist for the dermal exposure route. As none of the parameters retained as POPCs in this HHRA had available dermal TRVs, the dermal exposure doses were compared to the oral TRVs considering dermal absorption efficiency for soil (i.e., the use of dermal relative absorption factors; RAFs). The application of dermal RAFs is discussed in Attachment E. A summary of available TRVs reviewed for use in the multi-media assessment is provided in Attachment E. Based on US EPA (2024), none of the POPCs retained in the HHRA are considered to be mutagenic, and therefore, age-dependent adjustment factors (ADAFs) from Health Canada (2013) do not need to be applied in the human health risk assessment.

The chronic TRVs selected for use in the multi-media assessment are presented in Table 4-6 and Table 4-7.

4.4 RISK CHARACTERIZATION

Risk characterization is the last step in the risk assessment process that combines the results of the exposure assessment and the toxicity assessment for each POPC to estimate the potential for non-carcinogenic and carcinogenic human health effect(s), from exposure to that compound.

Risk estimates were calculated by comparing the estimated exposures with those exposures that were determined to be acceptable (i.e., TRVs). For non-carcinogenic exposures, risk estimates were calculated as hazard quotients (HQs). For carcinogenic exposures, risk estimates were calculated for incremental lifetime cancer risks (ILCRs) and/or additional lung cancer mortality (ALCM) estimates. Details regarding the risk characterization process, including calculation of risk estimates, are provided in Attachment D for the inhalation assessment and Attachment E for the multi-media assessment.

4.4.1 INHALATION ASSESSMENT

4.4.1.1 ACUTE INHALATION

For the acute assessment, POPCs were evaluated for threshold (i.e., non-carcinogenic) parameters, where the risk estimate is expressed as a HQ. HQs for threshold POPCs were calculated by dividing the exposure dose by the TRV (i.e., RfC) as follows:

$$HQ = \frac{C_{Air}}{Acute\ Inhalation\ TRV} \quad \text{Equation 1}$$

Where:

HQ = HQ (unitless)

C_{Air} = POPC Concentration in air ($\mu\text{g}/\text{m}^3$) (i.e., exposure dose)
TRV = Reference concentration ($\mu\text{g}/\text{m}^3$)

A target HQ of 1.0 for POPCs is considered acceptable for inhalation exposures that incorporate background exposure (Project plus baseline), below which indicates that exposures would not be expected to result in adverse human health effects and risks are likely negligible (Health Canada 2023a). Given that conservative assumptions are used by regulatory authorities in the development of the TRVs, HQs greater than 1.0 do not necessarily indicate that adverse human health effects will occur, but that the likelihood that an adverse effect will increase as the HQ rises above 1.0.

As discussed in Section 4.1.2 and Attachment D, the points of reception were grouped into the following: Initial Air Quality PORs (PORs 1 to 29), Additional PORs (PORs 30 to 41), and MPOI. For each POPC evaluated, the maximum acute HQ from the POR groupings were summarised for baseline and each Project phase (construction and operations). The maximum acute HQs for POPCs are presented in Table 4-8.

Hazard quotients for NO_2 were below the target of 1 (meaning predicted concentrations are below the acceptable reference concentration) when the maximum average of predicted 98th percentile results from three consecutive years was selected as the EPC, which is in alignment with the statistical approach applicable for the selected TRV for NO_2 (CCME CAAQC). Therefore, risks are considered negligible and not discussed further. Hazard quotients are above the target HQ of 1 for DPM at the MPOI only, with HQs at PORs all below the target. A discussion of the results above the targets is provided below.

4.4.1.1.1 DIESEL PARTICULATE MATTER

DPM is defined as particulate matter derived from diesel combustion emissions and consists of fine particulate matter ($\text{PM}_{2.5}$) and ultrafine particulate matter, which are released directly or formed secondarily via gaseous precursors in exhaust and evaporative emissions (Health Canada 2016). DPM risks were evaluated by a comparison of the predicted maximum 1-hour concentration with Health Canada's short-term guidance value of $10 \mu\text{g}/\text{m}^3$.

The maximum HQs at the MPOI were above 1.0 for all the project phases where $\text{HQ}=2.8$ and $\text{HQ}=2.9$ for construction and operations phases, respectively. The maximum HQs at the MPOI exceeded 1.0 for all the project phases where $\text{HQ}=2.9$ for both construction and operations phases when accounting for Project and baseline concentrations.

DPM consists of fine and ultrafine particulate matter that may be released directly from fuel combustion in diesel engines or is formed by secondary particulates in the exhaust. Therefore, $\text{PM}_{2.5}$ was used in the air dispersion modelling as a surrogate for DPM in which $\text{PM}_{2.5}$ from combustion processes including blasting was used to model DPM concentrations (WSP 2025a).

As mentioned, the MPOI is a theoretical point that is a non-static location, where maximum air concentrations are predicted outside of the Project property boundaries, in close proximity to the PA. As the MPOI is a conservative assumption that varies and is typically used for the human health worst-case scenario, individuals are not likely to be exposed to concentrations that relate to exposures above the risk target (i.e., HQ above 1).

Although HQs above the target of 1 were identified at the MPOI, the predicted frequency of DPM concentrations above targets was low ranging from 0.13% (construction / closure) to 0.15% (operations), which equates to less than 24 hours of predicted DPM concentrations above targets in a year.

Health Canada (2016) reviewed results from controlled human exposure studies to establish the critical effect and point of departure (POD) for short-term exposures to DPM (Health Canada 2016). The majority of the toxicological evidence related to respiratory and cardiovascular health effects. Increases in airway resistance at $100 \mu\text{g}/\text{m}^3$ was observed in studies with health and/or mildly asthmatic subjects exposed to DPM for 2 hours (Mudway et al. 2004; Riedl et al. 2012; Stenfors et al. 2004; as cited in Health Canada 2016). Furthermore, reported respiratory inflammation were observed in healthy subjects exposed to $100 \mu\text{g}/\text{m}^3$ of DPM for 2 hours, but not in asthmatic subjects who were also exposed (Behndig et al. 2006, 2011; Stenfors et al. 2004; as cited in Health Canada 2016). Therefore, $100 \mu\text{g}/\text{m}^3$ was selected as the POD for short-term exposure based on critical effects observed at a consistent exposure level. Health

Canada then applied a total uncertainty factor of 10 to the POD of 100 µg/m³ to account for sensitive subgroups (e.g., age, disease or genetic factors) and for extrapolation from a low observed adverse effect level (LOAEL) to a NOAEL to derive the short-term limit of 10 µg/m³. Maximum predicted Project plus Baseline 1-hour concentrations of DPM were 28.3 and 28.6 µg/m³ for construction / closure and operations phases, respectively, which is below the POD of 100 µg/m³. Therefore, potential risk from Project-related DPM exposure is low, given the predicted concentrations are below the POD of 100 µg/m³, the predicted frequency of DPM concentrations above targets are low (< 1day/year), conservative assumptions were used in the air quality assessment, the assumption that all PM_{2.5} vehicle combustion was related to DPM is conservative, and people are not expected to be at the MPOI for extended periods that would constitute risk.

4.4.1.2 CHRONIC INHALATION

For the chronic inhalation assessment, DPM was evaluated as a carcinogen. For non-threshold (i.e., carcinogenic) parameters, risk estimates are expressed as ILCR, as recommended by Health Canada (2024). ILCR values are related to increased cancer risks as a result of incremental parameter exposures originating from the Project. ILCR values were compared to an acceptable target of 1 in 100,000 (i.e., 1.0E-05), below which Health Canada considers risks to be negligible (Health Canada 2024). Given that conservative assumptions are used by regulatory authorities in the development of the slope factor, ILCR values exceeding 1.0E-05 do not necessarily indicate that adverse human health impacts will actually occur, but only the likelihood that an adverse effect will increase as the ILCR value increases.

Cancer risk for DPM in the chronic inhalation assessment were calculated as ILCRs by multiplying the exposure dose (i.e., concentration of POPC in air) by the TRV (i.e., IUR) as follows:

$$ILCR = \sum C_{Air} \times TR_i \times ADAF_i \times IUR \quad \text{Equation 2}$$

Where:

- ILCR = Incremental lifetime cancer risk (unitless)
- C_{Air} = POPC concentration in air (µg/m³)
- TR_i = Fraction of time exposed for period *i* (year/80 year), where a lifespan is assumed to be 80 years (Health Canada 2024)
- ADAF_i = Age-dependant adjustment factor for carcinogens and life stage *i* (unitless)
- IUR = Inhalation unit risk (µg/m³)⁻¹

ADAFs are applied to non-threshold carcinogens POPCs that act through a mutagenic mode of action (Health Canada 2024). As stated in Section 4.3.2, none of the carcinogenic POPC (i.e., arsenic or DPM) are assumed to be mutagenic, so the ADAFs were set as 1 for each life stage.

In addition to the calculation of ILCRs based on a TRV (i.e., Cal EPA IUR), cancer risk for DPM was also estimated in the HHRA inhalation assessment using an approach recommended by Health Canada (2023b). The approach was used to provide an estimate of the ALCM associated with additional DPM emissions related to the Project at the chronic PORs (i.e., POR 2 to 29, 39, 41).

The estimated ALCM values were calculated for each Project phase, as well as total incremental ALCM to estimate potential carcinogenic effects from DPM associated with all phases of the Project, which is calculated as the sum of the ALCM for the three Project phases that were assumed to emit DPM. These estimates were compared to the Health Canada acceptable target of 1 in 100,000 (2010; 2024).

The ILCRs for DPM based on the Cal EPA IUR are presented in Table 4-9 and the estimated ALCMs based on Health Canada (2023b) are presented in Table 4-10. Further details regarding the methodology and assumptions used to estimate the incremental cancer risks are presented in Attachment D. In all instances the calculated ILCR and ALCM from chronic exposure to DPM (Table 4-9 and Table 4-10) are below the acceptable target of 1 in 100,000 (i.e., 1.0E-05), as such, unacceptable cancer risks are not expected from predicted Project emissions of DPM and are not discussed further.

4.4.2 MULTI-MEDIA ASSESSMENT

The potential for adverse health effects via oral exposure was assessed by quantifying chronic exposure via soil, food and water based on average and heavy consumer consumption rates for the Indigenous receptor and all life stages (i.e., infant to adult). Risk estimates were calculated by comparing the estimated exposures (from the exposure assessment) with those exposures that were determined to be acceptable (i.e., TRVs from the toxicity assessment).

4.4.2.1 METHODOLOGY FOR THRESHOLD (NON-CARCINOGENIC) POPC

For threshold (i.e., non-carcinogenic) POPCs, risk estimates are expressed as hazard quotients (HQs). HQs were calculated by dividing the total exposure dose by the TRV (i.e., RfD or tolerable daily intake) as follows:

$$HQ = \frac{Dose}{RfD}$$

Where:

HQ = Hazard quotient (unitless)

Dose = Estimated dose (mg/kg-bw/day)

RfD = Reference dose (mg/kg-bw/day)

The HQs for each threshold POPC were summed over the exposure pathways evaluated to determine the potential risk associated with total exposure to a POPC. Health Canada (2023a) indicates a target HQ of 1.0 is applicable for threshold POPC HHRAs if all potential exposure pathways for applicable media and background (i.e., baseline) exposure is considered (i.e., Project plus Baseline). When evaluating for project-related exposures (i.e., Project alone), a target HQ of 0.2 is considered acceptable to compensate for background exposure not considered. Project alone HQs equal to or below the target of 0.2 are deemed negligible (Health Canada 2023a). An HQ below the risk target indicates that exposures would not be expected to result in adverse human health effects. Given that conservative assumptions were used by regulatory authorities in the development of the TRVs, HQs greater than the risk target do not necessarily indicate that adverse human health impacts will occur, but that the likelihood that an adverse effect will increase as the HQ rises above the risk target.

A target HQ of 1.0 has been applied to the Project plus Baseline HQs to identify potential risks. While all potential exposure pathways at the site from the Project and background have been considered in the HHRA, it is recognized that potential exposure through consumer goods and market foods have not been fully considered. A target HQ of 0.2 has also been applied when evaluating Project-related (i.e., Project alone) exposures.

Details regarding the methods and calculation of HQs, including assumptions and a worked example, are provided in Attachment E.

4.4.2.2 METHODOLOGY FOR NON-THRESHOLD (CARCINOGENIC) POPC

For non-threshold (i.e., carcinogenic) POPCs, risk estimates are expressed as lifetime cancer risk (LCR) and ILCR, as recommended by Health Canada (2023a). Calculated LCR values in the HHRA are specifically related to parameter exposures from existing environmental conditions (i.e., baseline) and not related to incremental cancer risks from the project. ILCR values are related to increased cancer risks as a result of exposures originating from the Project alone. ILCR values were compared to an acceptable target of 1 in 100,000 (Health Canada 2023a). Given that conservative assumptions are used by regulatory authorities in the development of the slope factor, ILCR values greater than 1.0E-05 do not necessarily indicate that unacceptable risks will actually occur, but only the likelihood that ILCR values may be unacceptable and further evaluation of the conservative assumptions used to predict risks or other lines of evidence may be warranted.

There are no acceptable target levels for LCR available from regulatory agencies. Based on cancer incidence data from 1997 to 2020 obtained from the Canadian Cancer Registry (Statistics Canada 2023) the following LCR risks are reported in the Canadian population:

- Lifetime probability of developing cancer for all causes was 44.3% (i.e., 0.443 risk)
- Lifetime probability of mortality from cancer was 22.5% (i.e., 0.225 risk) in Canada.

When calculating ILCR values according to Health Canada (2023a) guidance, the lifetime adjustment factor (LAF) is incorporated, which is an adjustment coefficient to relate the exposure concentrations to the number of years considered to be a part of that life stage. It is calculated with the following equation:

$$LAF_i = \frac{t_i}{t_{total}}$$

Where:

LAF_i = Lifetime adjustment factor for lifestage *i* (unitless)

T_i = Length of time of lifestage *i* (years)

T_{total} = Total life expectancy (years)

LAFs applied for each lifestage in the HHRA are calculated based on age group duration (in years) and life span duration (in years) recommended by Health Canada (2023a), as provided in Attachment E.

To account for the length of each Project phase and thus exposure, a ratio was applied to the calculation of the ILCR to relate the exposure concentrations to the number of years of a lifetime occupied by each project phase relative to a lifetime, assuming that a receptor is born at the start of the project. This assumption allows for maximum time of exposure, resulting in a conservative estimate.

The ratio of Project phase to lifespan is calculated as follows:

$$Ratio_{P-L-i} = \frac{t_{phase-i}}{t_{total}}$$

Where:

Ratio_{P-L-i} = Ratio of Project phase to lifespan for Project phase *i* (unitless)

T_{phase-i} = Length of time of Project phase *i* (years)

T_{total} = Total life expectancy (years)

ILCR values in toxicological studies are calculated with an oral slope factor. The slope factor, LAFs, and Project phase ratios were used in the following equation in the HHRA to calculate a ILCR value for a lifetime of exposure (representing a composite receptor):

$$ILCR_w = \sum Dose_{total\ i} \times LAF_i \times ADAF_i \times Ratio_{P-L-w} \times SF$$

Where:

ILCR_w = Incremental lifetime cancer risk (unitless) for all life stages related to incremental parameter exposures because of the Project (i.e., Project Alone) during phase *w*

Dose_{total i} = Total dose for life stage *i* (mg/kg bw/day)

LAF_i = Lifetime adjustment factor for life stage *i* (unitless)

ADAF_i = Age-dependant adjustment factor for carcinogens and life stage *i* (unitless)

Ratio_{P-L-w} = Ratio of Project phase to lifespan for Project phase *w* (unitless)

SF = Cancer risk slope factor (mg/kg bw/day)⁻¹

ADAF (Health Canada 2023a) are applied to non-threshold carcinogens POPCs that act through a mutagenic mode of action. As stated in Section 4.3.2, none of the carcinogenic POPC (i.e., arsenic) are assumed to be mutagenic, so the ADAFs were set as 1 for each life stage.

ILCRs are calculated for a composite receptor, which considers an exposure over the 80-year lifespan of an individual, assumed to begin at the onset of the Project (i.e., construction phase) and represents the receptor evaluated for exposure to carcinogens in the multi-media assessment.

$$ILCR_{composite} = \sum ILCR_w$$

Where:

$ILCR_{composite}$ = Incremental lifetime cancer risk (unitless) for all life stages related to incremental parameter exposures because of the Project (i.e., Project Alone) across all Project phases

$ILCR_w$ = Incremental lifetime cancer risk (unitless) for all life stages related to incremental parameter exposures because of the Project (i.e., Project Alone) during phase w

For the POPCs, only arsenic was evaluated as a carcinogen for the multi-media assessment. Details regarding the calculation of ILCRs, including assumptions, worked example and ILCR results, are provided in Attachment E.

4.4.2.3 RISK ESTIMATES

Estimated HQs for all life stages of the Indigenous resident (i.e., average consumer and heavy consumer) are presented in Attachment E for baseline and Project phases (i.e., construction, operations and closure).

The maximum HQs for the most sensitive receptors (e.g., the toddler representing the most sensitive receptor for exposure to non-carcinogenic POPCs) for baseline and each Project phase are presented for the Indigenous resident, as summarised in Table 4-11 and Table 4-12 for the average and heavy consumer, respectively. As stated above, a target HQ of 1 has been applied to the Project plus Baseline HQs to identify potential risks and a target HQ of 0.2 is applied for Project-alone exposures, where Project Alone HQs below 0.2 are considered negligible. Therefore, POPCs with Project plus Baseline HQs below 1 and / or Project Alone HQs below 0.2 are considered negligible and are not discussed further.

HQs are calculated by dividing the total or Project phase exposure dose by the TRV. The percent (%) contributions of exposure pathways for each POPC for the toddler, adult and adult female life stages for the Indigenous residents receptors (average and heavy consumer) are presented in Table 4-13 for the operations phase. Exposure pathway contributions are approximately the same for baseline and Project phases (construction, operations, and closure), which are presented in detail in Table E1-3 (Attachment E) for each PCOC, receptor and mine phase.

Estimated HQs for baseline and the Project phases (i.e., construction, operations and closure) were above the target of 1.0 for the following POPCs and receptor groups:

- Indigenous Resident (average consumer): Arsenic (inorganic) and methylmercury for Project plus Baseline, primarily related to baseline exposures. All HQs were below the 0.2 target for Project Alone indicating that Project related risks are considered negligible.
- Indigenous Resident (heavy consumer): Arsenic (inorganic), mercury (inorganic) and methylmercury for Project plus Baseline, primarily related to baseline exposures. All HQs were below the 0.2 target for Project Alone indicating that Project related risks are considered negligible.

Selenium HQs were below the target of 1 for Project plus Baseline and below the target of 0.2 for Project Alone for all Project phases for both Indigenous resident receptors (average and heavy consumer). Therefore, potential risks are considered to be negligible and not discussed further. A discussion of the results above the targets is provided below.

In terms of non-threshold risks, estimated ILCRs for the lifetime composite of the Indigenous resident receptor for the average consumer and heavy consumer during each of the Project phases (i.e., construction, operations, closure) along with the total ILCR for an 80- year lifetime are presented in detail in Attachment E and summarised in Table 4-14. ILCR values are below the target ILCR of 1 in 100,000 (i.e., 1.0E-05) indicating that unacceptable carcinogenic risks are not expected from the Project.

4.4.2.4 ARSENIC

Maximum arsenic HQs for the toddler were above the target of 1 for the Indigenous resident (average and heavy consumer) for baseline and all Project phases (Table 4-11 and Table 4-12), when accounting for Project plus Baseline exposures.

For the Indigenous resident (average consumer), HQs were above 1 for baseline and all Project phases, when accounting for Project plus Baseline, but were lower than HQs estimated for the heavy consumer. Predicted maximum HQs for arsenic were for the toddler, where HQs were 3.4 for baseline and ranged from 3.3 (closure and post closure) to 3.4 (construction and operations) when accounting for Project plus Baseline, as summarized in Table 4-11. When accounting for Project Alone contributions, HQs for arsenic were below the 0.2 target for all Project phases. This indicated that Project plus Baseline HQs above the acceptable target of 1 are associated with the background conditions (i.e., baseline) rather than the Project and the Project is not expected to increase arsenic-related human health risks for the average consumer living, working, and recreating in the LSA and RSA. Projected HQs for the adult life stage were lower than the toddler, where HQs were 1.7 for baseline and ranged from 1.6 (post closure) to 1.7 (construction, operations, closure) for Project phases when accounting for Project plus Baseline (See Table E1-5 in Attachment E).

The primary exposure pathway for the toddler and adult receptor to arsenic was predicted to be through surface water related pathways (e.g., ingestion of drinking water, incidental ingestion of surface water, dermal contact through swimming and bathing), which was a conservative assumption as receptors are not expected to consume surface water on a chronic or long-term basis. The relative contribution of each pathway to overall risk is presented in Table 4-13.

For the Indigenous resident (heavy consumer), predicted maximum HQs were 4.6 for baseline and ranged from 4.3 (post-closure) to 4.6 (construction) when accounting for Project plus Baseline (Table 4-12). When accounting for Project-Along contributions, HQs were below the target HQ of 0.2 for all phases, ranging from 0.01 (post-closure) to 0.02 (operations and closure), and are considered negligible. Therefore, risk above the acceptable target of 1 is associated with the background conditions rather than the Project, and the Project is not expected to increase arsenic-related human health risks for the heavy consumer living, working, and recreating in the LSA and RSA. Exposure to arsenic via surface water related pathways was the primary exposure pathway contributing to HQs for the toddler and adult in baseline and project cases, as presented in Table 4-13.

4.4.2.5 MERCURY

A mercury bioaccumulation study was conducted under separate cover (WSP 2026a) to evaluate potential risks to human health associated with fish and surface water consumption, based on predicted changes in fish tissue mercury and methylmercury concentrations resulting from treated effluent discharge. The methylmercury and inorganic mercury hazard quotients were assessed for various life stages (i.e., adult female, adult male and toddler), consumers (i.e., heavy and average fish consumer), locations, and pathways (i.e., consumption of Northern Pike, Walleye and Whitefish; including consumption of surface water as a drinking water source while practicing traditional activities). For both Indigenous resident receptors (average and heavy consumer), baseline HQs for inorganic mercury or methylmercury often were greater than the target of 1, indicating potential health risks under existing conditions, which is reflected in the existing local fish consumption advisories from MECP. However, Project-related contributions were calculated to be negligible, with Project-related HQs below the Health Canada target of 0.2 (Health Canada 2023a) where a target HQ of less than or equal to 0.2 would be deemed negligible and the risk assessment may conclude that there is no anticipated human health risks associated with predicted increased exposure to mercury (i.e., inorganic mercury and methylmercury).

The mercury bioaccumulation study report concluded that predicted Project-related changes in surface water and fish concentrations were non-detectable outside the range of baseline. It should be noted that that the mercury bioaccumulation study report focused only on exposure pathways of ingestion of fish and surface water. Therefore, the multi-media assessment completed for mercury in this HHRA focused on exposures from other media and the multi-media model HQs (Table E1-6a, Attachment E) were combined with the HQs calculated in the mercury bioaccumulation study (Table E1-6b, Attachment E) to estimate total HQs from all sources of exposure related to the Project site (Table E1-6c, Attachment E). Total HQs for inorganic mercury and methyl mercury are summarised in the following sections.

4.4.2.6 *INORGANIC MERCURY*

Inorganic mercury risk estimates were calculated as a sum of HQs for fish and surface water pathways (estimated from the Mercury Bioaccumulation Study Report; WSP 2026a) and HQs for other assessed exposure pathways, estimated from the multi-media assessment (Attachment E).

For the Indigenous resident (average consumer - toddler), HQs were below 1 for Project plus Baseline and below 0.2 for Project Alone for all Project phases (Table 4-11). Therefore, risks are considered to be negligible for the average consumer from exposure to inorganic mercury.

For the Indigenous resident (heavy consumer - toddler), predicted maximum HQs for inorganic mercury were equal to or marginally above 1.0 for baseline and all Project phases when accounting for Project plus Baseline exposures (Table 4-12), where HQs were 1.0 for baseline and ranged from 1.0 (construction and post closure) to 1.1 (operations and closure) for the Project phases. When accounting for Project Alone contributions, HQs were below the target HQ of 0.2 for all phases, with HQs ranging from 0.0032 (construction) to 0.074 (closure) for Project phases. This indicates that risk above the target of 1.0 for Project plus Baseline is associated with the background conditions and not the Project. Ingestion of fish was the primary exposure pathway contributing to HQs for the toddler for baseline and Project phases. The relative contribution of each pathway to overall risk can be found in Table 4-13. Given that Project Alone HQs are below the target of 0.2, they are considered negligible and the Project is not expected to increase inorganic mercury-related health risks for people (i.e., heavy consumer) living, working, and recreating in the LSA and RSA.

For inorganic mercury, a female adult (of child-bearing age) was also evaluated to represent sensitive populations for exposure to developmental toxicants. As presented in Table 4-15, baseline and Project plus Baseline HQs for inorganic mercury for the adult female life stage were below 1 for the average and heavy consumer. When accounting for Project only contributions, maximum mercury HQs for the adult female were also below the target HQ of 0.2. Therefore, Project related HQs are considered negligible and the Project is not expected to increase mercury related human health risks for the average or heavy consumer residing in the LSA or RSA.

4.4.2.7 *METHYLMERCURY*

Methylmercury risk estimates were calculated as a sum of HQs for fish and surface water pathways (estimated from the Mercury Bioaccumulation Study Report; WSP 2026a) and HQs for other assessed exposure pathways, estimated from the multi-media assessment (Attachment E).

Maximum methylmercury HQs for the Indigenous resident (average and heavy consumer) toddler were above 1.0 for the for baseline and all Project phases (Table 4-11 and Table 4-12, respectively), when accounting for Project plus Baseline exposures. When accounting for Project only contributions (Project Alone), HQs for methylmercury were below the target of 0.2 for all Project phases. Therefore, Project related HQs are considered negligible and the Project is not expected to increase methylmercury-related human health risks for the Indigenous resident (average or heavy consumer) residing in the LSA or RSA. Exposure to methylmercury through dietary consumption pathways, specifically fish ingestion, was the primary (i.e., greater than 95%) exposure pathway contributing to HQs for the toddler for baseline and Project phases, as presented in Table 4-13.

For methylmercury, a female adult (of child-bearing age) was also evaluated to represent sensitive populations for exposure to developmental toxicants. As presented in Table 4-15, Project plus Baseline HQs for the adult female life stage were at 1 but lower than for the toddler (Table 4-12). When accounting for Project only contributions (Project Alone), maximum methylmercury HQs for the adult female were

below the target HQ of 0.2. Therefore, Project related HQs are considered negligible and the Project is not expected to increase methylmercury-related human health risks for the adult female residing in the LSA. Exposure to methylmercury via dietary consumption pathways, specifically fish ingestion, was the primary (i.e., >95%) exposure pathway contributing to HQs for the adult in the baseline and Project phases. A detailed summary of the relative contribution of methylmercury for each pathway to overall risk is presented in Table 4-13.

4.5 UNCERTAINTY ASSESSMENT

Uncertainty in HHRA is derived from assumptions required to make a prediction of risk. HHRA will typically incorporate conservative assumptions when faced with uncertainty or limited data to ensure that risks are not underestimated, and the values are typically selected to represent a reasonable worst-case assumption or condition.

The HHRA relied on predicted data from the Air Quality Assessment (WSP 2025a) and Receiver Water Quality Modelling Report (WSP 2025e), which were developed based on conservative assumptions and uncertainties (full details are provided in the respective reports) which include but are not limited to the following:

- Air quality assessment focused on worst case emissions throughout the life of mining phases.
- Air quality assessment incorporated conservative estimates of baseline conditions.
- Water quality assessment incorporated a conservative water balance model.

The HHRA incorporated conservative assumptions that represent reasonable worst-case assumptions so that the assessment of risks to receptors (i.e., Indigenous resident) were unlikely to be understated for the Project phases.

As a result of the scientific investigations, literature reviews and risk assessment guidance followed in the preparation of this HHRA, it is believed that the risk assessment results presented a reasonable yet conservative evaluation of the risk to human receptors predicted from the Project. Where uncertainty was encountered in the development of the risk estimates, reasonable yet conservative assumptions were made, or data were selected, to help ensure that risks were not underestimated.

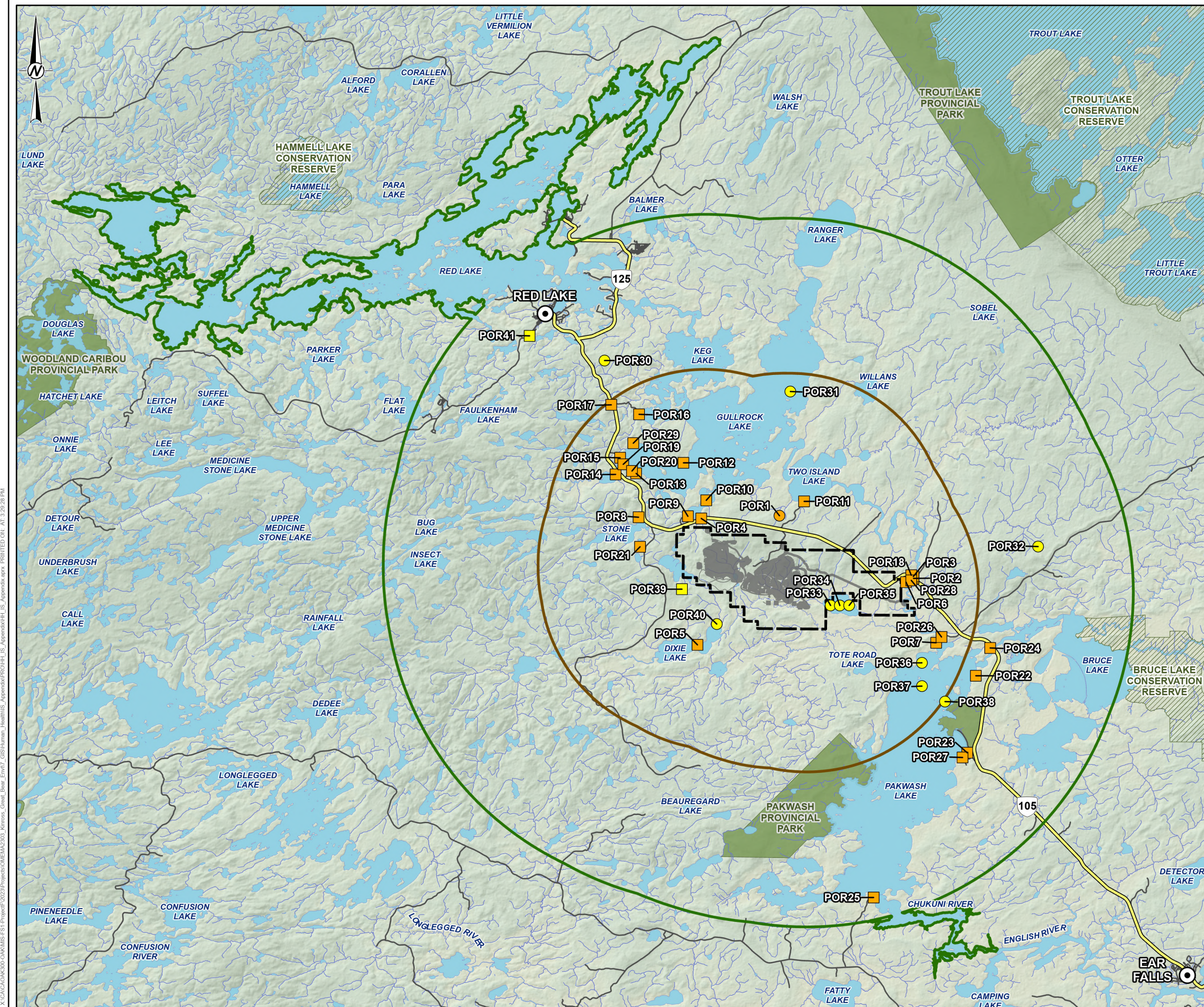
A risk assessment containing a high degree of confidence is based on:

- Conditions where the problem is defined with a high level of certainty based on data and physical observations.
- An acceptable and reasonable level of conservatism in assumptions, which will help ensure that risks are overstated.
- An appreciation of the bounds and limitations of the final solution.

The exposure assessment performed as part of this study was based on:

- Available data to describe existing site conditions (baseline conditions).
- Conservative assumptions for certain parameters, as required.
- Well-understood and generally accepted methods for risk prediction.

A summary of the assumptions and possible sources of uncertainty in the HHRA and their overall effect on the determination of risk in the HHRA is presented in Table 4-16 for the multi-media assessment and Table 4-17 for the inhalation assessment.



LEGEND

- LEASED CLAIMS BOUNDARY
- GREAT BEAR PROJECT FOOTPRINT
- LOCAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
- REGIONAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY

INITIAL AIR QUALITY POINT OF RECEPTION (POR)

- SHORT-TERM STAY (ACUTE)
- LONG-TERM STAY (CHRONIC)

ADDITIONAL POINT OF RECEPTION (POR)

- SHORT-TERM STAY (ACUTE)
- LONG-TERM STAY (CHRONIC)

0 2.5 5 10
1:250,000 KILOMETRES

NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. LEASED CLAIMS BOUNDARY PROVIDED BY GREAT BEAR RESOURCES, APRIL 2025
 3. SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025
 4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

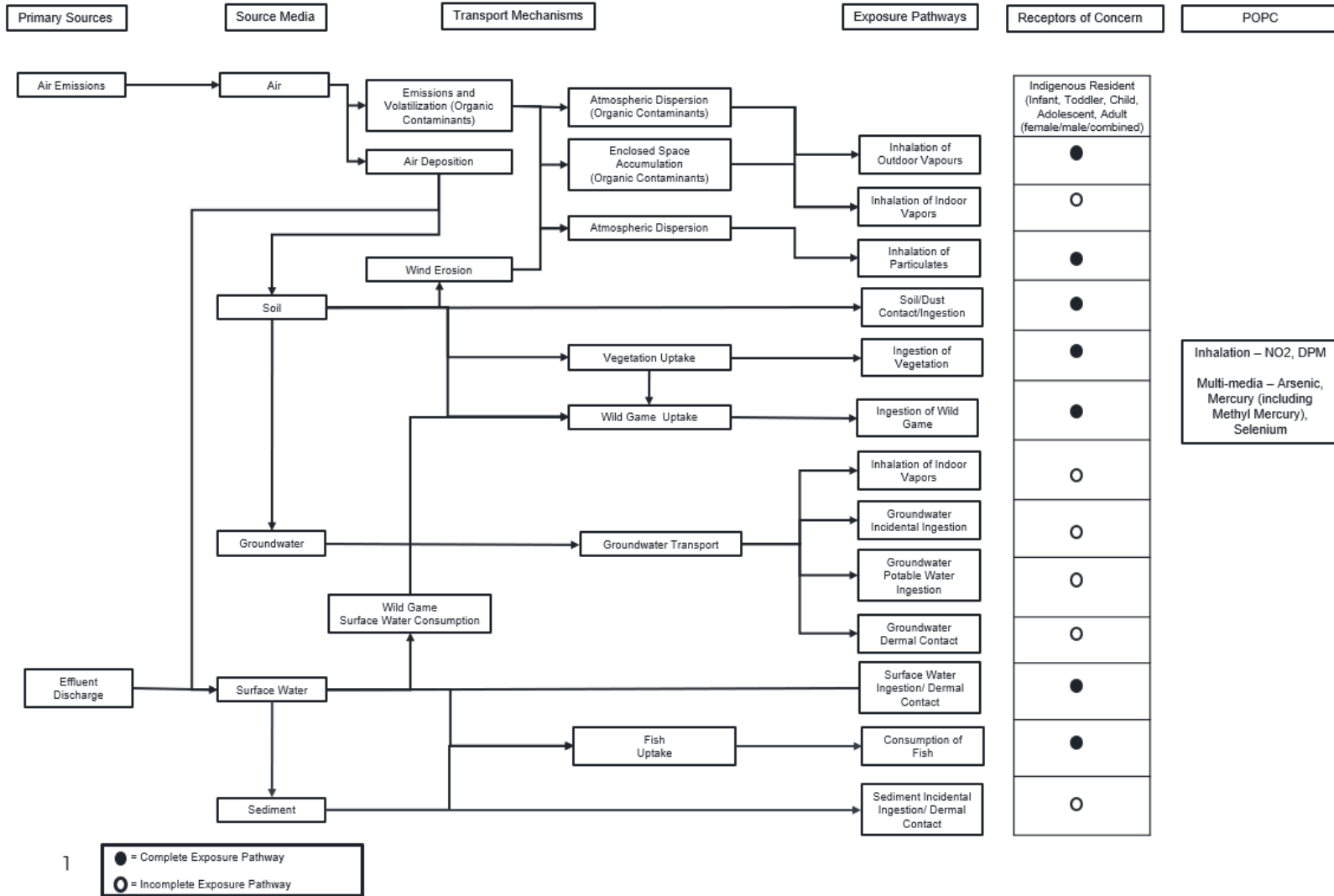
TITLE
HHERA SPATIAL BOUNDARIES AND POINTS OF RECEPTION

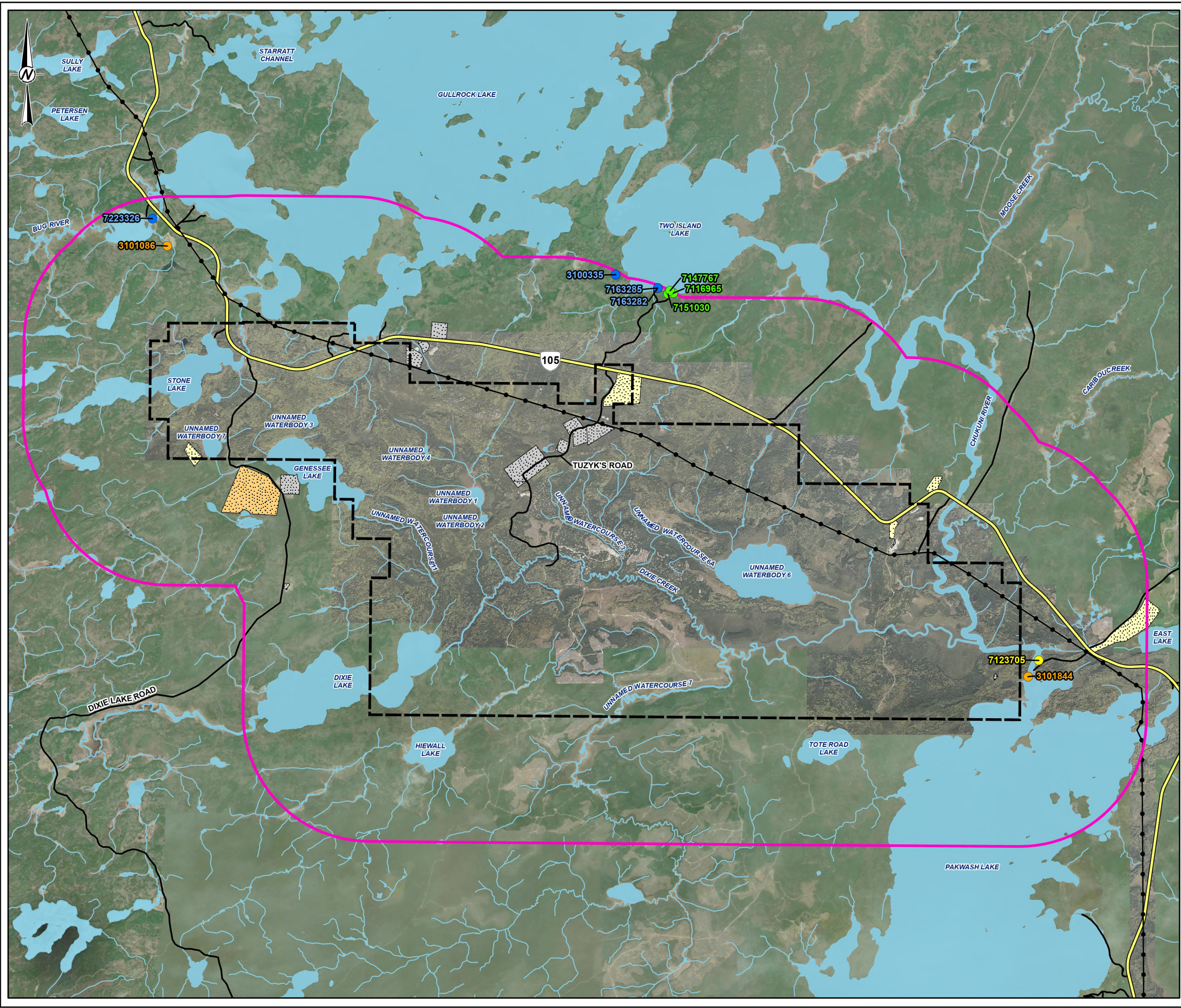
CONSULTANT	YYYY-MM-DD	2026-02-12
	DESIGNED	---
	PREPARED	MD
	REVIEWED	---
	APPROVED	---

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A4 (81mm)

Figure 4-2: Conceptual Site Model for the HHRA

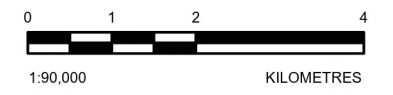




- LEGEND**
- PROPERTY BOUNDARY
 - 3 KM BUFFER ZONE
 - HIGHWAY
 - LOCAL ROAD
 - EXISTING TRANSMISSION LINE
 - WATERCOURSE
 - WATERBODY

- AGGREGATE PERMITS**
- AGGREGATE PIT
 - MTO AGGREGATE PIT
 - MTO AGGREGATE PIT/QUARRY

- WATER SUPPLY WELL**
- COMMERCIAL
 - DOMESTIC
 - PUBLIC
 - UNKNOWN



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. AERIAL IMAGERY PROVIDED BY GREAT BEAR RESOURCES (SCENE DATE: SEPTEMBER 2022)
 3. PROPERTY BOUNDARY PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2024.
 4. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 5. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

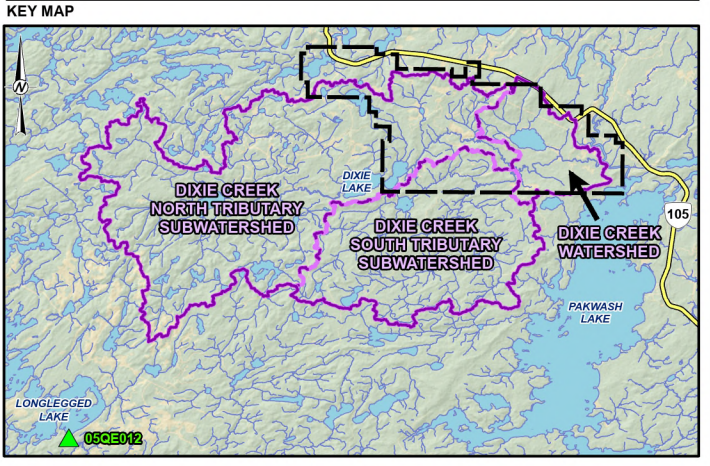
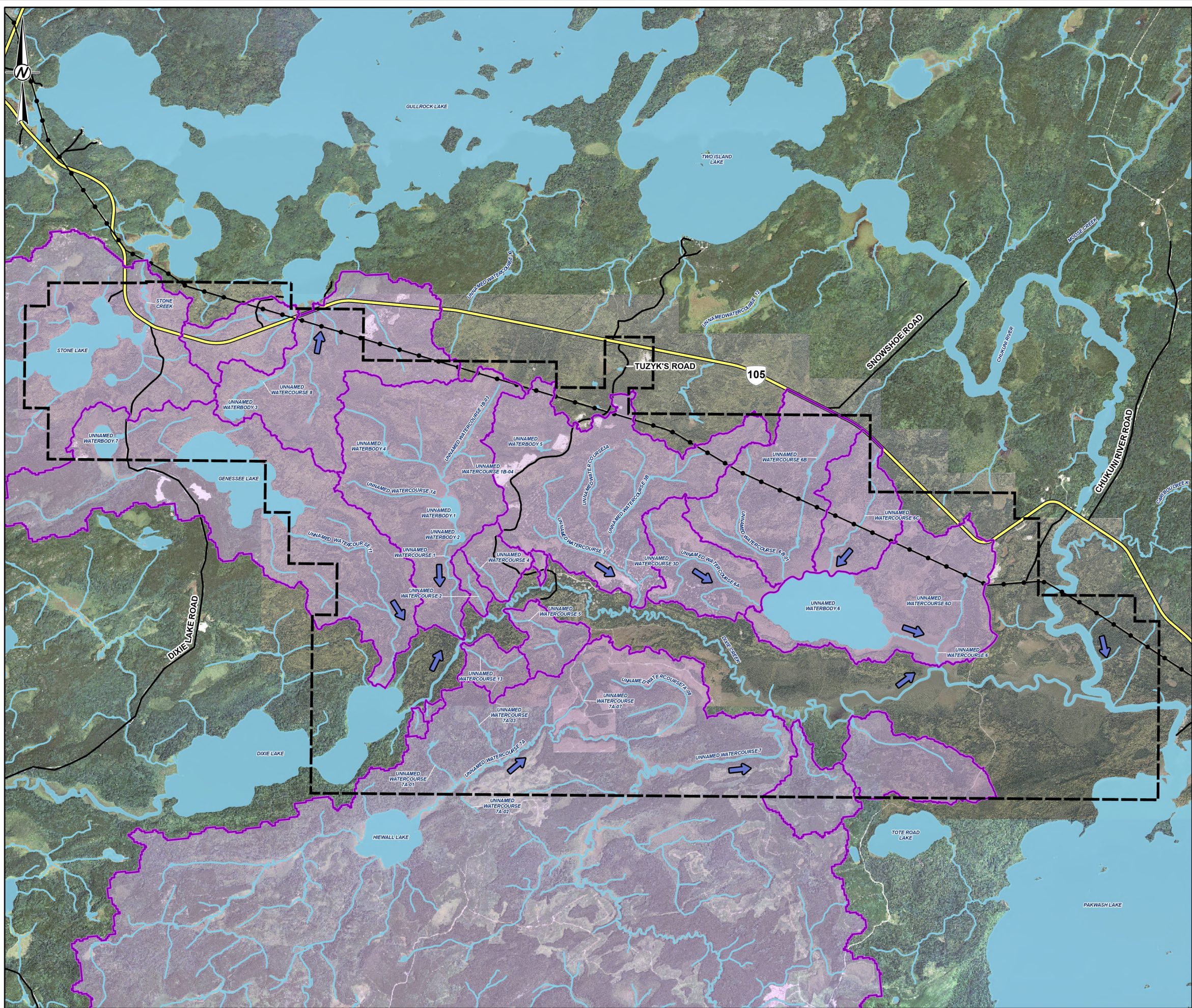
TITLE
WATER SUPPLY WELL RECORDS

CONSULTANT	YYYY-MM-DD	2026-03-06
	DESIGNED	----
	PREPARED	MD
	REVIEWED	----
	APPROVED	----

PROJECT NO. CA0031271 CONTROL 0001 REV. A FIGURE 4-3

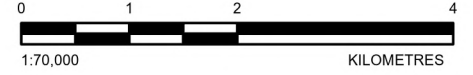
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D



SCALE: 1:70,000

- LEGEND**
- PROPERTY BOUNDARY
 - HYDROMETRIC STATION (SHOWN IN KEY MAP)
 - PROPERTY SUBCATCHMENT
 - DIXIE CREEK SUBWATERSHED (SHOWN IN KEY MAP)
 - DIXIE CREEK WATERSHED (SHOWN IN KEY MAP)
 - HIGHWAY
 - LOCAL ROAD
 - EXISTING TRANSMISSION LINE
 - WATERCOURSE
 - WATERBODY



- NOTE(S)**
1. ALL LOCATIONS ARE APPROXIMATE
- REFERENCE(S)**
1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. AERIAL IMAGERY PROVIDED BY GREAT BEAR RESOURCES (SCENE DATE: SEPTEMBER 2022).
 3. PROPERTY BOUNDARY PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2024.
 4. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 5. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT		GREAT BEAR RESOURCES	
PROJECT		GREAT BEAR PROJECT	
TITLE		LOCAL WATERSHED AREAS	
CONSULTANT	YYYY-MM-DD	2026-03-31	
	DESIGNED	----	
	PREPARED	MD	
	REVIEWED	----	
	APPROVED	----	

PROJECT NO. CA0031271 CONTROL 0001 REV. A FIGURE 4-4

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Table 4-1: Summary of Traditional Food Species Selected for the Multi-Media Model

Species Category	FNFNES Top 3 Species (Chan et al. 2014) ⁽²⁾	Selected for HHRA	Rationale
Small Mammals (game meat)	Rabbit	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾ .
Large Mammals (game meat)	Moose	Yes and Caribou	Identified in TKLUS reports for 5 communities ⁽¹⁾ . Caribou was identified by 3 communities.
	Deer	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾ .
Large Mammals (organ meat)	Moose liver	Yes	Top consumed species (Chan et al. 2014)
	Moose kidney	Yes	Top consumed species (Chan et al. 2014)
	Caribou liver	Yes	Top consumed species (Chan et al. 2014)
Fish	Walleye	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾
	Lake Whitefish	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾
	Northern Pike	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾
Traditional Plants	Wild Rice	Yes and Labrador Tea, Mint	Identified in TKLUS reports for 5 communities ⁽¹⁾ . Labrador Tea was identified by 5 communities and mint by 4 communities.
Berries	Blueberries	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾ . Chokecherries / Pin Cherries and Cranberries were also frequently consumed; however Blueberries were used in the model ⁽³⁾ .
	Raspberries	Yes	Identified in TKLUS reports for 5 communities ⁽¹⁾
Birds	Canada Goose	Yes	Identified in TKLUS reports for 4 out of 5 communities.
	Partridge	Yes and Grouse	Identified in TKLUS reports for 4 out of 5 communities. Partridge and Grouse were both listed as consumed species by the communities. The wildlife characteristics of these birds are similar therefore; a single receptor was used to represent both Partridge and Grouse.
	Ducks	Yes	Identified in TKLUS reports for 4 out of 5 communities.

Notes:

- 1 The five communities include ANA, LSFN, WFN, NWMOC and RLEF.
- 2 The most consumed species from Ecozone 1.
- 3 While Chokecherry / Pin Cherry and Cranberry were identified as frequently consumed, based on a comparison of available consumption rates, the Blueberry and Raspberry consumption rates from Ontario Ecozone 1 were considered protective of the Ontario-wide Boreal Shield consumption rates for the Chokecherry / Pin Cherry and Cranberry. Therefore, the Blueberry and Raspberry species were selected for the multi-media model.

Table 4-2: Exposure Pathways Evaluated in the Multi-media Assessment

Media	Exposure Pathway	Indigenous Resident
Soil	Incidental ingestion Dermal contact Soil dust inhalation	Yes
Groundwater	Ingestion Dermal contact (while bathing)	No
Surface Water	Ingestion (as a drinking water source)	Yes
	Dermal contact (during recreation / bathing)	Yes
	Incidental ingestion (during recreation / bathing)	Yes (No for infant)
Sediment	Incidental ingestion Dermal contact (during recreation / bathing)	No
Berries	Ingestion	Yes
Traditional Plants (Labrador Tea, Mint, Wild Rice)	Ingestion	Yes (No for infant)
Garden Produce (aboveground and belowground)	Ingestion	Yes (No for infant)
Fish Meat (Walleye, Northern Pike and Lake Whitefish fillets)	Ingestion	Yes (No for infant)
Wild Game Meat (moose, caribou, deer, rabbit, grouse/partridge, duck, Canada goose)	Ingestion	Yes (No for infant)
Organ Meat (Moose liver, Moose kidney, Caribou liver, Caribou kidney)	Ingestion	Yes (No for infant)

Notes:

✓ = pathway evaluated; * = pathway not evaluated.

Table 4-3: Points of Receptions for the Inhalation Assessment

POR ID	Exposure Type	POR Type
POR1	Acute	Initial Air Quality POR
POR2	Chronic	Initial Air Quality POR
POR3	Chronic	Initial Air Quality POR
POR4	Chronic	Initial Air Quality POR
POR5	Chronic	Initial Air Quality POR
POR6	Chronic	Initial Air Quality POR
POR7	Chronic	Initial Air Quality POR
POR8	Chronic	Initial Air Quality POR
POR9	Chronic	Initial Air Quality POR
POR10	Chronic	Initial Air Quality POR
POR11	Chronic	Initial Air Quality POR
POR12	Chronic	Initial Air Quality POR
POR13	Chronic	Initial Air Quality POR
POR14	Chronic	Initial Air Quality POR
POR15	Chronic	Initial Air Quality POR
POR16	Chronic	Initial Air Quality POR
POR17	Chronic	Initial Air Quality POR
POR18	Chronic	Initial Air Quality POR
POR19	Chronic	Initial Air Quality POR
POR20	Chronic	Initial Air Quality POR
POR21	Chronic	Initial Air Quality POR
POR22	Chronic	Initial Air Quality POR
POR23	Chronic	Initial Air Quality POR
POR24	Chronic	Initial Air Quality POR
POR25	Chronic	Initial Air Quality POR
POR26	Chronic	Initial Air Quality POR
POR27	Chronic	Initial Air Quality POR
POR28	Chronic	Initial Air Quality POR
POR29	Chronic	Initial Air Quality POR
POR30	Acute	Additional POR
POR31	Acute	Additional POR
POR32	Acute	Additional POR
POR33	Acute	Additional POR
POR34	Acute	Additional POR
POR35	Acute	Additional POR
POR36	Acute	Additional POR
POR37	Acute	Additional POR
POR38	Acute	Additional POR
POR39	Chronic	Additional POR
POR40	Acute	Additional POR
POR41	Chronic	Additional POR

Notes:

ID= Identification; POR= Point of reception

Table 4-4: Acute (i.e., 1-hour) TRVs for Parameters of Potential Concern ($\mu\text{g}/\text{m}^3$)

POPC	TRV ($\mu\text{g}/\text{m}^3$)	Target Organ(s) / Effect	Source
NO ₂	79	Health-based effect (three-year average of the annual 98th percentile of the daily maximum 1-hour average nitrogen dioxide concentrations)	CCME (2025)
DPM	10	Respiratory Effects (increased airway resistance and respiratory inflammation)	Health Canada (2016)

Notes:

$\mu\text{g}/\text{m}^3$ = micrograms per cubic metre; CCME= Canadian Council of Ministers of the Environment; DPM= diesel particulate matter; POPC= parameter of potential concern; TRV= toxicity reference value.

Table 4-5: Chronic (i.e., annual) TRVs for Parameters of Potential Concern ($\mu\text{g}/\text{m}^3$ or $(\mu\text{g}/\text{m}^3)^{-1}$)

POPC	Classification	TRV ($\mu\text{g}/\text{m}^3$ or $(\mu\text{g}/\text{m}^3)^{-1}$)	Target Organ(s) / Effect	Source
DPM	Non-Carcinogenic (RfC)	5	Pulmonary inflammation and histopathology	Health Canada (2016)
	Carcinogenic (IUR)	0.0003	Lung cancer	Cal OEHHA (2011)

Notes:

$\mu\text{g}/\text{m}^3$ = micrograms per cubic metre; Cal OEHHA = California Office of Environmental Health Hazard Assessment; DPM= diesel particulate matter; IUR = inhalation unit risk; POPC= parameter of potential concern; RfC = reference concentration; TRV= toxicity reference value.

Table 4-6: Chronic Oral/Dermal Reference Doses for Parameters of Potential Concern (mg/kg bw/day)

POPC	Oral / Dermal Reference Dose (mg/kg bw/day)	Target Organ(s) / Effect	Source
Arsenic	0.00006	Endocrine and cardiovascular systems	US EPA (2025b), US EPA (2025c)
Inorganic Mercury	0.0003	Immunotoxicity (autoimmune glomerulonephritis)	Health Canada (2025a) and US EPA (1995)
Organic Mercury (Methylmercury)	0.0002 (Sensitive population) 0.00047 (General Population)	Neuro-developmental toxicity	Health Canada (2025a)
Selenium	0.0055 (0 – 6 months) 0.0060 (6 months - <5 years) 0.0063 (5 years - <12 years) 0.0062 (12 years - <20 years) 0.0057 (≥20 years)	Hair and nail brittleness and loss (signs and symptoms of chronic selenosis)	Health Canada (2025a)

Notes:

mg/kg bw/day = milligrams per kilograms of body weight per day; POPC= parameter of potential concern; US EPA = United States Environmental Protection Agency.

Table 4-7: Oral Slope Factors for Parameters of Potential Concern (mg/kg bw/day)⁻¹

POPC	Oral / Dermal Slope Factor (mg/kg bw/day) ⁻¹	Target Organ(s) / Effect	Source
Arsenic	1.8	Bladder, liver and lung cancer	Health Canada (2025a)

Notes:

(mg/kg bw/day)⁻¹ = per milligram per kilograms of body weight per day, POPC= parameter of potential concern.

Table 4-8: Maximum Acute Hazard Quotients (HQs) for PORs and MPOI

POPC	Exposure Period	Receptor Group	Baseline	Project Alone ⁽²⁾		Project + Baseline ⁽²⁾		POR with Max HQ
				Construction/ Closure ⁽¹⁾	Operations	Construction/ Closure ⁽¹⁾	Operations	
NO ₂ ⁽³⁾	1-Hour	MPOI	0.06	0.64	0.87	0.70	0.93	N/A
NO ₂ ⁽³⁾	1-Hour	Air Quality POR	0.06	0.56	0.57	0.62	0.63	POR1
NO ₂ ⁽³⁾	1-Hour	Additional POR	0.06	0.63	0.64	0.70	0.70	POR33 -Construction / Closure POR39 - Operations
DPM	1-Hour	MPOI	0.046	2.8	2.9	2.9	2.9	N/A
DPM	1-Hour	Air Quality POR	0.046	0.46	0.42	0.51	0.47	POR21
DPM	1-Hour	Additional POR	0.046	0.23	0.22	0.28	0.27	POR39

Notes:

DPM= diesel particulate matter; MPOI= maximum point of impingement; N/A = not applicable; NO₂= nitrogen dioxide; POPC= parameter of potential concern; POR= point of reception.

- Air emissions associated with the Project during Active Closure are assumed to be the same as during construction.
- Air emissions associated with the Project are assumed to be 0 during post-closure (following Project decommissioning).
- The CCME CAAQS for NO₂ is based on the maximum average of predicted 98th percentile results from three consecutive years (CCME 2025). The matching statistic was selected as the EPC for NO₂ for the MPOI and each POR for each Project phase. This is consistent with the approach applied by the Air Quality discipline (WSP 2025a).

Gray shade and bold = HQ is above risk target of 1.

Table 4-9: Maximum Chronic Carcinogenic Risk Estimates (Incremental Lifetime Cancer Risk) for the Indigenous Receptor

POPC	Exposure Period	Receptor Group	Construction/ Closure ²	Operations	Total ILCR ^{1,3}	POR with Max ILCR
DPM	Annual	Air Quality POR	1.2E-06	4.3E-06	5.5E-06	POR4
DPM	Annual	Additional POR	1.7E-06	4.9E-06	6.6E-06	POR39
Acceptable ILCR			<1.0E-05			

Notes:

ILCR= incremental lifetime cancer risk; Max = maximum; POPC = parameter of potential concern; POR= point of reception

1 Incremental lifetime cancer risk is based on a lifespan of 80 years.

2 Air emissions associated with the Project during closure are assumed to be the same as during construction.

3 Air emissions associated with the Project are assumed to be 0 during post-closure (following Project decommissioning).

Table 4-10: Estimated Additional Lung Cancer Mortality Cases from the Project per 100,000 People in the Canadian Population

POR	Project Phase			
	Construction	Operations	Active Closure	Total ALCM
POR2	0.05	0.35	0.05	0.44
POR3	0.05	0.34	0.05	0.44
POR4	0.09	0.63	0.09	0.80
POR5	0.07	0.55	0.07	0.68
POR6	0.06	0.41	0.06	0.52
POR7	0.03	0.20	0.03	0.26
POR8	0.04	0.26	0.04	0.34
POR9	0.07	0.50	0.07	0.64
POR10	0.07	0.50	0.07	0.64
POR11	0.09	0.60	0.09	0.77
POR12	0.04	0.27	0.04	0.35
POR13	0.03	0.20	0.03	0.26
POR14	0.02	0.18	0.02	0.23
POR15	0.02	0.17	0.02	0.21
POR16	0.02	0.15	0.02	0.19
POR17	0.02	0.12	0.02	0.15
POR18	0.05	0.35	0.05	0.44
POR19	0.02	0.18	0.02	0.22
POR20	0.03	0.19	0.03	0.25
POR21	0.04	0.28	0.04	0.36
POR22	0.02	0.13	0.02	0.16
POR23	0.01	0.10	0.01	0.13
POR24	0.02	0.13	0.02	0.17
POR25	0.01	0.06	0.01	0.08
POR26	0.03	0.20	0.03	0.25
POR27	0.01	0.10	0.01	0.13
POR28	0.05	0.37	0.05	0.47
POR29	0.02	0.17	0.02	0.21
POR39	0.12	0.71	0.12	0.95
POR41	0.01	0.07	0.01	0.09
Acceptable Target (ALCM) ⁽¹⁾ < 1				

Notes:

ALCM = additional lung cancer mortality per 100,000; POR = point of reception

An incremental lifetime cancer risk of 1 in 100,000 is considered negligible (Health Canada 2023b)).

Table 4-11: Maximum Non-Carcinogenic Risk Estimates (Hazard Quotients) for the Indigenous Receptor (Average Consumer, Toddler) by Project Phase

POPC	Project + Baseline					Project Alone			
	Baseline	Construction	Operations	Closure	Post Closure	Construction	Operations	Closure	Post Closure
Inorganic Arsenic	3.4	3.4	3.4	3.3	3.3	0.0084	0.012	0.013	0.0083
Inorganic Mercury ⁽¹⁾	0.30	0.30	0.32	0.32	0.30	0.0012	0.020	0.020	0.0022
Methylmercury ⁽¹⁾	1.9	1.9	1.9	1.9	1.9	0.0063	0.049	0.052	0.013
Selenium	0.11	0.11	0.11	0.11	0.12	0.0037	0.0058	0.0088	0.024

Notes:

HQ= hazard quotient; POPC = parameter of potential concern.

For Project + Baseline, HQ values > 1.0 are shaded and **bolded**.

For Project Alone, HQ values > 0.2 are shaded and **bolded**.

1 Inorganic Mercury and methylmercury risk estimates were calculated as a sum of HQs for fish and surface water pathways (estimated from the Mercury Bioaccumulation Study Report, WSP, 2026b) and HQs for other assessed exposure pathways (estimated from the multi-media assessment).

Table 4-12: Maximum Non-Carcinogenic Risk Estimates (Hazard Quotients) for the Indigenous Receptor (Heavy Consumer, Toddler) by Project Phase

POPC	Project + Baseline					Project Alone			
	Baseline	Construction	Operations	Closure	Post Closure	Construction	Operations	Closure	Post Closure
Inorganic Arsenic	4.6	4.6	4.5	4.4	4.3	0.018	0.020	0.020	0.010
Inorganic Mercury ⁽¹⁾	1.0	1.0	1.1	1.1	1.0	0.0032	0.073	0.074	0.0062
Methylmercury ⁽¹⁾	6.8	6.8	6.9	6.9	6.8	0.019	0.18	0.18	0.041
Selenium	0.44	0.45	0.45	0.47	0.47	0.014	0.021	0.035	0.085

Notes:

HQ= hazard quotient; POPC = Parameter of potential concern.

For Project + Baseline, HQ values > 1.0 are shaded and **bolded**.

For Project Alone, HQ values > 0.2 are shaded and **bolded**.

1 Inorganic Mercury and methylmercury risk estimates were calculated as a sum of HQs for fish and surface water pathways (estimated from the Mercury Bioaccumulation Study Report (WSP, 2026b) and HQs for other assessed exposure pathways (estimated from the multi-media assessment).

Table 4-13: Relative Pathway Contributions (%) to Risk for Toddler, Adult Female, and Adult Receptors

Receptor	Pathway	Toddler		Adult Female		Adult	
		Contribution (%)	Exposure (mg/day)	Contribution (%)	Exposure (mg/day)	Contribution (%)	Exposure (mg/day)
Indigenous Resident (Heavy Consumer)	Arsenic						
	Soil	3.74%	1.68E-04	0.93%	8.10E-05	0.83%	8.10E-05
	Surface Water	62.14%	2.79E-03	72.64%	6.35E-03	65.34%	6.35E-03
	Plants	8.06%	3.62E-04	8.08%	7.06E-04	9.19%	8.93E-04
	Game	1.92%	8.65E-05	3.08%	2.69E-04	2.30%	2.24E-04
	Fish	24.14%	1.09E-03	15.27%	1.33E-03	22.34%	2.17E-03
	Total	100%	4.50E-03	100%	8.74E-03	100%	9.72E-03
	Mercury (inorganic)						
	Soil	0.12%	6.79E-06	0.08%	8.72E-06	0.04%	8.72E-06
	Surface Water	0.02%	8.88E-07	0.02%	2.22E-06	0.01%	2.22E-06
	Plants	1.39%	7.86E-05	1.40%	1.59E-04	0.71%	1.74E-04
	Game	2.25%	1.27E-04	3.28%	3.73E-04	1.34%	3.28E-04
	Fish	96.22%	5.43E-03	95.23%	1.09E-02	97.90%	2.40E-02
	Total	100%	5.64E-03	100%	1.14E-02	100%	2.45E-02
	Methylmercury						
	Soil	0.00%	5.84E-08	0.00%	2.10E-08	0.00%	2.10E-08
	Surface Water	0.00%	3.38E-08	0.00%	8.45E-08	0.00%	8.45E-08
	Plants	0.01%	1.73E-06	0.01%	3.58E-06	0.00%	3.90E-06
	Game	2.69%	6.12E-04	4.57%	2.12E-03	1.61%	1.58E-03
	Fish	97.30%	2.22E-02	95.43%	4.43E-02	98.39%	9.68E-02
Total	100%	2.28E-02	100.00%	4.64E-02	100.00%	9.84E-02	
Indigenous Resident (Average Consumer)	Arsenic						
	Soil	4.98%	1.68E-04	1.14%	8.10E-05	1.11%	8.10E-05
	Surface Water	82.72%	2.79E-03	89.10%	6.35E-03	86.75%	6.35E-03
	Plants	4.43%	1.50E-04	3.84%	2.73E-04	4.67%	3.42E-04
	Game	0.76%	2.57E-05	0.91%	6.47E-05	0.91%	6.66E-05
	Fish	7.11%	2.40E-04	5.02%	3.58E-04	6.56%	4.80E-04
	Total	100%	3.38E-03	100%	7.12E-03	100%	7.32E-03
	Mercury (inorganic)						
	Soil	0.12%	6.79E-06	0.08%	8.72E-06	0.04%	8.72E-06
	Surface Water	0.02%	8.88E-07	0.02%	2.22E-06	0.01%	2.22E-06
	Plants	1.01%	5.56E-05	0.95%	1.05E-04	0.47%	1.15E-04
	Game	0.75%	4.15E-05	1.08%	1.20E-04	0.44%	1.07E-04
	Fish	98.10%	5.43E-03	97.87%	1.09E-02	99.04%	2.40E-02
	Total	100%	5.53E-03	100%	1.11E-02	100%	2.42E-02
	Methylmercury						
	Soil	0.00%	5.84E-08	0.00%	2.10E-08	0.00%	2.10E-08
	Surface Water	0.00%	3.38E-08	0.00%	8.45E-08	0.00%	8.45E-08

Receptor	Pathway	Toddler		Adult Female		Adult	
		Contribution (%)	Exposure (mg/day)	Contribution (%)	Exposure (mg/day)	Contribution (%)	Exposure (mg/day)
	Plants	0.01%	1.12E-06	0.00%	2.17E-06	0.00%	2.34E-06
	Game	0.84%	1.87E-04	1.18%	5.31E-04	0.50%	4.83E-04
	Fish	99.16%	2.22E-02	98.81%	4.43E-02	99.50%	9.68E-02
	Total	100%	2.23E-02	100.00%	4.49E-02	100.00%	9.73E-02

Notes:

%= percent; mg/day= milligrams per day.

Table 4-14: Summary of ILCR Values for Inorganic Arsenic (Inorganic) for the Indigenous Resident (Heavy and Average Consumer)

POPC	Receptor Type	Construction	Operations	Closure	Post-Closure	Total ILCR
Inorganic Arsenic	Average Consumer	1.8E-08	1.5E-07	1.8E-08	1.2E-07	3.1E-07
	Heavy Consumer	4.2E-08	3.3E-07	3.5E-08	2.1E-07	6.8E-07

Notes:

ILCR= incremental lifetime cancer risk; POPC = parameter of potential concern.

ILCR values > 10E-5 are highlighted and **bolded**.

Table 4-15: Hazard Quotients for the Adult Female Indigenous Receptor (Average and Heavy Consumer)

Receptor	POPC	Baseline	Project + Baseline				Project Alone			
			Construction	Operations	Closure	Post Closure	Construction	Operations	Closure	Post Closure
Indigenous Resident (Average Consumer)	Inorganic Mercury	0.21	0.21	0.21	0.21	0.21	0.00088	0.016	0.016	0.0015
	Methylmercury	0.97	0.97	1.0	1.0	0.97	0.0047	0.027	0.028	0.0091
Indigenous Resident (Heavy Consumer)	Inorganic Mercury	0.56	0.57	0.60	0.60	0.56	0.0020	0.040	0.040	0.0041
	Methylmercury	3.5	3.6	3.7	3.6	3.5	0.013	0.096	0.10	0.032

Notes:

POPC = parameter of potential concern.

For Baseline and Project + Baseline, HQ values > 1.0 are shaded and **bolded**.

For Project Alone, HQ values > 0.2 are shaded and **bolded**.

Inorganic Mercury and methylmercury risk estimates were calculated as a sum of HQs for fish and surface water pathways (estimated from the Mercury Bioaccumulation Study Report; WSP 2026a) and HQs for other assessed exposure pathways (estimated from the multi-media assessment).

Project Alone HQ values may be the same or greater than observed differences in HQ values for "Project + Baseline minus Baseline" as the maximum incremental change in Project Alone may not coincide with the location of the Project + Baseline maximum.

Table 4-16: Uncertainties and Assumptions in the Multi-Media Assessment

Assumption	Uncertainty	Over / Under-Estimate of Risk	Rationale
Problem Formulation and Exposure Assessment			
Receptors	Low to moderate	Neutral to Overestimate	The most sensitive human receptors were assumed to be people (infant to adult) who were assumed to live in the LSA / RSA throughout their lifetime, that participated in harvesting and consuming 100% of their traditional foods from the LSA / RSA. Both a heavy and average consumer of traditional foods (i.e., Indigenous resident) were evaluated. The most sensitive age group evaluated for non-carcinogenic effects was a toddler. A female adult (of child-bearing age) was also evaluated to represent sensitive populations for exposure to developmental toxicants.
Receptor exposure durations and frequencies	Moderate-Low	Overestimate	An exposure term of 1 was assumed for all receptors and exposure pathways in terms of the days exposed per year and the total years exposed per lifetime. Swimming / bathing in surface water was assumed to occur for 2 hours per day, 365 days per year.
Measured concentrations in media	Low	Neutral	Measured baseline concentrations in primary exposure media (air, soil, plants, surface water, game and fish) were determined to be representative of baseline conditions. With the exception of lichen or predicted media (e.g., garden produce or browse), these media were collected within the Project LSA or RSA. Their concentrations were considered applicable for use in the multi-media model to estimate reasonable estimates of representative baseline concentrations or calculate bioaccumulation factors.
Concentrations used for screening	Low	Neutral or Overestimate	Maximum concentrations in each media were used in the initial identification of POPC.
Sediment exposure	Low	Neutral or Underestimate	Sediment quality is not anticipated to be impacted by the Project and sediment predictions were not modelled (WSP 2025e). While sediment is present within waterbodies in the LSA and RSA, Project related changes to these waterbodies are assessed through receiver surface water quality modelling and changes to sediment were considered insignificant in comparison. Water quality modelling assumed that there would not be a material change in sediment quality and the incremental change from the Project was assumed to be zero. While several nearby lakes and creeks located within the vicinity of the Project may be accessed by people during fishing, swimming or boating, the larger lakes are deep reducing the likelihood for sediment contact. Swimming may occur off docks at personal waterfront residences (lodges, cabins), and limited sediment contact is expected. Although some smaller lakes and creeks may be shallow enough or have near-shore areas where people could contact sediment while wading or fishing, any such contact during these activities is expected to be minimal and it is anticipated that shoes would be worn during these activities. There is a beach present along Pakwash Lake Provincial Park within the RSA where sediment exposure can occur along the shore, however this exposure potential can be considered through the soil exposure assessment. The assessment of potential Project impacts to soil and surface water are considered to be protective of Project-related changes to sediment quality
Groundwater exposure	Low	Neutral or Underestimate	It was assumed that an Indigenous resident's access to groundwater would be limited to exposure via groundwater wells. There are no groundwater drinking water wells present within zone of influence of the Project (WSP 2025g). Groundwater exposure pathways were therefore considered to be incomplete for the Project, and groundwater was not considered in the HHRA multi-media model.

Assumption	Uncertainty	Over / Under-Estimate of Risk	Rationale
Use of statistics as EPCs	Low	Neutral	Statistics (i.e., 95% UCLM) were selected for use as EPCs where sufficient sample size was available. Where not appropriate to apply a statistic (i.e., sample size <10), the maximum concentration was selected EPC.
Food consumption rates	Moderate	Overestimate	Consumption rates of wild foods were obtained from Chan et al. (2014; 2021) and reflect a heavy consumer as compared to an average consumer.
	Moderate	Neutral or Overestimate	The species selected for assessment as traditional food in the HHRA may not represent the full scope of species consumed by Indigenous people in the LSA and RSA. However, the selected species were based on available data from surveys of Indigenous people in Ontario (i.e., FNFNES; Chan et al., 2014; 2021) and TKLUS reports collected specifically for the Project. Collectively, the species incorporated in the multi-media model are considered reasonable and representative of the types of foods consumed by Indigenous people in the LSA / RSA.
	Low	Neutral or Overestimate	While infants may not start consuming solid foods until around six months of age, the HHRA assumed that infants living within Indigenous communities in the area of the Project may ingest berries; no other traditional food items were assumed to be consumed by infants.
	Low	Neutral or Overestimate	Relative consumption rates of other vegetables, root vegetables, and wild game for infants, toddlers, children, teens, and adults for the general Canadian population, and fish and wild game ingestion rates for the Canadian Indigenous population and Canadian general population are available from Richardson (1997). These ingestion rates were used to adjust the adult ingestion rate to derive ingestion rates for other life stages.
	Low	Neutral or Overestimate	Ratios for the calculation of consumption rates for the infant (berries only), toddler child and teen were based on the relative consumption rates for these lifestages to an adult female consumption rate. The adult female consumption rate was assumed as a proxy for the infant, toddler, child and teen consumption rate as it was assumed that the dietary intake of these lifestages was better aligned with the adult female of the household rather than the adult male or combined sexes.
	Low	Neutral	Fish consumption rates assumed for Indigenous receptors (average and heavy consumers). The HHRA used fish consumption rates defined in the FNFNES for Ontario for average and heavy consumers only in Ecozone 1 (Chan et al. 2014). The Chan et al (2014) study surveyed six communities in Ecozone 1, which included the ANA community, and represents the best source of information for characterizing Indigenous traditional food consumption rates in Canada. A memo (Grassy Narrows Land Protection Team 2025) from ANA indicated that the pre-contamination fish consumption rate was 200 pounds/person/year, which is equivalent to 249 grams/day. The sum of the adult male heavy consumer consumption rate in Ecozone 1 (Chan et al. 2014) was 242 grams per day, which indicates that consumption rates assumed in the assessment are likely representative of pre-contamination ANA subsistence rates. Further, the consumption rates are similar to the adult fish consumption rate of 220 grams/day for eaters only reported by Richardson (1997), which was derived from studies investigating wild game consumption data among a sample of 2250 Indigenous participants in Canada from data collected in 1971 and 1972 as part of the Nutrition Canada Survey. Therefore, the fish consumption rates from Chan et al (2014) were considered representative for use in the HHRA.

Assumption	Uncertainty	Over / Under- Estimate of Risk	Rationale
Total food intake volume	Moderate	Underestimate	The HHRA characterized risks assuming a large portion of the Indigenous Resident's diet (i.e., traditional plants, berries, garden produce, game meat and fish) and exposure (i.e., soil and surface water) was derived from the LSA and RSA. However, this assumption does not include potential exposures that might be obtained from market basket or retail foods (e.g., background dietary intakes), supplements or other exposure routes (e.g., cosmetic products) to POPCs (i.e., metals) derived from outside the LSA / RSA. It is difficult to identify these potential sources, and information on their typical contribution to a traditional food diet to characterize total exposure is not available (Chan et al. 2014; 2021). As such, the predicted multi-media exposures to POPCs in the HHRA may underestimate total risks with the exclusion of exposure to outside sources (e.g., retail foods, supplements and cosmetics); however, the amount of total food assumed to be consumed by the Indigenous Resident sourced from the LSA / RSA in the multi-media model was assumed to be reasonable assuming most of an individual's food was derived from the land.
POPC concentrations in food items	Low	Neutral or Overestimate	Berry, traditional plants, and fish tissue samples were collected within the LSA and used in the multi-media assessment. Measured concentrations of POPCs in other food items (e.g., mallard) were obtained from the literature (Chan et al. 2014; 2021) where available or predicted using a food chain model approach.
	Low	Neutral or Overestimate	The HHRA assumed that an individual's diet was largely based on food derived from the land, which was assumed to be part of their normal diet. Although there is no analysis of site-specific game meat quality, measured concentrations and uptake models were used to predict concentrations in game meat. Due to the conservatism incorporated into the uptake values and bioavailability assumptions, the estimated game meat concentrations are likely to overestimate risk.
	Low	Neutral or Overestimate	It was assumed that there is a uniform distribution of parameters in vegetation and game meat (especially the edible portions, such as the fruit and muscles) and that an equilibrium is rapidly established in the tissues of the plant or meat.
Dietary assumptions for wildlife receptors in the food chain model	Low to Moderate	Under or Overestimate	It is expected that wildlife diets would include a variety of items, especially depending on the season and availability of food. Dietary assumptions for wildlife receptors may oversimplify foods consumed.
Parameter speciation in environmental media	Low to Moderate	Overestimate	The toxicity of arsenic and mercury differs based on its form (organic vs. inorganic). A conservative approach was taken in the assessment whereby conservative estimates (e.g., 95% UCLMs) or reasonable estimates (e.g., average) of apportionments were obtained from market basket studies, or site-specific data were used.
Site-specific BAFs	Low	Neutral or Overestimate	Calculated site-specific BAF values were based on tissue and media samples collected in support of the HHERA (details in Attachment A). For fish, the calculated BAF values were based on co-located fish and surface water samples from the Chukuni River between 2022 to 2024. The fish samples used in the calculations were standardized to fish lengths for human consumption. As such, site-specific fish BAFs were based on measured surface water concentrations and fish (i.e., Northern Pike, Walleye and forage fish). The US EPA (1997) noted that the mean BAFs derived from field studies are believed to be better estimates of mercury bioaccumulation in natural systems than values derived from laboratory studies. The calculated BAFs are considered representative as they are based on measured field data that implicitly includes the

Assumption	Uncertainty	Over / Under-Estimate of Risk	Rationale
			mercury relationships between plankton (benthic invertebrates and zooplankton), fish and surface water (i.e., food web model) and are in alignment with BAFs reported in literature.
Literature BAFs	Low to Moderate	Neutral	Some predicted concentrations in traditional foods (i.e., vegetation) were based on published uptake factors from predicted concentrations in soil in the absence of site-specific data.
Oral RAFs for mercury and selenium	Low to Moderate	Overestimate	The oral RAF for inorganic mercury, methylmercury and selenium was assumed to be 1. This assumes that the metabolism of parameters in an individual is zero. This is especially important since some metabolism and depuration would occur during the lifespan of an individual.
<i>In vitro</i> bioaccessability assay	Low	Neutral	A bioavailability assay of arsenic in site-specific soil was performed to assess the absorption potential in the gut. This was used to estimate the dose of arsenic through the soil ingestion pathway.
Toxicity Assessment			
TRVs used in assessment	Low	Overestimate	Toxicity data are based on sensitive endpoints subject to availability of studies and uncertainty and / or safety factors are applied to account for inter- and intra-species variability.
Toxicity of Mixtures	Low	Neutral	A chemical mixture is a combination of two or more POPCs that have a similar mode of action or similar effects on the same target organ (Health Canada 2024). The interaction of the POPCs in the mixture can affect the toxicity of the individual POPCs to receptors. The POPC interactions can include additivity (the combined effect is equal to the sum of the individual effects), antagonism (one effect blocks or reduces another), synergism (the combined effect is greater than the sum of individual effects) or potentiation (a non-toxic chemical increases the effect of a another). It is challenging to evaluate the toxicity of mixtures because of a lack of toxicity studies evaluating this in the scientific literature. The POPCs assessed in the HHRA (i.e., arsenic, mercury and selenium) are not considered interactive, as such, a mixture toxicity assessment was not required.
Risk Characterization			
Risk characterization	Low	Overestimate	The level of conservatism associated with the characterization of risk, in particular from the Project, was assumed to be relatively high due to the conservative assumptions incorporated into the measured and / or modelling of predicted parameter concentrations in various media including air, soil, surface water and traditional foods, as well as the use of published uptake factors to model parameter concentrations into some traditional food items including wild game. In addition, it was conservatively assumed that 100% of traditional foods and water consumed by receptors are from the LSA / RSA and bioaccessible.
	Moderate	Neutral	A hazard quotient of 1.0 to evaluate non-carcinogenic risks from exposure to POPCs was used in the multi-media model when considering Project plus baseline exposures. It assumes that the intake from food items incorporated into the total estimated daily intake for the Indigenous resident, considers a total diet. Given that contributions from market basket or retail foods (i.e., external sources of potential POPC other than the Project) was unknown, potential risks may be underestimated for total daily intake. However, the amount of total food assumed to be consumed by the Indigenous Resident in the multi-media model was assumed to be reasonable and non-carcinogenic risks related to Project Alone exposures are all less than the target of 0.2, which is deemed to be negligible (Health Canada 2023a).

Notes:

BAF = bioaccumulation factor; EPC = exposure point concentration; FNFNES = First Nations Food, Nutrition and Environment Study; HHERA = human health and ecological risk assessment; HHRA = human health risk assessment; LSA = local study area; POPC = parameter of potential concern; RAF = relative absorption factor; RSA = regional study area; TKLUS = Traditional Knowledge Land Use Study; TRV = toxicity reference value; ZOI = zone of influence; 95UCLM = 95th percentile upper confidence limit of the mean.

Table 4-17: Uncertainties and Assumptions in the Inhalation Assessment

Assumption	Uncertainty	Over / Under-Estimate of Risk	Rationale
Problem Formulation and Exposure Assessment			
Receptors	Low to moderate	Neutral to Overestimate	The most sensitive human receptors were assumed to be people who were assumed to spend an extended time outside within the LSA and RSA throughout their lifetime.
Receptor exposure durations and frequencies	Moderate	Overestimate	No adjustment to exposure time based on time spent outside of the LSA or RSA was made, equating to an exposure term of 1 for each averaging period. The receptors in the inhalation assessment were assumed to be present for the entirety of each averaging period.
Modelled concentrations in air	Moderate	Overestimate	Conservatism was built into the various aspects of the Air Dispersion Model, and the conservative assumptions used in the assessment are described in the Air Quality Assessment (WSP 2025a)
Measured concentrations in media	Low	Neutral	Measured concentrations in air are considered representative of baseline conditions.
Baseline concentrations used for identification of POPCs (Tier 1 screening)	Low	Neutral or Overestimate	Maximum 90th percentile of the measured or predicted 1-hour and 24-hours averages concentrations were used in the initial identification of POPCs (i.e., Tier 1 screening) for the 1-hour and 24-hours averaging period. Maximum annual averages of measured or predicted annual concentrations were used in the initial identification of POPCs for the annual averaging period. This is considered to be a conservative approach and is consistent with the Air Quality Assessment (WSP 2025a).
Use of statistics as EPCs	Low	Neutral	The maximum average of 98th percentile of three consecutive years of predicted air quality concentrations was selected as the EPC for NO ₂ at each POR and the MPOI. This approach is consistent with both CCME methodology for the derivation of the NO ₂ CAAQS, and the approach used by the Air Quality Assessment (WSP 2025a). The maximum predicted concentration with meteorological anomalies removed was applied as the EPC for DPM at the MPOI for Project phases. This methodology is consistent with MECP (2017) guidance and the approach used by the Air Quality Assessment (WSP 2025a). Maximum project annual average concentrations were selected as the EPC for DPM at the PORs.
Inhalation RAFs	Low to Moderate	Overestimate	The inhalation RAF for all POPCs was assumed to be 1 as per Health Canada guidance (Health Canada 2017a). This assumes that the absorption through the inhalation pathway is more significantly different (i.e., greater or less) than absorption through the oral (i.e., ingestion) pathway for the POPCs.
Toxicity Assessment			
TRVs used in assessment	Low	Overestimate	Toxicity data are typically based on sensitive endpoints subject to availability of studies. Uncertainty and safety factors are applied to derive TRVs to account for inter- and intraspecies variability. Details regarding the derivation of selected TRVs are provided in Attachment D.
Risk Characterization			
Risk characterization	Low	Overestimate	The level of conservatism associated with the characterization of risk, in particular from the Project, is relatively high due to the conservative assumptions incorporated into the modelling of predicted parameter concentrations in air. In addition, it was conservatively assumed that 100% of risk from inhalation is due from project-related air.

Notes:

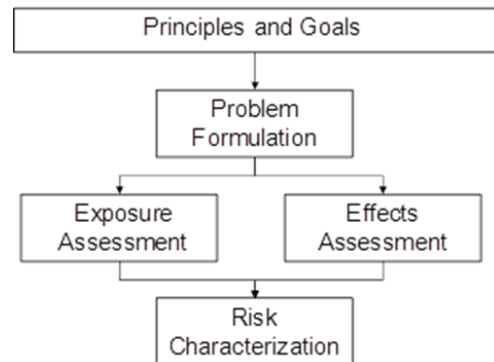
CAAQS = Canadian Ambient Air Quality Standards; CCME = Canadian Council of Ministers of the Environment; EPC = exposure point concentration; DPM = diesel particulate matter; HHRA = human health risk assessment; LSA = local study area; MECP = Ontario Ministry of Environment, Conservation and Parks; MPOI = maximum point of impingement; NO₂ = nitrogen dioxide; POPC = parameter of potential concern; POR = point of reception; RAF = relative absorption factor; RSA = regional study area; TRV = toxicity reference value.

5 ECOLOGICAL RISK ASSESSMENT

ERA is a process used to assess the potential risks to ecological receptors resulting from one or more environmental stressors. The ERA follows a standard risk assessment framework consistent with FCSAP and CCME ERA Guidance (FCSAP 2012a; CCME 2020), as illustrated in the diagram below.

The fundamental steps in the ERA are:

- **Principles and goals:** describe the purpose of the ERA and answer the question: Why is the risk assessment being conducted?
- **Problem formulation:** identifies the issues at the site and sets out the framework within which the ERA will be conducted.
- **Exposure assessment:** quantifies the degree to which ecological receptors encounter POPCs.
- **Toxicity assessment (or effects assessment):** characterizes the potential ecological effects of each POPC.
- **Risk characterization:** discusses the magnitude and likelihood of adverse ecological effects based on the outcomes of the exposure and toxicity assessments.



Uncertainty is an inherent aspect of the ERA process due to necessary assumptions regarding the Project site, receptor characteristics and mathematical modelling. Uncertainties may arise from a number of areas due to some inherent lack of precision about the true value of a parameter (e.g., body weight, ingestion rate, inhalation rate), level of exposure and potential adverse effect. Uncertainties are accounted for by assuming conservative receptor assumptions and exposure scenarios to exaggerate exposures and by using conservative TRVs to help ensure that risks are not underestimated.

The ERA was conducted according to industry accepted risk assessment practices and methodologies and followed guidance published and endorsed by federal and provincial government agencies. This approach is consistent with ERAs conducted for previous projects in Ontario that have been reviewed by IAAC. Guidance documents relied upon in the ERA are identified in Section 2.5.

5.1 PRINCIPLES AND GOALS

Risk assessment principles identify that assessment goals are required to specify the objectives of the ERA with sufficient clarity to enable the identification and assessment of risks relating to ecological health.

5.1.1 SITE MANAGEMENT GOAL

An important first step is to understand the purpose and application of the ERA. The ERA management goal is the overall planning objective and is a high-level narrative statement that reflects the scope of work and objectives of the ERA. The management goals for the ERA are to:

- Evaluate Project-related health effects on ecological receptors.
- Determine the potential risks to wildlife (mammals, birds, amphibians and reptiles), and plant, soil invertebrate, and aquatic life communities from Project-related POPCs in environmental media (soil, sediment, surface water and food) under existing conditions (baseline) and for each of the Project phases (i.e., construction, operations and closure).

- Determine the potential risks to species at risk (SAR) from Project-related POPCs in environmental media (soil, sediment, surface water and food) under baseline conditions and for each of the Project phases.
 - Evaluate and summarize the predicted Project-related changes in ecological health risks for each of the Project phases and compare the changes between baseline and Project contributions.
-

5.1.2 PROTECTION GOALS

The protection goal for community receptors (e.g., terrestrial plants, soil invertebrates and aquatic life) and common mammals and birds (i.e., non-SAR) in the ERA is the protection/maintenance of healthy populations and communities. For SAR, the protection goal is the protection of individuals because impairment of individuals could imperil populations of SAR.

For the evaluation of amphibians and reptiles, mammals and birds were used as surrogates given that there is a general lack of data regarding exposure and effects of parameters on amphibians and reptiles. This approach is consistent with that used by the US EPA in conducting ERAs for terrestrial phase amphibians and reptiles (US EPA 2008). It is believed that exposure to birds is likely higher because birds have higher energy demands than amphibians and reptiles (i.e., endothermy is energetically more demanding than exothermy). As a result, birds would have higher food intake (and thus incidental soil and food ingestion) relative to amphibians and reptiles. However, this approach does not address the dermal pathway of exposure to amphibians which could be important for some parameter groups. As well, this approach does not address differences in sensitivity to parameters between birds and amphibians and reptiles. Differences can be expected but the lack of available toxicity data on amphibians and reptiles precludes a robust comparison to birds.

The FCSAP ERA guidance for amphibians (ECCC 2019) lists several lines of evidence that can be used in the evaluation of potential risks to amphibians (the guidance document does not address reptiles). These lines of evidence do not explicitly state using birds as surrogates; however, the guidance document does indicate that if bird toxicity data are used as surrogates per US EPA (2008), then another line of evidence should also be used. This type of information is not currently available for the Project. The uncertainty in the amphibian and reptile assessment has been noted in Section 5.6. Therefore, as noted for mammals and birds, the protection goal for terrestrial phase amphibians and reptiles in the ERA is maintenance of healthy communities and populations. Aquatic phase amphibians are addressed under the evaluation of the aquatic life community receptor.

5.1.3 ASSESSMENT AND MEASUREMENT ENDPOINTS

Assessment and measurement endpoints link protection goals to a specific scope of work within the ERA. Assessment endpoints are explicit expressions of the environmental value that is to be protected (FCSAP 2012a; CCME 2020). Measurement endpoints are conceptually related to assessment endpoints and can be used to characterize risks to an ecological receptor. For example, using aquatic receptors, one measurement endpoint is comparison of predicted surface water concentrations to surface water quality criteria which are protective of the aquatic community. Comparison to surface water quality criteria was considered to be a conservative evaluation of the potential risks to aquatic life. Therefore, POPCs with concentrations below surface water criteria were considered to pose negligible risks to ecological receptors. Assessment and measurement endpoints used in the ERA are presented in Table 5-1.

5.2 PROBLEM FORMULATION

The problem formulation step defines the conditions at the Site as they relate to ecological receptors. In this step, POPCs were identified, and an ecological conceptual site model was developed that describes basic assumptions regarding fate and transport of POPCs, ecological receptors and exposure pathways within the LSA.

As part of the baseline studies completed for the Project, extensive characterization of plant and invertebrate communities, terrestrial and aquatic wildlife (including mammals, birds, amphibians and reptiles) as well as SAR was completed. When selecting the ecological receptors assessed as part of the ERA, emphasis was placed on species that are present in or near or important to the LSA.

The ERA relied on a LSA (Figure 2-2) and RSA (Figure 2-3), as previously defined for the HHERA (Section 3.2) and used for biological baseline data collection. The LSA and RSA were considered in the identification of ecological receptors and exposure pathways pertinent to the ERA.

5.2.1 IDENTIFICATION OF PARAMETERS OF POTENTIAL CONCERN

During the construction, operations and closure phases of the Project, air emissions and / or surface water releases will occur. This is described in more detail in Section 3.5.3.

In Section 3.7, POPCs were identified based on comparison to regulatory criteria (protective of human and ecological health) in environmental media (i.e., soil and surface water) (i.e., Tier 1 screening) or based on potential for bioaccumulation in the environment. The screening identified the following POPCs for further evaluation in the ERA:

- Soil: arsenic, mercury, selenium.
- Surface water: total phosphorus, aluminum, arsenic, chromium, copper, iron, lead, mercury, selenium.

A Tier 2 screening to identify POPCs in soil and surface water for the ERA was conducted by comparing predicted concentrations for each Project phase (construction, operations, closure, post-closure) to baseline concentrations (i.e., existing conditions) and screening criteria protective of ecological exposure pathways (e.g., direct contact, soil and food ingestion, surface water consumption and protection of aquatic life). Given the assessment of amphibians and reptiles used mammals and birds as a surrogate, the screening to identify POPCs for mammals and birds also informed the POPCs retained for amphibians and reptiles.

For soil, the Tier 2 screening used the maximum predicted soil concentrations for the construction, operations and closure Project phases. While not specifically modelled, it was assumed that predicted deposition rates during the closure phase would be equal to the construction phase. The predicted soil concentration during the operations and closure phases included contribution from soil deposition during the previous Project phases. It was assumed there would be no air emissions and therefore no soil deposition after the completion of the closure phase.

For surface water, the Tier 2 screening used the maximum predicted surface water concentration (i.e., maximum monthly average) for baseline (i.e., existing conditions) and the construction, operations, closure and post-closure Project phases at the individual surface water quality modelling nodes listed in Table B-2 (Attachment B) and Figure 3-2.

The following approach was used to identify POPCs for the ERA:

- If the predicted concentration was greater than its screening criteria and demonstrated an increase from baseline, the POPC was retained for further evaluation in the ERA.
- If the predicted concentration was below the screening criteria or did not increase from baseline, the POPC was not retained for further evaluation in the ERA.

The screening criterion represents a concentration to which a receptor can be exposed without experiencing adverse effects. Comparison to ecological screening criteria was considered to be a conservative evaluation of the potential risks to ecological receptors. Therefore, POPCs with concentrations below the ecological screening criteria were considered to pose negligible risks to ecological receptors. In addition, the ERA focused on POPCs with changes in concentrations due to the Project. Therefore, POPCs with concentrations above ecological screening criteria, and higher concentrations during the Project phases compared to baseline, were identified as POPCs for further evaluation to determine potential risks to ecological receptors. The details of the Tier 2 screening for soil and surface water are provided in the following sections.

5.2.1.1 SOIL

Ecological Screening Criteria

Terrestrial plants and soil invertebrates may be exposed to POPCs in soil via direct contact with soil. Wildlife (mammals and birds) may be exposed to POPCs in soil via incidental ingestion of soil and consumption of food items (plants and / or prey) that have accumulated POPCs from soil.

To address these receptors and pathways, predicted soil concentrations were screened against the following ecological screening criteria:

- CCME Soil Quality Guideline for Environmental Health (SQG_{Es}) for agricultural land use (CCME 1999b and updates, internet site), including:
 - Soil contact – soil concentration protective of terrestrial plants and soil invertebrates from direct contact with soil.
 - Soil and food ingestion – soil concentration protective of wildlife from incidental ingestion of soil and consumption of food items that have accumulated parameters from soil. Criteria protective of mammals and birds are only provided under agricultural land use, which is appropriate for use at the Site as it is in a remote area that requires a higher level of ecological protection to ensure ecological functioning.
- Ontario MECP soil components for Table 2 – full depth, potable water scenario, agricultural land use, coarse-textured soil (MOECC 2016), including:
 - Plants and soil organisms – soil concentration protective of terrestrial plants and soil invertebrates from direct contact with soil.
 - Mammals and birds – soil concentration protective of mammals and birds from incidental ingestion of soil and from consumption of food items that have accumulated parameters from soil.

A POPC was retained as a POPC for the ERA if maximum predicted soil concentrations were greater than the lowest ecological screening criterion for direct contact (plants and soil invertebrates) or soil and food ingestion (terrestrial wildlife) and increased compared to maximum baseline soil concentrations.

Results

The detailed results of the screening for soil for terrestrial plants and soil invertebrates and terrestrial mammals and birds are presented in Table C1-11 (Attachment C). Arsenic was identified as a POPC for terrestrial plants and soil invertebrates.

No POPCs were identified for terrestrial mammals and birds based on screening soil concentrations against ecological screening criteria. However, mercury was carried forward as a POPC for wildlife (and thus amphibians and reptiles) because it is considered a bioaccumulative substance in the aquatic environment and it was retained as a POPC in surface water for the evaluation of aquatic-feeding wildlife (See Section 5.2.1.2). Mercury was not considered further for terrestrial wildlife (except for those of importance to Indigenous people, such as spruce grouse and bald eagle; See Section 5.2.2) as predicted soil concentrations were below the soil ecological screening criteria which are protective of the food ingestion pathway.

Selenium is considered a bioaccumulative substance in the aquatic environment; however, it was not retained as a POPC for terrestrial or aquatic wildlife because predicted surface water concentrations were below the surface water criterion protective of the bioaccumulation pathway for wildlife (See Section 5.2.1.2).

5.2.1.2 SURFACE WATER

Ecological Screening Criteria

Wildlife (mammals and birds) may be exposed to POPCs in surface water via water consumption. Aquatic life (i.e., aquatic plants, aquatic invertebrates, fish and amphibians) may be exposed to POPCs in surface water via direct contact with surface water.

To address water consumption by wildlife, maximum predicted surface water concentrations for each surface water quality modelling node were screened against the following ecological screening criteria:

- CCME (WQGs for the Protection of Agricultural Water Uses, Livestock Water (CCME 1999c)
- BC MWLRS Surface Water Quality Guidelines for Wildlife and Livestock Water (BC MWLRS 2025b)

Ontario lacks surface water criteria specific to wildlife drinking water; therefore, preference was given to the CCME WQG (livestock), followed by other provincial criteria. The BC MWLRS WQG (wildlife) for selenium was selected over the CCME WQG (livestock) as it is protective of dietary accumulation, which is the most critical pathway for selenium exposure by wildlife (British Columbia Ministry of the Environment and Climate Change 2014). Parameters were identified as POPCs for further evaluation for wildlife if the predicted concentrations were above criteria and increased compared to maximum baseline surface water concentrations.

To address direct contact with surface water by aquatic life, predicted surface water concentrations were screened against the following screening criteria:

- MECP Provincial Water Quality Objective (MOEE 1994)
- CCME WQGs-PAL, freshwater, long-term (CCME 1999c and updates, internet site)
- ECCC Federal Water Quality Guideline (FWQG) (ECCC 2026)

The more conservative value of the MECP and CCME criteria was selected. Where a ECCC FWQG was available, it was preferentially selected over CCME and MECP as it was assumed to be based on a more recent evaluation of the scientific literature and considers site-specific toxicity modifying factors such as hardness, temperature, pH and dissolved organic carbon (DOC).

Surface water criteria that were dependent on toxicity modifying factors were derived using water quality information from baseline data (i.e., temperature, pH, DOC) or specific to the Project phase (i.e., hardness) and surface water quality modelling node. Criteria were derived using predicted minimum hardness for each Project phase and surface water quality modelling node. Temperature, pH, and DOC were not modelled; therefore, 25th percentile values/concentrations were used from the nearest baseline monitoring station corresponding to the surface water quality modelling node (Table C1-12, Attachment C). Given that temperature, pH and DOC have a protective effect on toxicity for the POPCs assessed, the 25th percentile was used to derive conservative criteria, consistent with the Receiver Water Quality Modelling Report (WSP 2025e).

Results

The detailed results of the screening for surface water for wildlife and aquatic life are presented in Table C1-12 (Attachment C).

For wildlife, predicted concentrations of all POPCs were below ecological screening criteria protective of wildlife water consumption for all Project phases and surface water quality modelling nodes. As discussed above, mercury is a bioaccumulative substance in the aquatic environment. The CCME WQG (livestock) does not account for accumulation of mercury in dietary items, therefore, mercury (inorganic and methylmercury) was carried forward as a POPC for wildlife.

There were no available screening criteria for wildlife water consumption for phosphorus and iron. These parameters were not retained for further evaluation in the ERA based on the following rationale:

- Phosphorus: Phosphorus is generally considered a nutrient and not a toxicant, such that criteria for total phosphorus are intended to limit eutrophication (i.e., nutrient enrichment) in aquatic environments (CCME 2004, MOEE 1994). Phosphorus is an essential nutrient that serves a variety of

biochemical, intracellular, and ion balance purposes in tissues. Government agencies often do not develop regulatory criteria for phosphorus. Adverse health risks to wildlife from consumption of phosphorus in water are expected to be negligible.

- Iron: Iron is an essential nutrient for mammals and birds and relevant TRVs have not been published for these receptors. In their review of animal studies, the US EPA (2006) reported no treatment-related effects of iron in various studies using rats. In rats exposed to drinking water containing iron, there were no dose-related effects other than body weight gain and reduced water intake, which was attributed to decreased palatability of water, as opposed to the toxicity of the iron itself.

For aquatic life, the following POPCs were retained as POPCs for direct contact with surface water as they exceeded the selected ecological screening criteria and increased from baseline concentrations:

- Arsenic: at surface water quality modelling node PAK-OUT (Outlet of Pakwash Lake).
- Iron: at surface water quality modelling node DIX-2 (Dixie Creek after confluence with Unnamed Watercourse 1).

All other POPCs were below ecological screening criteria protective of aquatic life for all Project phases and surface water quality modelling nodes, or predicted concentrations did not increase from baseline, and were not evaluated further in the ERA.

5.2.2 IDENTIFICATION OF RECEPTORS OF CONCERN

A functioning ecosystem involves interactions of multiple species ranging in size and complexity from bacteria to apex predators. Each species is likely to respond differently to concentrations of parameters in environmental media. Because it is not possible to directly assess the risk to each individual species, it is necessary to simplify the complex ecosystem into organism groups and trophic linkages and select receptors of concern (ROCs) for assessment in the ERA.

ROCs are any non-human individual, species, population, community, habitat or ecosystem that may potentially be exposed to POPCs at a site. A ROC should be ecologically relevant to the site and should have a reasonable potential to be found on a site. The identification of ROCs for a site begins with the compilation of relevant site information, such as basic site characteristics, habitat types and species present on the site, including SAR. In the case of selecting lower trophic level ROCs such as plants and invertebrates, the community as a whole is typically identified as the ROC. Conversely, for higher trophic levels such as mammals and birds, the ROCs are typically identified at the species level. For higher trophic levels, appropriate surrogate receptors are selected as ROCs to represent a group of receptors with similar characteristic features.

Based on review of the species inventories for the LSA conducted as part of the Terrestrial Baseline Environment Report (Northern Bioscience 2025), a representative subset of ecological receptors was selected for evaluation in the ERA. Ecological receptors were selected for the ERA by considering the following criteria as outlined in ERA guidance (CCME 2020):

- Characteristic of land use based on local and regional habitat surveys and species inventory including identification of SAR.
- Most likely to be exposed to POPCs due to habitat and potential Project emissions.
- Able to serve as a baseline from which the effects of change can be evaluated.
- Representative of various levels in the aquatic and terrestrial trophic web.
- Economic or socially valued.
- Indigenous and / or culturally valued.

Based on the results of the baseline species inventories, ROCs that are present within the LSA and RSA included: terrestrial plants, soil invertebrates, mammals, birds, amphibians and reptiles and aquatic receptors. A summary of the SAR in the LSA and RSA and the selected ROCs and representative species for the ERA are provided in the sections below.

5.2.2.1 SPECIES AT RISK

The SAR considered in the selection of ROCs for the ERA were consistent with those assessed in the Impact Statement. The following species were confirmed to be present in the LSA and RSA and have a *Species at Risk Act, 2002* Schedule 1 or *Endangered Species Act, 2007* designation (Northern Bioscience 2025, WSP 2025f).

- Mammal SAR
 - Caribou (Boreal Population; Boreal Caribou) (*Rangifer tarandus*)
 - Five bats (Little Brown Myotis; *Myotis lucifugus*, Northern Myotis ;*Myotis septentrionalis*, Hoary Bat; *Lasiurus cinereus*, Silver-haired Bat; *Lasionycteris noctivagans* and Eastern Red Bat; *Lasiurus borealis*)
 - Wolverine (*Gulo gulo*)
- Avian SAR
 - Bank Swallow (*Riparia riparia*)
 - Barn Swallow (*Hirundo rustica*)
 - Canada Warbler (*Cardellina canadensis*)
 - Common Nighthawk (*Chordeiles minor*)
 - Eastern Whip-poor-will (*Antrostomus vociferus*)
 - Eastern Wood-pewee (*Contopus virens*)
 - Evening Grosbeak (*Coccothraustes vespertinus*)
 - Olive-sided Flycatcher (*Contopus cooperi*)
 - Rusty Blackbird (*Euphagus carolinus*)
 - Short-eared Owl (*Asio flammeus*)
 - Yellow Rail (*Coturnicops noveboracensis*)
- Reptile and Amphibian SAR
 - Common Snapping Turtle (*Chelydra serpentina*)

The ERA evaluated SAR individually or through the selection of other representative species used as surrogates. Based on the POPCs identified in Section 5.2.2.1, aquatic-feeding wildlife were carried forward for further evaluation of mercury. As such, the Little Brown Myotis and the Yellow Rail were considered as they feed primarily from the aquatic environment. The Little Brown Myotis was selected as a ROC and was used as a surrogate for the other SAR bats. The Yellow Rail was evaluated by using the Spotted Sandpiper as a surrogate as both species have similar foraging habits and diet. Terrestrial wildlife, except for species of importance to Indigenous people, were not selected as ROCs as no POPCs were retained based on screening of soil and surface water concentrations to wildlife soil and food ingestion or surface water consumption criteria. The screening for terrestrial wildlife was considered protective of SAR wildlife, therefore the SAR mammals and birds which feed primarily in the terrestrial environment were not evaluated further. The Yellow-banded Bumble Bee (*Bombus terricola*) was federally and provincially listed as special concern and was assessed in the Impact Statement as a SAR. The ERA focusses on SAR listed as endangered or threatened (CCME 2020); therefore, the Yellow-banded Bumble Bee was not considered further in the ERA.

5.2.2.2 SELECTED RECEPTORS OF CONCERN

ROCs selected for evaluation in the ERA included terrestrial plants, soil invertebrates, mammals, birds, amphibians, reptiles and aquatic life. Consistent with CCME (2020) guidance, terrestrial plants and soil invertebrates were assessed as a community rather than as separate species. Aquatic receptors (aquatic plants, aquatic invertebrates, fish and amphibians; aquatic phase) were also assessed as a community.

Terrestrial wildlife, except for spruce grouse and bald eagle, were not selected as ROCs as no POPCs were retained based on screening of soil and surface water concentrations to wildlife soil and food ingestion or surface water consumption criteria (Section 5.2.1). The Spruce Grouse and Bald Eagle were selected as ROCs because these species are of importance to Indigenous people (Section 7.11 of the Impact Statement). Wildlife feeding primarily from the aquatic environment and representative mammal and bird species from various trophic levels within the aquatic environment were selected as ROCs. FSCAP guidance for wildlife receptor characterization provides recommendations for surrogate mammal and bird receptors by feeding guild (herbivore, insectivore, omnivore, carnivore, piscivore) for terrestrial and aquatic environments for evaluation in an ERA (FCSAP 2012b). For this ERA, the FSCAP surrogate receptors for aquatic environments that were identified in the LSA or RSA as part of the Terrestrial Baseline Environment Report (Northern Bioscience 2025) were selected for evaluation, with the addition of other species to provide a range in body sizes and to address all feeding guilds. The selected ROCs and rationale for selection are presented in Table 5-2.

5.2.3 IDENTIFICATION OF EXPOSURE PATHWAYS

For POPCs to have adverse effects on ecological receptors, they must come in contact with the receptor. The means by which this occurs is referred to as an exposure pathway and is dependent on the nature of the POPC and ecological receptor. A complete (or operable) exposure pathway is one that meets the following criteria (CCME 2020):

- A source of POPC of interest must be present.
- Release and transport mechanisms and media must be available to move the POPC from the source to the ecological receptor.
- An opportunity must exist for the ecological receptor to contact the affected media.
- A means must exist by which the POPC is taken up by the ecological receptor, such as ingestion, inhalation, or direct contact.

The exposure pathways considered in the ERA and rationale for the exposure pathways being included in or excluded from the assessment are described in Table 5-3.

5.2.4 CONCEPTUAL SITE MODEL

The conceptual site model for the ERA represents the interactions between the receptors and the POPCs through the identified exposure pathways and is presented in Figure 5-1. The relevant exposure pathways are designated by arrows leading from the POPC source media to each receptor. Terrestrial plants, soil invertebrates and aquatic life were assessed as communities rather than individual species, as described in Section 5.2.2. Amphibians and reptiles were assessed qualitatively. All other receptors (i.e., bird and mammal species) were assessed using the ERA food chain model (Attachment F).

5.3 EXPOSURE ASSESSMENT

The exposure assessment estimates the amount of a POPC to which each of the ecological receptors are exposed via each complete (or operable) exposure pathway. For terrestrial plants and soil invertebrates, exposure is expressed as the concentration of a POPC in soil (mg/kg). For aquatic life (i.e., aquatic plants, aquatic invertebrates, fish and amphibians), exposure is expressed as the concentration of a POPC in surface water (milligrams per litre; mg/L). This permits the evaluation of exposure relative to TRVs for terrestrial plants, soil invertebrates and aquatic life that are expressed in this way. The exposure concentrations in soil and surface water are referred to as exposure point concentrations (EPCs). For wildlife (mammals and birds), food chain modelling was completed to calculate exposure estimates (referred to as doses; mg/kg-bw/day) based on ingestion of abiotic media (e.g., soil, sediment, surface water) and ingestion of food items that have accumulated POPCs from abiotic media. Again, this permits evaluation of exposure relative to the TRVs for mammals and birds that are expressed in this way.

The exposure assumptions for each receptor group, including the EPCs used for plants and soil invertebrates and aquatic life and the details of the food chain model that was used in the assessment of mammals and birds are provided in the following sections.

5.3.1 TERRESTRIAL PLANTS AND SOIL INVERTEBRATES

Based on the ERA Tier 2 screening (Section 5.2.1), arsenic was the only POPC carried forward in soil for assessment of potential risks to terrestrial plants and soil invertebrates.

To evaluate the potential risks to terrestrial plants and soil invertebrates from arsenic in soil, the EPCs for soil were calculated from measured baseline soil concentrations and predicted soil concentrations from dust deposition during the Project. Baseline soil quality data were collected as part of the Soil and Traditional Foods sampling program and are described in Attachment A. Dust deposition rates were provided by the Air Quality Discipline and were used to predict soil concentrations from dust deposition for each Project phase. As a conservative approach, maximum dust deposition rates for arsenic provided by the Air Quality Discipline were used to predict potential future soil concentrations, using the methods described in Attachment B. It was assumed that there was no atmospheric deposition of POPCs under baseline conditions and during the post-closure phase. It was conservatively assumed that POPCs in soil do not degrade or erode appreciably in soil. Therefore, the Project-related contribution to POPC concentrations in soil via deposition accumulates over the phases of the Project and soil concentrations from deposition included the current and previous Project phases. The concentrations of arsenic deposited to soil were then summed with the 90th percentile baseline soil concentrations to calculate the total maximum soil concentration over the life of the Project, using the same methods described in the food chain model (Attachment F, Section 2.3.1).

Terrestrial plants and immobile soil invertebrates are considered sessile receptors and could be exposed to soil in the areas with the highest baseline and predicted concentrations of POPCs in soil. However, assessing risks based on the 90th percentile (i.e., the concentration that 90% of plant and invertebrates are expected to be exposed to) is consistent with the ecological protection goals for lower trophic organisms to protect community structure and ecological function rather than individuals. The 90th percentile soil concentrations for predicted Project phases were calculated using the same methods described above (i.e., using maximum deposition rates), but concentrations of arsenic deposited to soil were summed with 90th percentile baseline soil concentrations to calculate total 90th percentile soil concentrations. The 90th percentile soil concentrations are the same as the soil EPCs used in the food chain model to calculate POPC uptake from soil into plants (i.e., subsurface soil; top 20 centimetres soil depth) (Table F1-1, Attachment F).

In the ERA, risks to terrestrial plants and soil invertebrates from arsenic were estimated using the 90th percentile soil concentrations as the EPCs as shown in Table 5-4 below.

5.3.2 AQUATIC LIFE

Based on the ERA Tier 2 screening (Section 5.2.1), the following POPCs were carried forward in surface water for assessment of potential risks to aquatic life: arsenic at surface water quality modelling node PAK-OUT (Outlet of Pakwash Lake) and iron at surface water quality modelling node DIX-2 (Dixie creek after confluence with unnamed watercourse 1).

To evaluate the potential risks to aquatic life from arsenic and iron, the EPCs for water were based on predicted surface water concentrations provided in the Receiver Water Quality Modelling Report (WSP 2025e). Predictions were provided as monthly average concentrations for baseline and for all Project phases (i.e., construction, operations and closure) over the lifetime of the Project at individual surface water quality modelling nodes. The maximum monthly average concentrations were selected as the EPCs for arsenic and iron for aquatic life for each surface water quality modelling node and assessment phase as a conservative approach. Maximum annual averages for each surface water quality modelling node and assessment phase were also used to provide a more representative concentration estimate of long-term (i.e., chronic) constituent exposure. Baseline and predicted maximum monthly average surface water concentrations for each surface water quality modelling node and Project phase

are provided in Table C1-12 (Attachment C). The EPCs for the two-surface water quality modelling nodes with POPCs identified for aquatic life (Section 5.2.1) are provided in Table 5-5 below.

5.3.3 MAMMALS AND BIRDS

For wildlife (mammals and birds), a food chain model was used to calculate exposure estimates based on ingestion of abiotic media (e.g., soil, sediment, surface water) and ingestion of food items that have accumulated POPCs from abiotic media. Exposure was calculated in terms of an estimated total daily intake (mg dw/day) which was then converted to an exposure dose based on the receptor's body weight (mg/kg-bw/day). The exposure dose was calculated with the following considerations:

- Receptor characteristics (e.g., body weight, ingestion rates, inhalation rates and dietary composition and preferences).
- Parameter speciation (e.g., inorganic versus organic mercury).
- EPCs of POPCs in environmental media (i.e., soil, sediment, surface water, terrestrial vegetation, small mammals, terrestrial and aquatic invertebrates, aquatic plants and fish).

Based on the ERA Tier 2 screening (Section 5.2.1), mercury was carried forward for assessment of potential risks to mammals and birds given that mercury is bioaccumulative in the aquatic environment (as methylmercury) and is a parameter of concern to local community residents. Selenium and arsenic were not retained as POPCs for evaluation of wildlife in the ERA. However, these parameters were included in the food chain model to estimate wild game tissue concentrations that were used as inputs to the human health multi-media model.

Details regarding the receptor characteristics and assumptions about parameter speciation (i.e., mercury) used as inputs to the food chain model and the methods for calculating EPCs and wildlife exposure estimates are provided in Attachment F and summarized below.

Where available, receptor characteristics (e.g., body weight, food ingestion rate, water ingestion rate, soil / sediment ingestion rate and dietary compositions) were obtained from FCSAP (2012b). In the absence of FCSAP guidance, various literature sources, including provincial and international guidance, other sources commonly used in risk assessment and the primary literature were consulted. In the absence of federal or provincial guidance, air inhalation rates were calculated based on allometric equations from the US EPA (1993).

Mercury was identified as a POPC for mammals and birds, but mercury can be present in both inorganic and organic forms in environmental media. Methylmercury is the predominant form present in fish tissues but measured data was not available for the environmental media used in the food chain model (e.g., soil, sediment, surface water, browse, berries, lichen, arthropods, earthworms, small mammals, aquatic plants and aquatic invertebrates and fish). Therefore, a literature search was conducted to estimate the amount of methylmercury (organic) relative to the amount of (inorganic) mercury present in environmental media. Further details regarding the assumed mercury speciation for each medium are presented in Attachment F. EPCs of various media used in the food chain model were based on measured baseline concentrations (i.e., existing conditions), predicted concentrations obtained directly from other technical disciplines (e.g., dust deposition rates and surface water quality concentrations), or were estimated from baseline data and modelled deposition rates or bioaccumulation models. Details regarding baseline data used in the ERA are provided in Attachment A. Details regarding predicted modelled data used in the ERA are provided in Attachment B. Methods for deriving EPCs for baseline and Project phases (construction, operations, closure, post-closure) and the EPCs used for calculating the wildlife exposure estimates are provided in Attachment F and briefly summarized below.

- Soil: EPCs were calculated based on measured baseline soil concentrations (i.e., 90th percentile baseline soil concentrations; Attachment A) and predicted soil concentrations estimated from dust deposition rates (as provided by the Air Quality discipline, see Attachment B). The incremental soil concentrations were added to the baseline EPCs to calculate EPCs for soil for each Project phase (i.e., construction, operations, closure). It was assumed that there was no atmospheric deposition of POPCs under baseline conditions and during the post-closure phase.

- Dust: EPCs for soil dust were calculated based on total surface soil concentrations (i.e., sum of measured baseline surface soil concentrations and predicted surface soil concentrations from deposition) for each Project phase. Soil dust concentrations were calculated from the soil EPCs using a standard dust ratio provided by Health Canada (2024).
- Sediment: It was determined that the Project would not have any material effect on the concentrations of POPCs in sediment. As a result, the EPCs for sediment were determined from the baseline sediment samples collected during the Fisheries Resources Baseline sampling program (WSP 2025d). The 90th percentile sediment concentrations of all samples collected from waterbodies within the LSA (Table A1-3, Attachment A) were used as the EPCs for wildlife for the purposes of the ERA.
- Surface water: Monthly average surface water concentrations were predicted for every month occurring in the Project, at each surface water quality modelling node, as provided by the Water Quality discipline (WSP 2025e). The highest monthly average concentration of all surface water quality modelling nodes was identified for each Project phase. This highest monthly average concentration was selected as the EPC for each Project phase for the ERA. Water quality predictions also included baseline water quality concentrations, and the maximum baseline concentration of all surface water quality modelling nodes was used as the baseline surface water EPC. Baseline and predicted surface water EPCs can be found in Table A1-4 (Attachment A) and Table B1-5 (Attachment B), respectively.
- Browse and berries: EPCs were determined based on dust deposition to plant surfaces, calculated using models from the US EPA (2005a), and accumulation from soil, calculated using literature regression models for browse (Bechtel Jacobs Company 1998) or BAFs for berries (Baes et al. 1994). Site-specific co-located soil and vegetation samples were not used to develop regression models or BAFs for browse or berries as most of the species sampled were more relevant to human consumption than wildlife. Browse (or berries) tissue concentrations were calculated using the regression models or BAFs and the soil EPCs. Calculated browse (or berry) tissue concentrations from air deposition and accumulation from soil were then summed to calculate total concentrations which were then used as the EPCs for the Project phases.
- Lichen: EPCs were determined based on dust deposition to plant surfaces, calculated using models from the US EPA (2005a). Lichen EPCs were calculated based only on dust deposition because they primarily take up parameters from the air rather than from soil. Lichen tissues were not collected or analyzed for mercury within the LSA. In the absence of Ontario-specific published lichen data, baseline sampling data from the Kemess mine project (Ardea Biological Consulting 2015) were used to establish lichen EPCs for the Project. The maximum concentrations from the Kemess data set (Table A4-1, Attachment A) were used to establish baseline EPCs. The EPCs for lichen were calculated as the sum of the baseline concentrations from the Kemess mine and plant surface deposition from airborne particles (dust).
- Terrestrial invertebrates (i.e., arthropods and earthworms) and small mammals: EPCs were determined using literature regression models for uptake from Sample et al. (1998a,b). Site-specific BAFs or regression models were not used as baseline sampling results for terrestrial invertebrates or small mammals were not available for the Project. Terrestrial invertebrate and small mammal tissue concentrations were calculated using the regression models and the soil EPCs.
- Aquatic Plants: EPCs were determined using literature bioconcentration factors (BCFs) for uptake from surface water by aquatic plants from the US EPA (1999). Some baseline data are available for aquatic plants (periphyton); however, these were not used to calculate site-specific BCFs for the Project. The literature BCFs predict similar aquatic plant tissue concentrations to baseline aquatic plant tissue concentrations so this was considered to be a reasonable approach. The aquatic plant tissue concentrations were calculated using the literature BCFs and the surface water EPCs.
- Aquatic Invertebrates: EPCs were determined using literature BCFs for uptake from surface water by aquatic invertebrates from Argonne National Laboratory (2001). Some baseline data are available for aquatic invertebrates (zooplankton); however, these were not used to calculate site-specific BCFs for the Project. The literature BCFs predict similar aquatic invertebrate tissue concentrations to baseline aquatic invertebrate tissue concentrations so this was considered to be a reasonable approach. The

aquatic invertebrate tissue concentrations were calculated using the literature BCFs and surface water EPCs.

- Fish: EPCs were determined using site-specific BCFs for uptake from surface water by fish. Composite small-bodied fish tissue samples were collected from 2022 to 2023 as part of the 2022 to 2025 Fisheries Resources Baseline Report for the Project (WSP 2025d). Site-specific BCFs were derived using the 90th percentile of measured fish tissue concentrations and the highest of the maximum monthly average baseline water quality concentrations from all surface water quality modelling nodes (Attachment A, Table A1-10). Only small-bodied composite fish tissue samples were included in the calculation of the BCFs as these would be most relevant to wildlife consumption.

Wildlife exposure estimates, expressed as estimated daily intakes of POPCs (mg/day), were calculated for the following exposure pathways: soil contact (including incidental soil ingestion and dust inhalation), incidental sediment ingestion, surface water ingestion, and food ingestion, as described in Attachment F. The estimated daily intakes for each exposure pathway were summed to obtain a total EDI. The total estimate daily intakes were converted to doses (mg/kg-bw/day) using receptor body weights, then used to evaluate risks to wildlife in the LSA from the Project in the risk characterization.

Further details on the calculation of wildlife exposure estimates and doses and a sample calculation are provided in Attachment F.

5.4 TOXICITY ASSESSMENT

Toxicity assessment involves the classification of the toxic effects and the identification of TRVs for POPCs. A TRV is an estimate of the amount of a POPC that ecological receptors can be exposed to without experiencing adverse health effects.

For terrestrial plants and soil invertebrates, TRVs are expressed as an acceptable concentration (in mg/kg) in the media to which the ecological receptor is exposed (i.e., soil). For aquatic life, TRVs are also expressed as an acceptable concentration (in mg/L) in the media to which the ecological receptor is exposed (i.e., surface water). For mammals and birds, the TRV is expressed as an acceptable dose (in mg/kg-bw/day). The TRVs are used as thresholds for comparison with exposure concentrations / doses during risk characterization.

5.4.1 TERRESTRIAL PLANTS AND SOIL INVERTEBRATES

The CCME (1999b, current to 2025) derived guidelines for soil (soil contact guideline) that are considered to be protective of direct contact by both terrestrial plants and soil invertebrates. These derivations involved the generation of extensive datasets of toxicity data for effects on survival, growth, and reproduction and the identification of suitable toxicity data for guideline development. The CCME SQG_E for direct soil contact for agricultural land use was used as the TRV for arsenic for terrestrial plants and soil invertebrates, as presented in Table 5-6 below. This is considered a conservative approach as the SQG_E is intended to be applied at the screening stage of an ERA.

5.4.2 AQUATIC LIFE

The CCME (1999c, current to 2025) derived guidelines for surface water that are considered to be protective of direct contact with surface water by aquatic life, including aquatic plants, aquatic invertebrates, amphibians (aquatic phase) and fish. These derivations involved the generation of extensive datasets of toxicity data for effects on survival, growth, reproduction and development and the identification of suitable toxicity data for guideline development. The CCME WQG for the Protection of Aquatic Life (long-term) was used as the TRV for arsenic in surface water for aquatic life.

The FWQG developed by ECCC was selected as the TRV for iron as it is based on the most recent science, follows CCME (2007) guidance for derivation of WQG-PALs and incorporates site-specific toxicity modifying factors (i.e., pH and dissolved organic carbon) to establish a site-specific water quality guideline.

The surface water TRVs for aquatic life used in the ERA are presented in Table 5-7 below. Use of the CCME WQG for the Protection of Aquatic Life for arsenic and ECCC FWQG for iron as TRVs is considered a conservative approach as these guidelines are intended to be applied at the screening stage of an ERA.

5.4.3 MAMMALS AND BIRDS

Toxicity reference values were identified for mammals and birds for two different levels of protection:

- 1) No-observed adverse effect level (NOAEL)-TRVs. NOAEL-TRVs are more protective than lowest-observed adverse effect level (LOAEL)-TRVs (see below). NOAEL-TRVs were used for listed wildlife species or species at risk. NOAEL-TRVs were considered to represent minimal to low effect levels.
- 2) LOAEL-TRVs. LOAEL-TRVs were used for all non-listed (or common) wildlife species. LOAEL-TRVs were considered to represent low to moderate effects.

Only mercury was identified as a POPC for wildlife. The derivations of the NOAEL- and LOAEL-TRVs for inorganic and organic (methyl) mercury are summarized below.

The TRVs were adopted from federal (CCME and FCSAP), provincial (MECP) regulatory agencies, and other sources commonly used in risk assessment (e.g., Sample et al. 1996) and the primary literature (e.g., Fuchsman et al. 2017). The CCME provides TRVs for mammals and birds for methylmercury and not for inorganic mercury. FCSAP provides TRVs for mammals and birds for inorganic mercury; however, the source of the selected TRVs (CEAEQ 2012) could not be obtained for review; therefore, these TRVs were not considered in the ERA. The MECP provides TRVs (LOAELs) for mammals and birds for both inorganic and methylmercury, which were adopted from Sample et al. (1996).

The selected TRVs are based on survival, growth and reproduction endpoints because protection of these endpoints was assumed to protect population viability (CCME 2020). Selected TRVs and endpoints are provided in Table 5-8. Further details on the derivations of the selected TRVs are provided in Attachment F.

5.5 RISK CHARACTERIZATION

Risk characterization combines the findings of the exposure assessment with the findings of the toxicity assessment to determine the potential for adverse effects, or risks, to ecological receptors using quantitative or qualitative approaches. The characterization of risks also includes consideration of the uncertainty and conservatism in the ERA.

For terrestrial plants and soil invertebrates, aquatic life and mammals and birds, the risk characterization used a quantitative method to estimate overall risks from exposure to Project-influenced media by calculating a hazard quotient (HQ). For the assessment of community-based receptors, the HQ is defined as the EPC of the POPC in the associated media (e.g., soil, surface water) divided by the TRV for the community receptors (e.g., terrestrial plants, soil invertebrates, aquatic life). For mammals and birds, the HQ is defined as the dose divided by the TRV for mammals or birds. The HQ was calculated as follows:

$$HQ = \frac{EPC \text{ or Dose}}{TRV}$$

Where:

HQ	= Hazard Quotient (unitless)
EPC or Dose	= EPC (mg/kg for plants and soil invertebrates; mg/L for aquatic life) or dose (mg/kg-bw/day for mammals and birds)
TRV	= Toxicity reference value (mg/kg for plants and soil invertebrates; mg/L for aquatic life; mg/kg-bw/day for mammals and birds)

In general, if the HQ is less than 1.0, no unacceptable risks to ecological receptors would be expected, because concentrations are below levels known to cause adverse effects (CCME 2020, MOE 2011b). Conversely, if the HQ exceeds 1.0, it may be inferred that adverse effects on individuals are possible and further consideration was given to the difference between HQs calculated for the Project phases and the HQs calculated for baseline.

For the assessment of amphibians and reptiles, a qualitative approach was used given that there is a general lack of data regarding exposure and effects of parameters on amphibians and reptiles.

5.5.1 TERRESTRIAL PLANTS AND SOIL INVERTEBRATES

The HQs for terrestrial plants and soil invertebrates were calculated by comparing predicted soil concentrations for each of the Project phases to the TRVs protective of terrestrial plants and soil invertebrate communities. HQs for post-closure were not calculated as it was assumed that there was no atmospheric deposition of POPCs during the post-closure phase. The HQs are presented in Table 5-9.

The HQs calculated for terrestrial plants and soil invertebrates were below the target of 1.0 for all Project phases. In addition, there was no measurable change in the HQs for the Project phases compared to baseline because the contribution of arsenic from dust deposition from the Project was negligible. Therefore, Project activities are not expected to result in unacceptable risks to terrestrial plant and soil invertebrate communities.

5.5.2 AQUATIC LIFE

The HQs for aquatic life were calculated by comparing predicted surface water concentrations for the Project phases to the TRVs protective of aquatic life. The HQs are presented in Table 5-10.

The HQs calculated using maximum monthly average predicted surface water concentrations were marginally above the target of 1.0 for all Project phases for arsenic and iron. However, there was no measurable increase in the HQs for the Project phases compared to baseline because the increase in the surface water concentrations from the Project were marginal. When using the maximum annual average predicted surface water concentration, HQs were equal to 1.0 for iron and marginally above 1.0 for the Project phases for arsenic, but showed little difference from baseline (i.e., change in HQ of less than 0.1). The HQs are likely overestimated due to a number of conservative assumptions used in the calculations of the EPCs and derivations of the TRVs. For the EPC, a number of conservative assumptions were incorporated in the surface water quality modeling such that surface water concentrations are not under predicted. In addition, the maximum monthly average is representative of a worst-case exposure while the maximum annual average concentration is representative of long-term (i.e., chronic) constituent exposure. A conservative approach was used in the derivation of the arsenic TRV which is based on an EC50 (effect concentration that effects 50% of the test species) for growth of algae of 50 µg/L (the most sensitive organism to arsenic identified) multiplied by an arbitrary uncertainty factor of 10 (CCME 2001a). A conservative approach was also used in the derivation of the iron TRV, which is hardness- and pH-dependent, by using the 25th percentile baseline surface water quality. Given the conservative assumptions used in the calculations of the HQs and the negligible contributions to the HQ by the Project, Project activities are not expected to result in unacceptable risks to aquatic life communities.

5.5.3 MAMMALS AND BIRDS

The HQs for mammals and birds were calculated by dividing the exposure doses estimated using the food chain model by the mammalian and avian TRVs. NOAEL-TRVs were used for listed wildlife species or species at risk (i.e., little brown myotis) and LOAEL-TRVs were used for all non-listed (or common) wildlife species. The HQs for mammals and birds are presented in Table 5-11.

The HQs for all mammals and birds receptors and all Project phases were below the target HQ of 1.0, with the exception of methylmercury for the belted kingfisher. The HQs for the belted kingfisher were marginally above 1.0 for baseline and the Project phases. However, changes in calculated HQs between baseline and the Project phases were less than 0.1 for construction and operations and negligible during

closure and post-closure. The risks for the belted kingfisher were driven by consumption of fish and incorporated conservative assumptions in the derivation of the EPCs and TRVs (See Section 5.6 for further discussion about the conservative assumptions used in the ERA). Given the negligible contributions to the baseline HQ by the Project, Project activities are not expected to result in unacceptable risks to mammals and birds.

5.5.4 AMPHIBIANS AND REPTILES

As discussed in Section 5.1.2, amphibians (terrestrial phase) and reptiles were qualitatively evaluated using mammals and birds as surrogates given that there is a general lack of data regarding exposure and effects of parameters on amphibians and reptiles.

The assessment of mammals and birds identified risks from exposure to methylmercury for the Belted Kingfisher (i.e., HQ marginally greater than 1.0). However, these risks were attributed to baseline and no unacceptable risks due to the Project were identified for mammals and birds. Similarly, the assessment of aquatic life identified risks for arsenic and iron for aquatic life, however these risks were attributed to baseline surface water conditions and there were no unacceptable risks due to the Project for aquatic life. As such, it was also concluded that there were no unacceptable risks due to the Project for amphibians and reptiles.

5.6 UNCERTAINTY ASSESSMENT

Uncertainty in ERA results from assumptions required to make a prediction of risk. ERA will typically incorporate conservative assumptions when faced with uncertainty or limited data to ensure that risks are not underestimated, and the values are typically selected to represent a reasonable worst-case assumption or condition.

The ERA relied on predicted data from the Air Quality Assessment (WSP 2025a) and Receiver Water Quality Modelling Report (WSP 2025e), which were developed based on conservative assumptions and uncertainties (full details are provided in the respective reports). Additionally, the ERA incorporated conservative assumptions that represent reasonable worst-case assumptions regarding exposure predictions so that the assessment of risks to ecological receptors were not understated for the Project phases.

As a result of the scientific investigations, literature reviews and risk assessment guidance followed in the preparation of the ERA, it is believed that the risk estimates present a reasonable yet conservative evaluation of the risk to ecological receptors predicted from the Project. Where uncertainty was encountered in the development of the risk estimates, reasonable yet conservative assumptions were made, or data were selected, to help ensure that risks were not underestimated.

A risk assessment containing a high degree of confidence is based on:

- Conditions where the problem is defined with a high level of certainty based on data and physical observations.
- An acceptable and reasonable level of conservatism in assumptions, which will help ensure that risks are overstated.
- An appreciation of the bounds and limitations of the final solution.

A summary of the assumptions and possible sources of uncertainty in the ERA and their overall effect on the determination of risks in the ERA are presented in Table 5-12.

Figure 5-1: Conceptual Site Model for the ERA

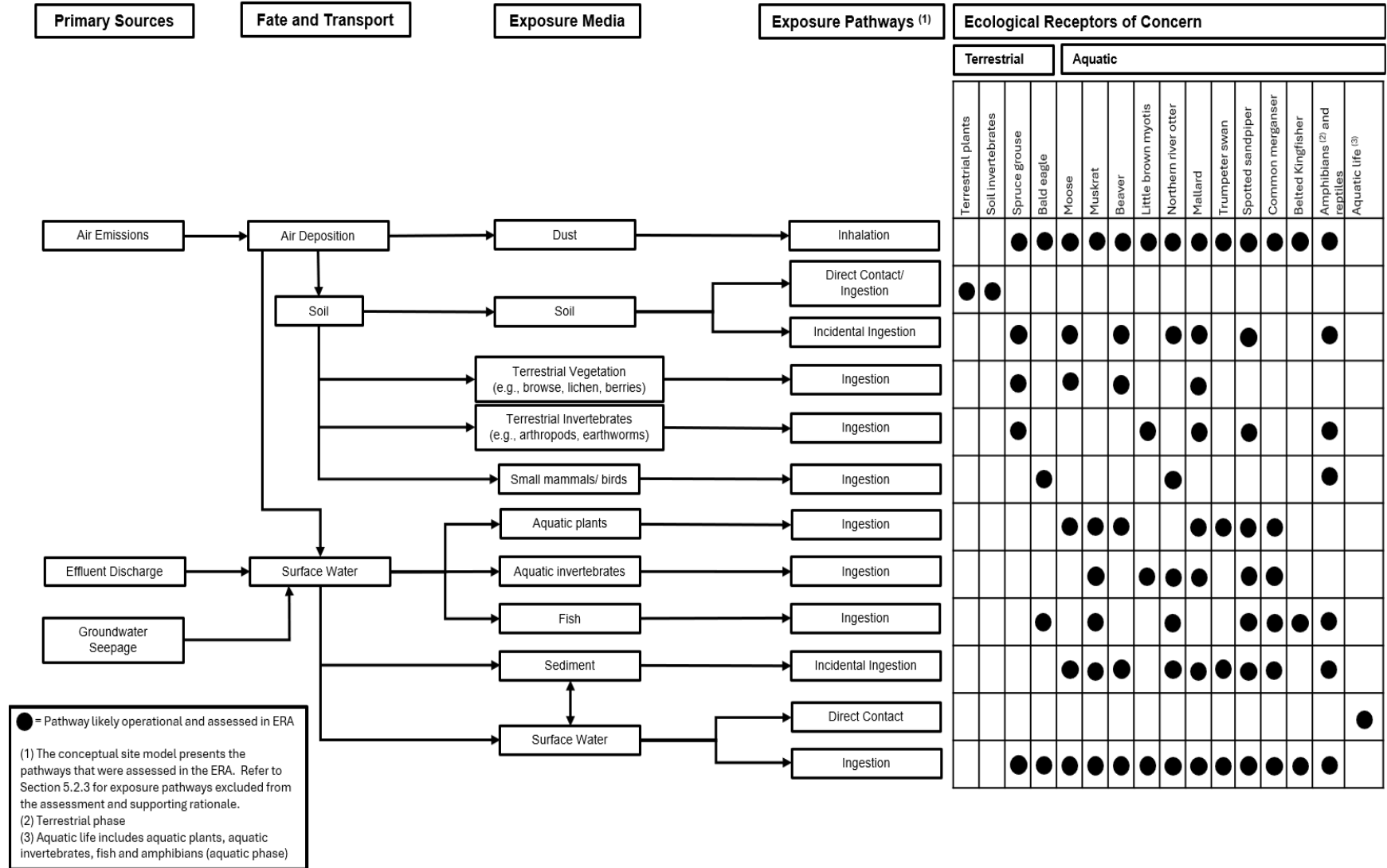


Table 5-1: Assessment and Measurement Endpoints

Receptor Group / Feeding Guild	Assessment Endpoints	Measurement Endpoints
Terrestrial plant and soil invertebrate communities	Plant and soil invertebrate community structure and ecological function, including as a food source for wildlife.	<p><i>Screening to identify POPCs</i> Comparison of predicted soil concentrations to applicable ecological screening criteria. Comparison of predicted soil concentrations to baseline concentrations to determine if a parameter dramatically or measurably increases during the Project phases.</p> <p><i>Risk Characterization</i> For identified POPCs, calculation of HQs which are the ratio of the soil concentration to the TRV that is protective of plants and soil invertebrates. Comparison of calculated HQs to acceptable risk levels from the CCME (2020) and Ontario MECP (MOE 2011b).</p>
Aquatic life communities	<p>Aquatic life community structure and ecological function, including as a food source for fish and wildlife.</p> <p>Abundance and viability of local fish population.</p>	<p><i>Screening to identify POPCs</i> Comparison of predicted surface water concentrations to applicable ecological screening criteria. Comparison of predicted surface water concentrations to baseline concentrations to determine if a parameter dramatically or measurably increases during the Project phases.</p> <p><i>Risk Characterization</i> For identified POPCs, calculation of HQs which are the ratio of the surface water concentration to the TRV for the protection of aquatic life. Comparison of calculated HQs to acceptable risk levels from the CCME (2020) and Ontario MECP (MOE 2011b).</p>
Wildlife Mammalian invertivore Mammalian herbivore Mammalian omnivore Mammalian carnivore / piscivore Avian invertivore Avian herbivore Avian omnivore Avian carnivore / piscivore Amphibians (terrestrial phase) Reptiles	<p>Abundance and viability of local populations and communities for common species.</p> <p>Protection of SAR at the individual level.</p>	<p><i>Screening to identify POPCs</i> Comparison of predicted soil and surface water concentrations to applicable ecological screening criteria.</p> <p>Comparison of predicted soil and surface water concentrations to baseline concentrations to determine if a parameter dramatically or measurably increases during the Project phases.</p> <p><i>Risk characterization</i> For identified POPCs, calculation of HQs, which are the ratio of exposure doses to TRVs that are protective of mammals and birds. Comparison of calculated HQs to acceptable risk levels from the CCME (2020) and Ontario MECP (MOE 2011b).</p>

Notes:

CCME = Canadian Council of Ministers of the Environment; HQ = hazard quotient; MECP = Ministry of the Environment, Conservation and Parks; POPC = parameter of potential concern; SAR = species at risk; TRV = toxicity reference value.

Table 5-2: Receptors of Concern Assessed in the Ecological Risk Assessment

Feeding Guild	Representative Species	Discussion
Community Receptors		
Terrestrial Plants	Terrestrial plant communities	Terrestrial plant communities are present in the LSA and may be exposed to POPCs in Project-influenced environmental media (e.g., soil).
Soil Invertebrates	Soil invertebrate communities	Soil invertebrate communities are present in the LSA and may be exposed to POPCs in Project-influenced environmental media (e.g., soil).
Aquatic Life	Aquatic communities, including plants, invertebrates, fish, and amphibians (aquatic phase) living within the water column	Aquatic life communities are present in the LSA and may be exposed to POPCs in Project-influenced environmental media (e.g. surface water).
Mammals		
Mammalian Invertivore	Little Brown Myotis (<i>Myotis lucifugus</i>) (SAR)	<p>The Little Brown Myotis was widely detected during acoustic monitoring within the RSA (Northern Bioscience 2025). The Little Brown Myotis is a SAR and was used in the ERA as a surrogate for other SAR bat species found in the LSA (i.e., Northern Myotis, Hoary Bat, Silver-haired Bat and Eastern Red Bat).</p> <p>The Little Brown Myotis is a nocturnal aerial forager which feeds over water with a diet consisting of mainly aquatic insects (e.g., Midges, Mosquitoes, Mayflies and Caddisflies). They also feed over forest trails, cliff faces, meadows and farmland where they consume a wide variety of insects, from moths and beetles to Crane Flies (Havens 2006).</p>
Mammalian Herbivore	Muskrat (<i>Ondatra zibethicus</i>)	The Muskrat was seen on trail cameras during baseline field studies in the PA and LSA (Northern Bioscience 2025). The Muskrat is a small-sized mammalian herbivore which lives in wetland habitats and consumes mostly aquatic vegetation, but also some invertebrates and fish (FCSAP 2012b).
	Beaver (<i>Castor canadensis</i>)	Beavers have been observed during baseline fieldwork and lodges and dams were widespread on major waterbodies and large stream systems (Northern Bioscience 2025). Beavers are a species of importance to Indigenous people, have socioeconomic and cultural value and were evaluated as a representative species for furbearers (Section 7.11 of the Impact Statement). Beavers are medium-sized mammalian herbivores which live in the aquatic environment and consume terrestrial and aquatic plants (Milligan and Humphries 2010).
	Moose (<i>Alces alces</i>)	Moose have been observed and moose habitat was identified during baseline field studies in the Project Area and LSA (Northern Bioscience 2025). Moose is a traditional food and is a species of importance to Indigenous people. Moose is a pVC for the Project as they were identified as a species of particular interest during Indigenous and public engagement. Moose are large-sized mammalian herbivores which live in forest and wetland habitats and consume terrestrial and aquatic plants (FCSAP 2012b).
Mammalian Carnivore/Piscivore	Northern River Otter (<i>Lontra canadensis</i>)	The northern river otter was seen on trail cameras and observed during aerial surveys during baseline field studies in the PA and LSA (Northern Bioscience 2025). The northern river otter is a carnivorous/piscivorous mammal which lives along wooded shores of lakes and consumes primarily fish, but also some aquatic invertebrates and small mammals / birds (FCSAP 2012b).

Feeding Guild	Representative Species	Discussion
Birds		
Avian Invertivore	Spotted Sandpiper (<i>Actitis macularius</i>)	The Spotted Sandpiper is a shorebird, inhabiting shores of lakes, ponds and streams (FCSAP 2012b) that was observed during the breeding season in the baseline field studies conducted in the Project Area and LSA (Northern Bioscience 2025). The spotted sandpiper is a migratory bird and does not overwinter in Canada. The Spotted Sandpiper forages primarily for terrestrial and aquatic invertebrates but also consumes some aquatic plants and fish (FCSAP 2012b). The Spotted Sandpiper was used as a surrogate for the Yellow Rail (SAR) which also consumes aquatic invertebrates (Leston and Bookhout 2020).
Avian Herbivore	Spruce Grouse (<i>Dendragapus canadensis</i>)	The Spruce Grouse was observed in the PA and / or LSA during the breeding season through aerial surveys (Northern Bioscience 2025). Grouse (including Spruce Grouse, Ruffed Grouse and Sharp-tailed Grouse) were identified as species of importance to Indigenous people during Indigenous and public engagement due to their importance as a subsistence species. The Spruce Grouse was selected to represent the three grouse species. The spruce grouse inhabits forests and primarily feeds on terrestrial plants, but its diet also includes insects and fungi (FCSAP 2012b).
	Trumpeter Swan (<i>Cygnus buccinator</i>)	The Trumpeter Swan was observed in the Project Area and / or LSA during the breeding season through aerial surveys and trail cameras (Northern Bioscience 2025). The Trumpeter Swan is a migratory bird that inhabits freshwater marshes, ponds and lakes. The swan mainly consumes aquatic plants above and below the water and occasionally consumes fish (Mitchel and Eichholz 2020).
Avian Omnivore	Mallard (<i>Anas platyrhynchos</i>)	The Mallard was observed in the PA and / or LSA during the breeding season via trail cameras (Northern Bioscience 2025). The mallard is migratory but may breed and overwinter in Canada. It lives in a wide variety of aquatic habitats (FCSAP 2012b). The mallard primarily feeds on aquatic plants and invertebrates but also consumes some plants, insects, and fish (FCSAP 2012b). They are of importance to Indigenous people because they are a culturally important food source.
Avian Carnivore/Piscivore	Belted Kingfisher (<i>Ceryle alcyon</i>)	The Belted Kingfisher was observed in the PA and / or LSA during the breeding season on trail cameras (Northern Bioscience 2025). It inhabits a wide variety of aquatic habitats (Kelly et al. 2020). The Belted Kingfisher primarily consumes fish (diet assumed to be 100% fish in the ERA) but also occasionally consumes other prey, including aquatic and terrestrial invertebrates, amphibians, reptiles, mammals, birds and plants (Kelly et al. 2020).
	Common Merganser (<i>Mergus merganser</i>)	The Common Merganser was observed in the PA and / or LSA during the breeding season (Northern Bioscience 2025). The Common Merganser is a migratory bird but may breed and overwinter in Canada. It inhabits lakes and rivers in forested habitats and primarily forages for fish but occasionally consumes aquatic invertebrates and plants (FCSAP 2012b).
	Bald Eagle (<i>Haliaeetus leucocephalus</i>)	The Bald Eagle was observed (adults and juveniles) in the PA and / or LSA during the breeding season via aerial surveys and trail camera monitoring (Northern Bioscience 2025). The bald eagle is migratory but may breed and overwinter in Canada. Although it was formerly listed as Special Concern in Ontario, it has now been downlisted and was not assessed as a SAR in the Impact Statement. The Bald Eagle was identified as a species of importance to Indigenous people during Indigenous and public engagement due to its socio-economic and cultural value. The Bald Eagle inhabits areas near large bodies of water such as rivers and lakes (FCSAP 2012b). It is an opportunistic forager and scavenger that preferentially eats fish but also consumes a variety of prey items (small mammals and birds) (FCSAP 2012b).

Feeding Guild	Representative Species	Discussion
Amphibians and Reptiles		
Amphibians (Carnivore)	Wood Frog (<i>Lithobates sylvaticus</i>)	The Wood Frog was heard in the LSA during in-person nocturnal surveys (Northern Bioscience 2025). This amphibian has a broad distribution in North America, and lives in a variety of habitats (e.g., tundra, thickets, wet meadows, bogs, coniferous and deciduous forests) but requires seasonal or semi-permanent water bodies to breed (Kiehl 2015). The Wood Frog is a good ecological indicator of a healthy environment, and its diet is dominated by arthropods such as insects and spiders, although they occasionally consume earthworms, snails, and slugs (FCSAP 2012b).
Reptiles (Carnivore)	Common Gartersnake (<i>Thamnophis sirtalis</i>)	The Eastern Gartersnake (<i>Thamnophis sirtalis sirtalis</i>) was observed (heard) in the LSA during the baseline field studies (Northern Bioscience 2025). Due to lack of specific receptor information (e.g., habitat, diet) for the Eastern Gartersnake, the Common Gartersnake was used as a surrogate as it is more well-studied. The common garter snake is native to North America and found widely across the continent, typically near aquatic habitats (FCSAP 2012b). Their diet is variable and habitat-dependent but includes amphibians, insects / earthworms, small mammals, fish and birds (FCSAP 2012b). The Eastern Gartersnake was used as a surrogate for the Common Snapping Turtle (SAR) which also consumes fish, amphibians, birds, small mammals and aquatic plants (Bosch 2003).

Notes:

ERA = ecological risk assessment; LSA = local study area; POPC = parameter of potential concern; pVC = pathway valued component; RSA = regional study area; SAR = species at risk.

Table 5-3: Exposure Pathways Assessed in the Ecological Risk Assessment

Exposure Pathway	Receptor Group(s)	Carried forward in ERA?	Rationale
Inhalation of Vapours	Mammals and Birds Amphibians and Reptiles	No	This pathway is considered negligible as vapours would be rapidly mixed with ambient air and diluted, resulting in concentrations that would pose negligible risks to wildlife. This approach is consistent with the approach used by the United States Department of Energy (Sample and Suter 1994) and the US EPA (2005b) where inhalation of parameters is considered negligible and exposure via this pathway is not evaluated. This approach with respect to inhalation exposure is consistent with that used by the Ontario MECP in the development of the soil and groundwater standards where inhalation exposure was considered but an assessment was not conducted because there is currently not enough information to perform such an assessment (MOE 2011b).
Soil Direct Contact	Terrestrial Plants Soil Invertebrates	Yes	Soil POPCs were identified for terrestrial plants and soil invertebrates. The primary route of exposure for terrestrial plants is through root uptake of POPCs in soil. The primary route of exposure for soil invertebrates is direct contact with, or ingestion of, POPCs in soil.
Foliar Uptake of Dust	Terrestrial Plants	No	Soil POPCs were identified for terrestrial plants; however, exposure to POPCs from foliar uptake from dust is negligible compared to root uptake from soil. Foliar uptake from particulate (dust) deposition was evaluated in the ERA for the spruce grouse (terrestrial species of importance to Indigenous people) and to

Exposure Pathway	Receptor Group(s)	Carried forward in ERA?	Rationale
			account for total exposure to POPCs for those mammals and birds that feed from both terrestrial and aquatic environments.
Inhalation of Dust	Mammals and Birds Amphibians and Reptiles	Yes	While no soil POPCs were identified for mammals and birds, inhalation of dust was evaluated in the ERA for the Spruce Grouse (terrestrial species of importance to Indigenous people) and to account for total exposure to POPCs for mammals and birds that feed from both the terrestrial and aquatic environments. Amphibians and reptiles were evaluated qualitatively.
Incidental Soil Ingestion	Mammals and Birds Amphibians and Reptiles	Yes	While no soil POPCs were identified for mammals and birds, incidental soil ingestion was evaluated in the ERA for the spruce grouse (terrestrial species of importance to Indigenous people) and to account for total exposure to POPCs for those mammals and birds that feed from both terrestrial and aquatic environments. Amphibians and reptiles were evaluated qualitatively.
Dermal Contact with Soil and Surface Water	Mammals and Birds Amphibians and Reptiles	No	Exposure to soil and surface water POPCs via dermal contact is considered minimal. The dominant pathway for both birds and mammals is usually ingestion. Feathers and fur limit the amount of contact that parameters have with skin, and soil adhered to feathers or fur is ultimately ingested during grooming (Sample and Suter 1994). Furthermore, the data necessary to evaluate dermal contact exposures is often lacking (US EPA 1993), or if available, based on studies in which the parameter is applied directly to the skin by shaving the fur from laboratory rodents (US EPA 2005b), a type of exposure that would not occur in the natural environment. Amphibians and reptiles were evaluated qualitatively.
Food Consumption	Mammals and Birds Amphibians and Reptiles	Yes	While no surface water POPCs were identified for wildlife drinking water, mercury (inorganic and methylmercury) was retained as a POPC in surface water as it is bioaccumulative in the aquatic environment and is a parameter of concern for Indigenous communities around the Project. Food consumption includes ingestion of aquatic food items that have taken up POPCs from surface water, including aquatic plants, aquatic invertebrates and fish. While no soil POPCs were identified for mammals and birds, consumption of food items (terrestrial vegetation, invertebrates, small mammals) that have taken up POPCs from soil was evaluated in the ERA for the Spruce Grouse (terrestrial species of importance to Indigenous people) and to account for total exposure to POPCs for those mammals and birds that feed from both terrestrial and aquatic environments. Amphibians and reptiles were evaluated qualitatively.
Surface Water Ingestion	Mammals and Birds Amphibians and Reptiles	Yes	While no surface water POPCs were identified for wildlife drinking water, surface water ingestion was evaluated in the ERA for the Spruce Grouse (terrestrial species of importance to Indigenous people) and to account for total exposure to POPCs

Exposure Pathway	Receptor Group(s)	Carried forward in ERA?	Rationale
			for those mammals and birds that feed from both terrestrial and aquatic environments. Amphibians and reptiles were evaluated qualitatively.
Direct Contact with Surface Water	Aquatic life (including aquatic phase amphibians)	Yes	Surface water POPCs were identified for aquatic life.
Incidental Sediment Ingestion	Mammals and Birds Amphibians and Reptiles	Yes	Sediment quality is not anticipated to be significantly impacted by the Project and changes to sediment quality were not modelled. However, baseline sediment was evaluated to account for total exposure by mammals and birds. Amphibians and reptiles were evaluated qualitatively.
Direct Contact with Sediment	Aquatic life	No	Sediment quality is not anticipated to be significantly impacted by the Project and changes to sediment quality were not modelled. The assessment of potential Project impacts to surface water and exposure by aquatic life was considered the primary and most relevant exposure pathway to be protective of Project-related changes to aquatic life.
Direct Contact with or Ingestion of Groundwater	Terrestrial Plants Soil Invertebrates Mammals and Birds Amphibians and Reptiles	No	The Project may influence groundwater quality within the Project Area and the LSA adjacent to the Project Area, as a result of fugitive groundwater seepage from Project facilities (Section 7.7 of the Impact Statement). There are areas of shallow groundwater (e.g., less than 2 metres below ground surface) within the LSA (WSP 2025g) which would be accessible to ecological receptors. However, it was assumed in the ERA that groundwater exposure by terrestrial ecological receptors would be insignificant and minimal in comparison to soil and surface water exposure pathways. Furthermore, changes to groundwater quality due to the Project were not modelled; therefore, effects to ecological receptors could not be assessed for this potential pathway. As a result, all exposure pathways to groundwater by terrestrial plants, terrestrial invertebrates, mammals, birds and amphibians and reptiles were not carried forward in the ERA. For aquatic life, it was assumed that the assessment of surface water exposure pathways was protective of groundwater discharge to surface water.

Notes:

POPC = parameter of potential concern; ERA = ecological risk assessment; LSA = local study area;
MECP = Ministry of the Environment, Conservation and Parks.

Table 5-4: Soil Exposure Point Concentrations for Terrestrial Plants and Soil Invertebrates

POPC	Baseline / Project Phase	Measured 90th Percentile and Calculated Soil Concentration from Dust Deposition (mg/kg)
Arsenic	Baseline	15
	Construction	15
	Operations	15
	Closure	15

Notes:
mg/kg = milligrams per kilogram; POPC = parameter of potential concern

Table 5-5: Surface Water Exposure Point Concentrations for Aquatic Life

POPC	Surface Water Quality Modelling Node	Baseline / Project Phase / After Project	Maximum Monthly Average Water Concentration (mg/L)	Maximum Annual Average Water Concentration (mg/L)
Arsenic	PAK-OUT (Outlet of Pakwash Lake)	Baseline	0.0058	0.0051
		Construction	0.0061	0.0054
		Operations	0.0061	0.0053
		Closure	0.0060	0.0053
		Post-Closure	0.0061	0.0053
Iron	DIX-2 (Dixie Creek after confluence with Unnamed Watercourse 1)	Baseline	0.55	0.47
		Construction	0.56	0.48
		Operations	0.55	0.47
		Closure	0.55	0.46
		Post-Closure	0.53	0.44

Notes:
mg/L = milligrams per liter; POPC = parameter of potential concern

Table 5-6: Soil Toxicity Reference Value for Terrestrial Plants and Soil Invertebrates

POPC	TRV for Terrestrial Plants and Soil Invertebrates (mg/kg)	Reference
Arsenic	17	CCME SQG _E (CCME 2001a) for soil contact pathway, agricultural land use

Notes:
mg/kg = milligrams per kilogram; CCME = Canadian Council of Ministers of the Environment; SQG_E = Soil Quality Guideline for Environmental Health; POPC = parameter of potential concern; TRV = toxicity reference value.

Table 5-7: Surface Water Toxicity Reference Values for Aquatic Life

POPC	TRV for Aquatic Life (mg/L)	Reference
Arsenic	0.0050	CCME WQG for the Protection of Aquatic Life, Freshwater, Long-term. (CCME 2001b)
Iron	0.46	ECCC FWQG for iron is pH and hardness-dependent and is calculated using the iron FWQG look-up table or calculator (ECCC 2024). The TRV was calculated using the 25th percentile of Site-specific baseline water quality (pH of 6.9 and dissolved organic carbon of 4.6 mg/L) from monitoring station SW-03 (corresponding to surface water quality modelling node DIX-2).

Notes:
CCME = Canadian Council of Ministers of the Environment; ECCC = Environment and Climate Change Canada; mg/L = milligrams per litre; POPC = parameter of potential concern; TRV = toxicity reference value; WQG-PAL = Water Quality Guideline for the Protection of Freshwater Aquatic Life.

Table 5-8: Toxicity Reference Values for Mammals and Birds

Receptor Group	POPC	TRV (mg/kg-bw/day)	Endpoint and Reference
NOAEL-TRV			
Mammals	Inorganic Mercury	1.00	NOAEL for effects on reproduction (i.e., kit weight, fertility, and kit survival) in mink that were exposed to mercuric chloride in their diet throughout gestation for six months (Aulerich et al. 1974; as cited in Sample et al. 1996).
Mammals	Methylmercury	0.08	NOAEL for survival of mink (Chamberland 1996; Laperle et al. 1998) as cited in CCME 2000.
Birds	Inorganic Mercury	0.45	NOAEL for effects on reproduction (i.e., fertility, hatchability) in Japanese Quail that were exposed to as mercuric chloride in their diet over one year (Hill and Schaffner 1976; as cited in Sample et al 1996).
Birds	Methylmercury	0.031	Tolerable daily intake used by the CCME in the derivation of the tissue-based guideline for methylmercury for birds. It was based on the geometric mean of the LOAEL and NOAEL without application of an uncertainty factor (CCME 2000).
LOAEL-TRV			
Mammal	Inorganic Mercury	10.0	The LOAEL was derived by applying a 10-fold uncertainty factor to the NOAEL based on LANL (2024) guidance.
Mammal	Methylmercury	0.14	LOAEL for survival of mink (Chamberland 1996; Laperle et al. 1998) as cited in CCME 2000.
Avian	Inorganic Mercury	0.90	A LOAEL for effects on reproduction (i.e., fertility, hatchability) in laboratory Japanese Quail that were exposed to as mercuric chloride in their diet over one year (Hill and Schaffner 1976; as cited in Sample et al 1996).
Avian	Methylmercury	0.050	Lowest effective concentration to induce a 20% effect / effects threshold / LOAEL for birds (Fuchsman et al. 2017).

Notes:

LOAEL = lowest observed adverse effect level; mg/kg-bw/day = milligrams per kilogram of body weight per day; NOAEL = no observed adverse effect level; POPC = parameter of potential concern; TRV = toxicity reference value.

Table 5-9: Hazard Quotients for Terrestrial Plants and Soil Invertebrates

POPC	Project Phase	EPC (mg/kg)	TRV (mg/kg)	HQ
Arsenic	Baseline	15	17	0.88
	Construction	15		0.88
	Operations	15		0.88
	Closure	15		0.88

Notes:

EPC = exposure point concentration; HQ = hazard quotient; mg/kg = milligrams per kilogram; POPC = parameter of potential concern; TRV = toxicity reference value.

Table 5-10: Hazard Quotients for Aquatic Life

POPC	Surface Water Quality Modelling Node	Baseline / Project Phase / After Projectg	EPC (mg/L)		TRV (mg/L)	HQ	
			Maximum Monthly Average	Maximum Annual Average		Maximum Monthly Average	Maximum Annual Average
Arsenic	PAK-OUT (Outlet of Pakwash Lake)	Baseline	0.0058	0.0051	0.0050	1.2	1.0
		Construction	0.0061	0.0054		1.2	1.1
		Operations	0.0061	0.0053		1.2	1.1
		Closure	0.006	0.0053		1.2	1.1
		Post Closure	0.0061	0.0053		1.2	1.1
Iron	DIX-2 (Dixie Creek after confluence with Unnamed Watercourse 1)	Baseline	0.55	0.47	0.46	1.2	1.0
		Construction	0.56	0.48		1.2	1.0
		Operations	0.55	0.47		1.2	1.0
		Closure	0.55	0.46		1.2	1.0
		Post Closure	0.53	0.44		1.1	1.0

Notes:

EPC = exposure point concentration; HQ = hazard quotient; mg/L = milligrams per litre; POPC = parameter of potential concern; TRV = toxicity reference value.

Bold / shaded = hazard quotient above the target of 1.0.

Table 5-11: Hazard Quotients for Mammals and Birds

Receptor	POPC	Baseline	Construction	Operations	Closure	Post-Closure
Little Brown Myotis (SAR) ⁽¹⁾	Inorganic Mercury	0.0075	0.0077	0.0076	0.0075	0.0074
	Methylmercury	0.037	0.041	0.039	0.037	0.036
Muskrat	Inorganic Mercury	0.0012	0.0014	0.0013	0.0012	0.0012
	Methylmercury	0.031	0.035	0.034	0.031	0.030
Beaver	Inorganic Mercury	0.00013	0.00015	0.00014	0.00013	0.00013
	Methylmercury	0.0017	0.0019	0.0018	0.0017	0.0016
Moose	Inorganic Mercury	0.00019	0.00021	0.00020	0.00019	0.00019
	Methylmercury	0.0013	0.0015	0.0014	0.0013	0.0013
Northern River Otter	Inorganic Mercury	0.00023	0.00026	0.00024	0.00023	0.00022
	Methylmercury	0.083	0.093	0.089	0.083	0.079
Spotted Sandpiper	Inorganic Mercury	0.041	0.042	0.041	0.041	0.041
	Methylmercury	0.25	0.27	0.26	0.25	0.25
Spruce Grouse	Inorganic Mercury	0.0049	0.0050	0.0050	0.0050	0.0050
	Methylmercury	0.0050	0.0051	0.0051	0.0051	0.0050
Trumpeter Swan	Inorganic Mercury	0.0069	0.0078	0.0075	0.0069	0.0067
	Methylmercury	0.025	0.028	0.027	0.025	0.024
Mallard	Inorganic Mercury	0.0074	0.0082	0.0079	0.0074	0.0071
	Methylmercury	0.039	0.044	0.042	0.039	0.038
Belted Kingfisher	Inorganic Mercury	0.011	0.012	0.012	0.011	0.010
	Methylmercury	1.1	1.2	1.2	1.1	1.1
Common Merganser	Inorganic Mercury	0.0048	0.0054	0.0052	0.0048	0.0046
	Methylmercury	0.44	0.50	0.48	0.44	0.43
Bald Eagle	Inorganic Mercury	0.0018	0.0020	0.0019	0.0018	0.0017
	Methylmercury	0.18	0.20	0.19	0.18	0.17

Notes:

POPC = parameter of potential concern

Bold / shaded = hazard quotient above the target of 1.0.

1 Hazard quotients for SAR (i.e., little brown myotis) were calculated using NOAEL-TRVs. HQs for all other species were calculated using LOAEL-TRVs.

Table 5-12: Assumptions and Uncertainties in the Ecological Risk Assessment

Assumption	Uncertainty	Over / Under- Estimate of Risk	Rationale
Problem Formulation			
Receptors	Low	Neutral	The selection of ecological receptors for the ERA relied on a review of the species inventories for the LSA conducted as part of the Terrestrial Baseline Environment Report (Northern Bioscience 2025). The selected ecological receptors were representative of those found in the PA and LSA.
Use of representative wildlife receptors	Low	Neutral	The use of wildlife receptors as representative receptors for other receptors within the same group with similar habitats and diets is intended to limit the number of ecological receptors evaluated. The receptors selected are considered to be sensitive, representative and consistently present on the site, and to be highly exposed to the POPCs present at the site via relevant exposure pathways. Therefore, it is reasonable to assume that conclusions that are reached in respect of the modelled ecological receptors can be generalized to other ecological receptors that might use the site.
Species at Risk	Low	Neutral to Overestimate	Based on a review of the federal and provincial SAR lists, all threatened and endangered species were considered within the ERA. Based on the conservatism built into the assessment, there is low uncertainty associated with the interpretation of risks for SAR.
Exposure Assessment			
Receptor Characteristics	Low	Neutral	The receptor characteristics for mammals and birds were selected primarily from the FCSAP ERA (FCSAP 2012b) or other sources if values were not provided in the guidance, including US EPA (1993), Sample and Suter (1994), Beyer et al. (1994), Canadian Wildlife Service and Canadian Wildlife Federation (2017), Beyer et al. (2008), and Mitchell and Eichholz (2020). In general, these characteristics are considered to provide reasonable estimates of exposure.
Abiotic media EPCs (e.g., soil, sediment, surface water)	Low	Overestimate	The ERA relied on predicted data from the Air Quality Assessment (WSP 2025a) and Receiver Water Quality Modelling Report (WSP 2025e), which were developed based on conservative assumptions and uncertainties (full details are provided in the respective reports). Exposure concentrations were based on 90th percentile (soil), maximum (sediment) or maximum monthly average concentrations (surface water). This is a conservative approach and may overestimate exposure in some cases.
Dust deposition modelling and soil EPCs	Low	Overestimate	It was assumed that POPCs in soil do not degrade or erode appreciably in soil. Therefore, Project related contributions to POPC concentrations in soil via deposition accumulates over the phases of the Project. The assumption of minimal or negligible losses from soil for metals and metalloids is conservative and likely results in an overestimate of the predicted soil concentrations.
Mercury speciation	Low	Underestimate, Neutral or Overestimate	The toxicity of mercury differs based on its form (organic versus inorganic). The percentage of methylmercury in environmental media was based on literature studies.
Bioaccumulation models – site-specific BCFs derived using measured data	Low	Neutral	Use of site-specific BCFs derived using measured baseline sample data (i.e., fish tissue and surface water) is considered to provide reasonable estimates of fish tissue EPCs.
Bioaccumulation models – literature values	Moderate	Neutral or Overestimate	Use of literature bioaccumulation models (i.e., BAFs, BCFs or natural logarithmic relationships) for browse, berries, soil invertebrates, small mammals, aquatic invertebrates and

Assumption	Uncertainty	Over / Under- Estimate of Risk	Rationale
			aquatic plants (BJC 1998, Baes et al. 1984, Sample et al. 1998a,b, Argonne National Laboratory 2001, US EPA 1999) in the absence of site-specific data may provide reasonable estimates or overestimate actual concentrations in these wildlife food items. Where literature sources provided options of bioaccumulation models for both conservative and typical estimates, the models for typical estimates were used. The use of literature bioaccumulation models from the consulted sources is a well accepted practice for ERAs conducted in Canadian and international jurisdictions.
Lichen EPCs	Low to Moderate	Underestimate, Neutral or Overestimate	In the absence of site-specific lichen data and published data from Ontario, baseline sampling data from the Kemess mine project (Ardea Biological Consulting 2015) were used to establish lichen EPCs for the Project.
Bioavailability of POPCs	High	Overestimate	It was assumed that all POPCs in environmental media were 100% bioavailable. This is a conservative approach because POPCs in the natural environment may have limited bioavailability relative to those in media that are typically used in the toxicity studies that form the basis of the TRVs.
Home Range	Low	Neutral to Overestimate	Home range of wildlife receptors was not considered in the ERA. Therefore, all receptors are conservatively assumed to spend 100% of their time exposed to the POPC concentrations within the LSA, which has the potential to overestimate potential risks to receptors with home ranges larger than the LSA.
Toxicity Assessment			
Mammal and bird TRVs	Low	Underestimate, Neutral or Overestimate	The TRVs used in the toxicity assessment for mammals and birds are based on toxicity studies using laboratory / domestic species and not wildlife species. Wildlife species may be more or less sensitive than laboratory / domestic species.
Avian TRV for methylmercury	Low	Neutral or Overestimate	Fuchsman et al. (2017) conducted a comprehensive literature review of reproductive effects in birds from dietary exposure to methylmercury. The review was conducted to identify effect thresholds for methylmercury that could be used to support ecological risk assessments. Effect thresholds ranged from 0.05 to 0.5 mg/kg bw/day. The lowest value in the range (0.05 mg/kg bw/day) was selected as the LOAEL for the ERA.
Toxicity of Mixtures	Low	Neutral	A chemical mixture is a combination of two or more POPCs. The interaction of the POPCs in the mixture can affect the toxicity of the individual POPCs to ecological receptors. The POPC interactions can include additivity (the combined effect is equal to the sum of the individual effects), antagonism (one effect blocks or reduces another), synergism (the combined effect is greater than the sum of individual effects) or potentiation (a non-toxic chemical increases the effect of a another). While multiple POPCs (i.e., arsenic and iron) were retained for evaluation of aquatic receptors, the toxicity of mixtures was not considered in the ERA due to a lack of toxicity studies evaluating this in the scientific literature. However, given the predicted changes in arsenic and iron concentrations from baseline were small and chemical interactions between these POPCs are not expected, it is unlikely that potential mixture toxicity would contribute to the estimated risks for aquatic life.

Assumption	Uncertainty	Over / Under- Estimate of Risk	Rationale
Risk Characterization			
Risk characterization	Low	Overestimate	Individual level endpoints of survival, growth, reproduction and development were used for receptors and extrapolated to population-level effects. However, individual-level endpoints do not necessarily translate to population-level effects which could overestimate risks.
Amphibians and reptiles	High	Neutral or overestimate	<p>Mammals and birds were used as surrogates for terrestrial phase amphibians and reptiles as per US EPA (2008) guidance. This is considered a reasonable approach for the soil and food ingestion pathways; however, it does not address the dermal pathway of exposure.</p> <p>The dermal exposure pathway could be an important exposure pathway for terrestrial phase amphibians and reptiles for some parameter groups (e.g., organic compounds like volatile organic compounds, pesticides, petroleum hydrocarbons, and explosives) (US EPA 2005b; Weir et al. 2010). However, dermal uptake of metals is unlikely because metals bound to soil are unlikely to dissociate from the soil and cross the skin, and should the metal dissociate from soil, ionic species have a low tendency to cross the skin (US EPA 2005b).</p> <p>CCME (2007) states that aquatic organisms can be used as proxy for the evaluation of amphibians (aquatic phase) as water quality guidelines are intended to be protective of all forms of aquatic life (algae, macrophytes, invertebrates, fish, amphibians), including sensitive life stages (such as tadpoles). Therefore, the assessment of aquatic phase amphibians was addressed in the evaluation of the aquatic life pathway.</p> <p>The predicted changes in surface water and/or soil concentrations associated with the Project were minimal and are not expected to materially increase exposure from baseline conditions. While there is high uncertainty in the assessment of amphibians and reptiles, due to the minimal change in predicted surface water and soil concentrations due to the Project, the qualitative assessment using mammals and birds and aquatic life as surrogates provides a reasonable estimate or overestimate of risk to amphibians and reptiles in the ERA.</p>

Notes:

BAF = bioaccumulation factor; BCF = bioconcentration factor; EPC = exposure point concentration; ERA = ecological risk assessment; FCSAP = Federal Contaminated Sites Action Plan; LSA; local study area; POPC = parameter of potential concern; SAR = species at risk; TRV = toxicological reference value.

6 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT CONCLUSIONS

The HHERA was conducted to evaluate Project-related health effects on human and ecological receptors, where risks were estimated through the HHRA and ERA.

6.1 HUMAN HEALTH RISK ASSESSMENT CONCLUSIONS:

Inhalation Assessment:

An HHRA inhalation assessment was completed to assess risk from short-term (acute) and long term (chronic) inhalation exposure to the following POPCs:

- Air: NO₂ (1-hour averaging period), DPM (1-hour and annual averaging periods).

In the acute inhalation assessment (1-hour averaging period), there were no HQs above targets for NO₂, when the maximum average of predicted 98th percentile results from three consecutive years was selected as the EPC, which is in alignment with the statistical approach applicable for the selected TRV for NO₂ (CCME CAAQC).

Hazard quotients for DPM were above the target HQ of 1 at the MPOI only, however the predicted frequency of DPM concentrations above targets was low ranging from 0.13% (construction / closure) to 0.15% (operations), which equates to less than 24 hours of DPM concentrations above targets in a year. Health Canada (2016) reviewed results from controlled human exposure studies to establish the critical effect and POD for short-term exposures to DPM (Health Canada 2016). The majority of the toxicological evidence related to respiratory and cardiovascular health effects. Increases in airway resistance at 100 µg/m³ was observed in studies with health and/or mildly asthmatic subjects exposed to DPM for 2 hours (Mudway et al. 2004; Riedl et al. 2012; Stenfors et al. 2004; as cited in Health Canada 2016). Furthermore, reported respiratory inflammation were observed in healthy subjects exposed to 100 µg/m³ of DPM for 2 hours, but not in asthmatic subjects who were also exposed (Behndig et al. 2006, 2011; Stenfors et al. 2004; as cited in Health Canada 2016). Therefore, 100 µg/m³ was selected as the POD for short-term exposure based on critical effects observed at a consistent exposure level. Health Canada then applied a total uncertainty factor of 10 to the POD of 100 µg/m³ to account for sensitive subgroups (e.g., age, disease or genetic factors) and for extrapolation from a LOAEL to a NOAEL to derive the short-term limit of 10 µg/m³. Maximum predicted Project plus Baseline 1-hour concentrations of DPM were 28.3 and 28.6 µg/m³ for construction/closure and operations phases, respectively, which is below the POD of 100 µg/m³. Therefore, potential risk from Project-related DPM exposure is low, given the predicted concentrations are below the POD of 100 µg/m³, the predicted frequency of DPM concentrations above the target is low (< 1day/year), conservative assumptions were used in the air quality assessment, the assumption that all PM_{2.5} Since combustion was related to DPM is conservative, and people are not expected to be at the MPOI for extended periods that would constitute risk.

For the chronic inhalation assessment, DPM was evaluated as a carcinogen by calculating ILCR and ALCM associated with additional DPM emissions related to the Project at the chronic PORs. In all instances the calculated ILCR and ALCM from chronic exposure to DPM were below the acceptable target of 1 in 100,000 (i.e., 1.0E-05), and as such, unacceptable cancer risks are not expected from predicted Project emissions of DPM.

Multi-media Assessment:

An HHRA multi-media assessment was completed to assess risk from oral and dermal exposure to the following threshold (non-carcinogenic) and non-threshold (carcinogenic) POPCs in soil, surface water and foods within the LSA and RSA:

- Arsenic, mercury and selenium.

In the assessment of threshold (non-carcinogenic) POPCs (arsenic, mercury and selenium), estimated HQ values for baseline and the Project plus Baseline phases (i.e., construction, operations and closure) were above the target value of 1.0 for the following POPCs and receptor groups, however HQs were below the 0.2 target for Project Alone, indicating that Project related risks are considered negligible.

- Indigenous resident (average consumer): HQs for Arsenic (inorganic) and methylmercury for Project plus Baseline were above the target of 1, primarily related to baseline exposures. HQs were below the 0.2 target for Project Alone indicating that Project related risks are considered negligible.
- Indigenous resident (heavy consumer): HQs for Arsenic (inorganic), mercury (inorganic) and methylmercury were above the target of 1 for Project plus Baseline, primarily related to baseline exposures. HQs were below the 0.2 target for Project Alone, indicating that Project related risks are considered negligible.

Selenium HQs were below the target of 1 for Project plus Baseline and below 0.2 for Project Alone for all Project phases for both Indigenous resident receptors (average and heavy consumer). Therefore, risks from selenium are considered to be negligible.

Arsenic was also evaluated as a non-threshold (carcinogenic) substance by estimating Project related incremental lifetime cancer risk through the calculation of ILCRs. ILCRs values are below the target of 1 in 100,000 risk (i.e., 10E-05), therefore risks are considered negligible.

In summary, the calculated risk levels associated with project related changes are negligible. Therefore, potential risks resulting from the Project are not anticipated for human receptors who may spend their time in cabins, lodges, camps or residences and / or practice traditional land use, in areas surrounding the Project. The predicted risks are based on conservative assumptions that likely resulted in risks that are overly conservative.

6.2 ERA CONCLUSIONS

The ERA evaluated risks to terrestrial plants and soil invertebrates as a result of predicted changes to soil quality (i.e., due to aerial deposition of dust) for arsenic. Calculated HQs were below or equal to the target of 1.0 for all Project phases (i.e., construction, operations and closure). In addition, there was no measurable change in the HQs for the Project phases compared to baseline because the contribution of arsenic from dust deposition from the Project was negligible. Therefore, Project activities are not expected to result in unacceptable risks to terrestrial plant and soil invertebrate communities.

The ERA evaluated risks to aquatic life communities (i.e., aquatic plants, aquatic invertebrates, fish, amphibians [aquatic phase]) as a result of predicted changes to surface water quality (i.e., due to effluent discharge) for arsenic (at surface water quality modelling node PAK-OUT) and iron (at surface water quality modelling node DIX-2). HQs calculated using maximum monthly average predicted surface water concentrations were marginally above the target of 1.0 for all Project phases (i.e., construction, operations and closure) for arsenic and iron. However, there was no measurable increase in the HQs for the Project phases compared to baseline because the increase in the surface water concentrations from the Project were marginal. When using the maximum annual average predicted surface water concentration, HQs were equal to 1.0 for iron and marginally above 1.0 for the Project phases for arsenic, but showed little difference from baseline (i.e., change in HQ of less than 0.1). Given the conservative assumptions used in the calculations of the HQs and the negligible contributions to the HQs by the Project, Project activities are not expected to result in unacceptable risks to aquatic life communities.

The ERA evaluated risks to mammals and birds as a result of predicted changes to soil quality (i.e., due to aerial deposition of dust), surface water quality (i.e., due to effluent discharge) and changes in food item quality (e.g., terrestrial vegetation, small mammals, terrestrial and aquatic invertebrates, aquatic plants and fish) resulting from the changes in soil and surface water quality. A food chain model was used to estimate exposure via incidental ingestion of soil and sediment, ingestion of surface water and consumption of food. HQs for all mammal and bird receptors and all Project phases were below the target HQ of 1.0, with the exception of methylmercury for the belted kingfisher, which is a piscivore. The HQs for the belted kingfisher were marginally above 1.0 for baseline and the Project phases (i.e., construction,

operations, closure, post-closure). However, changes in calculated HQs between baseline and the Project phases were less than 0.1 for construction and operations and negligible during closure and post-closure. Given the negligible contributions to the baseline HQ by the Project, Project activities are not expected to result in unacceptable risks to mammals and birds.

The ERA evaluated risks to amphibians (terrestrial phase) and reptiles by using a qualitative approach where mammals and birds were used as surrogates given that there is a general lack of data regarding exposure and effects of parameters on amphibians and reptiles. There were no unacceptable risks identified for mammals and birds, except for marginal risks for the Belted Kingfisher that were attributed to baseline. As such, Project activities are not expected to result in unacceptable risks to amphibians and reptiles.

6.3 SUMMARY

Negligible human health and ecological health risks were identified in HHERA. Therefore, Project activities are not expected to result in changes to environmental quality that would result in unacceptable risks to human or ecological health.

Great Bear Resources will complete monitoring according to regulatory requirements and commitments in the Impact Statement, including an ambient air quality monitoring program and an environmental effects monitoring program, which can be used to confirm predictions in the HHERA. The ambient air quality monitoring program will monitor ambient air quality in the LSA and RSA, while the environmental effects monitoring program will monitor surface water and fish tissue concentrations in the LSA (Chukuni River and Dixie Creek) and RSA (Pakwash Lake).

7 REFERENCES

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Attachment A
Baseline Data



1 BASELINE ENVIRONMENTAL DATA

This attachment summarizes the data and methods used to estimate concentrations of parameters in environmental media for the Human Health and Ecological Risk Assessment (HHERA) conducted to support the Great Bear Gold Project (the Project). This attachment summarizes the baseline chemistry data compiled in support of the HHERA, the summary statistics applied in the HHERA for the Tier 1 screening or as exposure point concentrations (EPCs), including rationale for their selection, and the calculation of site-specific bioaccumulation factors (BAFs) used to predict environmental concentrations (i.e., plant and fish tissue concentrations) for the baseline (i.e., existing conditions), project phases (construction, operations, and closure), and post-closure.

Data, collected from several studies conducted within the local study area (LSA) of the Project, literature sources or modelled by other disciplines, were used to represent baseline environmental conditions (i.e., existing conditions prior to mining activity) for the Project. The LSA was defined to capture potential direct and indirect effects from the Project. Baseline data which were collected from 2022 to 2025 through Project-specific sampling programs, or available from other projects within the region, from published literature sources, or modelled by other disciplines, were reviewed to determine their suitability for inclusion to characterize baseline conditions.

Baseline data (either measured or modelled) were available for air, soil, sediment, surface water, vegetation (including berries, traditional plants, wild rice), fish tissue and wild game. It is noted that both baseline and predicted concentrations were used in the HHERA. Depending on the media, predicted concentrations were derived using baseline data as required. Details on the methodology used to derive these predicted concentrations are provided in Attachment B.

1.1 AIR

Baseline air quality is influenced by local sources of emissions (e.g., road dust, regional exploration activities, etc.), long-range transport of air parameters, and natural sources such as wildfires. Air quality concentrations were measured from three air quality monitoring stations located within the LSA to establish appropriate baseline air quality concentrations for suspended particulate matter (SPM), metals, particulate matter <10 micrometres (PM₁₀), particulate matter <2.5 micrometres (PM_{2.5}), diesel particulate matter (DPM), total dustfall, silica, nitrogen dioxide (NO₂), sulfur dioxide (SO₂), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and mercury vapour. Baseline air quality samples were collected from July 2022 to January 2025, as per the Final Ambient Air Quality Baseline Monitoring Report (WSP 2025a).

Background air chemistry data from existing regional published air data from Environment and Climate Change Canada's (ECCC) National Air and Pollution Surveillance (NAPS) program (ECCC 2024) were also incorporated into the baseline dataset. Statistical summaries of the data collected at the baseline stations were prepared in accordance with the Ministry of Environment Conservation and Parks (MECP) Operations Manual for Air Monitoring in Ontario. Further details are provided in the Final Ambient Air Quality Baseline Monitoring Report (WSP 2025a).

The baseline air quality concentrations obtained from the three air quality monitoring stations and the NAPS database, were summarized for 10-minute, 1-hour, 8-hour, 24-hour, 30-day and annual averaging periods. The baseline air quality concentrations for these averaging periods are presented in Attachment A1 (Table A1-1). Baseline air quality conditions were characterized using a 90th percentile for 1-hour and 24-hour averaging periods, and an average for the annual averaging period. These baseline air quality concentrations are used in the Tier 1 screening to identify parameters of potential concern (POPCs) in the HHERA based on comparison to health-based screening criteria, as described in Attachment C of the HHERA. Furthermore, baseline air quality concentrations were used in the human health inhalation assessment as EPCs to characterize baseline exposure to POPCs via the inhalation pathway. Baseline air quality data could only be considered for screening and inclusion in the inhalation assessment when data for a parameter was available. Baseline data were not available for some

parameters. Baseline air quality concentrations were also summed with Project related air quality concentrations to calculate Project phase EPCs to assess exposure during Project phases.

1.2 SOIL

Baseline metals and PAH concentrations in soil were measured as part of the Soil and Traditional Foods sampling program conducted by Great Bear Resources Ltd. (Great Bear Resources) in 2023 (Attachment A2). Surficial soil samples (co-located with vegetation samples) were collected and analyzed for metals and PAHs at 21 locations within the Project Area. Further details, including sampling methodology and sampling locations for the Soil and Traditional Foods sampling program, are presented in Attachment A2.

To derive summary statistics on the baseline soil data, United States Environmental Protection Agency (US EPA) software, Pro UCL Version 5.2, was used (US EPA 2022). For samples with non-detected concentrations (i.e., concentrations below the laboratory reporting detection limit [RDL]), the full detection limit was assumed to be the concentration for calculating summary statistics. Summary statistics of the baseline soil quality data are presented in Attachment A1 (Table A1-2). The ProUCL outputs for the soil data are provided in Attachment A3. The maximum measured soil concentrations were used in the Tier 1 screening to identify POPCs in the HHERA (see Attachment C of the HHERA for screening details). The 95% upper confidence limit of the mean (UCLM) was used as the EPC to predict receptor exposure concentration for soil in the human health risk assessment (HHRA; see Attachment E of the HHERA), while the 90th percentile was used as the EPC to predict receptor exposure concentration for soil in the ecological risk assessment (ERA); (see Attachment F of the HHERA). These EPCs were incorporated into the derivation of site-specific BAFs (see Sections 2 and 3).

1.3 SEDIMENT

A baseline sediment monitoring program was conducted between 2022 and 2024 by WSP Canada Inc. (WSP) to characterize baseline sediment quality in the LSA. Surficial sediment samples were collected from the following waterbodies: Dixie Creek, Genessee Lake, Chukuni River, Pakwash Lake, and other unnamed waterbodies and watercourses. Sediment samples were analyzed for metals parameters. Further details of the sediment monitoring program, including sampling methodology and sampling locations, are presented in the Great Bear Project Fisheries Resources Baseline Report (WSP 2025b).

To derive summary statistics on the baseline sediment data, the US EPA ProUCL (US EPA 2022) software was used. Summary statistics of the baseline sediment data are presented in Attachment A1 (Table A1-3). The ProUCL outputs for the sediment data are provided in Attachment A3. The maximum measured sediment concentrations were used in the Tier 1 screening to identify baseline measurements that are above guidelines. Baseline EPCs for sediment were not used in the HHRA given the exposure pathway was not considered complete (see Attachment E of the HHERA). However, a 90th percentile baseline sediment EPC was used in the ERA to calculate exposure of ecological receptors through indirect ingestion (see Section 2).

1.4 SURFACE WATER

A baseline monitoring program was conducted by Blue Heron Environmental (from 2020 to 2021) and Great Bear Resources (from 2022 to 2024) to characterize the baseline surface water quality in the watersheds within the LSA, immediately downstream of the Project, and within the regional study area (RSA) (WSP 2025c). Since 2022, most surface water quality sampling was conducted monthly during periods of flow and when sites were safely accessible, resulting in approximately 10 to 12 sampling events per station each year for analysis of metals including methylmercury and ultra-low detection mercury, anions, nutrients and co-factors (i.e., hardness). The sampling locations, sampling methodology and analytical data are presented in the Water Quality Baseline Report (WSP 2025c).

Existing conditions (i.e., baseline) for surface water quality for incorporation into the HHERA are based on model baseline condition presented in the Receiver Water Quality Modelling Report (WSP 2025e). Existing conditions of Project area watercourses and waterbodies, including the Chukuni River (the receiving environment) are equivalent to monthly median (or average) baseline concentrations, where the number of samples available for each month were greater than three. In cases where only one or two baseline data samples were available for that month (e.g., winter months when monitoring locations could not be safely accessed during the baseline sampling program), source term inputs for unnamed watercourses were instead developed as seasonal inputs (i.e. quarterly grouping: November to January, February to April, May to July, August to October). For unnamed waterbodies, if less than three datapoints per month were available, source terms were developed for under ice versus. open water seasons (November to April and May to October). Model source terms for existing conditions are provided in Appendix A of WSP 2025e. Model predictions were generated at strategically selected locations (referred to as nodes) that represent locations where the Project is expected to interact with the surface water receiving environment (WSP 2025d). A total of 20 modelling nodes were identified within the Dixie Creek, Chukuni River, Pakwash Lake, Genesee Lake, Unnamed Waterbodies or Watercourses watersheds as presented in Table A-1 below. It is noted that four nodes (i.e., UN_1, UN_2, UN_4 and UN_6) were removed from the water quality model for the HHERA. Node UN-6 showed no change from the existing surface water quality conditions and was therefore not carried forward in the water quality impact assessment while nodes UN-1, UN-2, and UN-4 will be compensated for and thus not assessed for impacts.

The HHERA focused on waterbodies receiving direct discharge of effluent (i.e., Chukuni River) and those most influenced by site water management and relevant for human use (i.e., Dixie Creek and Pakwash Lake). In the HHERA model, exposure to surface water from Chukuni River was considered as a worst case given it is the receiving waterbody of effluent discharge. The predicted surface water quality data nodes in Chukuni River, Dixie Creek, Pakwash Lake, Genesee Lake, and Small unnamed waterbodies and watercourses as presented in Table A-1 was used to represent baseline conditions. The baseline surface water dataset used in the HHERA is consistent with the baseline dataset used in the receiver water quality model to predict future water quality for the Project (WSP 2025d). Further details on the modelling approach, inputs and assumptions are provided in the Receiver Water Quality Model Report (WSP, 2025d).

The modeled surface water quality concentration provided in the Receiver Water Quality Model Report (WSP, 2025d) provided monthly average concentrations across 3 years of existing conditions data and 73 years of the Project lifespan. For the purposes of the HHERA, statistics were calculated for each Project phase to characterize potential human and wildlife exposures. Summary statistics of the modelled surface water baseline data are presented in Attachment A1 (Table A1-4). For the HHERA, the annual average concentration across all relevant water quality nodes, as presented in Table A-1, was calculated. For the ERA, the maximum monthly concentration across all relevant water quality nodes, as presented in Table A-1, was calculated. These EPCs were incorporated into the derivation of site-specific BAFs (see Sections 2 and 3). The predicted maximum monthly concentrations, across all relevant modelled nodes, were used in the Tier 1 screening to identify POPCs.

1.5 BERRIES, TRADITIONAL PLANTS, AND WILD RICE

A Soil and Traditional Foods sampling program was conducted by Great Bear Resources in 2023, which included co-located soil and vegetation sampling and analysis of metals and PAHs (Attachment A2). Vegetation samples of interest were identified based on their importance as food for human consumption (e.g., berries, Labrador tea, wild rice) informed by Indigenous Knowledge (IK). Vegetation samples were collected at 30 locations within the PA; however, only 22 samples were sent for analysis.

When vegetation species identified in the IK sources were not available at a given sampling location, alternative vegetation types that are known to be consumed by people were collected. Alternative vegetation types are flagged with an asterisk in the list below. Vegetation species collected as part of the Soil and Traditional Foods sampling program included the following:

- Berries: Canadian bunchberry* [*Cornus canadensis*], velvetleaf blueberry* [*Vaccinium myrtilloides*], chokecherry [*Prunus virginiana*], rosehips* [*Rosa spp.*], blueberries [*Vaccinium spp.*], raspberries [*Rubus idaeus*], These species may be consumed by both people and wildlife.
- Traditional Plant: bog Labrador tea* [*Rhododendron groenlandicum*], mountain ash* [*Sorbus americana*], Labrador tea [*Rhododendron spp.*], prickly wild rose* [*Rosa acicularis*], wild mint [*Mentha spp.*], paper birch* [*Betula papyrifera*], red-osier dogwood [*Cornus stolonifera*], chaga [*Inonotus obliquus*], chanterelle [*Cantharellus cibarius*], tamarack [*Larix laricina*], wild rice [*Zizania palustris*], turkey tail* [*Trametes versicolor*], common juniper [*Juniperus spp.*], cattail* [*Typha latifolia*], birch bark* [*Betula spp.*], lily pad [*Nymphaeaceae spp.*], alder bark* [*Alnus incana*], bog aster* [*Oclemena nemoralis*].

Further details including sampling methodology, sampling locations are presented in Attachment A2. Summary statistics of the baseline berry, traditional plant, and wild rice quality data for metals and PAHs are presented in Attachment A1 (Table A1-5 to Table A1-7), respectively. The ProUCL outputs for the traditional plant data are provided in Attachment A3.

The maximum measured concentration was used as the baseline berry EPC for the HHRA and a 90th percentile was used as the EPC for the ERA. For traditional plants, a 95% UCLM was used as the EPC for the HHRA. There was only one sample of wild rice collected, therefore measured concentrations from this single sample were used as EPCs in the HHRA. Traditional plants and wild rice were not considered food items for wildlife and were not incorporated into the ERA. These EPCs were incorporated into the derivation of site-specific BAFs (see Sections 2 and 3).

1.6 FISH TISSUE

A baseline fisheries resource sampling program was conducted between 2022 and 2024 by WSP, which included fish tissue sampling and analysis (WSP 2025b). The fish tissue sampling included the collection of fish samples from various waterbodies in the LSA including, Chukuni River, Dixie Creek, Genesee Lake, Pakwash Lake, and several unnamed waterbodies and watercourses. Large-bodied fish (skinless, boneless left dorsal epaxial muscle tissue) were collected and analysed individually, while small-bodied fish were pooled into composite samples. Sentinel species retained for analysis were determined at the time of field sampling, based on presence and abundance of the species within each sample location, and considering permitting allowances. Large-bodied sentinel fish species retained for tissue analysis included Cisco, Lake Whitefish, Northern Pike, Silver Redhorse, Walleye, White Sucker, and Yellow Perch. Composite samples of Brook Stickleback, Central Mudminnow, Finescale Dace, Iowa Darter, Lake Chub, Northern Redbelly Dace, Spottail Shiner, and Yellow Perch were collected. The sampling locations and sampling methodology are presented in the Great Bear Project Fisheries Resources Baseline Report (WSP 2025b). Fish tissues were submitted for analysis of total metals, methylmercury and moisture content.

Summary statistics of the baseline fish tissue quality data for small-bodied (i.e., <25 cm) and large-bodied fish (i.e., >25 cm), are presented in Attachment A1 (Table A1-8 and Table A1-9, respectively) for metals parameters. The ProUCL outputs for the fish tissue data are provided in Attachment A3. The 95% UCLM of the large-bodied fish for three top consumed fish species (Northern Pike, Walleye, and Lake Whitefish) were considered the fish-specific EPCs for the HHRA. The species of fish considered in the HHRA were identified based on their importance as food for human consumption, based on consumption rates published in the First Nations Food, Nutrition and Environment Study (FNFNES) available for Ontario (Chan et al. 2014), and information available from Indigenous communities, as detailed in HHERA Attachment E. Due to challenges acquiring sufficient samples of lake whitefish, this species is represented by including several other species with similar feeding habits and trophic status, which included yellow perch and white sucker. The ERA used the 90th percentile baseline concentration of fish less than 25 cm in length, which included yellow perch, white sucker, central mudminnow, finescale dace, brook stickleback, lake chub, iowa darter, spottail shinner and northern redbelly dace. Small-bodied fish were defined as those less than 25 cm in length which was consistent with the size range consumed by piscivorous wildlife receptors according to Environment Canada (2003). The HHRA used fish greater than 25 cm in length to be consistent with size ranges typically harvested for human consumption (MECP

2018) and to acknowledge that mercury bio-magnifies (Environment Canada 2003). These EPCs were incorporated into the derivation of site-specific BAFs (see Sections 2 and 3).

1.7 WILD GAME

As part of the Soil and Traditional Foods sampling program (Attachment A2), wild game tissues from the LSA were donated to Great Bear Resources by a local trapper, and sent for analysis of metals and PAH parameters to support the characterization of baseline wild game tissue concentrations for the Project. Seven samples of organ meat (i.e., six livers and one heart) from ruffed grouse (five livers, one heart) and spruce grouse (one liver) were donated for parameter analysis. No muscle tissue samples were provided.

The collected organ samples were of insufficient sample size and variety to accurately characterize baseline game tissue concentrations in the LSA and RSA. The ruffed and spruce grouse samples represented birds, whereas small and large mammals are also important receptors for the HHERA because they are consumed by humans or are considered species of importance to Indigenous communities. No muscle tissue concentrations were available for the grouse, and tissue concentrations of other wild game species relevant for the HHERA were not available. Additionally, ingestion of grouse organ meat was not considered to be a significant relative to muscle tissue consumption based on FNFNES consumption rates information for Ontario, and collected organ samples were not considered to be similar enough to muscle tissue to be considered for use to represent baseline conditions. Therefore, site-specific game organ meat samples were not used for the characterization of baseline conditions for the HHERA. Instead, baseline game meat concentrations were obtained from the FNFNES (Chan et al. 2014; 2021). FNFNES data contained summaries of sampled wild game tissues donated from several Indigenous groups within the subarctic Boreal Shield, the same ecozone as the Project. These data were considered an accurate representation of baseline game meat concentrations for the HHERA.

As such, the baseline wild game tissue data were not used in the HHERA. The analytical results of the wild game sample analysis can be found in Attachment A2.

Table A-1: Surface Water Quality Nodes for Predicted Water Concentrations Applicable to the HHERA

Watersheds/Surface Water Bodies	Water Quality Nodes
Dixie Creek	DIX-1, DIX-2, DIX-3, DIX-4, DIX-5
Chukuni River	CHK-1, CHK-2
Pakwash Lake	PAK-L, PAK-OUT, PAK-IN, PAK-IN-2
Genesee Lake	GEN-1, GEN-L
Unnamed Waterbodies or Watercourses	UN-3, UN-5, UN-L6

2 USE OF SUMMARY STATISTICS

Summary statistics, such as the 95% UCLM, 90th percentile, mean or maximum measured concentration, were used to characterize the baseline concentrations of POPCs in each environmental media for use in the HHERA. In the Tier 1 screening, maximum measured baseline concentrations for soil and sediment were used. For surface water, the maximum monthly average baseline concentrations were used in the Tier 1 screening. For air, 90th percentile for 1-hour and 24-hour averaging periods, and an average for the annual averaging period were used for Tier 1 screening.

For the derivation of site-specific BAFs, an appropriate EPC was selected for each environmental medium as discussed below. For soil, sediment, berries, traditional plants, wild rice, and fish tissue, EPCs based on measured baseline concentrations were used to develop site-specific BAFs that were then applied to predict tissue concentrations for the Project phases. For surface water, project baseline concentrations were used to develop site-specific BAFs applied to predict biota, tissue and/or traditional food concentrations. Different EPCs were selected for the HHRA and ERA models, as detailed in Table A-2 and Table A-3 below, respectively.

In general, a 95% UCLM was calculated when sufficient data (e.g., ≥10 samples) were available and used as the EPC for environmental media in the calculation of the BAFs. The 95% UCLM was calculated using US EPA’s ProUCL Software, Version 5.2 (US EPA 2022). For samples with a field duplicate, the higher concentration between the parent and duplicate sample was selected to avoid overrepresentation from a single sample location. The datasets included both detected and non-detected concentrations. Non-detected concentrations were indicated in the ProUCL input and were entered as the full detection limit. In datasets with a higher proportion of non-detected values, there may be higher uncertainty associated with the calculation of the 95% UCLM. As such, a 95% UCLM was not selected as an EPC for datasets with a less than 10 samples that reported concentrations above the RDL.

A summary of the selected EPC for each environmental media used to derive BAFs in the HHRA model is provided in Table A-2. The selected EPCs for each environmental media used to derive BAFs in the ERA model is provided in Table A-3.

Table A-2: Selection of Exposure Point Concentrations for Derivation of BAFs for HHRA Model

Environmental Media	Statistic Selected as EPC	Rationale
Air	Not applicable	Air was not considered for the derivation of BAFs in the HHRA.
Soil	95% UCLM	A sufficient number of sample locations and detected values (>10) was available to derive a 95% UCLM.
Sediment	Not applicable	Human exposure to sediment was not assessed in the HHRA (see Attachments C and E of the HHERA), therefore, no EPC for sediment was selected.
Surface Water	Annual average	An overall annual average concentration across applicable water quality nodes (see Table A-1) in Chukuni River, Dixie Creek, Pakwash Lake, Genessee Lake, and small unnamed waterbodies and watercourses were used as the EPC for human health. Surface water modelling nodes were selected based on locations that were accessible for receptors to use as drinking water sources. An average statistic was selected as it was conservatively assumed that human receptors could drink from multiple sources over their lifetime.
Berries	Maximum	An insufficient number of tissue samples with detected values (<10) was available for the calculation of a reliable 95% UCLM. Therefore, a maximum concentration was used as the EPC for the site-specific BAF calculation.
Traditional Plants	95% UCLM	A sufficient number of sample locations (>10) and detected values (>80) were available for some POPCs, therefore a 95% UCLM was derived and selected as the EPC for the site-specific BAF calculation. For POPCs with insufficient data, a site-specific BAF could not be calculated and literature BAFs were selected.

ATTACHMENT A: Baseline Environmental Data and Bioaccumulation Factors

Environmental Media	Statistic Selected as EPC	Rationale
Wild Rice	Single concentration from one sample	The concentration from the single wild rice sample collected was used as the EPC to calculate the site-specific BAF.
Fish Tissue	95% UCLM	A sufficient number of tissue samples with detected values (>10) were available to calculate a 95% UCLM. EPCs were calculated on a species-specific basis for Northern Pike, Walleye, and Lake Whitefish. Therefore, the 95% UCLM for Northern Pike, Walleye and Lake Whitefish were used as the EPCs for the site-specific BAF calculation.

Notes:

> = greater than; 95% UCLM = 95 percent upper confidence limit of the mean; BAF = bioaccumulation factor; EPC = exposure point concentration; HHERA= human health and ecological risk assessment; HHRA = human health risk assessment; POPC = parameter of potential concern

Table A-3: Selection of Exposure Point Concentrations for Derivation of BAFs for ERA Model

Environmental Media	Statistic Selected as EPC	Rationale
Air	Not applicable	Air was not considered for the derivation of BAFs in the ERA.
Soil	90 th Percentile	The 90 th percentile of the measured concentrations was selected as the EPC as it was assumed to be a more conservative estimate than a 95% UCLM for the ERA as wildlife has more opportunity to travel around the LSA, and could have more contact with areas with higher concentrations of POPCs.
Sediment	90 th Percentile	The 90 th percentile of the measured concentrations was selected as the EPC as it was assumed to be a more conservative estimate than a 95% UCLM for the ERA as wildlife has more opportunity to travel around the LSA, and could have more contact with areas with higher concentrations of POPCs.
Surface Water	Maximum monthly average	An overall maximum monthly average concentration across applicable water quality nodes (see Table A-1) in Chukuni River, Dixie Creek, Pakwash Lake, Genessee Lake, and small unnamed waterbodies and watercourses were used as the EPC for wildlife exposures. Surface water modelling nodes were selected based on locations that were accessible for receptors to use as drinking water sources. A maximum statistic was selected as it was conservatively assumed that wildlife receptors would travel and access more varied water sources, increasing the likelihood of drinking from a water source with a higher concentration of POPCs.
Berries	90 th percentile	The 90 th percentile of the measured concentrations was selected as the EPC as it was assumed to be a more conservative estimate than the maximum concentration as wildlife has more opportunity to travel around the LSA, and could have more contact with areas with higher concentrations of POPCs
Traditional Plants and Wild Rice	Not applicable	Traditional plants and wild rice were not considered food items for wildlife and were not incorporated into the ERA.
Fish	90 th percentile	The 90 th percentile was assumed to be a more conservative estimate – wildlife has more opportunity to travel around the LSA, and could have more contact with areas with higher concentrations of POPCs

Notes:

95% UCLM = 95 percent upper confidence limit of the mean; BAF = bioaccumulation factor; EPC = exposure point concentration; ERA = ecological risk assessment; LSA = local study area; POPC = parameter of potential concern.

3 SITE-SPECIFIC BIOACCUMULATION FACTORS

Site-specific BAFs were used to predict tissue concentrations of POPCs in dietary items for the HHERA, including in traditional plants, berries, wild rice and fish, which were used to characterize multi-media pathway risks for humans and ecological receptors within the LSA and RSA. A BAF is the ratio of the concentration of a parameter in an organism to the concentration in the surrounding media (i.e., soil or surface water). A BAF considers the accumulation of POPCs from all exposure routes in the environment, allowing it to account for total POPC accumulation. Use of site-specific BAFs is preferable to literature-based values, as the latter generally do not account for factors that would affect the bioavailability of substances in a site-specific manner.

Using the EPCs described in Table A-2 and Table A-3, site-specific BAFs were estimated for berries, traditional plants, wild rice and fish using the measured soil or modelled surface water baseline data. The technical approach used to estimate dietary and/or tissue concentrations of POPCs varied depending on the media type (e.g., soil or surface water) and mechanism of uptake, and were described as follows:

- Berries: site-specific BAFs and measured baseline soil concentrations were used to predict tissue concentrations.
- Traditional plants (not including wild rice): site-specific BAFs and measured baseline soil concentrations were used to predict tissue concentrations.
- Wild rice: site-specific BAFs for wild rice and modelled baseline surface water concentrations were used to predict tissue concentrations.
- Fish: site-specific BAFs and modelled baseline surface water concentrations were used to predict tissue concentrations.

For each tissue type, a BAF was generated only when the media concentration (denominator) was a detected concentration, irrespective of whether the tissue concentration (in wet weight; numerator) was a detected or non-detected concentration. This was done so that the calculated BAF is not underestimated when the media concentration is a non-detect concentration (i.e., greater than the actual concentration, and resulting in a lower BAF).

The equations for deriving site-specific BAFs from soil and surface water, along with example calculations based on arsenic are provided in the sections below.

The EPCs relied upon the calculation of site-specific BAFs and the resultant BAFs are presented in Table A1-10.

3.1 BIOACCUMULATION FROM SOIL

As discussed above, EPCs for berries and traditional plants were modelled in the HHERA using site-specific BAFs. These dietary items were assumed to uptake concentration of POPCs from soil. Thus, the site-specific BAFs were calculated using soil as the uptake media. Site-specific soil samples were considered for the derivation of BAFs, as recommended by Health Canada (2023). Details on the methods used to calculate the BAFs for vegetation (i.e., berries and traditional plants) are presented below:

$$BAF_{vegetation} = \frac{C_p}{C_s}$$

Where:

$BAF_{vegetation}$ = Site-specific bioaccumulation factor for terrestrial vegetation (kg soil/kg-WW biota)
 C_p = Concentration in plant tissue (mg/kg wet weight)

C_s = Concentration in soil (mg/kg)

An example BAF calculation is presented below for arsenic uptake from soils into berries and traditional plants.

Example 3-1: Bioaccumulation Factor of Arsenic from Soil to Berries

$$BAF_{berries} = \frac{2.63 \times 10^{-2} \text{ mg/kg}}{8.11 \text{ mg/kg}}$$
$$BAF_{berries} = 3.24 \times 10^{-3}$$

Example 3-2: Bioaccumulation Factor of Arsenic from Soil to Traditional Plants

$$BAF_{trad-plants} = \frac{5.77 \times 10^{-2} \text{ mg/kg}}{8.11 \text{ mg/kg}}$$
$$BAF_{trad-plants} = 7.11 \times 10^{-3}$$

3.2 BIOACCUMULATION FROM SURFACE WATER

EPCs for fish and wild rice were modeled in the HHERA using site-specific BAFs. These foods were determined to uptake a significant concentration of POPCs from surface water. Thus, the site-specific BAFs were calculated using surface water as the uptake media. Details on the methods used to calculate the BAFs are as follows:

$$BAF_{wild\ rice} = \frac{C_p}{C_w}$$

Where:

- $BAF_{wild\ rice}$ = Site-specific bioaccumulation factor (L water/kg-WW biota)
- C_p = Concentration in plant tissue (mg/kg wet weight)
- C_s = Concentration in surface water (mg/L)

Example 3-3: Bioaccumulation Factor of Arsenic from Surface Water to Wild Rice

$$BAF_{wild\ rice} = \frac{8.24 \times 10^{-2} \text{ mg/kg}}{4.03 \times 10^{-3} \text{ mg/L}}$$
$$BAF_{wild\ rice} = 20.5$$

Examples 3-4 to 3-6: Bioaccumulation Factor of Arsenic from Surface Water to Fish

$$BAF_{fish} = \frac{C_f}{C_w}$$

Where:

- BAF_{fish} = site-specific bioaccumulation factor (L water/kg-WW biota)
- C_f = concentration in fish tissue (mg/kg wet weight)
- C_w = concentration in surface water (mg/L)

Example 3-4: Bioaccumulation Factor of Arsenic from Surface Water to Northern Pike

$$BAF_{pike} = \frac{1.95 \times 10^{-1} \text{ mg/kg}}{4.03 \times 10^{-3} \text{ mg/L}}$$
$$BAF_{pike} = 48.4$$

Example 3-5: Bioaccumulation Factor of Arsenic from Surface Water to Walleye

$$BAF_{walleye} = \frac{1.00 \times 10^{-1} \text{ mg/kg}}{4.03 \times 10^{-3} \text{ mg/L}}$$
$$BAF_{walleye} = 24.8$$

Example 3-6: Bioaccumulation Factor of Arsenic from Surface Water to Lake Whitefish

$$BAF_{whitefish} = \frac{1.26 \times 10^{-1} \text{ mg/kg}}{4.03 \times 10^{-3} \text{ mg/L}}$$
$$BAF_{whitefish} = 31.3$$

Where the site-specific BAFs were estimated using an EPC for either the tissue or source media that was based on a detection limit, there is a higher degree of uncertainty and the BAF may overestimate the uptake into biota. In these cases, a literature-based BAF was considered if it was lower than the BAF estimated based on detection limits. BAFs from the literature were compiled from Baes et al., (1984); BJC (1998), Beyer and Sample (2017), Argonne National Laboratory 2001, Sample et al. (1998a; 1998b), US EPA (1999), US EPA (2005), and Chan et al. (2021). Details on which tissues/media were calculated using literature BAFs can be found in Table E1-12 (Attachment E).

A summary of the selected EPCs, site-specific BAFs is presented in Attachment A1 (Table A1-10). Discussion of literature BAFs is detailed in the HHRA and ERA model attachments (Attachment E and F, respectively).

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ATTACHMENT A: Baseline Environmental Data and Bioaccumulation Factors

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Sub-Attachment A1

Baseline Summary Statistics



SUBATTACHMENT A1: BASELINE SUMMARY STATISTICS

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- A1-1. Summary of Baseline Air Quality Data Concentrations:** Characterization of baseline air quality for human health exposure.
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- A1-3. Summary Statistics of Baseline Sediment Quality Concentrations:** Characterization of baseline sediment quality for wildlife health exposure.
- A1-4. Summary of Model Baseline Surface Water Quality Exposure Point Concentrations:** Characterization of baseline surface water quality for human and wildlife health exposure.
- A1-5. Summary Statistics of Baseline Plant Tissue Quality Concentrations - Berries:** Characterization of baseline berry concentrations collected during the soil and vegetation sampling program.
- A1-6. Summary Statistics of Baseline Plant Tissue Quality Concentrations - Traditional Plants:** Characterization of baseline traditional plant concentrations collected during the soil and vegetation sampling program.
- A1-7. Summary Statistics of Baseline Plant Tissue Quality Concentrations - Wild Rice:** Characterization of baseline wild rice concentrations collected during the traditional food sampling program.
- A1-8. Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health:** Characterization of baseline small fish for ecological health exposure.
- A1-9. Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health:** Characterization of baseline large fish for human health exposure.
- A1-10. Summary of Bioaccumulation Factors for Use in HHERA Modelling:** Selected statistics and baseline exposure concentrations used for the calculation of site specific BAFs, and BAF calculations for use in the multi-media models.

Table A1-1: Summary of Baseline Air Quality Data Concentrations						
Air Parameter	Averaging Period					
	10-minute ^(a)	1 hour ^(a)	8-hour ^(a)	24-hour ^(a)	30-day	Annual ^(b)
	Baseline Value ($\mu\text{g}/\text{m}^3$)					
Suspended Particulate Matter (SPM)	—	52.1	—	21.4	—	5.8
Inhalable Particulate (PM_{10})	—	26.2	—	18.3	—	9.6
Respirable Particulate ($\text{PM}_{2.5}$)	—	21.8	—	10	—	5.8
Diesel Particulate Matter (DPM)	—	0.46	—	0.19	—	0.089
Respirable Silica (SiO_2 , <10 μm) Cristobalite	—	0.2	—	0.1	—	0.1
Respirable Silica (SiO_2 , <10 μm) Quartz	—	2.2	—	0.92	—	0.5
Respirable Silica (SiO_2 , <10 μm) Total (Cris & Quartz)	—	2.2	—	0.92	—	0.53
Respirable Silica (SiO_2 , <10 μm) Tridymite	—	0.5	—	0.21	—	0.21
Nitrogen Dioxide (NO_2)	—	4.8	—	3.9	—	0.3
Carbon Monoxide (CO)	—	114	114	—	—	—
Sulphur Dioxide (SO_2)	5.2	3.9	—	3.2	—	0.3
Hydrogen Cyanide (HCN)	—	—	—	—	—	—
Calcium Oxide (CaO)	—	—	—	1.7	—	—
Copper Sulphate (CuSO_4)	—	—	—	—	—	—
Benzene	—	1.34	—	0.55	—	0.34
1,3-Butadiene	—	1.36	—	0.56	—	0.56
Benzo(a)pyrene	—	3.17E-05	—	1.30E-05	—	5.00E-06
Arsenic	—	6.82E-03	—	2.80E-03	—	2.00E-03
Cadmium	—	2.24E-03	—	9.20E-04	—	6.50E-04
Chromium	—	5.60E-03	—	2.30E-03	—	1.60E-03
Cobalt	—	2.24E-03	—	9.20E-04	—	6.50E-04
Copper	—	2.31E-01	—	9.50E-02	—	6.10E-02
Iron	—	3.17E-01	—	1.30E-01	—	6.30E-02
Lead	—	3.41E-03	—	1.40E-03	1.40E-03	1.00E-03
Lithium	—	2.92E-02	—	1.20E-02	—	8.70E-03
Manganese (Mn) in SPM	—	1.73E-02	—	7.10E-03	—	3.10E-03
Manganese (Mn) in PM_{10}	—	1.73E-02	—	7.10E-03	—	3.10E-03
Manganese (Mn) in $\text{PM}_{2.5}$	—	1.73E-02	—	7.10E-03	—	3.10E-03
Nickel (Ni) in SPM	—	3.41E-03	—	1.40E-03	—	1.00E-03
Nickel (Ni) in PM_{10}	—	3.41E-03	—	1.40E-03	—	1.00E-03
Selenium	—	1.12E-02	—	4.60E-03	—	3.20E-03
Sulphur	—	9.25E-01	—	3.80E-01	—	2.20E-01
Vanadium	—	5.60E-03	—	2.30E-03	—	1.60E-03
Zinc	—	3.17E-02	—	1.30E-02	—	7.30E-03
Mercury (Hg)	—	2.26E-05	—	9.30E-06	—	6.50E-06

Notes:

CaO = calcium oxide; CO = carbon monoxide; CuSO_4 : copper sulphate; DPM = diesel particulate matter; EPC = exposure point concentration; HCN = hydrogen cyanide; MPOI = maximum point of impingment; NO_2 = nitrogen dioxide; $\text{PM}_{2.5}$ = particulate matter less than 2.5 micron in diameter; PM_{10} = particulate matter less than 10 micron in diameter; SiO_2 = silica; SO_2 = sulphur dioxide; SPM = suspended particulate matter; μm = micrometer; $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter; '—' = no concentration measured

Baseline concentrations were obtained from 3 air quality monitoring stations, installed by Great Bear Resources, and the National Air Pollution Surveillance (NAPS) database (WSP 2025)

(a) Represents the 90th percentile of measured data.

(b) Represents the average of measured data.

References

1. WSP Canada (WSP). 2025. Great Bear Project, Final Ambient Air Quality Baseline Monitoring Report. Project No. OMEMA2303. Prepared by WSP Canada Inc. for Great Bear Resources Ltd. March 2025.

Table A1-2: Summary Statistics of Baseline Soil Quality Concentrations												
Parameters ^(c)	RDL	Units	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Non-Detect Count	Percent Non-Detect
Sample Preparation												
pH, IVBA Initial	0.01	pH units	1.46	1.5	1.5	1.51	1.53	1.53	1.52	21	0	0%
pH, IVBA final	0.01	pH units	1.49	1.6	1.5	1.55	1.57	1.57	1.55	21	0	0%
Weight, extraction (dry)	0.01	g	0.50	1.1	0.97	1.02	1.09	1.1	1.1	21	0	0%
Final volume	1	mL	100	100	100	n/a	100	100	100	21	0	0%
Physical Tests												
Moisture	0.25	%	5.3	87	18	24	33	25	17	21	0	0%
Metals												
Aluminum	50	mg/kg	2500	13800	6038	7543	13400	12600	8040	21	0	0%
Antimony	0.10	mg/kg	<0.10	1.4	0.21	0.42	0.37	0.33	0.22	21	9	43%
Arsenic	0.050	mg/kg	1.8	18	7.0	8.1	18	15	8.1	21	0	0%
Barium	0.50	mg/kg	11	96	33	41	64	52	45	21	0	0%
Beryllium	0.10	mg/kg	<0.10	0.43	0.16	0.20	0.32	0.26	0.21	21	8	38%
Bismuth	0.20	mg/kg	<0.20	0.20	0.20	n/a	0.20	0.20	0.20	21	20	95%
Boron	5.0	mg/kg	<5.0	5.3	5.0	n/a	5.0	5.0	5.0	21	20	95%
Cadmium	0.020	mg/kg	0.024	0.68	0.11	0.16	0.20	0.17	0.12	21	0	0%
Calcium	50	mg/kg	474	4910	2139	2563	3960	3310	2830	21	0	0%
Chromium	0.50	mg/kg	2.6	27	11	14.6	27	27	15	21	0	0%
Cobalt	0.10	mg/kg	0.3	12	3.3	5.0	12	7.0	3.8	21	0	0%
Copper	0.50	mg/kg	1.3	22	5.4	7.6	14	9.5	6.2	21	0	0%
Iron	50	mg/kg	1160	18100	8088	10008	17800	15400	11000	21	0	0%
Lead	0.50	mg/kg	2.5	17	6.3	7.8	15	9.7	7.0	21	0	0%
Lithium	2.0	mg/kg	<2.0	17	7.2	8.8	16	12	10	21	3	14%
Magnesium	20	mg/kg	250	5510	1994	2565	4910	4190	2970	21	0	0%
Manganese	1.0	mg/kg	11	1490	202	419	743	305	209	21	0	0%
Mercury	0.0050	mg/kg	0.0060	0.19	0.030	0.046	0.069	0.048	0.028	21	0	0%
Molybdenum	0.10	mg/kg	<0.10	1.5	0.35	0.52	0.88	0.78	0.33	21	1	5%
Nickel	0.50	mg/kg	0.69	17	6.1	7.9	15	13	9.1	21	0	0%
Phosphorus	50	mg/kg	54	759	313	384	636	613	369	21	0	0%
Potassium	100	mg/kg	120	2140	658	1033	1940	1870	820	21	0	0%
Selenium	0.20	mg/kg	<0.20	0.49	0.22	0.25	0.26	0.22	0.20	21	18	86%
Silver	0.10	mg/kg	<0.10	0.24	0.11	0.13	0.15	0.14	0.10	21	18	86%
Sodium	50	mg/kg	<50	172	81	97	157	146	107	21	5	24%
Strontium	0.50	mg/kg	5.8	26	14	16	21	21	18	21	0	0%
Sulfur	1000	mg/kg	<1000	1200	1010	n/a	1000	1000	1000	21	20	95%
Thallium	0.050	mg/kg	<0.050	0.18	0.076	0.091	0.16	0.13	0.084	21	10	48%
Tin	2.0	mg/kg	<2.0	<2	2.0	n/a	2.0	2.0	2.0	21	21	100%
Titanium	1.0	mg/kg	78	953	470	558	760	760	622	21	0	0%
Tungsten	0.50	mg/kg	<0.50	1.1	0.53	n/a	0.50	0.50	0.50	21	20	95%
Uranium	0.050	mg/kg	0.16	0.85	0.46	0.53	0.84	0.68	0.57	21	0	0%
Vanadium	0.20	mg/kg	4.8	45	17	22	40	33	21	21	0	0%
Zinc	2.0	mg/kg	2.9	59	21	26	39	38	30	21	0	0%
Zirconium	1.0	mg/kg	<1.0	3.2	1.5	1.8	2.6	2.3	1.9	21	10	48%
Leachable Metals												
Arsenic, IVBA (%)	1.0	%	10.8	47.2	24.5	27.9	35.5	34.2	30.2	21	0	0%
Arsenic, IVBA (leachate)	0.10	mg/L	<0.0050	0.10	0.024	0.019	0.10	0.050	0.0202	21	2	10%

Parameters ^(c)	RDL	Units	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Non-Detect Count	Percent Non-Detect
Polycyclic Aromatic Hydrocarbons (PAHs)												
Acenaphthene	0.005	mg/kg	<0.0050	<0.005	0.005	n/a	0.005	0.005	0.0050	21	21	100%
Acenaphthylene	0.005	mg/kg	<0.0050	<0.005	0.005	n/a	0.005	0.005	0.0050	21	21	100%
Acridine	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Anthracene	0.004	mg/kg	<0.0040	<0.004	0.004	n/a	0.004	0.004	0.004	21	21	100%
Benzo(a)anthracene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Benzo(a)pyrene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Benzo(b+j)fluoranthene	0.010	mg/kg	<0.010	0.071	0.013	n/a	0.010	0.010	0.010	21	20	95%
Benzo(b+j+k)fluoranthene	0.015	mg/kg	<0.015	0.071	0.018	n/a	0.015	0.015	0.015	21	20	95%
Benzo(g,h,i)perylene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Benzo(k)fluoranthene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Chrysene	0.010	mg/kg	<0.010	0.052	0.012	n/a	0.010	0.010	0.010	21	20	95%
Dibenz(a,h)anthracene	0.005	mg/kg	<0.0050	<0.005	0.005	n/a	0.005	0.005	0.005	21	21	100%
Fluoranthene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Fluorene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Methylnaphthalene, 1+2-	0.015	mg/kg	<0.015	<0.015	0.015	n/a	0.015	0.015	0.015	21	21	100%
Methylnaphthalene, 1-	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Methylnaphthalene, 2-	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Naphthalene	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%
Perylene	0.010	mg/kg	<0.010	0.018	0.010	n/a	0.010	0.010	0.010	21	20	95%
Phenanthrene	0.010	mg/kg	<0.010	0.1	0.015	n/a	0.015	0.010	0.010	21	19	90%
Pyrene	0.010	mg/kg	<0.010	0.1	0.014	n/a	0.010	0.010	0.010	21	20	95%
Quinoline	0.010	mg/kg	<0.010	<0.01	0.010	n/a	0.010	0.010	0.010	21	21	100%

Notes:

"<" = less than detection limit; % = percent; g = grams; IVBA = in vitro bioaccessibility assay; mg/kg = milligram per kilogram; mg/L = milligrams per litre; n/a = not available; PAH = polycyclic aromatic hydrocarbon; RDL = reporting detection limit; UCLM = upper confidence limit of the mean

(a) Statistics were calculated considering a non-detected value was equal to the full RDL.

(b) If the dataset contained an insufficient number of samples (i.e., <10) or a high percentage of non-detect concentrations (i.e., >80%), a 95% UCLM was not considered reliable and a value of "n/a" was assigned.

(c) It is noted that some of the summary statistics presented herein were not required for use in the Human Health and Ecological Risk Assessment, but are provided for completeness.

Table A1-3: Summary Statistics of Baseline Sediment Quality Concentrations												
Parameters ^(c)	LDL	Units	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Non-Detect Count	Percent Non-Detect
Aluminum	1.0	mg/kg	700	31600	9405	10128	20120	17800	12000	195	0	0%
Antimony	0.80	mg/kg	0.10	1.4	0.53	0.36	0.80	0.80	0.80	195	106	54%
Arsenic	0.50	mg/kg	0.70	37	7.6	8.3	17	14	11	195	0	0%
Barium	0.10	mg/kg	5.6	203	65	70	132	124	89	195	0	0%
Beryllium	0.020	mg/kg	0.020	0.82	0.28	0.30	0.58	0.54	0.38	195	9	5%
Bismuth	0.090	mg/kg	0.090	0.34	0.20	0.16	0.30	0.30	0.20	195	121	62%
Boron	1.0	mg/kg	1.0	10	5.0	4.2	8.0	7.6	5.9	195	92	47%
Cadmium	0.050	mg/kg	0.020	6.2	0.22	0.24	0.59	0.50	0.25	195	10	5%
Calcium	3.0	mg/kg	350	166000	6444	7836	9993	9326	7105	195	0	0%
Chromium	0.5	mg/kg	1.3	75	24	26	50	42	30	195	0	0%
Cobalt	0.010	mg/kg	0.20	21	6.7	7.2	14	13	8	195	0	0%
Copper	0.10	mg/kg	1.0	41	14	15	26	23	19	195	0	0%
Iron	1.0	mg/kg	533	41700	14054	14959	27730	25920	17350	195	0	0%
Lead	0.10	mg/kg	1.2	63	7	7.7	16	14	9	195	0	0%
Lithium	2.0	mg/kg	2.0	39	12	14	27	23	15	195	6	3%
Magnesium	1.0	mg/kg	150	85700	4657	5414	9687	8000	5210	195	0	0%
Manganese	0.50	mg/kg	7.1	1780	350	382.3	831	679	450	195	0	0%
Mercury	0.005	mg/kg	0.0050	0.22	0.052	0.049	0.13	0.11	0.050	195	60	31%
Molybdenum	0.10	mg/kg	0.10	1.4	0.38	0.42	1.0	0.86	0.46	195	5	3%
Nickel	0.50	mg/kg	0.70	54	17	18	31	30	24	195	0	0%
Phosphorus	3.0	mg/kg	45	1020	638	658	895	834	750	195	0	0%
Potassium	4.0	mg/kg	86	5330	1330	1443	3186	2536	1640	195	0	0%
Selenium	0.7	mg/kg	0.20	1.4	0.55	0.43	1.2	1.0	0.70	195	120	62%
Silver	0.10	mg/kg	0.10	0.15	0.10	0.11	0.12	0.12	0.10	38	29	76%
Silicon	3.0	mg/kg	0.10	3200	914	1049	2620	2400	1800	157	71	45%
Sodium	1.0	mg/kg	28	415	144	157	329	244	180	117	0	0%
Strontium	0.10	mg/kg	2.3	1770	92	109	267	217	159	195	6	3%
Sulfur	1000	mg/kg	6.1	4500	434	258	1500	1000	1000	116	32	28%
Thallium	0.020	mg/kg	0.020	0.41	0.13	0.14	0.31	0.26	0.16	195	20	10%
Tin	0.50	mg/kg	0.60	3.0	1.3	1.0	2.0	2.0	2.0	117	38	32%
Titanium	1.0	mg/kg	91	1530	777	873	1421	1340	918	38	0	0%
Tungsten	0.50	mg/kg	0.50	0.75	0.51	n/a	0.50	0.50	0.50	38	38	100%
Uranium	0.0020	mg/kg	0.0020	4.3	1.6	1.3	3.0	2.4	2.0	195	80	41%
Vanadium	3.0	mg/kg	0.33	71	15	17	45	38	24	195	1	1%
Yttrium	0.0040	mg/kg	1.1	68	16	18	48	32	26	157	0	0%
Zinc	0.70	mg/kg	2.5	6160	74	126	93	81	59	195	0	0%
Zirconium	1.0	mg/kg	1.0	14	6.0	6.9	11	11	7.8	38	2	5%

Notes:

mg/kg = milligram per kilogram; LDL = lowest detection limit; UCLM = upper confidence limit of the mean; "<" = less than detection limit

(a) Statistics were calculated considering a non-detected value was equal to the full LDL.

(b) If the dataset contained an insufficient number of samples (i.e., <10) or a high percentage of non-detect concentrations (i.e., >80%), a 95% UCLM was not considered reliable and a value of "n/a" was assigned.

(c) It is noted that some of the summary statistics presented herein were not required for use in the Human Health and Ecological Risk Assessment, but are provided for completeness.

Table A1-4: Summary of Model Baseline Surface Water Quality Exposure Point Concentrations			
Parameter	Units	Average	Maximum
		Model Baseline Concentrations	Baseline Concentrations
Chloride	mg/L	1.73E+00	5.18E+00
Ammonia Total	mg/L	5.57E-02	1.46E-01
Nitrate	mg/L	6.01E-02	1.96E-01
Nitrite	mg/L	7.85E-03	1.50E-02
Phosphorus Total	mg/L	2.68E-02	5.74E-02
Sulfate	mg/L	2.85E+00	6.09E+00
Cyanide Total	mg/L	2.51E-03	4.46E-03
Aluminum	mg/L	1.52E-01	2.50E-01
Antimony	mg/L	3.05E-04	4.50E-04
Arsenic	mg/L	4.03E-03	1.19E-02
Beryllium	mg/L	1.26E-05	3.20E-05
Boron	mg/L	5.69E-03	8.00E-03
Cadmium	mg/L	9.75E-06	2.07E-05
Calcium	mg/L	1.16E+01	1.53E+01
Chromium	mg/L	5.28E-04	1.06E-03
Cobalt	mg/L	1.50E-04	2.49E-04
Copper	mg/L	1.10E-03	1.72E-03
Iron	mg/L	3.47E-01	6.10E-01
Lead	mg/L	2.14E-04	2.12E-04
Magnesium	mg/L	3.13E+00	4.25E+00
Manganese	mg/L	2.29E-02	5.37E-02
Mercury	mg/L	1.45E-06	3.41E-06
Molybdenum	mg/L	2.23E-04	3.31E-04
Nickel	mg/L	8.73E-04	1.69E-03
Potassium	mg/L	1.08E+00	1.42E+00
Selenium	mg/L	1.08E-04	2.29E-04
Silver	mg/L	1.54E-05	2.66E-05
Thallium	mg/L	5.28E-06	7.00E-06
Tungsten	mg/L	4.91E-05	5.44E-05
Uranium	mg/L	1.29E-04	2.85E-04
Vanadium	mg/L	6.86E-04	1.01E-03
Zinc	mg/L	2.12E-03	2.21E-03
Zirconium	mg/L	6.27E-04	1.00E-03

Notes:

mg/L = milligram per litre.

Average model baseline concentrations represent the annual average concentrations used in the modeling for the Project phases, while maximum baseline concentrations represent the maximum monthly average concentrations from water quality nodes DIX_1, DIX_2, DIX_3, DIX_4, DIX_5 (Dixie Creek); CHK_1, CHK_2 (Chukuni River); PAK_L, PAK_OUT, PAK_IN, PAK_IN_2 (Pakwash Lake); GEN-1, GEN_L (Genesse Lake); UN_3, UN_5, UN_L6 (unnamed waterbodies and watercourses), used in the screening.

Table A1-5: Summary Statistics of Baseline Plant Tissue Quality Concentrations - Berries											
Parameters^(b)	RDL	Units	Minimum	Maximum	Mean^(a)	95th Percentile^(a)	90th Percentile^(a)	75th Percentile^(a)	Sample Count	Non-Detect Count	Percent Non-Detect
Physical Tests											
Moisture	0.50	%	58	88	75	87	86	84	7	0	0%
Metals											
Aluminum	0.40	mg/kg wwt	2.2	52	14	40	28	12	7	0	0%
Antimony	0.0020	mg/kg wwt	<0.0020	0.017	0.0042	0.013	0.0081	0.0020	7	6	86%
Arsenic	0.0040	mg/kg wwt	0.0050	0.026	0.013	0.025	0.024	0.018	7	2	29%
Barium	0.010	mg/kg wwt	0.80	6.5	2.9	5.7	4.9	3.3	7	0	0%
Beryllium	0.0020	mg/kg wwt	<0.0020	<0.0020	0.0020	0.0020	0.0020	0.0020	7	7	100%
Bismuth	0.0020	mg/kg wwt	<0.0020	<0.0020	0.0020	0.0020	0.0020	0.0020	7	7	100%
Boron	0.20	mg/kg wwt	0.66	7.1	2.6	6.3	5.5	3.4	7	0	0%
Cadmium	0.0010	mg/kg wwt	<0.0010	0.055	0.010	0.040	0.025	0.0034	7	4	57%
Calcium	4.0	mg/kg wwt	180	2130	730	1738	1345	815	7	0	0%
Cesium	0.0010	mg/kg wwt	<0.0010	0.27	0.060	0.20	0.14	0.043	7	1	14%
Chromium	0.010	mg/kg wwt	<0.010	0.041	0.032	0.041	0.040	0.040	7	6	86%
Cobalt	0.0040	mg/kg wwt	<0.0040	0.065	0.025	0.061	0.057	0.040	7	2	29%
Copper	0.020	mg/kg wwt	0.23	1.8	1.1	1.7	1.7	1.5	7	0	0%
Iron	0.60	mg/kg wwt	1.7	17	7.1	16	16	10	7	0	0%
Lead	0.0040	mg/kg wwt	<0.0040	0.010	0.0077	0.010	0.010	0.010	7	6	86%
Lithium	0.10	mg/kg wwt	<0.10	<0.10	0.10	0.10	0.10	0.10	7	7	100%
Magnesium	0.40	mg/kg wwt	76	810	283	701	593	328	7	0	0%
Manganese	0.010	mg/kg wwt	1.2	69	29	64	59	47	7	0	0%
Mercury	0.0010	mg/kg wwt	<0.0010	<0.0010	0.0010	0.0010	0.0010	0.0010	7	7	100%
Molybdenum	0.0040	mg/kg wwt	0.015	0.14	0.067	0.14	0.13	0.12	7	0	0%
Nickel	0.040	mg/kg wwt	0.044	0.47	0.19	0.40	0.33	0.22	7	0	0%
Phosphorus	2.0	mg/kg wwt	164	1020	507	985	949	728	7	0	0%
Potassium	4.0	mg/kg wwt	804	6130	2430	5275	4420	3215	7	0	0%
Rubidium	0.010	mg/kg wwt	0.65	13	7.0	13	13	11	7	0	0%
Selenium	0.010	mg/kg wwt	<0.010	<0.02	0.016	0.020	0.020	0.020	7	7	100%
Silver	0.0010	mg/kg wwt	<0.0010	<0.001	0.0010	0.0010	0.0010	0.0010	7	7	100%
Sodium	4.0	mg/kg wwt	<4.0	8.1	5.0	7.5	6.8	5.6	7	4	57%
Strontium	0.010	mg/kg wwt	0.30	8.0	2.7	6.9	5.7	3.6	7	0	0%
Tellurium	0.0040	mg/kg wwt	<0.0040	<0.0040	0.0040	0.0040	0.0040	0.0040	7	7	100%
Thallium	0.00040	mg/kg wwt	<0.00040	0.0024	0.0010	0.0024	0.0024	0.0016	7	4	57%
Tin	0.020	mg/kg wwt	<0.020	1.5	0.52	1.3	1.1	0.77	7	2	29%
Titanium	0.050	mg/kg wwt	<0.050	0.70	0.17	0.52	0.34	0.10	7	6	86%
Uranium	0.00040	mg/kg wwt	<0.00040	0.00064	0.00043	0.00057	0.00050	0.00040	7	6	86%
Vanadium	0.020	mg/kg wwt	<0.020	0.026	0.021	0.024	0.022	0.020	7	6	86%
Zinc	0.10	mg/kg wwt	0.76	8.0	2.3	6.3	4.6	2.0	7	0	0%
Zirconium	0.040	mg/kg wwt	<0.040	<0.040	0.040	0.040	0.040	0.040	7	7	100%

Table A1-5: Summary Statistics of Baseline Plant Tissue Quality Concentrations - Berries											
Parameters^(b)	RDL	Units	Minimum	Maximum	Mean^(a)	95th Percentile^(a)	90th Percentile^(a)	75th Percentile^(a)	Sample Count	Non-Detect Count	Percent Non-Detect
Speciated Metals											
Arsenate [As V]	0.005	mg/kg wwt	<0.0050	0.007	0.005	0.006	0.006	0.005	7	4	57%
Arsenite [As III]	0.001	mg/kg wwt	<0.0010	0.011	0.003	0.009	0.007	0.003	7	3	43%
Arsenobetaine [AsB], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	0.001	0.001	0.001	0.001	7	7	100%
Arsenocholine [AsC], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	0.001	0.001	0.001	0.001	7	7	100%
Dimethylarsinic acid [DMA], (as As)	0.001	mg/kg wwt	<0.0010	0.001	0.001	0.001	0.001	0.001	7	5	71%
Monomethylarsonic acid [MMA], (as As)	0.001	mg/kg wwt	<0.0010	0.004	0.002	0.003	0.003	0.001	7	5	71%
Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Acenaphthylene	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Anthracene	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Benz(a)anthracene	0.010	mg/kg wwt	<0.010	0.034	0.015	0.029	0.024	0.010	5	4	80%
Benzo(a)pyrene	0.010	mg/kg wwt	<0.010	0.028	0.014	0.024	0.021	0.010	5	4	80%
Benzo(b+j)fluoranthene	0.010	mg/kg wwt	<0.010	0.045	0.017	0.038	0.031	0.010	5	4	80%
Benzo(b+j+k)fluoranthene	0.015	mg/kg wwt	<0.015	0.091	0.030	0.076	0.061	0.015	5	4	80%
Benzo(g,h,i)perylene	0.010	mg/kg wwt	<0.010	0.037	0.015	0.032	0.026	0.010	5	4	80%
Benzo(k)fluoranthene	0.010	mg/kg wwt	<0.010	0.046	0.017	0.039	0.032	0.010	5	4	80%
Chrysene	0.010	mg/kg wwt	<0.010	0.043	0.017	0.036	0.030	0.010	5	4	80%
Dibenz(a,h)anthracene	0.010	mg/kg wwt	<0.010	0.033	0.015	0.028	0.024	0.010	5	4	80%
Fluoranthene	0.010	mg/kg wwt	<0.010	0.037	0.015	0.032	0.026	0.010	5	4	80%
Fluorene	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg wwt	<0.010	0.041	0.016	0.035	0.029	0.010	5	4	80%
Methylnaphthalene, 1-	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Methylnaphthalene, 2-	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Naphthalene	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Phenanthrene	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.010	0.010	0.010	5	5	100%
Pyrene	0.010	mg/kg wwt	<0.010	<0.04	0.016	0.034	0.028	0.010	5	5	100%

Notes:

% = percent; mg/kg = milligrams per kilogram; As= Arsenic; As V= Arsenate; As III= Arsenite; AsB = Arsenobetaine; AsC = Arsenocholine; DMA = dimethylarsinic acid; MMA = monomethylarsonic acid; PAHs = polycyclic aromatic hydrocarbons; RDL = reported detection limit; "<" = less than detection limit; wwt = wet weight.

(a) Statistics were calculated considering a non-detected value was equal to the full RDL.

(b) It is noted that some of the summary statistics presented herein were not required for use in the Human Health and Ecological Risk Assessment, but are provided for completeness.

Table A1-6: Summary Statistics of Baseline Plant Tissue Quality Concentrations - Traditional Plants												
Parameters ^(c)	RDL	Units	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Non-detect Count	Percent non-detect
Physical Tests												
Moisture	0.50	%	4.3	87	55	66	83	80	69	13	0	0%
Metals												
Aluminum	0.40	mg/kg wwt	1.3	150	28	57	84	40	34	13	0	0%
Antimony	0.0020	mg/kg wwt	<0.0020	0.0093	0.0031	0.0041	0.0062	0.0041	0.0034	13	7	54%
Arsenic	0.0040	mg/kg wwt	0.0044	0.12	0.040	0.058	0.11	0.10	0.05	13	0	0%
Barium	0.010	mg/kg wwt	0.17	71	20	29	50	35	24	13	0	0%
Beryllium	0.0020	mg/kg wwt	<0.0020	0.0057	0.0025	0.0034	0.0054	0.0046	0.0020	13	11	85%
Bismuth	0.0020	mg/kg wwt	<0.0020	0.0062	0.0030	0.0038	0.0060	0.0055	0.0039	13	8	62%
Boron	0.20	mg/kg wwt	0.38	13	5.3	7.1	10	8.6	7.7	13	0	0%
Cadmium	0.0010	mg/kg wwt	<0.0010	5.5	0.48	1.2	2.4	0.37	0.053	13	1	8%
Calcium	4.0	mg/kg wwt	28	7780	2800	3998	7048	6302	4020	13	0	0%
Cesium	0.0010	mg/kg wwt	0.0018	0.23	0.074	0.11	0.18	0.15	0.12	13	0	0%
Chromium	0.010	mg/kg wwt	<0.010	0.40	0.089	0.20	0.29	0.19	0.085	13	2	15%
Cobalt	0.0040	mg/kg wwt	<0.0040	0.17	0.037	0.12	0.14	0.10	0.034	13	1	8%
Copper	0.020	mg/kg wwt	1.1	19	4.0	6.6	15	10	3.8	13	0	0%
Iron	0.60	mg/kg wwt	4.0	201	40	78	132	78	41	13	0	0%
Lead	0.0040	mg/kg wwt	<0.0040	0.21	0.044	0.073	0.14	0.092	0.059	13	3	23%
Lithium	0.10	mg/kg wwt	<0.10	0.2	0.11	n/a	0.14	0.10	0.10	13	12	92%
Magnesium	0.40	mg/kg wwt	112	2190	738	1027	1872	1493	794	13	0	0%
Manganese	0.010	mg/kg wwt	2.2	539	135	218	457	372	152	13	0	0%
Mercury	0.0010	mg/kg wwt	<0.0010	0.051	0.010	0.017	0.034	0.023	0.0067	13	3	23%
Molybdenum	0.0040	mg/kg wwt	0.0071	0.79	0.15	0.40	0.57	0.41	0.15	13	1	8%
Nickel	0.040	mg/kg wwt	<0.040	0.89	0.27	0.40	0.72	0.59	0.43	13	1	8%
Phosphorus	2.0	mg/kg wwt	207	3020	733	1090	1783	915	678	13	0	0%
Potassium	4.0	mg/kg wwt	280	3930	2255	2806	3912	3776	2830	13	0	0%
Rubidium	0.010	mg/kg wwt	0.37	24	12	16	23	22	17	13	0	0%
Selenium	0.010	mg/kg wwt	<0.010	0.080	0.024	0.033	0.056	0.039	0.030	13	9	69%
Silver	0.0010	mg/kg wwt	<0.0010	0.18	0.026	0.033	0.14	0.099	0.012	13	7	54%
Sodium	4.0	mg/kg wwt	<4.0	14	6.7	0.056	12	11	9.0	13	3	23%
Strontium	0.010	mg/kg wwt	0.11	33	9.4	14	28	24	10	13	0	0%
Tellurium	0.0040	mg/kg wwt	<0.0040	<0.004	0.0040	n/a	0.0040	0.0040	0.0040	13	13	100%
Thallium	0.00040	mg/kg wwt	<0.00040	0.019	0.0026	0.0053	0.0095	0.0030	0.0025	13	4	31%
Tin	0.020	mg/kg wwt	<0.020	0.78	0.13	0.26	0.63	0.45	0.085	13	9	69%
Titanium	0.050	mg/kg wwt	<0.050	14	1.8	10	7.5	3.1	1.3	13	2	15%
Uranium	0.00040	mg/kg wwt	<0.00040	0.011	0.0019	0.0050	0.0057	0.0025	0.0022	13	5	38%
Vanadium	0.020	mg/kg wwt	<0.020	0.39	0.067	0.11	0.21	0.081	0.070	13	6	46%
Zinc	0.10	mg/kg wwt	1.7	91	24	48	91	78	22	13	0	0%
Zirconium	0.040	mg/kg wwt	<0.040	<0.14	0.071	n/a	0.14	0.13	0.080	13	13	100%

Table A1-6: Summary Statistics of Baseline Plant Tissue Quality Concentrations - Traditional Plants												
Parameters ^(c)	RDL	Units	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Non-detect Count	Percent non-detect
Speciated Metals												
Arsenate [As V]	0.005	mg/kg wwt	<0.0050	0.010	0.007	0.0081	0.0102	0.010	0.009	13	4	31%
Arsenite [As III]	0.001	mg/kg wwt	<0.0010	0.009	0.003	0.0047	0.00778	0.007	0.006	13	4	31%
Arsenobetaine [AsB], (as As)	0.001	mg/kg wwt	<0.0010	0.017	0.003	n/a	0.00934	0.004	0.001	13	10	77%
Arsenocholine [AsC], (as As)	0.001	mg/kg wwt	<0.0010	0.001	0.001	n/a	0.0011	0.001	0.001	13	11	85%
Dimethylarsinic acid [DMA], (as As)	0.001	mg/kg wwt	<0.0010	0.004	0.001	n/a	0.00266	0.002	0.001	13	10	77%
Monomethylarsonic acid [MMA], (as As)	0.001	mg/kg wwt	<0.0010	0.003	0.001	n/a	0.00176	0.001	0.001	13	11	85%
Polycyclic Aromatic Hydrocarbons (PAHs)												
Acenaphthene	0.010	mg/kg wwt	<0.010	<0.04	0.013	n/a	0.0265	0.013	0.010	13	13	100%
Acenaphthylene	0.010	mg/kg wwt	<0.010	0.018	0.011	n/a	0.0144	0.011	0.010	13	12	92%
Anthracene	0.010	mg/kg wwt	<0.010	0.020	0.011	n/a	0.0155	0.011	0.010	13	12	92%
Benzo(a)anthracene	0.010	mg/kg wwt	<0.010	0.042	0.014	n/a	0.0294	0.017	0.010	13	11	85%
Benzo(a)pyrene	0.010	mg/kg wwt	<0.010	0.028	0.012	n/a	0.02035	0.013	0.010	13	11	85%
Benzo(b+j)fluoranthene	0.010	mg/kg wwt	<0.010	0.035	0.013	n/a	0.02555	0.016	0.010	13	10	77%
Benzo(b+j+k)fluoranthene	0.015	mg/kg wwt	<0.015	0.071	0.022	n/a	0.05255	0.034	0.015	13	11	85%
Benzo(g,h,i)perylene	0.010	mg/kg wwt	<0.010	0.028	0.012	n/a	0.0199	0.012	0.010	13	12	92%
Benzo(k)fluoranthene	0.010	mg/kg wwt	<0.010	0.036	0.013	n/a	0.027	0.018	0.010	13	11	85%
Chrysene	0.010	mg/kg wwt	<0.010	0.047	0.015	n/a	0.03485	0.023	0.013	13	11	85%
Dibenz(a,h)anthracene	0.010	mg/kg wwt	<0.010	0.027	0.012	n/a	0.01935	0.012	0.010	13	11	85%
Fluoranthene	0.010	mg/kg wwt	<0.010	0.052	0.015	n/a	0.0358	0.020	0.010	13	9	69%
Fluorene	0.010	mg/kg wwt	<0.010	<0.03	0.013	n/a	0.0255	0.021	0.010	13	13	100%
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg wwt	<0.010	0.031	0.012	n/a	0.0229	0.015	0.010	13	11	85%
Methylnaphthalene, 1-	0.010	mg/kg wwt	<0.010	<0.01	0.010	n/a	0.01	0.010	0.010	13	13	100%
Methylnaphthalene, 2-	0.010	mg/kg wwt	<0.010	<0.01	0.010	n/a	0.01	0.010	0.010	13	13	100%
Naphthalene	0.010	mg/kg wwt	<0.010	<0.01	0.010	n/a	0.01	0.010	0.010	13	13	100%
Phenanthrene	0.010	mg/kg wwt	<0.010	0.020	0.011	n/a	0.0155	0.011	0.010	13	12	92%
Pyrene	0.010	mg/kg wwt	<0.010	0.060	0.020	n/a	0.0555	0.051	0.014	13	12	92%

Notes:

% = percent; mg/kg = milligrams per kilogram; As= Arsenic; As V= Arsenate; As III= Arsenite; AsB = Arsenobetaine; AsC = Arsenocholine; DMA = dimethylarsinic acid; MMA = monomethylarsonic acid; PAHs = polycyclic aromatic hydrocarbons; RDL = reported detection limit; "<" = less than detection limit; n/a = not available; UCLM = upper confidence limit of the mean; wwt = wet weight.

(a) Statistics were calculated considering a non-detected value was equal to the full RDL.

(b) If the dataset contained an insufficient number of samples (i.e., <10) or a high percentage of non-detect concentrations (i.e., >80%), a 95% UCLM was not considered reliable and a value of "n/a" was assigned. Water-dominant uptake species, wild rice and cattail, were excluded from the traditional food statistics.

(c) It is noted that some of the summary statistics presented herein were not required for use in the Human Health and Ecological Risk Assessment, but are provided for completeness.

Table A1-7: Summary Statistics of Baseline Plant Tissue Quality Concentrations - Wild Rice			
Parameters	RDL	Units	Sample Concentration
Physical Tests			
Moisture	0.50	%	29
Metals			
Aluminum	0.40	mg/kg wwt	9.4
Antimony	0.0020	mg/kg wwt	<0.0020
Arsenic	0.0040	mg/kg wwt	0.082
Barium	0.010	mg/kg wwt	0.19
Beryllium	0.0020	mg/kg wwt	<0.0020
Bismuth	0.0020	mg/kg wwt	<0.0020
Boron	0.20	mg/kg wwt	1.9
Cadmium	0.0010	mg/kg wwt	0.0037
Calcium	4.0	mg/kg wwt	153
Cesium	0.0010	mg/kg wwt	0.010
Chromium	0.010	mg/kg wwt	<0.040
Cobalt	0.0040	mg/kg wwt	0.016
Copper	0.020	mg/kg wwt	2.7
Iron	0.60	mg/kg wwt	19
Lead	0.0040	mg/kg wwt	<0.010
Lithium	0.10	mg/kg wwt	<0.10
Magnesium	0.40	mg/kg wwt	764
Manganese	0.010	mg/kg wwt	13
Mercury	0.0010	mg/kg wwt	0.0021
Molybdenum	0.0040	mg/kg wwt	0.16
Nickel	0.040	mg/kg wwt	0.14
Phosphorus	2.0	mg/kg wwt	2600
Potassium	4.0	mg/kg wwt	1920
Rubidium	0.010	mg/kg wwt	9.8
Selenium	0.010	mg/kg wwt	<0.020
Silver	0.0010	mg/kg wwt	<0.0010
Sodium	4.0	mg/kg wwt	14
Strontium	0.010	mg/kg wwt	0.31
Tellurium	0.0040	mg/kg wwt	<0.0040
Thallium	0.00040	mg/kg wwt	<0.00040
Tin	0.020	mg/kg wwt	<0.020
Titanium	0.050	mg/kg wwt	0.68
Uranium	0.00040	mg/kg wwt	0.0010
Vanadium	0.020	mg/kg wwt	0.021
Zinc	0.10	mg/kg wwt	28
Zirconium	0.040	mg/kg wwt	<0.040
Speciated Metals			
Arsenate [As V]	0.005	mg/kg wwt	0.0228
Arsenite [As III]	0.001	mg/kg wwt	0.0196
Arsenobetaine [AsB], (as As)	0.001	mg/kg wwt	<0.0010
Arsenocholine [AsC], (as As)	0.001	mg/kg wwt	<0.0010
Dimethylarsinic acid [DMA], (as As)	0.001	mg/kg wwt	0.0096
Monomethylarsonic acid [MMA], (as As)	0.001	mg/kg wwt	<0.0010

Table A1-7: Summary Statistics of Baseline Plant Tissue Quality Concentrations - Wild Rice			
Parameters	RDL	Units	Sample Concentration
Polycyclic Aromatic Hydrocarbons (PAHs)			
Acenaphthene	0.010	mg/kg wwt	<0.010
Acenaphthylene	0.010	mg/kg wwt	<0.010
Anthracene	0.010	mg/kg wwt	<0.010
Benzo(a)anthracene	0.010	mg/kg wwt	<0.020
Benzo(a)pyrene	0.010	mg/kg wwt	<0.010
Benzo(b+j)fluoranthene	0.010	mg/kg wwt	0.028
Benzo(b+j+k)fluoranthene	0.015	mg/kg wwt	0.047
Benzo(g,h,i)perylene	0.010	mg/kg wwt	0.019
Benzo(k)fluoranthene	0.010	mg/kg wwt	0.019
Chrysene	0.010	mg/kg wwt	<0.030
Dibenz(a,h)anthracene	0.010	mg/kg wwt	0.013
Fluoranthene	0.010	mg/kg wwt	0.013
Fluorene	0.010	mg/kg wwt	<0.010
Indeno(1,2,3-c,d)pyrene	0.010	mg/kg wwt	0.02
Methylnaphthalene, 1-	0.010	mg/kg wwt	<0.010
Methylnaphthalene, 2-	0.010	mg/kg wwt	<0.010
Naphthalene	0.010	mg/kg wwt	<0.010
Phenanthrene	0.010	mg/kg wwt	<0.010
Pyrene	0.010	mg/kg wwt	<0.010

Notes

% = percent; mg/kg = milligrams per kilogram; As= Arsenic; As V= Arsenate; As III= Arsenite; AsB = Arsenobetaine; AsC = Arsenocholine; DMA = dimethylarsinic acid; MMA = monomethylarsonic acid; PAHs = polycyclic aromatic hydrocarbons; RDL = reported detection limit; "<" = less than detection limit; wwt = wet weight.

Only 1 sample of wild rice was submitted for analysis from the Site

Sample concentrations below the RDL were assumed to equal to the RDL.

Table A1-8: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
2022 - All Species												
Moisture	%	0.50	75	81	78	78	81	80	79	40	40	0%
Aluminum	mg/kg ww	0.40	0.64	16	6.3	7.4	14	11	9.3	40	40	0%
Antimony	mg/kg ww	0.0020	0.0020	0.0051	0.0023	0.0025	0.0037	0.0033	0.0022	40	13	68%
Arsenic	mg/kg ww	0.0040	0.056	0.33	0.21	0.23	0.32	0.30	0.26	40	40	0%
Barium	mg/kg ww	0.010	1.0	2.7	1.7	1.9	2.5	2.4	2.0	40	40	0%
Beryllium	mg/kg ww	0.0020	0.0020	0.0020	0.0020	NV	0.0020	0.0020	0.0020	40	0	100%
Bismuth	mg/kg ww	0.0020	0.0020	0.0033	0.0021	0.0022	0.0026	0.0020	0.0020	40	3	93%
Boron	mg/kg ww	0.20	0.20	0.20	0.20	NV	0.20	0.20	0.20	40	0	100%
Cadmium	mg/kg ww	0.0010	0.0036	0.029	0.010	0.012	0.023	0.020	0.012	40	40	0%
Calcium	mg/kg ww	4.0	5880	14200	8683	9091	10745	10024	9435	40	40	0%
Cesium	mg/kg ww	0.0010	0.0013	0.055	0.011	0.016	0.050	0.024	0.012	40	40	0%
Chromium	mg/kg ww	0.010	0.010	0.054	0.022	0.025	0.044	0.042	0.033	40	30	25%
Cobalt	mg/kg ww	0.0040	0.011	0.27	0.11	0.13	0.23	0.23	0.16	40	40	0%
Copper	mg/kg ww	0.020	0.45	1.9	0.76	0.84	1.3	1.0	0.89	40	40	0%
Iron	mg/kg ww	0.60	26	73	46	49	69	62	55	40	40	0%
Lead	mg/kg ww	0.0040	0.0062	0.022	0.011	0.012	0.019	0.017	0.014	40	40	0%
Lithium	mg/kg ww	0.10	0.10	0.10	0.10	NV	0.10	0.10	0.10	40	0	100%
Magnesium	mg/kg ww	0.40	232	442	331	344	409	392	359	40	40	0%
Manganese	mg/kg ww	0.010	4.0	22	8.6	9.6	14	12	9.7	40	40	0%
Mercury	mg/kg ww	0.0010	0.019	0.17	0.067	0.078	0.15	0.13	0.086	40	40	0%
Methylmercury	µg/kg ww	1.0	0.025	0.21	0.088	0.10	0.20	0.16	0.11	40	40	0%
Molybdenum	mg/kg ww	0.0040	0.014	0.088	0.027	0.032	0.066	0.048	0.028	40	40	0%
Nickel	mg/kg ww	0.040	0.040	0.050	0.041	0.041	0.045	0.040	0.040	40	4	90%
Phosphorus	mg/kg ww	2.0	4080	8200	6026	6228	6956	6823	6613	40	40	0%
Potassium	mg/kg ww	4.0	2030	3390	2875	2933	3192	3073	2980	40	40	0%
Rubidium	mg/kg ww	0.010	0.89	11	4.4	5.2	9.0	8.1	7.6	40	40	0%
Selenium	mg/kg ww	0.010	0.13	0.40	0.21	0.23	0.38	0.34	0.24	40	40	0%
Sodium	mg/kg ww	4.0	635	1190	960	992	1141	1103	1033	40	40	0%
Strontium	mg/kg ww	0.010	3.9	14	7.2	7.9	11	10	8.4	40	40	0%
Tellurium	mg/kg ww	0.0040	0.0040	0.0040	0.0040	NV	0.0040	0.0040	0.0040	40	0	100%
Thallium	mg/kg ww	0.00040	0.0013	0.0078	0.0039	0.0044	0.0075	0.0064	0.0051	40	40	0%
Tin	mg/kg ww	0.020	0.025	0.15	0.068	0.074	0.10	0.094	0.080	40	40	0%
Uranium	mg/kg ww	0.00040	0.00056	0.0070	0.0019	0.0023	0.0044	0.0036	0.0022	40	40	0%
Vanadium	mg/kg ww	0.020	0.020	0.14	0.073	0.082	0.13	0.12	0.098	40	40	0%
Zinc	mg/kg ww	0.10	20	96	56	62	85	81	68	40	40	0%
Zirconium	mg/kg ww	0.040	0.040	0.040	0.040	NV	0.040	0.040	0.040	40	0	100%

Table A1-8: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
2023 - All Species												
Moisture	%	0.50	71	82	75	76	81	77	76	74	74	0%
Aluminum	mg/kg ww	0.40	0.53	108	11	14	35	26	13.0	74	74	0%
Antimony	mg/kg ww	0.0020	0.0020	0.0053	0.0024	0.0025	0.0039	0.0033	0.0024	74	23	69%
Arsenic	mg/kg ww	0.0040	0.056	0.61	0.20	0.22	0.38	0.31	0.25	74	74	0%
Barium	mg/kg ww	0.010	0.67	13	2.6	3.0	7.5	4.1	2.8	74	74	0%
Beryllium	mg/kg ww	0.0020	0.0020	0.0025	0.0020	NV	0.0020	0.0020	0.0020	74	1	99%
Bismuth	mg/kg ww	0.0020	0.0020	0.0028	0.0020	0.0021	0.0023	0.0020	0.0020	74	7	91%
Boron	mg/kg ww	0.20	0.20	0.20	0.20	NV	0.20	0.20	0.20	74	0	100%
Cadmium	mg/kg ww	0.0010	0.0010	0.024	0.0074	0.0085	0.016	0.013	0.010	74	73	1%
Calcium	mg/kg ww	4.0	6130	16900	10167	10638	14505	13000	11650	74	74	0%
Cesium	mg/kg ww	0.0010	0.0018	0.070	0.015	0.018	0.058	0.051	0.014	74	74	0%
Chromium	mg/kg ww	0.010	0.010	0.28	0.037	0.047	0.098	0.072	0.044	74	65	12%
Cobalt	mg/kg ww	0.0040	0.0057	0.28	0.062	0.074	0.15	0.14	0.093	74	74	0%
Copper	mg/kg ww	0.020	0.35	2.0	0.81	0.88	1.5	1.3	1.0	74	74	0%
Iron	mg/kg ww	0.60	13	221	52	57	86	74	63	74	74	0%
Lead	mg/kg ww	0.0040	0.0040	0.052	0.016	0.018	0.040	0.029	0.020	74	73	1%
Lithium	mg/kg ww	0.10	0.10	0.16	0.10	0.10	0.10	0.10	0.10	74	3	96%
Magnesium	mg/kg ww	0.40	311	551	410	420	500	487	442	74	74	0%
Manganese	mg/kg ww	0.010	2.8	39	14	15	29	24	17	74	74	0%
Mercury	mg/kg ww	0.0010	0.025	0.23	0.078	0.087	0.15	0.13	0.11	74	74	0%
Methylmercury	µg/kg ww	1.0	0.013	0.25	0.072	0.082	0.15	0.13	0.10	74	74	0%
Molybdenum	mg/kg ww	0.0040	0.012	0.052	0.023	0.025	0.041	0.035	0.028	74	74	0%
Nickel	mg/kg ww	0.040	0.040	0.16	0.045	0.049	0.063	0.049	0.041	74	19	74%
Phosphorus	mg/kg ww	2.0	4880	11700	7753	8025	10070	9415	8638	74	74	0%
Potassium	mg/kg ww	4.0	2100	3460	2973	3015	3264	3180	3068	74	74	0%
Rubidium	mg/kg ww	0.010	0.78	13	5.9	6.6	12	11	8.7	74	74	0%
Selenium	mg/kg ww	0.010	0.13	0.49	0.24	0.26	0.44	0.43	0.25	74	74	0%
Sodium	mg/kg ww	4.0	451	1100	871	901	1064	1037	981	74	74	0%
Strontium	mg/kg ww	0.010	3.3	20	8.6	9.3	16	13	10	74	74	0%
Tellurium	mg/kg ww	0.0040	0.0040	0.0040	0.0040	NV	0.0040	0.0040	0.0040	74	0	100%
Thallium	mg/kg ww	0.00040	0.0011	0.0096	0.0035	0.0039	0.0069	0.0060	0.0051	74	74	0%
Tin	mg/kg ww	0.020	0.020	0.20	0.081	0.090	0.16	0.14	0.11	74	73	1%
Uranium	mg/kg ww	0.00040	0.00040	0.0088	0.0022	0.0026	0.0059	0.0044	0.0027	74	71	4%
Vanadium	mg/kg ww	0.020	0.020	0.32	0.076	0.089	0.19	0.14	0.10	74	58	22%
Zinc	mg/kg ww	0.10	16	124	59	64	106	94	78	74	74	0%
Zirconium	mg/kg ww	0.040	0.040	0.14	0.045	0.049	0.070	0.044	0.040	74	10	86%

Table A1-8: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
All Years Combined - All Species												
Moisture	%	0.50	71	82	76	77	81	79	78	114	114	0%
Aluminum	mg/kg wwt	0.40	0.53	108	9.7	12	28	19	11	114	114	0%
Antimony	mg/kg wwt	0.0020	0.0020	0.0053	0.0024	0.0025	0.0038	0.0034	0.0024	114	36	68%
Arsenic	mg/kg wwt	0.0040	0.056	0.61	0.20	0.22	0.35	0.31	0.26	114	114	0%
Barium	mg/kg wwt	0.010	0.67	13	2.3	2.6	4.7	3.2	2.5	114	114	0%
Beryllium	mg/kg wwt	0.0020	0.0020	0.0025	0.0020	NV	0.0020	0.0020	0.0020	114	1	99%
Bismuth	mg/kg wwt	0.0020	0.0020	0.0033	0.0020	0.0021	0.0023	0.0020	0.0020	114	10	91%
Boron	mg/kg wwt	0.20	0.20	0.20	0.20	NV	0.20	0.20	0.20	114	0	100%
Cadmium	mg/kg wwt	0.0010	0.0010	0.029	0.0085	0.0094	0.020	0.016	0.010	114	113	1%
Calcium	mg/kg wwt	4.0	5880	16900	9646	9995	14235	12740	10675	114	114	0%
Cesium	mg/kg wwt	0.0010	0.0013	0.070	0.013	0.016	0.054	0.048	0.014	114	114	0%
Chromium	mg/kg wwt	0.010	0.010	0.28	0.032	0.037	0.077	0.057	0.040	114	95	17%
Cobalt	mg/kg wwt	0.0040	0.0057	0.28	0.077	0.090	0.22	0.16	0.12	114	114	0%
Copper	mg/kg wwt	0.020	0.35	2.0	0.79	0.85	1.5	1.2	0.92	114	114	0%
Iron	mg/kg wwt	0.60	13	221	50	53	77	70	60	114	114	0%
Lead	mg/kg wwt	0.0040	0.0040	0.052	0.014	0.015	0.031	0.022	0.017	114	113	1%
Lithium	mg/kg wwt	0.10	0.10	0.16	0.10	0.10	0.10	0.10	0.10	114	3	97%
Magnesium	mg/kg wwt	0.40	232	551	382	392	495	465	419	114	114	0%
Manganese	mg/kg wwt	0.010	2.8	39	12	13	26	22	15.4	114	114	0%
Mercury	mg/kg wwt	0.0010	0.019	0.23	0.074	0.081	0.15	0.13	0.10	114	114	0%
Methylmercury	µg/kg wwt	1.0	0.013	0.25	0.078	0.086	0.17	0.14	0.10	114	114	0%
Molybdenum	mg/kg wwt	0.0040	0.012	0.088	0.025	0.027	0.047	0.036	0.028	114	114	0%
Nickel	mg/kg wwt	0.040	0.040	0.16	0.044	0.046	0.053	0.048	0.040	114	23	80%
Phosphorus	mg/kg wwt	2.0	4080	11700	7147	7375	9788	9133	8083	114	114	0%
Potassium	mg/kg wwt	4.0	2030	3460	2939	2973	3234	3174	3050	114	114	0%
Rubidium	mg/kg wwt	0.010	0.78	13	5.4	5.9	11	9.9	8.1	114	114	0%
Selenium	mg/kg wwt	0.010	0.13	0.49	0.23	0.24	0.43	0.37	0.24	114	114	0%
Sodium	mg/kg wwt	4.0	451	1190	903	926	1100	1057	1006	114	114	0%
Strontium	mg/kg wwt	0.010	3.3	20	8.1	8.6	14	12	9.5	114	114	0%
Tellurium	mg/kg wwt	0.0040	0.0040	0.0040	0.0040	NV	0.0040	0.0040	0.0040	114	0	100%
Thallium	mg/kg wwt	0.00040	0.0011	0.0096	0.0036	0.0039	0.0071	0.0061	0.0051	114	114	0%
Tin	mg/kg wwt	0.020	0.020	0.20	0.076	0.083	0.15	0.14	0.096	114	113	1%
Uranium	mg/kg wwt	0.00040	0.00040	0.0088	0.0021	0.0023	0.0053	0.0043	0.0026	114	111	3%
Vanadium	mg/kg wwt	0.020	0.020	0.32	0.075	0.084	0.16	0.13	0.10	114	98	14%
Zinc	mg/kg dwt	0.10	16	124	58	62	98	88	76	114	114	0%
Zirconium	mg/kg dwt	0.040	0.040	0.14	0.043	0.046	0.052	0.040	0.040	114	10	91%

Notes:

% = percent; dwt = dry weight; mg/kg = milligrams per kilogram; n/a = not available; NV = no value; RDL = reported detection limit; wwt = wet weight; UCLM = upper confidence limit of the mean; µg/kg = micrograms per kilogram.

(a) Statistics were calculated considering a non-detected value was equal to the full RDL.

(b) If the dataset contained an insufficient number of samples (i.e., <10) or a high percentage of non-detect concentrations (i.e., >80%), a 95% UCLM was not considered reliable and a value of "n/a" was assigned.

Table A1-8: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
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(c) It is noted that some of the summary statistics presented herein were not required for use in the Human Health and Ecological Risk Assessment, but are provided for completeness.

Table A1-9: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
Forage Fish (>25 cm)												
Aluminum	mg/kg ww	0.40	0.40	22.00	1.56	2.4	3.28	2.3	1.4	46	33	28%
Antimony	mg/kg ww	0.0020	0.0020	0.007	0.0022	n/a	0.0022	0.0020	0.0020	46	3	93%
Arsenic	mg/kg ww	0.0040	0.028	0.29	0.11	0.13	0.22	0.19	0.15	46	46	0%
Barium	mg/kg ww	0.010	0.010	0.12	0.033	0.039	0.059	0.052	0.041	46	45	2%
Beryllium	mg/kg ww	0.0020	0.0020	0.0020	0.0020	n/a	0.0020	0.0020	0.0020	46	0	100%
Bismuth	mg/kg ww	0.0020	0.0020	0.0022	0.0020	n/a	0.0020	0.0020	0.0020	46	1	98%
Boron	mg/kg ww	0.20	0.20	0.20	0.20	n/a	0.20	0.20	0.20	46	0	100%
Cadmium	mg/kg ww	0.0010	0.0010	0.0011	0.0010	n/a	0.0010	0.0010	0.0010	46	2	96%
Calcium	mg/kg ww	4.0	103	1200	343	406	855	624	423	46	46	0%
Cesium	mg/kg ww	0.0010	0.0036	0.017	0.0081	0.0090	0.016	0.014	0.010	46	46	0%
Chromium	mg/kg ww	0.010	0.010	0.080	0.013	0.016	0.023	0.017	0.012	46	13	72%
Cobalt	mg/kg ww	0.0040	0.0040	0.020	0.0047	0.005	0.0084	0.0045	0.0040	46	10	78%
Copper	mg/kg ww	0.020	0.14	0.45	0.21	0.22	0.34	0.28	0.23	46	46	0%
Iron	mg/kg ww	0.60	1.4	45.7	4.7	6.2	6.4	6.0	4.4	46	46	0%
Lead	mg/kg ww	0.0040	0.0040	0.013	0.0044	n/a	0.0062	0.0041	0.0040	46	5	89%
Lithium	mg/kg ww	0.10	0.10	0.10	0.10	n/a	0.10	0.10	0.10	46	0	100%
Magnesium	mg/kg ww	0.40	281	378	324	331	370	364	347	46	46	0%
Manganese	mg/kg ww	0.010	0.11	0.76	0.28	0.32	0.57	0.44	0.31	46	46	0%
Mercury	mg/kg ww	0.0010	0.051	0.32	0.14	0.16	0.25	0.24	0.18	46	46	0%
Methylmercury	µg/kg ww	1.0	25	333	104	121	221	197	129	46	46	0%
Molybdenum	mg/kg ww	0.0040	0.0040	0.0045	0.0040	n/a	0.0040	0.0040	0.0040	46	2	96%
Nickel	mg/kg ww	0.040	0.040	0.046	0.040	n/a	0.040	0.040	0.040	46	1	98%
Phosphorus	mg/kg ww	2.0	2130	3380	2554	2627	3193	3045	2675	46	46	0%
Potassium	mg/kg ww	4.0	3610	5060	4370	4447	4860	4720	4548	46	46	0%
Rubidium	mg/kg ww	0.010	2.7	9.2	5.5	6.0	8.4	8.0	6.5	46	46	0%
Selenium	mg/kg ww	0.010	0.14	0.43	0.25	0.27	0.36	0.34	0.31	46	46	0%
Sodium	mg/kg ww	4.0	224	399	283	292	336	315	302	46	46	0%
Strontium	mg/kg ww	0.010	0.023	0.59	0.15	0.19	0.43	0.26	0.19	46	46	0%
Tellurium	mg/kg ww	0.0040	0.0040	0.0040	0.0040	n/a	0.0040	0.0040	0.0040	46	0	100%
Thallium	mg/kg ww	0.00040	0.00040	0.0036	0.0017	0.0019	0.0034	0.0030	0.0021	46	44	4%
Tin	mg/kg ww	0.020	0.020	0.049	0.027	0.029	0.044	0.039	0.032	46	26	43%
Uranium	mg/kg ww	0.00040	0.00040	0.0012	0.00043	n/a	0.00041	0.00040	0.00040	46	3	93%
Vanadium	mg/kg ww	0.020	0.020	0.051	0.021	n/a	0.020	0.020	0.020	46	1	98%
Zinc	mg/kg ww	0.10	2.6	5.7	3.75	3.9	5.1	4.9	4.3	46	46	0%
Zirconium	mg/kg ww	0.040	0.040	0.12	0.044	n/a	0.068	0.051	0.040	46	6	87%

Table A1-9: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
Walleye (28-52 cm)												
Aluminum	mg/kg ww	0.40	0.40	2.6	1.0	1.2	2.0	1.8	1.4	30	27	10%
Antimony	mg/kg ww	0.0020	0.0020	0.012	0.0025	n/a	0.0050	0.0020	0.0020	30	2	93%
Arsenic	mg/kg ww	0.0040	0.031	0.25	0.084	0.10	0.18	0.14	0.10	30	30	0%
Barium	mg/kg ww	0.010	0.010	0.072	0.022	0.026	0.046	0.039	0.025	30	26	13%
Beryllium	mg/kg ww	0.0020	0.0020	0.0020	0.0020	n/a	0.0020	0.0020	0.0020	30	0	100%
Bismuth	mg/kg ww	0.0020	0.0020	0.0028	0.0020	n/a	0.0020	0.0020	0.0020	30	1	97%
Boron	mg/kg ww	0.20	0.20	0.20	0.20	n/a	0.20	0.20	0.20	30	0	100%
Cadmium	mg/kg ww	0.0010	0.0010	0.0014	0.0010	n/a	0.0010	0.0010	0.0010	30	3	90%
Calcium	mg/kg ww	4.0	92	409	191	219	339	316	261	30	30	0%
Cesium	mg/kg ww	0.0010	0.0072	0.11	0.029	0.034	0.044	0.040	0.031	30	30	0%
Chromium	mg/kg ww	0.010	0.010	0.030	0.013	0.014	0.027	0.019	0.012	30	14	53%
Cobalt	mg/kg ww	0.0040	0.0040	0.0040	0.0040	n/a	0.0040	0.0040	0.0040	30	0	100%
Copper	mg/kg ww	0.020	0.11	0.24	0.17	0.18	0.22	0.21	0.19	30	30	0%
Iron	mg/kg ww	0.60	1.6	5.1	2.8	3.1	3.8	3.7	3.3	30	30	0%
Lead	mg/kg ww	0.0040	0.0040	0.048	0.0084	0.012	0.036	0.017	0.0042	30	8	73%
Lithium	mg/kg ww	0.10	0.10	0.10	0.10	n/a	0.10	0.10	0.10	30	0	100%
Magnesium	mg/kg ww	0.40	257	342	305	313	339	336	327	30	30	0%
Manganese	mg/kg ww	0.010	0.069	0.19	0.12	0.13	0.17	0.15	0.13	30	30	0%
Mercury	mg/kg ww	0.0010	0.21	0.86	0.40	0.46	0.78	0.64	0.43	30	30	0%
Methylmercury	µg/kg ww	1.0	87	498	256	289	437	394	323	30	30	0%
Molybdenum	mg/kg ww	0.0040	0.0040	0.0040	0.0040	n/a	0.0040	0.0040	0.0040	30	0	100%
Nickel	mg/kg ww	0.040	0.040	0.040	0.040	n/a	0.040	0.040	0.040	30	0	100%
Phosphorus	mg/kg ww	2.0	2060	2940	2486	2548	2797	2762	2615	30	30	0%
Potassium	mg/kg ww	4.0	3920	4990	4558	4641	4816	4810	4758	30	30	0%
Rubidium	mg/kg ww	0.010	5.8	25	14	15	21	20	16	30	30	0%
Selenium	mg/kg ww	0.010	0.16	0.25	0.20	0.21	0.24	0.24	0.21	30	30	0%
Sodium	mg/kg ww	4.0	199	303	248	256	294	269	262	30	30	0%
Strontium	mg/kg ww	0.010	0.014	0.13	0.057	0.069	0.12	0.12	0.084	30	30	0%
Tellurium	mg/kg ww	0.0040	0.0040	0.0040	0.0040	n/a	0.0040	0.0040	0.0040	30	0	100%
Thallium	mg/kg ww	0.00040	0.0011	0.0064	0.0035	0.0039	0.0053	0.0050	0.0044	30	30	0%
Tin	mg/kg ww	0.020	0.020	0.035	0.022	0.024	0.034	0.029	0.021	30	10	67%
Uranium	mg/kg ww	0.00040	0.00040	0.00040	0.00040	n/a	0.00040	0.00040	0.00040	30	0	100%
Vanadium	mg/kg ww	0.020	0.020	0.020	0.020	n/a	0.020	0.020	0.020	30	0	100%
Zinc	mg/kg ww	0.10	3.1	4.4	3.6	3.7	4.1	4.0	3.8	30	30	0%
Zirconium	mg/kg ww	0.040	0.040	0.052	0.040	n/a	0.040	0.040	0.040	30	1	97%

Table A1-9: Summary Statistics of Baseline Fish Tissue Quality Concentrations For Human Health

Parameters	Units	RDL	Minimum	Maximum	Mean ^(a)	95% UCLM ^(b)	95th Percentile ^(a)	90th Percentile ^(a)	75th Percentile ^(a)	Sample Count	Detection Count	Percent Non-Detect
Northern Pike (40-70 cm)												
Aluminum	mg/kg ww	0.40	0.40	8.1	1.4	1.9	4.7	3.1	1.6	52	41	21%
Antimony	mg/kg ww	0.0020	0.0020	0.0020	0.0020	n/a	0.0020	0.0020	0.0020	52	0	100%
Arsenic	mg/kg ww	0.0040	0.019	0.70	0.16	0.20	0.38	0.35	0.20	52	52	0%
Barium	mg/kg ww	0.010	0.010	0.17	0.05	0.062	0.12	0.089	0.073	52	51	2%
Beryllium	mg/kg ww	0.0020	0.0020	0.0020	0.0020	n/a	0.0020	0.0020	0.0020	52	0	100%
Bismuth	mg/kg ww	0.0020	0.0020	0.0036	0.0021	n/a	0.0028	0.0023	0.0020	52	7	87%
Boron	mg/kg ww	0.20	0.20	0.20	0.20	n/a	0.20	0.20	0.20	52	0	100%
Cadmium	mg/kg ww	0.0010	0.0010	0.0026	0.0010	n/a	0.0010	0.0010	0.0010	52	3	94%
Calcium	mg/kg ww	4.0	136	1460	606	685	1273	1099	819	52	52	0%
Cesium	mg/kg ww	0.0010	0.0076	0.090	0.027	0.031	0.052	0.047	0.035	52	52	0%
Chromium	mg/kg ww	0.010	0.010	0.10	0.015	0.016	0.028	0.021	0.012	52	18	65%
Cobalt	mg/kg ww	0.0040	0.0040	0.0064	0.0041	n/a	0.0042	0.0040	0.0040	52	5	90%
Copper	mg/kg ww	0.020	0.064	0.22	0.14	0.15	0.20	0.19	0.16	52	52	0%
Iron	mg/kg ww	0.60	0.85	11	3.2	3.6	6.9	5.7	3.6	52	52	0%
Lead	mg/kg ww	0.0040	0.0040	0.014	0.0048	0.0053	0.0085	0.0067	0.0040	52	11	79%
Lithium	mg/kg ww	0.10	0.10	0.10	0.10	n/a	0.10	0.10	0.10	52	0	100%
Magnesium	mg/kg ww	0.40	141	486	325	336	375	360	348	52	52	0%
Manganese	mg/kg ww	0.010	0.12	1.5	0.52	0.59	0.99	0.94	0.66	52	52	0%
Mercury	mg/kg ww	0.0010	0.065	0.87	0.34	0.38	0.64	0.57	0.40	52	52	0%
Methylmercury	µg/kg ww	1.0	64	576	237	264	411	401	319	52	52	0%
Molybdenum	mg/kg ww	0.0040	0.0040	0.0040	0.0040	n/a	0.0040	0.0040	0.0040	52	0	100%
Nickel	mg/kg ww	0.040	0.040	0.040	0.040	n/a	0.040	0.040	0.040	52	0	100%
Phosphorus	mg/kg ww	2.0	1140	3420	2554	2629	2994	2887	2695	52	52	0%
Potassium	mg/kg ww	4.0	2030	4950	4201	4303	4669	4599	4373	52	52	0%
Rubidium	mg/kg ww	0.010	3.4	13	6.9	7.4	12	11	7.6	52	52	0%
Selenium	mg/kg ww	0.010	0.072	0.21	0.16	0.17	0.20	0.19	0.18	52	52	0%
Sodium	mg/kg ww	4.0	124	446	301	314	399	380	321	52	52	0%
Strontium	mg/kg ww	0.010	0.036	0.81	0.29	0.34	0.63	0.55	0.43	52	52	0%
Tellurium	mg/kg ww	0.0040	0.0040	0.0040	0.0040	n/a	0.0040	0.0040	0.0040	52	0	100%
Thallium	mg/kg ww	0.00040	0.00082	0.015	0.0037	0.0044	0.0089	0.0048	0.0042	52	52	0%
Tin	mg/kg ww	0.020	0.020	0.078	0.029	0.032	0.053	0.043	0.032	52	32	38%
Uranium	mg/kg ww	0.00040	0.00040	0.00047	0.00040	n/a	0.00042	0.00040	0.00040	52	4	92%
Vanadium	mg/kg ww	0.020	0.020	0.020	0.020	n/a	0.020	0.020	0.020	52	1	98%
Zinc	mg/kg ww	0.10	2.0	8.8	4.7	5.0	6.7	6.1	5.19	52	52	0%
Zirconium	mg/kg ww	0.040	0.040	0.065	0.041	n/a	0.040	0.040	0.040	52	2	96%

Notes:

% = percent; ">" = greater than; mg/kg = milligrams per kilogram; n/a = not available; RDL = reported detection limit; ww = wet weight; UCLM = upper confidence limit of the mean; µg/kg = micrograms per kilogram.

(a) Statistics were calculated considering a non-detected value was equal to the full RDL.

(b) If the dataset contained an insufficient number of samples (i.e., <10) or a high percentage of non-detect concentrations (i.e., >80%), a 95% UCLM was not considered reliable and a value of "n/a" was assigned.

(c) It is noted that some of the summary statistics presented herein were not required for use in the Human Health and Ecological Risk Assessment, but are provided for completeness.

Table A1-10: Summary of Bioaccumulation Factors for Use in HHERA Modelling														
Parameters	EPC/Selected Statistic								Site-Specific BAFs					
	Soil ^(a)	Traditional Plants ^(b)	Berries ^(c)	Northern Pike ^(d)	Walleye ^(e)	Forage Fish ^(f,g)	Wild Rice ^(h)	Surface Water ⁽ⁱ⁾	Soil-Traditional Plants	Soil-Berries	Surface Water Northern Pike	Surface Water Walleye	Surface Water Forage Fish	Surface Water Wild Rice
	mg/kg dw	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/L	kg-soil / kg-plant	kg-soil / kg-plant	L-water/kg-fish	L-water/kg-fish	L-water/kg-fish	L-water/kg-rice
Human Health														
Sample Preparation														
pH, IVBA Initial	1.51E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
pH, IVBA final	1.55E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Weight, extraction (dry)	1.02E+00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Final volume	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Metals														
Aluminum	7.54E+03	5.72E+01	5.24E+01	1.87E+00	1.20E+00	2.36E+00	9.40E+00	1.52E-01	7.59E-03	6.95E-03	1.23E+01	7.84E+00	1.55E+01	6.17E+01
Antimony	4.20E-01	4.12E-03	1.72E-02	n/a	n/a	n/a	n/a	<0.0020	3.05E-04	9.81E-03	4.10E-02	NC	NC	NC
Arsenic	8.11E+00	5.77E-02	2.63E-02	1.95E-01	1.00E-01	1.26E-01	8.24E-02	4.03E-03	7.11E-03	3.24E-03	4.84E+01	2.48E+01	3.13E+01	2.05E+01
Barium	4.12E+01	2.88E+01	6.49E+00	6.24E-02	2.61E-02	3.89E-02	1.91E-01	N/A	7.01E-01	1.58E-01	NC	NC	NC	NC
Beryllium	2.03E-01	3.40E-03	<0.0020	n/a	n/a	n/a	<0.0020	1.26E-05	1.67E-02	NC	NC	NC	NC	NC
Bismuth	n/a	3.83E-03	<0.0020	n/a	n/a	n/a	<0.0020	N/A	NC	NC	NC	NC	NC	NC
Boron	n/a	7.06E+00	7.06E+00	n/a	n/a	n/a	1.87E+00	5.69E-03	NC	NC	NC	NC	NC	3.29E+02
Cadmium	1.63E-01	1.22E+00	5.50E-02	n/a	n/a	n/a	n/a	9.75E-06	7.48E+00	3.37E-01	NC	NC	NC	0.00E+00
Calcium	2.56E+03	4.00E+03	2.13E+03	6.85E+02	2.19E+02	4.08E+02	1.53E+02	1.16E+01	1.56E+00	8.31E-01	5.90E+01	1.88E+01	3.49E+01	1.32E+01
Chromium	1.46E+01	1.98E-01	4.10E-02	1.56E-02	1.42E-02	1.62E-02	<0.040	5.28E-04	1.35E-02	2.80E-03	2.96E+01	2.69E+01	3.07E+01	NC
Cobalt	4.98E+00	1.16E-01	6.53E-02	n/a	n/a	5.36E-03	1.64E-02	1.50E-04	2.33E-02	1.31E-02	NC	NC	3.57E+01	1.09E+02
Copper	7.57E+00	6.62E+00	1.81E+00	1.52E-01	1.79E-01	2.24E-01	2.67E+00	1.10E-03	8.74E-01	2.39E-01	1.39E+02	1.63E+02	2.04E+02	2.44E+03
Iron	1.00E+04	7.79E+01	1.65E+01	3.59E+00	3.05E+00	6.25E+00	1.93E+01	3.47E-01	7.78E-03	1.65E-03	1.03E+01	8.79E+00	1.80E+01	5.56E+01
Lead	7.80E+00	7.25E-02	1.00E-02	5.26E-03	1.21E-02	n/a	<0.010	2.14E-04	9.30E-03	1.28E-03	2.46E+01	5.65E+01	NC	NC
Lithium	8.85E+00	n/a	<0.10	n/a	n/a	n/a	<0.10	N/A	NC	NC	NC	NC	NC	NC
Magnesium	2.57E+03	1.03E+03	8.10E+02	3.36E+02	3.15E+02	3.31E+02	7.64E+02	3.13E+00	4.00E-01	3.16E-01	1.07E+02	1.00E+02	1.06E+02	2.44E+02
Manganese	4.19E+02	2.18E+02	6.90E+01	5.89E-01	1.25E-01	3.16E-01	1.27E+01	2.29E-02	5.20E-01	1.65E-01	2.57E+01	5.45E+00	1.38E+01	5.54E+02
Mercury	4.62E-02	1.73E-02	<0.0010	3.81E-01	4.57E-01	1.60E-01	2.10E-03	1.45E-06	3.74E-01	NC	2.63E+05	3.15E+05	1.10E+05	1.45E+03
Molybdenum	5.18E-01	3.99E-01	1.42E-01	n/a	n/a	n/a	1.59E-01	2.23E-04	7.70E-01	2.74E-01	NC	NC	NC	7.12E+02
Nickel	7.90E+00	4.00E-01	4.66E-01	n/a	n/a	n/a	1.43E-01	8.73E-04	5.07E-02	5.90E-02	NC	NC	NC	1.64E+02
Phosphorus	3.84E+02	1.09E+03	1.02E+03	2.63E+03	2.55E+03	2.63E+03	2.60E+03	N/A	2.84E+00	2.65E+00	NC	NC	NC	NC
Potassium	1.03E+03	2.81E+03	6.13E+03	4.30E+03	4.64E+03	4.45E+03	1.92E+03	1.08E+00	2.72E+00	5.93E+00	4.00E+03	4.31E+03	4.13E+03	1.78E+03
Selenium	2.49E-01	3.28E-02	<0.02	1.66E-01	2.07E-01	2.72E-01	<0.020	1.08E-04	1.32E-01	NC	1.54E+03	1.92E+03	2.52E+03	1.85E+01
Silver	1.27E-01	3.28E-02	<0.001	N/A	N/A	N/A	<0.0010	1.54E-05	2.58E-01	NC	NC	NC	NC	NC
Sodium	9.74E+01	5.56E-02	8.10E+00	3.14E+02	2.56E+02	2.92E+02	1.41E+01	N/A	5.71E-04	8.31E-02	NC	NC	NC	NC
Strontium	1.61E+01	1.42E+01	7.98E+00	3.38E-01	6.90E-02	1.87E-01	3.11E-01	N/A	8.83E-01	4.96E-01	NC	NC	NC	NC
Sulfur	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Thallium	9.13E-02	5.29E-03	2.44E-03	4.36E-03	3.92E-03	1.91E-03	<0.00040	5.28E-06	5.79E-02	2.67E-02	8.27E+02	7.43E+02	3.62E+02	NC
Tin	n/a	2.61E-01	1.53E+00	3.15E-02	2.40E-02	2.89E-02	<0.020	N/A	NC	NC	NC	NC	NC	NC
Titanium	5.58E+02	1.02E+01	7.03E-01	N/A	N/A	N/A	6.80E-01	N/A	1.83E-02	1.26E-03	NC	NC	NC	NC
Tungsten	n/a	N/A	N/A	N/A	N/A	N/A	N/A	6.80E-01	NC	NC	NC	NC	NC	NC
Uranium	5.31E-01	5.04E-03	6.40E-04	n/a	n/a	n/a	1.02E-03	1.29E-04	9.49E-03	1.21E-03	NC	NC	NC	7.91E+00
Vanadium	2.20E+01	1.13E-01	2.60E-02	n/a	n/a	n/a	2.10E-02	6.86E-04	5.14E-03	1.18E-03	NC	NC	NC	3.06E+01
Zinc	2.61E+01	4.81E+01	8.00E+00	4.97E+00	3.67E+00	3.94E+00	2.76E+01	2.12E-03	1.84E+00	3.07E-01	2.35E+03	1.73E+03	1.86E+03	1.30E+04
Zirconium	1.78E+00	n/a	<0.040	n/a	n/a	n/a	<0.040	6.27E-04	NC	NC	NC	NC	NC	NC
Metals														
Arsenic, IVBA (%)	2.79E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Arsenic, IVBA (leachate)	1.86E-02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Speciated Metals														
Arsenate [As V]	N/A	8.10E-03	6.70E-03	N/A	N/A	N/A	2.28E-02	N/A	NC	NC	NC	NC	NC	NC
Arsenite [As III]	N/A	4.66E-03	1.14E-02	N/A	N/A	N/A	1.96E-02	N/A	NC	NC	NC	NC	NC	NC
Arsenobetaine [AsB], (as As)	N/A	n/a	<0.0010	N/A	N/A	N/A	<0.0010	N/A	NC	NC	NC	NC	NC	NC
Arsenocholine [AsC], (as As)	N/A	n/a	<0.0010	N/A	N/A	N/A	<0.0010	N/A	NC	NC	NC	NC	NC	NC
Dimethylarsinic acid [DMA], (as As)	N/A	n/a	1.30E-03	N/A	N/A	N/A	9.60E-03	N/A	NC	NC	NC	NC	NC	NC
Monomethylarsinic acid [MMA], (as As)	N/A	n/a	3.90E-03	N/A	N/A	N/A	<0.0010	N/A	NC	NC	NC	NC	NC	NC

Table A1-10: Summary of Bioaccumulation Factors for Use in HHERA Modelling														
Parameters	EPC/Selected Statistic								Site-Specific BAFs					
	Soil ^(a)	Traditional Plants ^(b)	Berries ^(c)	Northern Pike ^(d)	Walleye ^(e)	Forage Fish ^(f,g)	Wild Rice ^(h)	Surface Water ⁽ⁱ⁾	Soil-Traditional Plants	Soil-Berries	Surface Water Northern Pike	Surface Water Walleye	Surface Water Forage Fish	Surface Water Wild Rice
	mg/kg dw	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/L	kg-soil / kg-plant	kg-soil / kg-plant	L-water/kg-fish	L-water/kg-fish	L-water/kg-fish	L-water/kg-rice
Polycyclic Aromatic Hydrocarbons (PAHs)														
Acenaphthene	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Acenaphthylene	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Acridine	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Anthracene	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Benz(a)anthracene	n/a	n/a	3.40E-02	N/A	N/A	N/A	<0.020	N/A	NC	NC	NC	NC	NC	NC
Benz(a)pyrene	n/a	n/a	2.80E-02	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Benz(b+h)fluoranthene	n/a	n/a	4.50E-02	N/A	N/A	N/A	2.80E-02	N/A	NC	NC	NC	NC	NC	NC
Benz(b+j+k)fluoranthene	n/a	n/a	9.10E-02	N/A	N/A	N/A	4.70E-02	N/A	NC	NC	NC	NC	NC	NC
Benz(g,h,i)perylene	n/a	n/a	3.70E-02	N/A	N/A	N/A	1.90E-02	N/A	NC	NC	NC	NC	NC	NC
Benz(k)fluoranthene	n/a	n/a	4.60E-02	N/A	N/A	N/A	1.90E-02	N/A	NC	NC	NC	NC	NC	NC
Chrysene	n/a	n/a	4.30E-02	N/A	N/A	N/A	<0.030	N/A	NC	NC	NC	NC	NC	NC
Dibenz(a,h)anthracene	n/a	n/a	3.30E-02	N/A	N/A	N/A	1.30E-02	N/A	NC	NC	NC	NC	NC	NC
Fluoranthene	n/a	n/a	3.70E-02	N/A	N/A	N/A	1.30E-02	N/A	NC	NC	NC	NC	NC	NC
Fluorene	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Indeno(1,2,3-c,d)pyrene	n/a	n/a	4.10E-02	N/A	N/A	N/A	2.00E-02	N/A	NC	NC	NC	NC	NC	NC
Methylnaphthalene, 1+2-	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Methylnaphthalene, 1-	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Methylnaphthalene, 2-	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Naphthalene	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Perylene	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Phenanthrene	n/a	n/a	<0.010	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Pyrene	n/a	n/a	<0.04	N/A	N/A	N/A	<0.010	N/A	NC	NC	NC	NC	NC	NC
Quinoline	n/a	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	NC	NC	NC	NC	NC
Ecological Health														
Sample Preparation														
pH, IVBA initial	1.53E+00	N/A	N/A	N/A	N/A	0.00E+00	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
pH, IVBA final	1.57E+00	N/A	N/A	N/A	N/A	0.00E+00	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Weight, extraction (dry)	1.09E+00	N/A	N/A	N/A	N/A	0.00E+00	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Final volume	1.00E+02	N/A	N/A	N/A	N/A	0.00E+00	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Physical Tests														
Moisture ¹	N/A	N/A	86%	N/A	N/A	Variable ¹	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aluminum	1.26E+04	3.95E+01	2.80E+01	N/A	N/A	2.65E+01	N/A	2.50E-01	N/A	1.58E-02	N/A	N/A	4.28E+02	N/A
Antimony	3.30E-01	4.12E-03	8.08E-03	N/A	N/A	3.33E-03	N/A	4.50E-04	N/A	1.74E-01	N/A	N/A	3.34E+01	N/A
Arsenic	1.46E+01	9.51E-02	2.37E-02	N/A	N/A	3.05E-01	N/A	1.188E-02	N/A	1.15E-02	N/A	N/A	1.18E+02	N/A
Barium	5.17E+01	3.53E+01	4.91E+00	N/A	N/A	4.10E+00	N/A	N/A	N/A	6.76E-01	N/A	N/A	NC	N/A
Beryllium	2.60E-01	4.56E-03	2.00E-03	N/A	N/A	2.00E-03	N/A	3.20E-05	N/A	5.47E-02	N/A	N/A	2.82E+02	N/A
Bismuth	2.00E-01	5.54E-03	2.00E-03	N/A	N/A	2.00E-03	N/A	N/A	N/A	7.11E-02	N/A	N/A	NC	N/A
Boron	5.00E+00	8.63E+00	5.54E+00	N/A	N/A	2.00E-01	N/A	8.00E-03	N/A	7.87E+00	N/A	N/A	1.13E+02	N/A
Cadmium	1.67E-01	3.68E-01	2.49E-02	N/A	N/A	2.04E-02	N/A	2.07E-05	N/A	1.06E+00	N/A	N/A	4.45E+03	N/A
Calcium	3.31E+03	6.30E+03	1.35E+03	N/A	N/A	1.27E+04	N/A	1.53E+01	N/A	2.89E+00	N/A	N/A	3.49E+03	N/A
Chromium	2.66E+01	1.85E-01	4.04E-02	N/A	N/A	7.19E-02	N/A	1.06E-03	N/A	1.08E-02	N/A	N/A	2.75E+02	N/A
Cobalt	7.03E+00	1.00E-01	5.74E-02	N/A	N/A	2.28E-01	N/A	2.49E-04	N/A	5.81E-02	N/A	N/A	4.13E+03	N/A
Copper	9.47E+00	1.04E+01	1.68E+00	N/A	N/A	1.24E+00	N/A	1.72E-03	N/A	1.26E+00	N/A	N/A	3.04E+03	N/A
Iron	1.54E+04	7.84E+01	1.60E+01	N/A	N/A	7.44E+01	N/A	6.10E-01	N/A	7.37E-03	N/A	N/A	4.93E+02	N/A
Lead	9.68E+00	9.24E-02	1.00E-02	N/A	N/A	2.89E-02	N/A	2.12E-04	N/A	7.35E-03	N/A	N/A	5.52E+02	N/A
Lithium	1.22E+01	1.00E-01	1.00E-01	N/A	N/A	1.00E-01	N/A	N/A	N/A	5.83E-02	N/A	N/A	NC	N/A
Magnesium	4.19E+03	1.49E+03	5.93E+02	N/A	N/A	4.87E+02	N/A	4.25E+00	N/A	1.01E+00	N/A	N/A	4.63E+02	N/A
Manganese	3.05E+02	3.72E+02	5.90E+01	N/A	N/A	2.43E+01	N/A	5.37E-02	N/A	1.38E+00	N/A	N/A	1.83E+03	N/A
Mercury	4.76E-02	2.27E-02	1.00E-03	N/A	N/A	1.28E-01	N/A	3.41E-06	N/A	1.49E-01	N/A	N/A	1.69E+05	N/A
Molybdenum	7.80E-01	4.09E-01	1.35E-01	N/A	N/A	4.78E-02	N/A	3.31E-04	N/A	1.23E+00	N/A	N/A	6.51E+02	N/A
Nickel	1.31E+01	5.89E-01	3.28E-01	N/A	N/A	4.80E-02	N/A	1.69E-03	N/A	1.78E-01	N/A	N/A	1.19E+02	N/A
Phosphorus	6.13E+02	9.15E+02	9.49E+02	N/A	N/A	9.13E+03	N/A	N/A	N/A	1.10E+01	N/A	N/A	NC	N/A
Potassium	1.87E+03	3.78E+03	4.42E+03	N/A	N/A	3.07E+03	N/A	1.42E+00	N/A	1.68E+01	N/A	N/A	9.79E+03	N/A
Selenium	2.20E-01	3.94E-02	2.00E-02	N/A	N/A	4.28E-01	N/A	2.29E-04	N/A	6.47E-01	N/A	N/A	7.57E+03	N/A
Silver	1.40E-01	9.89E-02	1.00E-03	N/A	N/A	N/A	N/A	2.66E-05	N/A	5.08E-02	N/A	N/A	NC	N/A
Sodium	1.46E+02	1.05E+01	6.84E+00	N/A	N/A	1.10E+03	N/A	N/A	N/A	3.33E-01	N/A	N/A	NC	N/A
Strontium	2.12E+01	2.36E+01	5.74E+00	N/A	N/A	1.23E+01	N/A	N/A	N/A	1.93E+00	N/A	N/A	NC	N/A
Sulfur	1.00E+03	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Thallium	1.34E-01	2.96E-03	2.39E-03	N/A	N/A	6.42E-03	N/A	7.00E-06	N/A	1.27E-01	N/A	N/A	4.14E+03	N/A
Tin	2.00E+00	4.48E-01	1.08E+00	N/A	N/A	1.41E-01	N/A	N/A	N/A	3.85E+00	N/A	N/A	NC	N/A
Titanium	7.60E+02	3.10E+00	3.41E-01	N/A	N/A	N/A	N/A	N/A	N/A	3.19E-03	N/A	N/A	NC	N/A
Tungsten	5.00E-01	N/A	N/A	N/A	N/A	N/A	N/A	5.44E-05	N/A	NC	N/A	N/A	NC	N/A
Uranium	6.78E-01	2.47E-03	4.96E-04	N/A	N/A	4.28E-03	N/A	2.85E-04	N/A	5.20E-03	N/A	N/A	6.27E+01	N/A
Vanadium	3.32E+01	8.06E-02	2.24E-02	N/A	N/A	1.39E-01	N/A	1.01E-03	N/A	4.80E-03	N/A	N/A	5.57E+02	N/A
Zinc	3.79E+01	7.85E+01	4.58E+00	N/A	N/A	9.44E+01	N/A	2.21E-03	N/A	8.59E-01	N/A	N/A	1.73E+05	N/A
Zirconium	2.30E+00	1.32E-01	4.00E-02	N/A	N/A	4.00E-02	N/A	1.00E-03	N/A	1.24E-01	N/A	N/A	1.80E+02	N/A

Table A1-10: Summary of Bioaccumulation Factors for Use in HHERA Modelling

Parameters	EPC/Selected Statistic								Site-Specific BAFs					
	Soil ^(a)	Traditional Plants ^(b)	Berries ^(c)	Northern Pike ^(d)	Walleye ^(e)	Forage Fish ^(f,g)	Wild Rice ^(h)	Surface Water ⁽ⁱ⁾	Soil-Traditional Plants	Soil-Berries	Surface Water Northern Pike	Surface Water Walleye	Surface Water Forage Fish	Surface Water Wild Rice
	mg/kg dw	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/kg ww	mg/L	kg-soil / kg-plant	kg-soil / kg-plant	L-water/kg-fish	L-water/kg-fish	L-water/kg-fish	L-water/kg-rice
Metals														
Arsenic, IVBA (%)	3.42E+01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Arsenic, IVBA (leachate)	5.04E-02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Speciated Metals														
Arsenate [As V]	N/A	9.96E-03	5.80E-03	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Arsenite [As III]	N/A	7.20E-03	6.66E-03	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Arsenobetaine [AsB], (as As)	N/A	3.54E-03	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Arsenocholine [AsC], (as As)	N/A	1.08E-03	1.00E-03	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Dimethylarsinic acid [DMA], (as As)	N/A	1.62E-03	1.18E-03	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Monomethylarsonic acid [MMA], (as As)	N/A	1.00E-03	2.70E-03	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Polycyclic Aromatic Hydrocarbons (PAHs)														
Acenaphthene	5.00E-03	1.30E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.42E+01	N/A	N/A	NC	N/A
Acenaphthylene	5.00E-03	1.08E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.42E+01	N/A	N/A	NC	N/A
Acridine	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Anthracene	4.00E-03	1.10E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.78E+01	N/A	N/A	NC	N/A
Benzo(a)anthracene	1.00E-02	1.68E-02	2.44E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.74E+01	N/A	N/A	NC	N/A
Benzo(a)pyrene	1.00E-02	1.27E-02	2.08E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.48E+01	N/A	N/A	NC	N/A
Benzo(b)fluoranthene	1.00E-02	1.61E-02	3.10E-02	N/A	N/A	N/A	N/A	N/A	N/A	2.20E+01	N/A	N/A	NC	N/A
Benzo(b+h)fluoranthene	1.50E-02	3.41E-02	6.06E-02	N/A	N/A	N/A	N/A	N/A	N/A	2.87E+01	N/A	N/A	NC	N/A
Benzo(g,h,i)perylene	1.00E-02	1.18E-02	2.62E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.86E+01	N/A	N/A	NC	N/A
Benzo(k)fluoranthene	1.00E-02	1.80E-02	3.16E-02	N/A	N/A	N/A	N/A	N/A	N/A	2.25E+01	N/A	N/A	NC	N/A
Chrysene	1.00E-02	2.27E-02	2.98E-02	N/A	N/A	N/A	N/A	N/A	N/A	2.12E+01	N/A	N/A	NC	N/A
Dibenz(a,h)anthracene	5.00E-03	1.17E-02	2.38E-02	N/A	N/A	N/A	N/A	N/A	N/A	3.39E+01	N/A	N/A	NC	N/A
Fluoranthene	1.00E-02	1.95E-02	2.62E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.86E+01	N/A	N/A	NC	N/A
Fluorene	1.00E-02	2.10E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	7.11E+00	N/A	N/A	NC	N/A
Indeno(1,2,3-c,d)pyrene	1.00E-02	1.48E-02	2.86E-02	N/A	N/A	N/A	N/A	N/A	N/A	2.03E+01	N/A	N/A	NC	N/A
Methylnaphthalene, 1+2-	1.50E-02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Methylnaphthalene, 1-	1.00E-02	1.00E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	7.11E+00	N/A	N/A	NC	N/A
Methylnaphthalene, 2-	1.00E-02	1.00E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	7.11E+00	N/A	N/A	NC	N/A
Naphthalene	1.00E-02	1.00E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	7.11E+00	N/A	N/A	NC	N/A
Perylene	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A
Phenanthrene	1.00E-02	1.10E-02	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	7.11E+00	N/A	N/A	NC	N/A
Pyrene	1.00E-02	5.10E-02	2.80E-02	N/A	N/A	N/A	N/A	N/A	N/A	1.99E+01	N/A	N/A	NC	N/A
Quinoline	1.00E-02	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NC	N/A	N/A	NC	N/A

Notes:

As= Arsenic; As V= Arsenate; As III= Arsenite; AsB = Arsenobetaine; AsC = Arsenocholine; BAF = bioaccumulation factor; dw = dry weight; DMA = dimethylarsinic acid; EPC = exposure point concentration; HHERA = Human Health and Ecological Risk Assessment; IVBA = in vitro bioaccessibility assay; kg = kilogram; L = litre; mg/kg = milligram per kilogram; mg/L = milligram per litre; MMA = monomethylarsonic acid; n/a = not available; N/A = not applicable; NC = not calculated; PAHs = polycyclic aromatic hydrocarbons; ww = wet weight

- The selected soil EPC is the 95% UCLM for human health and the 90th percentile for ecological health.
- The selected statistic used for traditional plants is the 95% UCLM for human health and the 90th percentile for ecological health.
- The selected statistic used for berries is the maximum for human health and the 90th percentile for ecological health.
- The selected statistic used for northern pike is the 95% UCLM. Samples of fish between 40-70 cm were considered relevant to human health.
- The selected statistic used for walleye is the 95% UCLM. Samples of fish between 28-52 cm were considered relevant to human health.
- The selected statistic used for forage fish for human health is the 95% UCLM and the 90th percentile for ecological health. Samples of fish greater than 25 cm were considered relevant to human health. Composite samples of small bodied fish less than 25 cm were used for ecological health.
- The forage fish concentrations presented for ecological health are the wet weight concentrations corresponding to the highest 90th percentile dry weight concentrations
- The EPC for wild rice is the result of the analysis of the single collected composite sample from the community.
- The EPC for surface water used in the BAF calculation was the modelled baseline water quality from the Water Quality discipline. The statistics used were the annual average for human health and the maximum monthly average for ecological health.
- The selected media moisture content for ecological health is a 90th percentile for berries and the average for forage fish.
- The moisture content used to convert to dry weight varies based on sampling year. The specific moisture contents can be found in Table 1-8.
- The BAF presented for surface water-wild rice for selenium is calculated using the RDL reported in the FNFNES supplemental data (0.002 mg/kg) (Chan et al 2021).

The BAFs for ecological health have been converted to dry weight using the selected site-specific moisture content.

For tissue samples with no detects, a literature-based BAF was used in the Human Health and Ecological Risk Assessment rather than a site-specific BAF.

Sub-Attachment A2
Soil and Traditional Food Sampling
Program

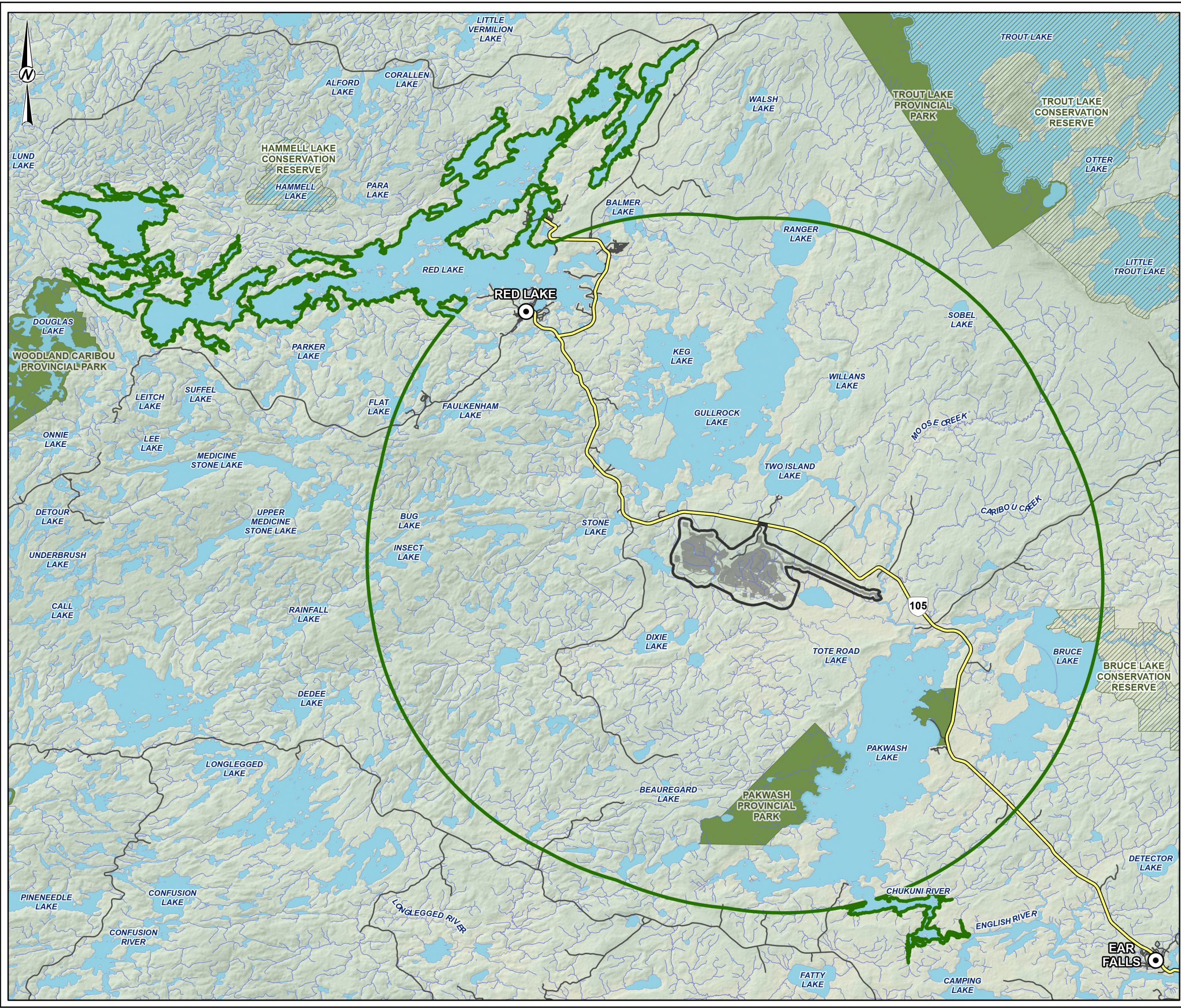


1 INTRODUCTION

Great Bear Resources Ltd. (Great Bear Resources), a wholly owned subsidiary of Kinross Gold Corp., is planning to develop, operate and eventually reclaim a new gold mine on the Great Bear Property (the Property) located east of Red Lake, Ontario. Great Bear Resources, on behalf of WSP Canada Inc. (WSP), conducted a Soil and Traditional Foods sampling program to support the human health risk assessment (HHRA) component of the Human Health and Ecological Risk Assessment (HHERA) for the Great Bear Gold Project (the Project), which is a proposed underground and open pit mine and process plant with related facilities. The purpose of the field program was to determine baseline concentrations of metals and polycyclic aromatic hydrocarbons (PAHs) in soil, vegetation, and wild game collected within the HHERA Local Study Area (LSA) and Regional Study Area (RSA), as shown on Figure A2-1 and Figure A2-2, respectively. The Project Area shown corresponds to the mine site footprint.

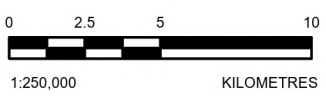
Co-located soil and vegetation samples, as well as wild game samples, were collected for the Project to characterize baseline conditions in the HHRA. Vegetation and wild game collected as part of the program were based on species that are considered of importance by Indigenous people residing in the area of the Project or were species of samples donated by Indigenous community members. In the HHRA, these data will support the assessment of current human health exposure through plant ingestion and soil contact pathways, such as incidental ingestion and dermal contact. Co-located soil and vegetation data can also be used to determine the uptake relationship between soil and plants.

This attachment summarizes the field methods, laboratory analysis results, and Quality Assurance/Quality Control (QA/QC) results for the data collected to support the HHRA.



LEGEND

- GREAT BEAR PROJECT FOOTPRINT
- PROJECT AREA
- REGIONAL STUDY AREA FOR HUMAN HEALTH AND ECOLOGICAL HEALTH RISK ASSESSMENT
- TOWN
- CONSERVATION RESERVE
- PROVINCIAL PARK
- HIGHWAY
- LOCAL ROAD
- WATERCOURSE
- WATERBODY



NOTE(S)
 1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)
 1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
 2. ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
 3. SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025.
 4. COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
REGIONAL STUDY AREA FOR HUMAN AND ECOLOGICAL HEALTH RISK ASSESSMENT

CONSULTANT	YYYY-MM-DD	2026-02-06
DESIGNED	----	----
PREPARED	MD	----
REVIEWED	----	----
APPROVED	----	----

PROJECT NO.
CA0031271

CONTROL
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FIGURE
A2-2

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2 FIELD PROGRAM

2.1 METHODS

Great Bear Resources staff collected soil and vegetation samples from 30 locations within the Project Area between August 18, 2023, and September 12, 2023. Wild game samples were subsequently donated by Indigenous members from December 15, 2023, to February 22, 2024. Altogether, samples were obtained from 37 locations (Figure A2-3).

Co-located soil and vegetation sample locations were selected opportunistically, as the Soil and Traditional Foods sampling program was conducted concurrently with other field programs for the Project. The sampling locations are located within the Project Area. At each sampling location, soil and up to two vegetation types (berries and traditional plants) were collected depending on availability of target vegetation species.

Vegetation samples of interest were identified based on their importance as food for human consumption which was based on engagement with the local Indigenous communities. Vegetation species targeted for collection were informed by Indigenous Knowledge (IK) interviews with Lac Seul First Nation and Wabauskang First Nation. IK from the other communities living in the area of the Project (i.e., Asubpeeschoseewagong Netum Anishinabek [ANA], the Northwestern Ontario Métis Community [NWOMC] or Indigenous peoples living in Red Lake and Ear Falls), were not available at the time of field program development. Given that recreational, harvesting and gathering sites occur across various locations within the LSA and RSA, it was assumed that Indigenous people from these other communities could harvest similar vegetation species.

The specific sampling methods for each media are described in Section 2.1.1 (soil) and Section 2.1.2 (vegetation). As previously noted, wild game samples were obtained through voluntary donation; this is discussed in Section 2.1.3 .

The co-located soil and vegetation field program was developed in general accordance with the Canadian Council of Ministers of the Environment (CCME) Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 3 (CCME 2016a) and the Canadian Association for Laboratory Accreditation (CALA) Guide to Current Sampling Practices (CALA 2014). The guidance documents were used to develop study objectives, sample design, and quality assurance / quality control (QA/QC) protocols for the sampling of co-located soil and vegetation.

The following quality assurance measures and general sample procedures, consistent with the CCME Guidance Manual (CCME 2016a), were followed during the co-located soil and vegetation sample collection at each location:

- Cross-contamination during sample collection was minimized by wearing disposable nitrile gloves, which were changed between each sample. Sampling equipment (e.g., trowels) was washed with decontamination agents between each sample.
- Each sample jar or bag was labelled with a unique identifier and date sampled.
- A field logsheet was completed at each sampling location and included date, Global Positioning System (GPS) coordinates, soil sample ID, corresponding tissue sample ID(s), specific soil type collected, soil sample depth, vegetation species, vegetation tissue type, and the weight of vegetation samples.
- Duplicate samples were collected to assess reproducibility of the field sampling methods.
- Soil samples were collected in clean laboratory-supplied soil jars while vegetation samples were collected in clean zip-sealed bags.
- Chain-of-custody forms were completed and were checked to verify the information recorded before samples were submitted for chemical analysis.

SUBATTACHMENT A2: Soil and Traditional Foods Sampling Program

- Tissue samples were kept frozen and soil samples were kept refrigerated until they were submitted to the laboratory for analysis, accompanied with completed chain of custody forms.
-

2.1.1 SOIL

Specific soil sampling locations were selected based on the availability of the target vegetation and opportunistic sampling conducted during fieldwork for other sampling programs. Soil samples were collected using a trowel and packed into soil jars. Up to 30 samples of soil were targeted for the sampling program.

Between each sample, clean sampling techniques (i.e., decontamination procedures as per the CCME (2016a) Guidance Manual for Environmental Site Characterization) were followed. Soil samples were stored in a cooler with ice packs in the field (kept cool but not frozen). Soil samples were packed in a cooler with ice for shipping to ALS Environmental Laboratories (ALS) in Winnipeg, Manitoba for metals and PAH chemical analyses.

Sample jars were labelled with the sample ID, including the program name (CF for Country Foods), sample type (S for soil) and sample number for identifying co-located vegetation samples. Duplicate samples were identified with “DUP” within the sample ID.

2.1.2 VEGETATION

The types of vegetation targeted for the sampling program were based on the IK provided by Lac Seul First Nation and Wabauskang First Nation. These vegetation species included berries and traditional plants.

At each sampling plot location, one sample of each vegetation type was collected depending on the availability of target vegetation types. Vegetation samples were co-located with soil samples; a mass between 10 to 74 grams (wet weight) was collected for each vegetation sample. Vegetation samples consisted of only one vegetation type and species (e.g., blueberries), and not a combination of different vegetation types or species.

Up to 15 samples each of berries and traditional plants were targeted for the sampling program. Vegetation samples were hand-picked while wearing nitrile gloves, avoiding the inclusion of soil or debris. Leaves free of visible blemishes or desiccation, and ripe, unblemished berries were targeted and collected. Vegetation samples were not rinsed. Vegetation samples were placed in clean, labelled zip-sealed bags, and were placed on ice in coolers and frozen if they could not be shipped within 48 hours. Frozen samples were then packed into coolers with ice at various points during the field program and submitted to ALS Winnipeg, Manitoba for chemical analysis.

Vegetation samples were labelled with the sample ID, including program name (CF) and sample number for identifying the co-located soil sample. When collecting duplicate samples of vegetation tissue, two samples were collected from within the same sampling plot (preferably from the same plant) and each sample was processed as outlined above. Once placed in a zip-sealed bag, the duplicate sample was identified with “DUP” within the sample ID.

2.1.3 WILD GAME

Up to five wild game species (rabbit, beaver, partridge, waterfowl and moose) were targeted for sampling; however, only one species (grouse) was obtained through donation from a local trapper. A total of 7 grouse organ meat samples of liver or heart were received, with masses between 5-10 grams each. Wild game samples were appropriately labelled with a sample ID, including the program name (CF) and corresponding sample number for clear identification. All samples received were submitted to ALS Winnipeg, Manitoba, for analysis.

2.2 LABORATORY ANALYSIS

Samples were submitted to ALS in Winnipeg, Manitoba for analysis. The analytical methods used to evaluate the soil, vegetation and wild game samples, and a detailed list of parameters analyzed are provided in the laboratory Certificates of Analysis (Attachment A2-1). A summary of analyses is provided in Table A2-1.

Laboratory quality control for chemistry samples included analysis of method blanks, laboratory duplicates, spiked samples, and control samples using certified reference materials to assess precision and accuracy of chemical analyses. Laboratory data quality control reports were reviewed by WSP upon receipt to confirm that the laboratory data quality objectives had been met and that the appropriate quality control information had been reported. The methods and results of the laboratory data quality control review are provided in Section 2.3.

2.3 RESULTS

A summary of the number of soil, vegetation and wild game samples collected for the HHRA is provided in Table A2-2. Sampling locations are shown in Figure A2-3. In 2023, a total of 30 vegetation samples were collected from 30 discrete locations, while 7 wild game samples were provided by donation. It is noted that WSP reviewed the sample inventory to select the samples for laboratory submission; the samples were generally selected to capture species variability and to obtain sufficient sample quantities for statistical analysis in the HHRA. Detailed information including vegetation/wild game type and species collected at each location as well as sample location coordinates is provided in Attachment A2-2, Table A2-2-1.

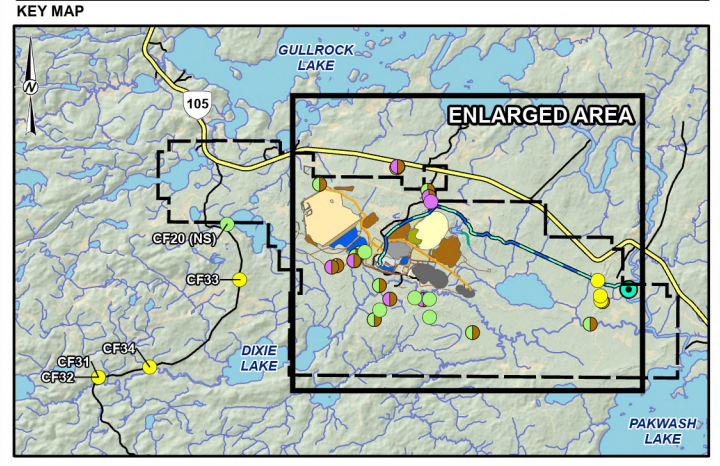
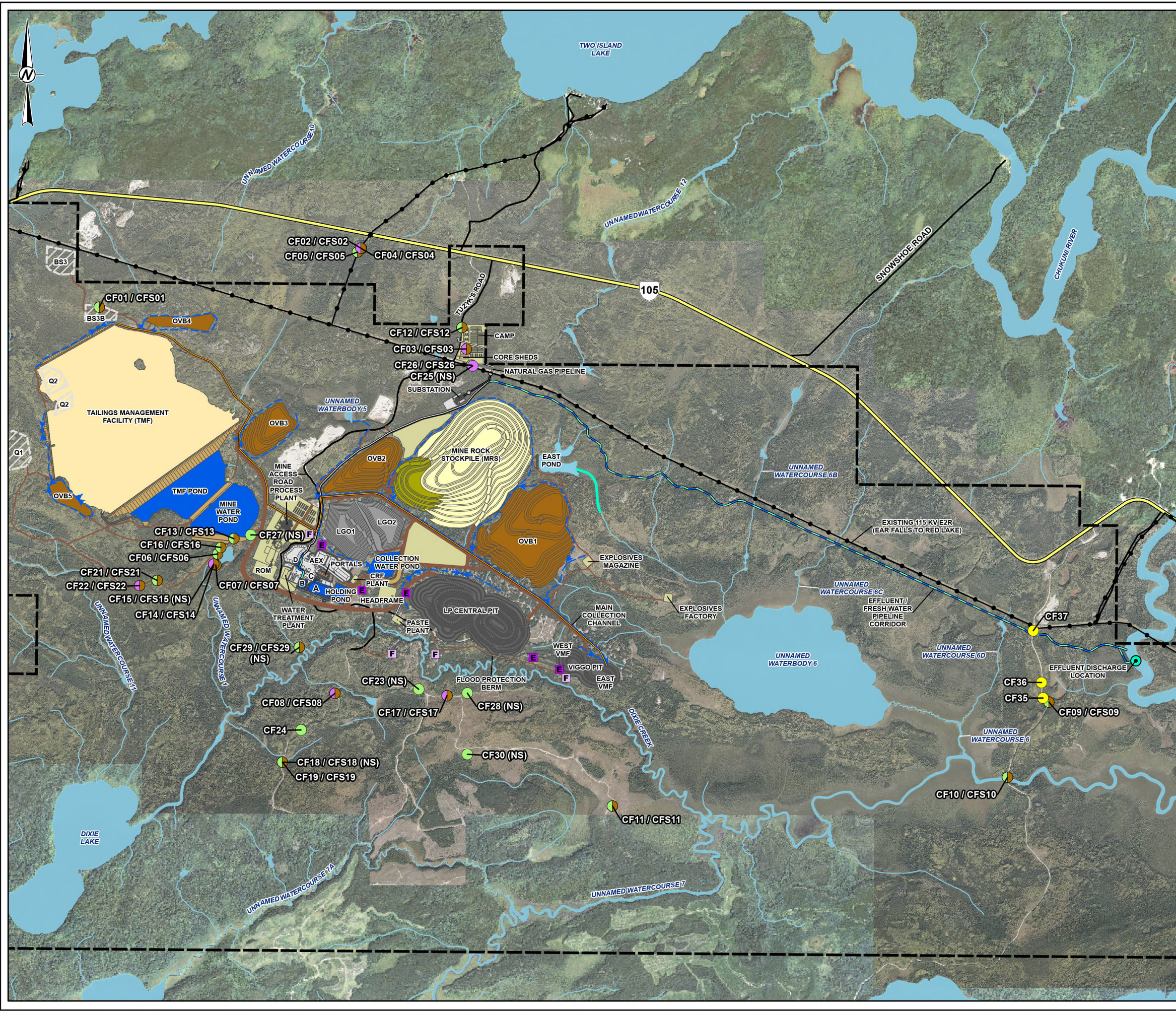
The analytical results are provided in Attachment A2-2, Table A2-2-2 (soil), Table A2-2-3 (berries), Table A2-2-4 (traditional plants), and Table A2-2-5 (wild game).

Collected vegetation and wild game species include:

- Berries: Canadian bunchberry* [*Cornus canadensis*], velvetleaf blueberry* [*Vaccinium myrtilloides*], chokecherry [*Prunus virginiana*], rosehips* [*Rosa spp.*], blueberries [*Vaccinium spp.*], raspberries [*Rubus idaeus*], These species may be consumed by both people and wildlife.
- Traditional Plant: bog Labrador tea* [*Rhododendron groenlandicum*], mountain ash* [*Sorbus americana*], Labrador tea [*Rhododendron spp.*], prickly wild rose* [*Rosa acicularis*], wild mint [*Mentha spp.*], paper birch* [*Betula papyrifera*], red-osier dogwood [*Cornus stolonifera*], chaga [*Inonotus obliquus*], chanterelle [*Cantharellus cibarius*], tamarack [*Larix laricina*], wild rice [*Zizania palustris*], turkey tail* [*Trametes versicolor*], common juniper [*Juniperus spp.*], cattail* [*Typha latifolia*], birch bark* [*Betula spp.*], lily pad [*Nymphaeaceae spp.*], alder bark* [*Alnus incana*], bog aster* [*Oclemena nemoralis*].
- Wild Game: Ruffed grouse [*Bonasa umbellus*], spruce grouse [*Dendragapus canadensis*]

It is noted that when vegetation species identified in the IK sources were not available at a given sampling location, alternative vegetation types that are known to be consumed by people were collected.

Alternative vegetation types are flagged above with an asterisk. As noted earlier, wild game species were donated by Indigenous trappers and were not collected as part of the field program.



LEGEND

	PROPERTY BOUNDARY		SAMPLING LOCATIONS (NOTE 5)
	HIGHWAY (INCLUDING ENBRIDGE PIPELINE)		TRADITIONAL PLANT AND SOIL
	LOCAL ROAD		BERRY AND SOIL
	EXISTING TRANSMISSION LINE		BERRY
	WATERCOURSE		TRADITIONAL PLANT
	WATERBODY		SMALL MAMMAL

PROPOSED MINE FEATURE

	OPEN PIT		ADVANCED EXPLORATION SITE (AEX)
	MINE ROCK STOCKPILE (NPAG)		ROCK QUARRY (Q) / SAND AND GRAVEL PIT (B)
	MINE ROCK STOCKPILE (PAG)		DIVERSION CHANNEL
	LOW GRADE ORE STOCKPILE (LGO)		FRESH AIR VENT RAISE
	OVERBURDEN STOCKPILE (OVB)		EXHAUST VENT RAISE
	TAILINGS MANAGEMENT FACILITY (TMF)		TRANSMISSION LINE
	DAM		TAILINGS PIPELINE
	POND		PASTE PLANT PIPELINE
	COLLECTION DITCH		EFFLUENT / FRESH WATER PIPELINE CORRIDOR
	MINE FACILITIES / INFRASTRUCTURE		EFFLUENT DISCHARGE LOCATION
	ROAD		
	PORTAL		

NOTE(S)

- ALL LOCATIONS ARE APPROXIMATE
- VMF: VIGGO MANAGEMENT FACILITY
- ROM: RUN OF MINE ORE
- AEX PONDS: A-AEX MINE WATER POND, B-AEX TREATED WATER POND, C-AEX SETTLING POND, D-AEX SEDIMENT POND
- NS: NOT SUBMITTED FOR ANALYSIS

REFERENCE(S)

- CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
- AERIAL IMAGERY PROVIDED BY GREAT BEAR RESOURCES (SCENE DATE: SEPTEMBER 2022)
- PROPERTY BOUNDARY PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2024.
- ROADS INFORMATION PROVIDED BY GREAT BEAR RESOURCES, AUGUST 2022.
- SITE PLAN BASED ON INFORMATION PROVIDED BY GREAT BEAR RESOURCES, DECEMBER 2024 / JUNE 2025.
- COORDINATE SYSTEM: NAD 1983 UTM ZONE 15N

CLIENT
GREAT BEAR RESOURCES

PROJECT
GREAT BEAR PROJECT

TITLE
SOIL AND TRADITIONAL FOOD SAMPLE LOCATIONS

CONSULTANT	YYYY-MM-DD	2026-02-06
	DESIGNED	----
	PREPARED	MD
	REVIEWED	----
	APPROVED	----

PROJECT NO. CA0031271	CONTROL 0001	REV. A	FIGURE A2-3
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PRINT: X:\CA\CA0031271-0001\Projects\2025\Projects\CA0031271-0001_Kinross_Great_Bear_Emirz_GSE\Country_Food\Sampling_Loc_Aug2025\Final_Country_Food_Sampling_Loc_Aug2025_PRINTED_OH_AT_12:47:29 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: AINSI B

SUBATTACHMENT A2: Soil and Traditional Foods Sampling Program

Table A2-1: Summary of Laboratory Analyses for Soil, Vegetation and Wild Game Samples

Analysis	Soil	Vegetation	Wild game
Moisture	✓	✓	✓
pH (IVBA)	✓	✗	✗
Total Metals	✓	✓	✓
Polycyclic Aromatic Hydrocarbons	✓	✓	✗
Speciated Metals (Arsenic)	✗	✓	✓
Speciated Metals (Methylmercury)	✗	✗	✓
Bioavailability (Arsenic)	✓	✗	✗

Notes:

✓ = analyzed; ✗ = not analyzed; IVBA = *In vitro* bioaccessibility.

Table A2-2: Number of Soil and Vegetation Samples Collected and Analyzed

Sample Medium	Number of Samples Collected	Total Samples Submitted for Analysis	Total Samples Analyzed
Soil	23(1)	20(1)	21
Vegetation – Berries	7(1)	6(1)	7
Vegetation – Traditional Plant	23(0)	15(0)	15
Wild Game	7(0)	7(0)	7

Notes:

() Numbers in parentheses indicate duplicate samples that were collected for quality assurance / quality control purposes.

3 QUALITY ASSURANCE / QUALITY CONTROL

3.1 FIELD

3.1.1 METHODS

For QA/QC purposes, one duplicate soil sample and one duplicate vegetation sample was collected and analyzed. The soil and vegetation tissue duplicates were collected at CF14, and the vegetation tissue duplicate comprised of a berry sample. Sample duplicates were collected to provide an indication of sample heterogeneity and of the reproducibility of the field sampling methods. Duplicate samples were collected using the same methods as described in Section 3.1.1 and Section 3.2.1.

The difference in results of the parent and duplicate samples was expressed as a relative percent difference (RPD) as an indicator of laboratory precision and sample heterogeneity. Lower RPD values indicate better precision in laboratory analysis and sample homogeneity. RPDs were calculated if both parent sample and duplicate concentrations were greater than five times the detection limit. The formula for computing the RPD is given below:

$$RPD = \frac{\text{abs}(\text{sample} - \text{duplicate})}{\text{mean}} \times 100 \quad \text{Equation 1}$$

Where:

RPD = relative percent difference

abs (sample duplicate) = absolute value of the concentration in the original sample minus the concentration in the duplicate sample

mean = average of the two concentrations

For soil, the analytical laboratory data quality objectives (DQOs) from CCME (2016a) were selected. The following RPD limits, for specified parameters analysed in soil are considered reasonable for laboratory duplicates (CCME 2016a):

- Moisture: In the absence of an RPD limit for moisture, the ≤ 20% salinity and electric conductivity RPD limit was used as a proxy.
- Metals: RPDs should be ≤ 30% with the exception of ≤ 40% for silver, aluminum, barium, mercury, potassium, molybdenum, sodium, lead, tin, strontium, and titanium; ≤ 35% for chromium.
- PAHs: RPDs should be ≤ 50%.

For field duplicates, there is an added variability introduced by matrix variability and inherent sampling and handling procedures. Assuming the field and laboratory errors are similar in magnitude, acceptance criteria twice those given above are considered (CCME, 2016b). Therefore, the RPD DQOs used to assess soil field duplicates consist of the following:

- Moisture: In the absence of an RPD limit for moisture, the ≤ 40% salinity and electric conductivity RPD limit was used as a proxy.

SUBATTACHMENT A2: Soil and Traditional Foods Sampling Program

- Metals: RPD DQO \leq 60% with the exception of \leq 80% for silver, aluminum, barium, mercury, potassium, molybdenum, sodium, lead, tin, strontium, and titanium; RPD DQO of \leq 70% for chromium.
- PAHs: RPD DQO \leq 100%.

For vegetation tissue samples, the CCME (2016b,c) guidance does not specify DQO for RPD values for most parameters. However, for methylmercury, CCME (2016b) applied the same RPD used for soils to tissue samples. Following this precedent, the soil DQO of each parameter was adopted as a surrogate for vegetation tissue RPD DQO.

3.1.2 RESULTS

3.1.2.1 SOIL

The RPD results for physical parameters, metals and PAHs in duplicate soil samples are presented in Attachment A2-3, Table A2-3-1. The RPD results for the parameters measured in the soil duplicate analysis met their respective RPD DQOs.

3.1.2.2 VEGETATION

The RPD results for physical parameters, metals, and PAH in duplicate vegetation tissue samples are presented in Attachment A2-3, Table A2-3-2. RPD results associated with wet weight (wwt) concentrations are discussed below. In general, the results of vegetation duplicate analysis met the RPD DQOs except for tin, which had a calculated RPD of 106% compared to its RPD DQO of 80% in sample CF14 (CF-DUP-01).

The RPD value outside the DQO for this parameter is likely due to the natural heterogeneity of vegetation tissues. Although this natural tissue variability could affect the precision of the individual results, selection of the duplicate samples was random, meaning that there would be no systematic bias in results due to variability. The vegetation tissue data collected are considered acceptable for use in the HHRA.

3.2 LABORATORY

3.2.1 METHODS

Soil and traditional food tissue chemical analyses were performed by ALS in Winnipeg, MB. The laboratory is accredited by the Canadian Association for Laboratory Accreditation.

Laboratory quality control for chemistry samples included analysis of method blanks, laboratory duplicates, spiked samples, and control samples using certified reference materials to assess precision and accuracy of chemical analyses. Laboratory data quality control reports were reviewed upon receipt to confirm that the laboratory DQOs had been met and that the appropriate quality control information had been reported.

The ALS Certificates of Analysis are provided in Attachment A2-1.

3.2.2 RESULTS

3.2.2.1 SOIL AND WILD GAME

The following data quality issues were identified in the ALS laboratory report for soil and wild game:

- Detection limits were adjusted for PAHs in CFS01, CFS02, CFS04, CFS05, CFS08, CFS13, CFS16, and CFS22 due to sample matrix effects, chromatographic interference from co-elution and high

moisture content. Two acridine samples (CFS03 and CFS22) were not reportable due to d9-acridine surrogate recoveries not meeting the ALS DQO minimum requirement. Sample matrix effects were suspected.

- The laboratory duplicate RPD for several PAHs (acenaphthene, anthracene, fluoranthene, fluorene, phenanthrene, and pyrene) were above the DQO in one anonymous sample and the laboratory duplicated RPD for metals (arsenic, barium, chromium, manganese, and zirconium) were above the DQO in sample CF33 due to sample heterogeneity.
- Silver and phosphorus in a laboratory control sample during a multi-element scan were marginally above the DQO (by less than 10%). This is considered acceptable by the laboratory provided that the other quality control samples indicate good performance for the elements in question and therefore was not considered to materially impact the data interpretation. The method blank results for magnesium in soil were above the ALS DQO. Soil samples collected for metals did not meet the specified hold times for analysis, while soil samples collected for invitro bioaccessibility (IVBA), metals, and PAH did not meet the specific hold times for sample extraction/preparation.
- Quality control sample frequency outliers were found in moisture content (gravimetry and micro) methods for laboratory duplicates, and IVBA for arsenic and lead for laboratory control samples.

The data quality issues listed above are not expected to affect the reliability of the analytical results for soil and wild game. While soil samples did not meet the specified hold times for analysis, many metals exhibit slow degradation if soil samples are stored properly. The soil samples were analyzed within 350 days of being collected, below the threshold at which meaningful degradation is expected for many metals (US EPA 2005). As such, being above holding times is not considered to compromise data integrity and usability. Further, none of the adjusted detection limits are elevated above environmental quality criteria for soil. The soil and wild game data are considered acceptable for use in the HHRA.

3.2.2.2 VEGETATION

The following data quality issues were identified in the ALS laboratory report for vegetation:

- Detection limits were adjusted for moisture content, some metals (zirconium), arsenic speciation (arsenate) and PAHs (acenaphthene, anthracene, benzo(a)anthracene, chrysene, fluorene, phenanthrene, pyrene) in 13 vegetation samples (CF01, CF05, CF06, CF07, CF09, CF10, CF11, CF13, CF14, CF16, CF19, CF21, CF26), due to sample matrix effects (e.g. chemical interference, colour, turbidity), insufficient sample volume, or chromatographic interference from co-elution.
- Quality control sample frequency outliers occurred in laboratory duplicates for PAHs and in laboratory control samples for arsenic species.

All samples collected met the specified hold times. The data quality issues listed above are not expected to affect the reliability of the analytical results for vegetation tissue. The vegetation data are considered acceptable for use in the HHRA.

3.3 SUMMARY OF QUALITY ASSURANCE / QUALITY CONTROL

Based on review of the field and laboratory QA/QC results, the soil, vegetation tissue and wild game tissue data are considered acceptable for use in the HHRA. The observed field duplicate variability was limited to one sample and indicates there is some heterogeneity among the parent and duplicate samples at that location. Although this variability could affect the precision of the individual results, selection of the duplicate samples was random, meaning that there would be no systemic bias in results due to variability. The laboratory QA/QC results identified some laboratory control sample and laboratory duplicate RPD outside the DQO ranges; however, the data quality issues are not expected to affect the reliability of the analytical results.

4 CONCLUSIONS

Great Bear Resources, under the guidance of WSP, undertook a Soil and Traditional Foods sampling program to support the Great Bear Gold Project. Co-located soil and vegetation tissue samples were collected, and samples of wild game were donated by Indigenous trappers. Based on the review of the field and laboratory QA/QC results, soil, vegetation tissue and wild game tissue data obtained in 2023 and 2024 are considered reliable and acceptable for use in a HHRA for the Project.

Analytical data quality was determined by assessing field duplicate variability and laboratory QA/QC samples for the respective laboratory reports. Although there is some variability in the QA/QC samples, the data are considered acceptable for use in the HHRA. Individual samples are generally not used in risk assessments. Instead, where sufficient samples are available, a conservative estimate of reasonable maximum exposure point concentrations (e.g., the 95% upper confidence limit of the mean) are generally used in risk assessments to estimate potential Project effects. The use of this statistic as a conservative exposure concentration quantitatively accounts for the variability among individual samples. The data are considered to be reliable and suitable for inclusion in the HHRA because the variability within samples was random (i.e., no systematic bias) and because the data will be pooled for calculation of statistics.

5 REFERENCES

- Canadian Association for Laboratory Accreditation (CALA). 2014. CALA Guide to Current Sampling Practices. Accessed: CALA Guide to Current Sampling Practices.
- Canadian Council of Ministers of the Environment (CCME). 2016a. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 3 — Suggested Operating Procedures (PN 1555; ISBN 978-1-77202-030-4).
- CCME. 2016b. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 4 — Analytical Methods (PN 1557; ISBN 978-1-77202-032-8).
- CCME. 2016c. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment: Volume 1 — Guidance Manual (PN 1551; ISBN 978-1-77202-026-7).
- United States Environmental Protection Agency (US EPA). 2005. Sample Holding Time Reevaluation. (EPA/600/R-05/124). <https://semspub.epa.gov/work/HQ/100001710.pdf>.

Attachment A2-1
Certificates of Analysis





CERTIFICATE OF ANALYSIS

Work Order	: WP2414182	Page	: 1 of 19
Client	: Great Bear Resources Ltd	Laboratory	: ALS Environmental - Winnipeg
Contact	: Ashley Moncrief	Account Manager	: Judy Dalmaijer
Address	: Great Bear Resources Ltd. 117 Forestry Road Red Lake ON Canada P0V 2M0	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg MB Canada R2J 3T4
Telephone	: 807 630 0203	Telephone	: +1 204 255 9720
Project	: PPR-022-3	Date Samples Received	: 04-Jun-2024 09:20
PO	: PPR-022-3	Date Analysis Commenced	: 18-Jun-2024
C-O-C number	: ----	Issue Date	: 06-Aug-2024 16:47
Sampler	: ----		
Site	: ----		
Quote number	: 2024 Standing offer_V2		
No. of samples received	: 22		
No. of samples analysed	: 22		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Dan Gebert	Laboratory Analyst	Metals, Burnaby, British Columbia
Ilmaz Badbezanchi	Supervisor - Metals Prep & Mercury	Metals, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Metals, Burnaby, British Columbia
Maya Urquhart	Lab Analyst	Metals, Burnaby, British Columbia
Sam Silveira	Analyst	Metals, Burnaby, British Columbia
Sorina Motea	Laboratory Analyst	Organics, Calgary, Alberta



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
LOR: Limit of Reporting (detection limit).

<i>Unit</i>	<i>Description</i>
%	percent
mg/kg wwt	milligrams per kilogram wet weight

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Qualifiers

<i>Qualifier</i>	<i>Description</i>
DLCI	Detection Limit Raised: Chromatographic interference due to co-elution.
DLIS	Detection Limit Adjusted due to insufficient sample.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
SMI	Surrogate recovery could not be measured due to sample matrix interference.



Analytical Results

Sub-Matrix: Biota					Client sample ID				
(Matrix: Biota)					CF01	CF02	CF03	CF04	CF05
Client sampling date / time					18-Aug-2023 00:00	18-Aug-2023 00:00	18-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-001	WP2414182-002	WP2414182-003	WP2414182-004	WP2414182-005
					Result	Result	Result	Result	Result
Physical Tests									
Moisture	----	E144/VA	0.50	%	57.4	88.1	83.6	78.8	59.7
Metals									
Aluminum	7429-90-5	E440A/VA	0.40	mg/kg wwt	11.1	5.28	11.6	3.47	11.5
Antimony	7440-36-0	E440A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Arsenic	7440-38-2	E440A/VA	0.0040	mg/kg wwt	0.0323	0.0110	0.0263	0.0044	0.0329
Barium	7440-39-3	E440A/VA	0.010	mg/kg wwt	31.6	2.82	2.60	5.79	36.2
Beryllium	7440-41-7	E440A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth	7440-69-9	E440A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron	7440-42-8	E440A/VA	0.20	mg/kg wwt	8.49	0.66	1.03	3.18	4.72
Cadmium	7440-43-9	E440A/VA	0.0010	mg/kg wwt	0.0012	<0.0010	0.0018	0.0021	<0.0010
Calcium	7440-70-2	E440A/VA	4.0	mg/kg wwt	1930	807	180	651	2190
Cesium	7440-46-2	E440A/VA	0.0010	mg/kg wwt	0.123	0.265	0.0496	0.0571	0.226
Chromium	7440-47-3	E440A/VA	0.010	mg/kg wwt	0.032	<0.010	<0.010	<0.010	0.017
Cobalt	7440-48-4	E440A/VA	0.0040	mg/kg wwt	0.0160	<0.0040	0.0047	0.0051	0.0230
Copper	7440-50-8	E440A/VA	0.020	mg/kg wwt	1.77	0.228	0.625	1.07	1.32
Iron	7439-89-6	E440A/VA	0.60	mg/kg wwt	21.4	1.70	2.88	4.02	15.6
Lead	7439-92-1	E440A/VA	0.0040	mg/kg wwt	0.0189	<0.0040	<0.0040	<0.0040	0.0108
Lithium	7439-93-2	E440A/VA	0.10	mg/kg wwt	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	7439-95-4	E440A/VA	0.40	mg/kg wwt	749	169	76.4	239	583
Manganese	7439-96-5	E440A/VA	0.010	mg/kg wwt	254	1.21	27.3	21.3	93.2
Mercury	7439-97-6	E510A/VA	0.0010	mg/kg wwt	0.0028	<0.0010	<0.0010	<0.0010	0.0030
Molybdenum	7439-98-7	E440A/VA	0.0040	mg/kg wwt	0.0151	0.0255	0.115	0.152	0.0071
Nickel	7440-02-0	E440A/VA	0.040	mg/kg wwt	0.168	0.044	0.097	<0.040	0.429
Phosphorus	7723-14-0	E440A/VA	2.0	mg/kg wwt	611	164	191	345	387
Potassium	7440-09-7	E440A/VA	4.0	mg/kg wwt	1810	1090	835	2320	1620
Rubidium	7440-17-7	E440A/VA	0.010	mg/kg wwt	14.0	9.91	3.96	23.6	12.2
Selenium	7782-49-2	E440A/VA	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010
Silver	7440-22-4	E440A.Ag/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium	7440-23-5	E440A/VA	4.0	mg/kg wwt	10.9	5.2	<4.0	<4.0	9.1



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF01	CF02	CF03	CF04	CF05
(Matrix: Biota)					Client sampling date / time	18-Aug-2023 00:00	18-Aug-2023 00:00	18-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-001	WP2414182-002	WP2414182-003	WP2414182-004	WP2414182-005	
					Result	Result	Result	Result	Result	
Metals										
Strontium	7440-24-6	E440A/VA	0.010	mg/kg wwt	6.20	4.26	0.302	2.30	6.27	
Tellurium	13494-80-9	E440A/VA	0.0040	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	
Thallium	7440-28-0	E440A/VA	0.00040	mg/kg wwt	<0.00040	<0.00040	<0.00040	<0.00040	0.00086	
Tin	7440-31-5	E440A/VA	0.020	mg/kg wwt	<0.020	<0.020	<0.020	0.776	<0.020	
Titanium	7440-32-6	E440A.Ti/VA	0.050	mg/kg wwt	0.499	<0.050	<0.050	<0.050	0.285	
Uranium	7440-61-1	E440A/VA	0.00040	mg/kg wwt	0.00074	<0.00040	<0.00040	<0.00040	<0.00040	
Vanadium	7440-62-2	E440A/VA	0.020	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	
Zinc	7440-66-6	E440A/VA	0.10	mg/kg wwt	9.86	0.76	0.94	1.71	6.45	
Zirconium	7440-67-7	E440A/VA	0.040	mg/kg wwt	<0.060 ^{DLM}	<0.040	<0.040	<0.040	<0.040	
Speciated Metals										
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	<0.0050	0.0050	0.0067	<0.0050	0.0066	
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	0.0039	0.0013	0.0114	0.0022	0.0068	
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	0.0029	0.0019	<0.0010	<0.0010	0.0010	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E642A.A/CG	0.010	mg/kg wwt	<0.040 ^{DLCl}	<0.010	<0.010	<0.010	<0.010	
Acenaphthylene	208-96-8	E642A.A/CG	0.010	mg/kg wwt	0.018	<0.010	<0.010	<0.010	<0.010	
Anthracene	120-12-7	E642A.A/CG	0.010	mg/kg wwt	0.010	<0.010	<0.010	<0.010	<0.020 ^{DLCl}	
Benz(a)anthracene	56-55-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.014	
Benzo(a)pyrene	50-32-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.011	
Benzo(b+j)fluoranthene	n/a	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.014	
Benzo(b+j+k)fluoranthene	n/a	E642A.A/CG	0.015	mg/kg wwt	<0.015	<0.015	<0.015	<0.015	0.030	
Benzo(g,h,i)perylene	191-24-2	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(k)fluoranthene	207-08-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.016	
Chrysene	218-01-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.014	
Dibenz(a,h)anthracene	53-70-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.010	
Fluoranthene	206-44-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	0.016	
Fluorene	86-73-7	E642A.A/CG	0.010	mg/kg wwt	<0.020 ^{DLCl}	<0.010	<0.010	<0.010	<0.030 ^{DLCl}	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF01	CF02	CF03	CF04	CF05
(Matrix: Biota)					Client sampling date / time	18-Aug-2023 00:00	18-Aug-2023 00:00	18-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-001	WP2414182-002	WP2414182-003	WP2414182-004	WP2414182-005	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Indeno(1,2,3-c,d)pyrene	193-39-5	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	0.013
Methylnaphthalene, 1-	90-12-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Methylnaphthalene, 2-	91-57-6	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	91-20-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	85-01-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	<0.020 ^{DLCL}
Pyrene	129-00-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	0.015
PAHs, total (EPA 16)	n/a	E642A.A/CG	0.040	mg/kg wwt	<0.058	<0.040	<0.040	<0.040	<0.040	0.123
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	E642A.A/CG	0.010	%	106	92.9	89.3	84.8	84.8	91.2
Naphthalene-d8	1146-65-2	E642A.A/CG	0.010	%	105	81.2	85.8	83.8	83.8	82.7
Phenanthrene-d10	1517-22-2	E642A.A/CG	0.010	%	82.3	99.0	94.0	93.2	93.2	73.0

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Biota (Matrix: Biota)					Client sample ID	CF06	CF07	CF08	CF09	CF10
Client sampling date / time					21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-006	WP2414182-007	WP2414182-008	WP2414182-009	WP2414182-010	
					Result	Result	Result	Result	Result	
Physical Tests										
Moisture	---	E144/VA	0.50	%	69.3	79.9	---	---	---	
Moisture	---	E144-H/VA	2.0	%	---	---	73.6	4.3	53.0	
Metals										
Aluminum	7429-90-5	E440A/VA	0.40	mg/kg wwt	1.32	4.46	---	---	---	
Aluminum	7429-90-5	E472A/VA	1.0	mg/kg wwt	---	---	52.4	150	10.1	
Antimony	7440-36-0	E472A/VA	0.0020	mg/kg wwt	---	---	<0.0020	0.0042	<0.0020	
Antimony	7440-36-0	E440A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	---	---	---	
Arsenic	7440-38-2	E440A/VA	0.0040	mg/kg wwt	0.0045	0.0219	---	---	---	
Arsenic	7440-38-2	E472A/VA	0.0060	mg/kg wwt	---	---	0.0219	0.0593	0.0158	
Barium	7440-39-3	E472A/VA	0.010	mg/kg wwt	---	---	3.86	16.5	18.7	
Barium	7440-39-3	E440A/VA	0.010	mg/kg wwt	1.51	14.0	---	---	---	
Beryllium	7440-41-7	E472A/VA	0.0020	mg/kg wwt	---	---	<0.0020	0.0052	<0.0020	
Beryllium	7440-41-7	E440A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	---	---	---	
Bismuth	7440-69-9	E472A/VA	0.0020	mg/kg wwt	---	---	<0.0020	0.0026	0.0062	
Bismuth	7440-69-9	E440A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	---	---	---	
Boron	7440-42-8	E472A/VA	0.20	mg/kg wwt	---	---	4.52	2.76	7.73	
Boron	7440-42-8	E440A/VA	0.20	mg/kg wwt	1.73	4.31	---	---	---	
Cadmium	7440-43-9	E440A/VA	0.0010	mg/kg wwt	0.0022	0.0011	---	---	---	
Cadmium	7440-43-9	E472A/VA	0.0020	mg/kg wwt	---	---	0.0550	0.412	0.0041	
Calcium	7440-70-2	E472A/VA	4.0	mg/kg wwt	---	---	822	779	7780	
Calcium	7440-70-2	E440A/VA	4.0	mg/kg wwt	1520	4020	---	---	---	
Cesium	7440-46-2	E472A/VA	0.0010	mg/kg wwt	---	---	<0.0010	0.0281	0.0018	
Cesium	7440-46-2	E440A/VA	0.0010	mg/kg wwt	0.152	0.118	---	---	---	
Chromium	7440-47-3	E440A/VA	0.010	mg/kg wwt	<0.010	0.030	---	---	---	
Chromium	7440-47-3	E472A/VA	0.040	mg/kg wwt	---	---	<0.040	0.403	0.068	
Cobalt	7440-48-4	E472A/VA	0.0040	mg/kg wwt	---	---	0.0268	0.167	0.0112	
Cobalt	7440-48-4	E440A/VA	0.0040	mg/kg wwt	<0.0040	0.0051	---	---	---	
Copper	7440-50-8	E440A/VA	0.020	mg/kg wwt	1.08	3.79	---	---	---	
Copper	7440-50-8	E472A/VA	0.040	mg/kg wwt	---	---	1.81	4.14	1.44	
Iron	7439-89-6	E440A/VA	0.60	mg/kg wwt	5.72	15.3	---	---	---	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF06	CF07	CF08	CF09	CF10
(Matrix: Biota)					Client sampling date / time	21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-006	WP2414182-007	WP2414182-008	WP2414182-009	WP2414182-010	
					Result	Result	Result	Result	Result	
Metals										
Iron	7439-89-6	E472A/VA	1.0	mg/kg wwt	---	---	16.5	201	23.4	
Lead	7439-92-1	E440A/VA	0.0040	mg/kg wwt	<0.0040	0.0088	---	---	---	
Lead	7439-92-1	E472A/VA	0.010	mg/kg wwt	---	---	<0.010	0.205	0.024	
Lithium	7439-93-2	E472A/VA	0.10	mg/kg wwt	---	---	<0.10	0.20	<0.10	
Lithium	7439-93-2	E440A/VA	0.10	mg/kg wwt	<0.10	<0.10	---	---	---	
Magnesium	7439-95-4	E472A/VA	0.40	mg/kg wwt	---	---	448	182	716	
Magnesium	7439-95-4	E440A/VA	0.40	mg/kg wwt	556	1660	---	---	---	
Manganese	7439-96-5	E472A/VA	0.010	mg/kg wwt	---	---	52.3	539	9.70	
Manganese	7439-96-5	E440A/VA	0.010	mg/kg wwt	7.52	21.6	---	---	---	
Mercury	7439-97-6	E511A/VA	0.0010	mg/kg wwt	---	---	<0.0010	0.0226	0.0030	
Mercury	7439-97-6	E510A/VA	0.0010	mg/kg wwt	<0.0010	0.0051	---	---	---	
Molybdenum	7439-98-7	E440A/VA	0.0040	mg/kg wwt	0.0610	0.432	---	---	---	
Molybdenum	7439-98-7	E472A/VA	0.0080	mg/kg wwt	---	---	0.142	0.0160	0.787	
Nickel	7440-02-0	E472A/VA	0.040	mg/kg wwt	---	---	0.466	0.499	0.612	
Nickel	7440-02-0	E440A/VA	0.040	mg/kg wwt	0.101	0.047	---	---	---	
Phosphorus	7723-14-0	E472A/VA	2.0	mg/kg wwt	---	---	902	207	678	
Phosphorus	7723-14-0	E440A/VA	2.0	mg/kg wwt	596	519	---	---	---	
Potassium	7440-09-7	E472A/VA	4.0	mg/kg wwt	---	---	1720	280	2510	
Potassium	7440-09-7	E440A/VA	4.0	mg/kg wwt	2500	2330	---	---	---	
Rubidium	7440-17-7	E472A/VA	0.010	mg/kg wwt	---	---	0.649	0.921	0.367	
Rubidium	7440-17-7	E440A/VA	0.010	mg/kg wwt	20.5	12.8	---	---	---	
Selenium	7782-49-2	E440A/VA	0.010	mg/kg wwt	<0.010	<0.010	---	---	---	
Selenium	7782-49-2	E472A/VA	0.020	mg/kg wwt	---	---	<0.020	0.040	<0.020	
Silver	7440-22-4	E472A.Ag/VA	0.0010	mg/kg wwt	---	---	<0.0010	0.0145	<0.0010	
Silver	7440-22-4	E440A.Ag/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	---	---	---	
Sodium	7440-23-5	E472A/VA	4.0	mg/kg wwt	---	---	6.0	9.0	6.9	
Sodium	7440-23-5	E440A/VA	4.0	mg/kg wwt	4.5	14.0	---	---	---	
Strontium	7440-24-6	E440A/VA	0.010	mg/kg wwt	3.79	8.99	---	---	---	
Strontium	7440-24-6	E472A/VA	0.020	mg/kg wwt	---	---	2.95	5.13	15.1	
Tellurium	13494-80-9	E472A/VA	0.0040	mg/kg wwt	---	---	<0.0040	<0.0040	<0.0040	



Analytical Results

Sub-Matrix: Biota					Client sample ID				
(Matrix: Biota)					CF06	CF07	CF08	CF09	CF10
Client sampling date / time					21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-006	WP2414182-007	WP2414182-008	WP2414182-009	WP2414182-010
					Result	Result	Result	Result	Result
Metals									
Tellurium	13494-80-9	E440A/VA	0.0040	mg/kg wwt	<0.0040	<0.0040	---	---	---
Thallium	7440-28-0	E472A/VA	0.00040	mg/kg wwt	---	---	<0.00040	0.00305	0.00072
Thallium	7440-28-0	E440A/VA	0.00040	mg/kg wwt	<0.00040	0.00101	---	---	---
Tin	7440-31-5	E472A/VA	0.020	mg/kg wwt	---	---	1.53	0.120	<0.020
Tin	7440-31-5	E440A/VA	0.020	mg/kg wwt	<0.020	<0.020	---	---	---
Titanium	7440-32-6	E440A.Ti/VA	0.050	mg/kg wwt	<0.050	0.156	---	---	---
Titanium	7440-32-6	E472A.Ti/VA	0.10	mg/kg wwt	---	---	<0.10	13.5	0.91
Uranium	7440-61-1	E472A/VA	0.00040	mg/kg wwt	---	---	<0.00040	0.0106	0.00084
Uranium	7440-61-1	E440A/VA	0.00040	mg/kg wwt	<0.00040	<0.00040	---	---	---
Vanadium	7440-62-2	E472A/VA	0.020	mg/kg wwt	---	---	<0.020	0.394	0.027
Vanadium	7440-62-2	E440A/VA	0.020	mg/kg wwt	<0.020	<0.020	---	---	---
Zinc	7440-66-6	E440A/VA	0.10	mg/kg wwt	3.47	7.82	---	---	---
Zinc	7440-66-6	E472A/VA	0.20	mg/kg wwt	---	---	8.00	91.4	7.96
Zirconium	7440-67-7	E472A/VA	0.040	mg/kg wwt	---	---	<0.040	<0.140 ^{DLM}	<0.080 ^{DLM}
Zirconium	7440-67-7	E440A/VA	0.040	mg/kg wwt	<0.040	<0.040	---	---	---
Speciated Metals									
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	<0.0050	<0.0057 ^{DLS}	<0.0050	0.0102	0.0064
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	<0.0010	0.0057	0.0035	<0.0010	<0.0010
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	0.0041	<0.0010
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	<0.0010	0.0013	0.0013	<0.0010	<0.0010
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	83-32-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	---	---	<0.010
Acenaphthylene	208-96-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	---	---	<0.010
Anthracene	120-12-7	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	---	---	<0.010
Benz(a)anthracene	56-55-3	E642A.A/CG	0.010	mg/kg wwt	0.042	<0.010	---	---	<0.010
Benzo(a)pyrene	50-32-8	E642A.A/CG	0.010	mg/kg wwt	0.028	<0.010	---	---	<0.010
Benzo(b+j)fluoranthene	n/a	E642A.A/CG	0.010	mg/kg wwt	0.035	<0.010	---	---	<0.010
Benzo(b+j+k)fluoranthene	n/a	E642A.A/CG	0.015	mg/kg wwt	0.071	<0.015	---	---	<0.015



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF06	CF07	CF08	CF09	CF10
(Matrix: Biota)										
Client sampling date / time					21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-006	WP2414182-007	WP2414182-008	WP2414182-009	WP2414182-010	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Benzo(g,h,i)perylene	191-24-2	E642A.A/CG	0.010	mg/kg wwt	0.028	<0.010	----	----	<0.010	
Benzo(k)fluoranthene	207-08-9	E642A.A/CG	0.010	mg/kg wwt	0.036	<0.010	----	----	<0.010	
Chrysene	218-01-9	E642A.A/CG	0.010	mg/kg wwt	0.047	<0.010	----	----	<0.010	
Dibenz(a,h)anthracene	53-70-3	E642A.A/CG	0.010	mg/kg wwt	0.027	<0.010	----	----	<0.010	
Fluoranthene	206-44-0	E642A.A/CG	0.010	mg/kg wwt	0.052	0.010	----	----	0.010	
Fluorene	86-73-7	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	----	----	<0.010	
Indeno(1,2,3-c,d)pyrene	193-39-5	E642A.A/CG	0.010	mg/kg wwt	0.031	<0.010	----	----	<0.010	
Methylnaphthalene, 1-	90-12-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	----	----	<0.010	
Methylnaphthalene, 2-	91-57-6	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	----	----	<0.010	
Naphthalene	91-20-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	----	----	<0.010	
Phenanthrene	85-01-8	E642A.A/CG	0.010	mg/kg wwt	0.010	<0.010	----	----	<0.010	
Pyrene	129-00-0	E642A.A/CG	0.010	mg/kg wwt	<0.050 ^{DLCL}	<0.010	----	----	<0.010	
PAHs, total (EPA 16)	n/a	E642A.A/CG	0.040	mg/kg wwt	0.336	<0.040	----	----	<0.040	
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	E642A.A/CG	0.010	%	87.2	90.5	----	----	91.8	
Naphthalene-d8	1146-65-2	E642A.A/CG	0.010	%	81.6	105	----	----	90.9	
Phenanthrene-d10	1517-22-2	E642A.A/CG	0.010	%	98.7	103	----	----	99.8	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF11	CF12	CF13	CF14	CF-DUP-01
(Matrix: Biota)					Client sampling date / time	28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-011	WP2414182-012	WP2414182-013	WP2414182-014	WP2414182-015	
					Result	Result	Result	Result	Result	
Physical Tests										
Moisture	---	E144/VA	0.50	%	49.3	---	---	---	---	---
Moisture	---	E144-H/VA	2.0	%	---	87.3	50.4	70.2	66.7	---
Metals										
Aluminum	7429-90-5	E440A/VA	0.40	mg/kg wwt	27.3	---	---	---	---	---
Aluminum	7429-90-5	E472A/VA	1.0	mg/kg wwt	---	16.9	35.2	2.6	2.2	---
Antimony	7440-36-0	E472A/VA	0.0020	mg/kg wwt	---	<0.0020	0.0038	<0.0020	0.0172	---
Antimony	7440-36-0	E440A/VA	0.0020	mg/kg wwt	0.0093	---	---	---	---	---
Arsenic	7440-38-2	E440A/VA	0.0040	mg/kg wwt	0.104	---	---	---	---	---
Arsenic	7440-38-2	E472A/VA	0.0060	mg/kg wwt	---	0.0180	0.119	<0.0060	<0.0060	---
Barium	7440-39-3	E472A/VA	0.010	mg/kg wwt	---	0.173	24.0	0.798	1.08	---
Barium	7440-39-3	E440A/VA	0.010	mg/kg wwt	11.7	---	---	---	---	---
Beryllium	7440-41-7	E472A/VA	0.0020	mg/kg wwt	---	<0.0020	<0.0020	<0.0020	<0.0020	---
Beryllium	7440-41-7	E440A/VA	0.0020	mg/kg wwt	0.0057	---	---	---	---	---
Bismuth	7440-69-9	E472A/VA	0.0020	mg/kg wwt	---	0.0039	0.0058	<0.0020	<0.0020	---
Bismuth	7440-69-9	E440A/VA	0.0020	mg/kg wwt	<0.0020	---	---	---	---	---
Boron	7440-42-8	E472A/VA	0.20	mg/kg wwt	---	0.38	5.85	1.91	2.28	---
Boron	7440-42-8	E440A/VA	0.20	mg/kg wwt	13.1	---	---	---	---	---
Cadmium	7440-43-9	E440A/VA	0.0010	mg/kg wwt	0.192	---	---	---	---	---
Cadmium	7440-43-9	E472A/VA	0.0020	mg/kg wwt	---	0.0475	0.0530	<0.0020	<0.0020	---
Calcium	7440-70-2	E472A/VA	4.0	mg/kg wwt	---	27.6	2500	440	520	---
Calcium	7440-70-2	E440A/VA	4.0	mg/kg wwt	6560	---	---	---	---	---
Cesium	7440-46-2	E472A/VA	0.0010	mg/kg wwt	---	0.0571	0.0528	0.0334	0.0329	---
Cesium	7440-46-2	E440A/VA	0.0010	mg/kg wwt	0.0161	---	---	---	---	---
Chromium	7440-47-3	E440A/VA	0.010	mg/kg wwt	0.207	---	---	---	---	---
Chromium	7440-47-3	E472A/VA	0.040	mg/kg wwt	---	0.085	0.074	<0.040	<0.040	---
Cobalt	7440-48-4	E472A/VA	0.0040	mg/kg wwt	---	0.0288	0.0266	0.0522	0.0653	---
Cobalt	7440-48-4	E440A/VA	0.0040	mg/kg wwt	0.116	---	---	---	---	---
Copper	7440-50-8	E440A/VA	0.020	mg/kg wwt	18.5	---	---	---	---	---
Copper	7440-50-8	E472A/VA	0.040	mg/kg wwt	---	3.37	1.06	1.37	1.60	---
Iron	7439-89-6	E440A/VA	0.60	mg/kg wwt	23.3	---	---	---	---	---



Analytical Results

Sub-Matrix: Biota (Matrix: Biota)					Client sample ID	CF11	CF12	CF13	CF14	CF-DUP-01
Client sampling date / time					28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-011	WP2414182-012	WP2414182-013	WP2414182-014	WP2414182-015	
					Result	Result	Result	Result	Result	
Metals										
Iron	7439-89-6	E472A/VA	1.0	mg/kg wwt	---	8.4	41.2	4.0	5.3	
Lead	7439-92-1	E440A/VA	0.0040	mg/kg wwt	0.0973	---	---	---	---	
Lead	7439-92-1	E472A/VA	0.010	mg/kg wwt	---	<0.010	0.073	<0.010	<0.010	
Lithium	7439-93-2	E472A/VA	0.10	mg/kg wwt	---	<0.10	<0.10	<0.10	<0.10	
Lithium	7439-93-2	E440A/VA	0.10	mg/kg wwt	<0.10	---	---	---	---	
Magnesium	7439-95-4	E472A/VA	0.40	mg/kg wwt	---	112	383	208	190	
Magnesium	7439-95-4	E440A/VA	0.40	mg/kg wwt	2190	---	---	---	---	
Manganese	7439-96-5	E472A/VA	0.010	mg/kg wwt	---	2.23	402	6.40	6.29	
Manganese	7439-96-5	E440A/VA	0.010	mg/kg wwt	73.6	---	---	---	---	
Mercury	7439-97-6	E511A/VA	0.0010	mg/kg wwt	---	<0.0010	0.0067	<0.0010	<0.0010	
Mercury	7439-97-6	E510A/VA	0.0010	mg/kg wwt	0.0227	---	---	---	---	
Molybdenum	7439-98-7	E440A/VA	0.0040	mg/kg wwt	0.0264	---	---	---	---	
Molybdenum	7439-98-7	E472A/VA	0.0080	mg/kg wwt	---	<0.0080	0.0118	0.0154	0.0206	
Nickel	7440-02-0	E472A/VA	0.040	mg/kg wwt	---	0.047	0.118	0.205	0.189	
Nickel	7440-02-0	E440A/VA	0.040	mg/kg wwt	0.891	---	---	---	---	
Phosphorus	7723-14-0	E472A/VA	2.0	mg/kg wwt	---	646	522	542	553	
Phosphorus	7723-14-0	E440A/VA	2.0	mg/kg wwt	304	---	---	---	---	
Potassium	7440-09-7	E472A/VA	4.0	mg/kg wwt	---	3930	1340	3280	3150	
Potassium	7440-09-7	E440A/VA	4.0	mg/kg wwt	666	---	---	---	---	
Rubidium	7440-17-7	E472A/VA	0.010	mg/kg wwt	---	22.9	2.36	13.3	12.8	
Rubidium	7440-17-7	E440A/VA	0.010	mg/kg wwt	5.29	---	---	---	---	
Selenium	7782-49-2	E440A/VA	0.010	mg/kg wwt	0.037	---	---	---	---	
Selenium	7782-49-2	E472A/VA	0.020	mg/kg wwt	---	<0.020	0.080	<0.020	<0.020	
Silver	7440-22-4	E472A.Ag/VA	0.0010	mg/kg wwt	---	0.180	0.0062	<0.0010	<0.0010	
Silver	7440-22-4	E440A.Ag/VA	0.0010	mg/kg wwt	0.0118	---	---	---	---	
Sodium	7440-23-5	E472A/VA	4.0	mg/kg wwt	---	4.0	5.2	<4.0	<4.0	
Sodium	7440-23-5	E440A/VA	4.0	mg/kg wwt	<4.0	---	---	---	---	
Strontium	7440-24-6	E440A/VA	0.010	mg/kg wwt	25.7	---	---	---	---	
Strontium	7440-24-6	E472A/VA	0.020	mg/kg wwt	---	0.111	3.96	1.14	1.52	
Tellurium	13494-80-9	E472A/VA	0.0040	mg/kg wwt	---	<0.0040	<0.0040	<0.0040	<0.0040	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF11	CF12	CF13	CF14	CF-DUP-01
(Matrix: Biota)					Client sampling date / time	28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-011	WP2414182-012	WP2414182-013	WP2414182-014	WP2414182-015	
					Result	Result	Result	Result	Result	
Metals										
Tellurium	13494-80-9	E440A/VA	0.0040	mg/kg wwt	<0.0040	---	---	---	---	
Thallium	7440-28-0	E472A/VA	0.00040	mg/kg wwt	---	0.00261	0.0191	0.00244	0.00235	
Thallium	7440-28-0	E440A/VA	0.00040	mg/kg wwt	0.00247	---	---	---	---	
Tin	7440-31-5	E472A/VA	0.020	mg/kg wwt	---	0.530	<0.020	0.242	0.784	
Tin	7440-31-5	E440A/VA	0.020	mg/kg wwt	<0.020	---	---	---	---	
Titanium	7440-32-6	E440A.Ti/VA	0.050	mg/kg wwt	0.950	---	---	---	---	
Titanium	7440-32-6	E472A.Ti/VA	0.10	mg/kg wwt	---	0.20	1.30	<0.10	<0.10	
Uranium	7440-61-1	E472A/VA	0.00040	mg/kg wwt	---	<0.00040	0.00247	<0.00040	<0.00040	
Uranium	7440-61-1	E440A/VA	0.00040	mg/kg wwt	0.00245	---	---	---	---	
Vanadium	7440-62-2	E472A/VA	0.020	mg/kg wwt	---	<0.020	0.070	<0.020	<0.020	
Vanadium	7440-62-2	E440A/VA	0.020	mg/kg wwt	0.067	---	---	---	---	
Zinc	7440-66-6	E440A/VA	0.10	mg/kg wwt	22.2	---	---	---	---	
Zinc	7440-66-6	E472A/VA	0.20	mg/kg wwt	---	7.69	32.0	1.60	1.46	
Zirconium	7440-67-7	E472A/VA	0.040	mg/kg wwt	---	<0.040	<0.060 ^{DLM}	<0.040	<0.040	
Zirconium	7440-67-7	E440A/VA	0.040	mg/kg wwt	<0.140 ^{DLM}	---	---	---	---	
Speciated Metals										
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	0.0077	0.0090	0.0102	<0.0050	<0.0050	
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	0.0085	0.0011	0.0073	<0.0010	<0.0010	
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	0.0172	<0.0010	<0.0010	
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	0.0011	0.0011	<0.0010	<0.0010	
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	0.0017	0.0041	<0.0010	<0.0010	<0.0010	
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Acenaphthylene	208-96-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Anthracene	120-12-7	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Benz(a)anthracene	56-55-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.034	<0.010	
Benzo(a)pyrene	50-32-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.028	<0.010	
Benzo(b+j)fluoranthene	n/a	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	0.010	0.045	<0.010	
Benzo(b+j+k)fluoranthene	n/a	E642A.A/CG	0.015	mg/kg wwt	<0.015	<0.015	<0.015	0.091	<0.015	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF11	CF12	CF13	CF14	CF-DUP-01
(Matrix: Biota)					Client sampling date / time	28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-011	WP2414182-012	WP2414182-013	WP2414182-014	WP2414182-015	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Benzo(g,h,i)perylene	191-24-2	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.037	<0.010	
Benzo(k)fluoranthene	207-08-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.046	<0.010	
Chrysene	218-01-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.020 ^{DLCI}	0.043	<0.010	
Dibenz(a,h)anthracene	53-70-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.033	<0.010	
Fluoranthene	206-44-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.037	<0.010	
Fluorene	86-73-7	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Indeno(1,2,3-c,d)pyrene	193-39-5	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	0.041	<0.010	
Methylnaphthalene, 1-	90-12-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 2-	91-57-6	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Naphthalene	91-20-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Phenanthrene	85-01-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	<0.010	<0.010	
Pyrene	129-00-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.060 ^{DLCI}	<0.040 ^{DLCI}	<0.010	
PAHs, total (EPA 16)	n/a	E642A.A/CG	0.040	mg/kg wwt	<0.040	<0.040	<0.073	0.344	<0.040	
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	E642A.A/CG	0.010	%	81.6	87.2	87.8	88.0	92.2	
Naphthalene-d8	1146-65-2	E642A.A/CG	0.010	%	75.9	85.6	Not ^{SMI} Determined	79.5	80.6	
Phenanthrene-d10	1517-22-2	E642A.A/CG	0.010	%	88.3	98.2	97.1	99.2	104	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF16	CF17	CF19	CF21	CF22
(Matrix: Biota)					Client sampling date / time	07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	09-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-016	WP2414182-017	WP2414182-018	WP2414182-019	WP2414182-020	
					Result	Result	Result	Result	Result	
Physical Tests										
Moisture	---	E144/VA	0.50	%	---	57.7	---	---	---	
Moisture	---	E144-H/VA	2.0	%	29.2	---	25.0	54.8	84.5	
Metals										
Aluminum	7429-90-5	E440A/VA	0.40	mg/kg wwt	---	10.2	---	---	---	
Aluminum	7429-90-5	E472A/VA	1.0	mg/kg wwt	9.4	---	33.5	20.4	11.8	
Antimony	7440-36-0	E472A/VA	0.0020	mg/kg wwt	<0.0020	---	0.0034	0.0028	<0.0020	
Antimony	7440-36-0	E440A/VA	0.0020	mg/kg wwt	---	<0.0020	---	---	---	
Arsenic	7440-38-2	E440A/VA	0.0040	mg/kg wwt	---	0.0050	---	---	---	
Arsenic	7440-38-2	E472A/VA	0.0060	mg/kg wwt	0.0824	---	0.0371	0.0203	0.0140	
Barium	7440-39-3	E472A/VA	0.010	mg/kg wwt	0.191	---	4.26	70.6	2.64	
Barium	7440-39-3	E440A/VA	0.010	mg/kg wwt	---	6.49	---	---	---	
Beryllium	7440-41-7	E472A/VA	0.0020	mg/kg wwt	<0.0020	---	<0.0020	<0.0020	<0.0020	
Beryllium	7440-41-7	E440A/VA	0.0020	mg/kg wwt	---	<0.0020	---	---	---	
Bismuth	7440-69-9	E472A/VA	0.0020	mg/kg wwt	<0.0020	---	<0.0020	0.0045	<0.0020	
Bismuth	7440-69-9	E440A/VA	0.0020	mg/kg wwt	---	<0.0020	---	---	---	
Boron	7440-42-8	E472A/VA	0.20	mg/kg wwt	1.87	---	1.41	8.67	1.06	
Boron	7440-42-8	E440A/VA	0.20	mg/kg wwt	---	7.06	---	---	---	
Cadmium	7440-43-9	E440A/VA	0.0010	mg/kg wwt	---	0.0048	---	---	---	
Cadmium	7440-43-9	E472A/VA	0.0020	mg/kg wwt	0.0037	---	5.45	0.0028	<0.0020	
Calcium	7440-70-2	E472A/VA	4.0	mg/kg wwt	153	---	640	2530	213	
Calcium	7440-70-2	E440A/VA	4.0	mg/kg wwt	---	2130	---	---	---	
Cesium	7440-46-2	E472A/VA	0.0010	mg/kg wwt	0.0101	---	0.0545	0.0514	0.0367	
Cesium	7440-46-2	E440A/VA	0.0010	mg/kg wwt	---	0.0030	---	---	---	
Chromium	7440-47-3	E440A/VA	0.010	mg/kg wwt	---	0.041	---	---	---	
Chromium	7440-47-3	E472A/VA	0.040	mg/kg wwt	<0.040	---	0.097	0.042	<0.040	
Cobalt	7440-48-4	E472A/VA	0.0040	mg/kg wwt	0.0164	---	0.0335	0.0088	<0.0040	
Cobalt	7440-48-4	E440A/VA	0.0040	mg/kg wwt	---	0.0163	---	---	---	
Copper	7440-50-8	E440A/VA	0.020	mg/kg wwt	---	1.17	---	---	---	
Copper	7440-50-8	E472A/VA	0.040	mg/kg wwt	2.67	---	12.0	1.49	0.681	
Iron	7439-89-6	E440A/VA	0.60	mg/kg wwt	---	15.6	---	---	---	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF16	CF17	CF19	CF21	CF22
(Matrix: Biota)					Client sampling date / time	07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	09-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-016	WP2414182-017	WP2414182-018	WP2414182-019	WP2414182-020	
					Result	Result	Result	Result	Result	
Metals										
Iron	7439-89-6	E472A/VA	1.0	mg/kg wwt	19.3	---	85.8	27.6	3.4	
Lead	7439-92-1	E440A/VA	0.0040	mg/kg wwt	---	0.0061	---	---	---	
Lead	7439-92-1	E472A/VA	0.010	mg/kg wwt	<0.010	---	0.047	0.016	<0.010	
Lithium	7439-93-2	E472A/VA	0.10	mg/kg wwt	<0.10	---	<0.10	<0.10	<0.10	
Lithium	7439-93-2	E440A/VA	0.10	mg/kg wwt	---	<0.10	---	---	---	
Magnesium	7439-95-4	E472A/VA	0.40	mg/kg wwt	764	---	794	825	79.2	
Magnesium	7439-95-4	E440A/VA	0.40	mg/kg wwt	---	810	---	---	---	
Manganese	7439-96-5	E472A/VA	0.010	mg/kg wwt	12.7	---	66.6	152	40.7	
Manganese	7439-96-5	E440A/VA	0.010	mg/kg wwt	---	69.0	---	---	---	
Mercury	7439-97-6	E511A/VA	0.0010	mg/kg wwt	0.0021	---	0.0514	0.0056	<0.0010	
Mercury	7439-97-6	E510A/VA	0.0010	mg/kg wwt	---	<0.0010	---	---	---	
Molybdenum	7439-98-7	E440A/VA	0.0040	mg/kg wwt	---	0.130	---	---	---	
Molybdenum	7439-98-7	E472A/VA	0.0080	mg/kg wwt	0.159	---	0.0578	0.0086	0.0237	
Nickel	7440-02-0	E472A/VA	0.040	mg/kg wwt	0.143	---	0.292	0.074	0.120	
Nickel	7440-02-0	E440A/VA	0.040	mg/kg wwt	---	0.236	---	---	---	
Phosphorus	7723-14-0	E472A/VA	2.0	mg/kg wwt	2600	---	3020	740	180	
Phosphorus	7723-14-0	E440A/VA	2.0	mg/kg wwt	---	1020	---	---	---	
Potassium	7440-09-7	E472A/VA	4.0	mg/kg wwt	1920	---	3900	2830	804	
Potassium	7440-09-7	E440A/VA	4.0	mg/kg wwt	---	6130	---	---	---	
Rubidium	7440-17-7	E472A/VA	0.010	mg/kg wwt	9.79	---	17.4	15.3	4.32	
Rubidium	7440-17-7	E440A/VA	0.010	mg/kg wwt	---	3.72	---	---	---	
Selenium	7782-49-2	E440A/VA	0.010	mg/kg wwt	---	<0.010	---	---	---	
Selenium	7782-49-2	E472A/VA	0.020	mg/kg wwt	<0.020	---	0.030	<0.020	<0.020	
Silver	7440-22-4	E472A.Ag/VA	0.0010	mg/kg wwt	<0.0010	---	0.120	<0.0010	<0.0010	
Silver	7440-22-4	E440A.Ag/VA	0.0010	mg/kg wwt	---	<0.0010	---	---	---	
Sodium	7440-23-5	E472A/VA	4.0	mg/kg wwt	14.1	---	7.3	<4.0	8.1	
Sodium	7440-23-5	E440A/VA	4.0	mg/kg wwt	---	<4.0	---	---	---	
Strontium	7440-24-6	E440A/VA	0.010	mg/kg wwt	---	7.96	---	---	---	
Strontium	7440-24-6	E472A/VA	0.020	mg/kg wwt	0.311	---	1.58	10.1	0.430	
Tellurium	13494-80-9	E472A/VA	0.0040	mg/kg wwt	<0.0040	---	<0.0040	<0.0040	<0.0040	



Analytical Results

Sub-Matrix: Biota					Client sample ID				
(Matrix: Biota)					CF16	CF17	CF19	CF21	CF22
Client sampling date / time					07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	09-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-016	WP2414182-017	WP2414182-018	WP2414182-019	WP2414182-020
					Result	Result	Result	Result	Result
Metals									
Tellurium	13494-80-9	E440A/VA	0.0040	mg/kg wwt	---	<0.0040	---	---	---
Thallium	7440-28-0	E472A/VA	0.00040	mg/kg wwt	<0.00040	---	0.00058	<0.00040	0.00087
Thallium	7440-28-0	E440A/VA	0.00040	mg/kg wwt	---	<0.00040	---	---	---
Tin	7440-31-5	E472A/VA	0.020	mg/kg wwt	<0.020	---	<0.020	0.085	0.758
Tin	7440-31-5	E440A/VA	0.020	mg/kg wwt	---	0.261	---	---	---
Titanium	7440-32-6	E440A.Ti/VA	0.050	mg/kg wwt	---	0.703	---	---	---
Titanium	7440-32-6	E472A.Ti/VA	0.10	mg/kg wwt	0.68	---	1.52	1.09	<0.10
Uranium	7440-61-1	E472A/VA	0.00040	mg/kg wwt	0.00102	---	0.00220	0.00107	<0.00040
Uranium	7440-61-1	E440A/VA	0.00040	mg/kg wwt	---	0.00064	---	---	---
Vanadium	7440-62-2	E472A/VA	0.020	mg/kg wwt	0.021	---	0.081	0.033	<0.020
Vanadium	7440-62-2	E440A/VA	0.020	mg/kg wwt	---	0.026	---	---	---
Zinc	7440-66-6	E440A/VA	0.10	mg/kg wwt	---	2.30	---	---	---
Zinc	7440-66-6	E472A/VA	0.20	mg/kg wwt	27.6	---	90.1	14.2	0.76
Zirconium	7440-67-7	E472A/VA	0.040	mg/kg wwt	<0.040	---	<0.100 ^{DLM}	<0.060 ^{DLM}	<0.040
Zirconium	7440-67-7	E440A/VA	0.040	mg/kg wwt	---	<0.040	---	---	---
Speciated Metals									
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	0.0228	<0.0050	0.0069	0.0087	0.0052
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	0.0196	<0.0010	<0.0010	0.0012	0.0022
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	0.0096	<0.0010	<0.0010	<0.0010	<0.0010
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	0.0039
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	83-32-9	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	---	---
Acenaphthylene	208-96-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	---	---
Anthracene	120-12-7	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	---	---
Benz(a)anthracene	56-55-3	E642A.A/CG	0.010	mg/kg wwt	<0.020 ^{DLCI}	<0.010	<0.010	---	---
Benzo(a)pyrene	50-32-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	---	---
Benzo(b+j)fluoranthene	n/a	E642A.A/CG	0.010	mg/kg wwt	0.028	<0.010	<0.010	---	---
Benzo(b+j+k)fluoranthene	n/a	E642A.A/CG	0.015	mg/kg wwt	0.047	<0.015	<0.015	---	---



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF16	CF17	CF19	CF21	CF22
(Matrix: Biota)					Client sampling date / time	07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	09-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-016	WP2414182-017	WP2414182-018	WP2414182-019	WP2414182-020	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Benzo(g,h,i)perylene	191-24-2	E642A.A/CG	0.010	mg/kg wwt	0.019	<0.010	<0.010	----	----	
Benzo(k)fluoranthene	207-08-9	E642A.A/CG	0.010	mg/kg wwt	0.019	<0.010	<0.010	----	----	
Chrysene	218-01-9	E642A.A/CG	0.010	mg/kg wwt	<0.030 ^{DLCL}	<0.010	<0.010	----	----	
Dibenz(a,h)anthracene	53-70-3	E642A.A/CG	0.010	mg/kg wwt	0.013	<0.010	<0.010	----	----	
Fluoranthene	206-44-0	E642A.A/CG	0.010	mg/kg wwt	0.013	<0.010	<0.010	----	----	
Fluorene	86-73-7	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	----	----	
Indeno(1,2,3-c,d)pyrene	193-39-5	E642A.A/CG	0.010	mg/kg wwt	0.020	<0.010	<0.010	----	----	
Methylnaphthalene, 1-	90-12-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	----	----	
Methylnaphthalene, 2-	91-57-6	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	----	----	
Naphthalene	91-20-3	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	----	----	
Phenanthrene	85-01-8	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	----	----	
Pyrene	129-00-0	E642A.A/CG	0.010	mg/kg wwt	<0.010	<0.010	<0.010	----	----	
PAHs, total (EPA 16)	n/a	E642A.A/CG	0.040	mg/kg wwt	0.112	<0.040	<0.040	----	----	
Polycyclic Aromatic Hydrocarbons Surrogates										
Chrysene-d12	1719-03-5	E642A.A/CG	0.010	%	86.6	85.2	86.3	----	----	
Naphthalene-d8	1146-65-2	E642A.A/CG	0.010	%	79.1	82.5	82.4	----	----	
Phenanthrene-d10	1517-22-2	E642A.A/CG	0.010	%	95.5	92.8	97.6	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF26	CF24	---	---	---
(Matrix: Biota)					Client sampling date / time	12-Sep-2023 00:00	11-Sep-2023 00:00	---	---	---
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-021	WP2414182-022	-----	-----	-----	
					Result	Result	---	---	---	
Physical Tests										
Moisture	---	E144-H/VA	2.0	%	46.5	70.1	---	---	---	
Metals										
Aluminum	7429-90-5	E472A/VA	1.0	mg/kg wwt	40.6	46.1	---	---	---	
Antimony	7440-36-0	E472A/VA	0.0020	mg/kg wwt	0.0023	<0.0020	---	---	---	
Arsenic	7440-38-2	E472A/VA	0.0060	mg/kg wwt	0.0510	0.0108	---	---	---	
Barium	7440-39-3	E472A/VA	0.010	mg/kg wwt	18.6	4.74	---	---	---	
Beryllium	7440-41-7	E472A/VA	0.0020	mg/kg wwt	<0.0020	0.0022	---	---	---	
Bismuth	7440-69-9	E472A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	---	---	---	
Boron	7440-42-8	E472A/VA	0.20	mg/kg wwt	6.36	2.26	---	---	---	
Cadmium	7440-43-9	E472A/VA	0.0020	mg/kg wwt	0.0226	0.0089	---	---	---	
Calcium	7440-70-2	E472A/VA	4.0	mg/kg wwt	5270	1630	---	---	---	
Cesium	7440-46-2	E472A/VA	0.0010	mg/kg wwt	0.0242	0.0063	---	---	---	
Chromium	7440-47-3	E472A/VA	0.040	mg/kg wwt	0.079	0.278	---	---	---	
Cobalt	7440-48-4	E472A/VA	0.0040	mg/kg wwt	0.0383	0.664	---	---	---	
Copper	7440-50-8	E472A/VA	0.040	mg/kg wwt	1.06	0.590	---	---	---	
Iron	7439-89-6	E472A/VA	1.0	mg/kg wwt	48.6	65.0	---	---	---	
Lead	7439-92-1	E472A/VA	0.010	mg/kg wwt	0.059	0.024	---	---	---	
Lithium	7439-93-2	E472A/VA	0.10	mg/kg wwt	<0.10	<0.10	---	---	---	
Magnesium	7439-95-4	E472A/VA	0.40	mg/kg wwt	599	149	---	---	---	
Manganese	7439-96-5	E472A/VA	0.010	mg/kg wwt	116	284	---	---	---	
Mercury	7439-97-6	E511A/VA	0.0010	mg/kg wwt	0.0057	<0.0010	---	---	---	
Molybdenum	7439-98-7	E472A/VA	0.0080	mg/kg wwt	0.319	0.174	---	---	---	
Nickel	7440-02-0	E472A/VA	0.040	mg/kg wwt	0.169	0.191	---	---	---	
Phosphorus	7723-14-0	E472A/VA	2.0	mg/kg wwt	959	80.6	---	---	---	
Potassium	7440-09-7	E472A/VA	4.0	mg/kg wwt	3280	1380	---	---	---	
Rubidium	7440-17-7	E472A/VA	0.010	mg/kg wwt	4.25	0.445	---	---	---	
Selenium	7782-49-2	E472A/VA	0.020	mg/kg wwt	<0.020	<0.020	---	---	---	
Silver	7440-22-4	E472A.Ag/VA	0.0010	mg/kg wwt	0.0010	0.0018	---	---	---	
Sodium	7440-23-5	E472A/VA	4.0	mg/kg wwt	4.5	164	---	---	---	
Strontium	7440-24-6	E472A/VA	0.020	mg/kg wwt	32.6	9.20	---	---	---	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF26	CF24	----	----	----
(Matrix: Biota)					Client sampling date / time	12-Sep-2023 00:00	11-Sep-2023 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414182-021	WP2414182-022	-----	-----	-----	
					Result	Result	----	----	----	
Metals										
Tellurium	13494-80-9	E472A/VA	0.0040	mg/kg wwt	<0.0040	<0.0040	----	----	----	
Thallium	7440-28-0	E472A/VA	0.00040	mg/kg wwt	0.00150	0.00103	----	----	----	
Tin	7440-31-5	E472A/VA	0.020	mg/kg wwt	<0.020	<0.020	----	----	----	
Titanium	7440-32-6	E472A.Ti/VA	0.10	mg/kg wwt	3.49	5.22	----	----	----	
Uranium	7440-61-1	E472A/VA	0.00040	mg/kg wwt	0.00189	0.00248	----	----	----	
Vanadium	7440-62-2	E472A/VA	0.020	mg/kg wwt	0.079	0.142	----	----	----	
Zinc	7440-66-6	E472A/VA	0.20	mg/kg wwt	12.5	2.60	----	----	----	
Zirconium	7440-67-7	E472A/VA	0.040	mg/kg wwt	<0.080 ^{DLM}	0.151	----	----	----	
Speciated Metals										
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	0.0070	0.0060	----	----	----	
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	0.0012	0.0017	----	----	----	
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	0.0013	<0.0010	----	----	----	
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	----	----	----	
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	----	----	----	
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	----	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



QUALITY CONTROL INTERPRETIVE REPORT

<p>Work Order : WP2414182</p> <p>Client : Great Bear Resources Ltd</p> <p>Contact : Ashley Moncrief</p> <p>Address : Great Bear Resources Ltd. 117 Forestry Road Red Lake ON Canada P0V 2M0</p> <p>Telephone : 807 630 0203</p> <p>Project : PPR-022-3</p> <p>PO : PPR-022-3</p> <p>C-O-C number : ----</p> <p>Sampler : ----</p> <p>Site : ----</p> <p>Quote number : 2024 Standing offer_V2</p> <p>No. of samples received : 22</p> <p>No. of samples analysed : 22</p>	<p>Page : 1 of 24</p> <p>Laboratory : ALS Environmental - Winnipeg</p> <p>Account Manager : Judy Dalmajjer</p> <p>Address : 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4</p> <p>Telephone : +1 204 255 9720</p> <p>Date Samples Received : 04-Jun-2024 09:20</p> <p>Issue Date : 06-Aug-2024 16:47</p>
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This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

- Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO: Data Quality Objective.
- LOR: Limit of Reporting (detection limit).
- RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "----" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Biota**

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF26	E511A	12-Sep-2023	09-Jul-2024	365 days	302 days	✔	12-Jul-2024	365 days	305 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF24	E511A	11-Sep-2023	09-Jul-2024	365 days	303 days	✔	12-Jul-2024	365 days	306 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF21	E511A	09-Sep-2023	09-Jul-2024	365 days	305 days	✔	12-Jul-2024	365 days	308 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF22	E511A	09-Sep-2023	09-Jul-2024	365 days	305 days	✔	12-Jul-2024	365 days	308 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF16	E511A	07-Sep-2023	09-Jul-2024	365 days	307 days	✔	12-Jul-2024	365 days	310 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF19	E511A	07-Sep-2023	09-Jul-2024	365 days	307 days	✔	12-Jul-2024	365 days	310 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF14	E511A	06-Sep-2023	09-Jul-2024	365 days	308 days	✔	12-Jul-2024	365 days	311 days	✔



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Mercury in Biota by CVAAS (WET units, Micro)											
LDPE bag CF-DUP-01	E511A	06-Sep-2023	09-Jul-2024	365 days	308 days	✔	12-Jul-2024	365 days	311 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Micro)											
LDPE bag CF13	E511A	30-Aug-2023	09-Jul-2024	365 days	315 days	✔	12-Jul-2024	365 days	318 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Micro)											
LDPE bag CF09	E511A	28-Aug-2023	09-Jul-2024	365 days	317 days	✔	12-Jul-2024	365 days	320 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Micro)											
LDPE bag CF10	E511A	28-Aug-2023	09-Jul-2024	365 days	317 days	✔	12-Jul-2024	365 days	320 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Micro)											
LDPE bag CF12	E511A	28-Aug-2023	09-Jul-2024	365 days	317 days	✔	12-Jul-2024	365 days	320 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Micro)											
LDPE bag CF08	E511A	21-Aug-2023	09-Jul-2024	365 days	324 days	✔	12-Jul-2024	365 days	327 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF17	E510A	07-Sep-2023	05-Jul-2024	365 days	302 days	✔	06-Jul-2024	365 days	304 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF11	E510A	28-Aug-2023	05-Jul-2024	365 days	312 days	✔	06-Jul-2024	365 days	314 days	✔	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF04	E510A	21-Aug-2023	05-Jul-2024	365 days	319 days	✔	06-Jul-2024	365 days	321 days	✔	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF06	E510A	21-Aug-2023	05-Jul-2024	365 days	319 days	✓	06-Jul-2024	365 days	321 days	✓	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF02	E510A	18-Aug-2023	05-Jul-2024	365 days	322 days	✓	06-Jul-2024	365 days	324 days	✓	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF03	E510A	18-Aug-2023	05-Jul-2024	365 days	322 days	✓	06-Jul-2024	365 days	324 days	✓	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF05	E510A	21-Aug-2023	09-Jul-2024	365 days	324 days	✓	18-Jul-2024	365 days	333 days	✓	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF07	E510A	21-Aug-2023	09-Jul-2024	365 days	324 days	✓	18-Jul-2024	365 days	333 days	✓	
Metals : Mercury in Biota by CVAAS (WET units, Routine)											
LDPE bag CF01	E510A	18-Aug-2023	09-Jul-2024	365 days	327 days	✓	18-Jul-2024	365 days	336 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF26	E472A	12-Sep-2023	09-Jul-2024	730 days	302 days	✓	09-Jul-2024	730 days	302 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF24	E472A	11-Sep-2023	09-Jul-2024	730 days	303 days	✓	09-Jul-2024	730 days	303 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF21	E472A	09-Sep-2023	09-Jul-2024	730 days	305 days	✓	09-Jul-2024	730 days	305 days	✓	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF22	E472A	09-Sep-2023	09-Jul-2024	730 days	305 days	✔	09-Jul-2024	730 days	305 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF16	E472A	07-Sep-2023	09-Jul-2024	730 days	307 days	✔	09-Jul-2024	730 days	307 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF19	E472A	07-Sep-2023	09-Jul-2024	730 days	307 days	✔	09-Jul-2024	730 days	307 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF14	E472A	06-Sep-2023	09-Jul-2024	730 days	308 days	✔	09-Jul-2024	730 days	308 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF-DUP-01	E472A	06-Sep-2023	09-Jul-2024	730 days	308 days	✔	09-Jul-2024	730 days	308 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF13	E472A	30-Aug-2023	09-Jul-2024	730 days	315 days	✔	09-Jul-2024	730 days	315 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF09	E472A	28-Aug-2023	09-Jul-2024	730 days	317 days	✔	09-Jul-2024	730 days	317 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF10	E472A	28-Aug-2023	09-Jul-2024	730 days	317 days	✔	09-Jul-2024	730 days	317 days	✔	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF12	E472A	28-Aug-2023	09-Jul-2024	730 days	317 days	✔	09-Jul-2024	730 days	317 days	✔	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF08	E472A	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	09-Jul-2024	730 days	324 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF17	E440A	07-Sep-2023	05-Jul-2024	730 days	302 days	✓	05-Jul-2024	730 days	303 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF11	E440A	28-Aug-2023	05-Jul-2024	730 days	312 days	✓	05-Jul-2024	730 days	313 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF04	E440A	21-Aug-2023	05-Jul-2024	730 days	319 days	✓	05-Jul-2024	730 days	320 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF06	E440A	21-Aug-2023	05-Jul-2024	730 days	319 days	✓	05-Jul-2024	730 days	320 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF02	E440A	18-Aug-2023	05-Jul-2024	730 days	322 days	✓	05-Jul-2024	730 days	323 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF03	E440A	18-Aug-2023	05-Jul-2024	730 days	322 days	✓	05-Jul-2024	730 days	323 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF05	E440A	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	10-Jul-2024	730 days	325 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF07	E440A	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	10-Jul-2024	730 days	325 days	✓	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF01	E440A	18-Aug-2023	09-Jul-2024	730 days	327 days	✔	10-Jul-2024	730 days	328 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF26	E472A.Ag	12-Sep-2023	09-Jul-2024	730 days	302 days	✔	09-Jul-2024	730 days	302 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF24	E472A.Ag	11-Sep-2023	09-Jul-2024	730 days	303 days	✔	09-Jul-2024	730 days	303 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF21	E472A.Ag	09-Sep-2023	09-Jul-2024	730 days	305 days	✔	09-Jul-2024	730 days	305 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF22	E472A.Ag	09-Sep-2023	09-Jul-2024	730 days	305 days	✔	09-Jul-2024	730 days	305 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF16	E472A.Ag	07-Sep-2023	09-Jul-2024	730 days	307 days	✔	09-Jul-2024	730 days	307 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF19	E472A.Ag	07-Sep-2023	09-Jul-2024	730 days	307 days	✔	09-Jul-2024	730 days	307 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF14	E472A.Ag	06-Sep-2023	09-Jul-2024	730 days	308 days	✔	09-Jul-2024	730 days	308 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF-DUP-01	E472A.Ag	06-Sep-2023	09-Jul-2024	730 days	308 days	✔	09-Jul-2024	730 days	308 days	✔	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF13	E472A.Ag	30-Aug-2023	09-Jul-2024	730 days	315 days	✓	09-Jul-2024	730 days	315 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF09	E472A.Ag	28-Aug-2023	09-Jul-2024	730 days	317 days	✓	09-Jul-2024	730 days	317 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF10	E472A.Ag	28-Aug-2023	09-Jul-2024	730 days	317 days	✓	09-Jul-2024	730 days	317 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF12	E472A.Ag	28-Aug-2023	09-Jul-2024	730 days	317 days	✓	09-Jul-2024	730 days	317 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF08	E472A.Ag	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	09-Jul-2024	730 days	324 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF17	E440A.Ag	07-Sep-2023	05-Jul-2024	730 days	302 days	✓	05-Jul-2024	730 days	303 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF11	E440A.Ag	28-Aug-2023	05-Jul-2024	730 days	312 days	✓	05-Jul-2024	730 days	313 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF04	E440A.Ag	21-Aug-2023	05-Jul-2024	730 days	319 days	✓	05-Jul-2024	730 days	320 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF06	E440A.Ag	21-Aug-2023	05-Jul-2024	730 days	319 days	✓	05-Jul-2024	730 days	320 days	✓	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF02	E440A.Ag	18-Aug-2023	05-Jul-2024	730 days	322 days	✓	05-Jul-2024	730 days	323 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF03	E440A.Ag	18-Aug-2023	05-Jul-2024	730 days	322 days	✓	05-Jul-2024	730 days	323 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF05	E440A.Ag	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	10-Jul-2024	730 days	325 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF07	E440A.Ag	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	10-Jul-2024	730 days	325 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF01	E440A.Ag	18-Aug-2023	09-Jul-2024	730 days	327 days	✓	10-Jul-2024	730 days	328 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF26	E472A.Ti	12-Sep-2023	09-Jul-2024	730 days	302 days	✓	09-Jul-2024	730 days	302 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF24	E472A.Ti	11-Sep-2023	09-Jul-2024	730 days	303 days	✓	09-Jul-2024	730 days	303 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF21	E472A.Ti	09-Sep-2023	09-Jul-2024	730 days	305 days	✓	09-Jul-2024	730 days	305 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF22	E472A.Ti	09-Sep-2023	09-Jul-2024	730 days	305 days	✓	09-Jul-2024	730 days	305 days	✓	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF16	E472A.Ti	07-Sep-2023	09-Jul-2024	730 days	307 days	✔	09-Jul-2024	730 days	307 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF19	E472A.Ti	07-Sep-2023	09-Jul-2024	730 days	307 days	✔	09-Jul-2024	730 days	307 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF14	E472A.Ti	06-Sep-2023	09-Jul-2024	730 days	308 days	✔	09-Jul-2024	730 days	308 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF-DUP-01	E472A.Ti	06-Sep-2023	09-Jul-2024	730 days	308 days	✔	09-Jul-2024	730 days	308 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF13	E472A.Ti	30-Aug-2023	09-Jul-2024	730 days	315 days	✔	09-Jul-2024	730 days	315 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF09	E472A.Ti	28-Aug-2023	09-Jul-2024	730 days	317 days	✔	09-Jul-2024	730 days	317 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF10	E472A.Ti	28-Aug-2023	09-Jul-2024	730 days	317 days	✔	09-Jul-2024	730 days	317 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF12	E472A.Ti	28-Aug-2023	09-Jul-2024	730 days	317 days	✔	09-Jul-2024	730 days	317 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF08	E472A.Ti	21-Aug-2023	09-Jul-2024	730 days	324 days	✔	09-Jul-2024	730 days	324 days	✔	



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Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF17	E440A.Ti	07-Sep-2023	05-Jul-2024	730 days	302 days	✓	05-Jul-2024	730 days	303 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF11	E440A.Ti	28-Aug-2023	05-Jul-2024	730 days	312 days	✓	05-Jul-2024	730 days	313 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF04	E440A.Ti	21-Aug-2023	05-Jul-2024	730 days	319 days	✓	05-Jul-2024	730 days	320 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF06	E440A.Ti	21-Aug-2023	05-Jul-2024	730 days	319 days	✓	05-Jul-2024	730 days	320 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF02	E440A.Ti	18-Aug-2023	05-Jul-2024	730 days	322 days	✓	05-Jul-2024	730 days	323 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF03	E440A.Ti	18-Aug-2023	05-Jul-2024	730 days	322 days	✓	05-Jul-2024	730 days	323 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF05	E440A.Ti	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	10-Jul-2024	730 days	325 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF07	E440A.Ti	21-Aug-2023	09-Jul-2024	730 days	324 days	✓	10-Jul-2024	730 days	325 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Routine)											
LDPE bag CF01	E440A.Ti	18-Aug-2023	09-Jul-2024	730 days	327 days	✓	10-Jul-2024	730 days	328 days	✓	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF26	E144-H	12-Sep-2023	----	----	----		08-Jul-2024	----	301 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF24	E144-H	11-Sep-2023	----	----	----		08-Jul-2024	----	302 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF21	E144-H	09-Sep-2023	----	----	----		08-Jul-2024	----	304 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF22	E144-H	09-Sep-2023	----	----	----		08-Jul-2024	----	304 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF16	E144-H	07-Sep-2023	----	----	----		08-Jul-2024	----	306 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF19	E144-H	07-Sep-2023	----	----	----		08-Jul-2024	----	306 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF14	E144-H	06-Sep-2023	----	----	----		08-Jul-2024	----	307 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF-DUP-01	E144-H	06-Sep-2023	----	----	----		08-Jul-2024	----	307 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF13	E144-H	30-Aug-2023	----	----	----		08-Jul-2024	----	314 days	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF09	E144-H	28-Aug-2023	----	----	----		08-Jul-2024	----	316 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF10	E144-H	28-Aug-2023	----	----	----		08-Jul-2024	----	316 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF12	E144-H	28-Aug-2023	----	----	----		08-Jul-2024	----	316 days	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF08	E144-H	21-Aug-2023	----	----	----		08-Jul-2024	----	323 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF17	E144	07-Sep-2023	----	----	----		18-Jun-2024	----	286 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF11	E144	28-Aug-2023	----	----	----		18-Jun-2024	----	296 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF04	E144	21-Aug-2023	----	----	----		18-Jun-2024	----	303 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF05	E144	21-Aug-2023	----	----	----		18-Jun-2024	----	303 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF06	E144	21-Aug-2023	----	----	----		18-Jun-2024	----	303 days	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF07	E144	21-Aug-2023	----	----	----		18-Jun-2024	----	303 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF01	E144	18-Aug-2023	----	----	----		18-Jun-2024	----	306 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF02	E144	18-Aug-2023	----	----	----		18-Jun-2024	----	306 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF03	E144	18-Aug-2023	----	----	----		18-Jun-2024	----	306 days	
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF16	E642A.A	07-Sep-2023	26-Jul-2024	364 days	324 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF17	E642A.A	07-Sep-2023	26-Jul-2024	364 days	324 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF19	E642A.A	07-Sep-2023	26-Jul-2024	364 days	324 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF14	E642A.A	06-Sep-2023	26-Jul-2024	364 days	325 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF-DUP-01	E642A.A	06-Sep-2023	26-Jul-2024	364 days	325 days	✔	30-Jul-2024	40 days	4 days	✔



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF13	E642A.A	30-Aug-2023	26-Jul-2024	364 days	332 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF10	E642A.A	28-Aug-2023	26-Jul-2024	364 days	334 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF11	E642A.A	28-Aug-2023	26-Jul-2024	364 days	334 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF12	E642A.A	28-Aug-2023	26-Jul-2024	364 days	334 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF04	E642A.A	21-Aug-2023	26-Jul-2024	364 days	341 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF05	E642A.A	21-Aug-2023	26-Jul-2024	364 days	341 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF06	E642A.A	21-Aug-2023	26-Jul-2024	364 days	341 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF07	E642A.A	21-Aug-2023	26-Jul-2024	364 days	341 days	✔	30-Jul-2024	40 days	4 days	✔
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)										
LDPE bag CF01	E642A.A	18-Aug-2023	26-Jul-2024	364 days	344 days	✔	30-Jul-2024	40 days	4 days	✔



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)											
LDPE bag CF02	E642A.A	18-Aug-2023	26-Jul-2024	364 days	344 days	✓	30-Jul-2024	40 days	4 days	✓	
Polycyclic Aromatic Hydrocarbons : PAHs by GC-MS (Wet Weight)											
LDPE bag CF03	E642A.A	18-Aug-2023	26-Jul-2024	364 days	344 days	✓	30-Jul-2024	40 days	4 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF26	E539A	12-Sep-2023	31-Jul-2024	730 days	324 days	✓	01-Aug-2024	730 days	325 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF24	E539A	11-Sep-2023	31-Jul-2024	730 days	325 days	✓	01-Aug-2024	730 days	326 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF21	E539A	09-Sep-2023	31-Jul-2024	730 days	327 days	✓	01-Aug-2024	730 days	328 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF22	E539A	09-Sep-2023	31-Jul-2024	730 days	327 days	✓	01-Aug-2024	730 days	328 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF16	E539A	07-Sep-2023	31-Jul-2024	730 days	329 days	✓	01-Aug-2024	730 days	330 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF17	E539A	07-Sep-2023	31-Jul-2024	730 days	329 days	✓	01-Aug-2024	730 days	330 days	✓	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)											
LDPE bag CF19	E539A	07-Sep-2023	31-Jul-2024	730 days	329 days	✓	01-Aug-2024	730 days	330 days	✓	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF14	E539A	06-Sep-2023	31-Jul-2024	730 days	330 days	✓	01-Aug-2024	730 days	331 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF-DUP-01	E539A	06-Sep-2023	31-Jul-2024	730 days	330 days	✓	01-Aug-2024	730 days	331 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF13	E539A	30-Aug-2023	31-Jul-2024	730 days	337 days	✓	01-Aug-2024	730 days	338 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF09	E539A	28-Aug-2023	31-Jul-2024	730 days	339 days	✓	01-Aug-2024	730 days	340 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF10	E539A	28-Aug-2023	31-Jul-2024	730 days	339 days	✓	01-Aug-2024	730 days	340 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF11	E539A	28-Aug-2023	31-Jul-2024	730 days	339 days	✓	01-Aug-2024	730 days	340 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF12	E539A	28-Aug-2023	31-Jul-2024	730 days	339 days	✓	01-Aug-2024	730 days	340 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF04	E539A	21-Aug-2023	31-Jul-2024	730 days	346 days	✓	01-Aug-2024	730 days	347 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF05	E539A	21-Aug-2023	31-Jul-2024	730 days	346 days	✓	01-Aug-2024	730 days	347 days	✓



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF06	E539A	21-Aug-2023	31-Jul-2024	730 days	346 days	✓	01-Aug-2024	730 days	347 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF07	E539A	21-Aug-2023	31-Jul-2024	730 days	346 days	✓	01-Aug-2024	730 days	347 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF08	E539A	21-Aug-2023	31-Jul-2024	730 days	346 days	✓	01-Aug-2024	730 days	347 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF01	E539A	18-Aug-2023	31-Jul-2024	730 days	349 days	✓	01-Aug-2024	730 days	350 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF02	E539A	18-Aug-2023	31-Jul-2024	730 days	349 days	✓	01-Aug-2024	730 days	350 days	✓
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF03	E539A	18-Aug-2023	31-Jul-2024	730 days	349 days	✓	01-Aug-2024	730 days	350 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Biota**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570463	2	29	6.9	5.0	✔
Mercury in Biota by CVAAS (WET units, Micro)	E511A	1534022	1	13	7.6	5.0	✔
Mercury in Biota by CVAAS (WET units, Routine)	E510A	1527880	2	9	22.2	5.0	✔
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A	1534023	1	13	7.6	5.0	✔
Metals in Biota by CRC ICPMS (WET units, Routine)	E440A	1527877	2	9	22.2	5.0	✔
Moisture Content by Gravimetry	E144	1500780	1	9	11.1	5.0	✔
Moisture Content by Gravimetry (Micro)	E144-H	1534017	1	13	7.6	5.0	✔
PAHs by GC-MS (Wet Weight)	E642A.A	1566417	0	16	0.0	5.0	✖
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag	1534020	1	13	7.6	5.0	✔
Silver in Biota by CRC ICPMS (WET units, Routine)	E440A.Ag	1527878	2	9	22.2	5.0	✔
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti	1534021	1	13	7.6	5.0	✔
Titanium in Biota by CRC ICPMS (WET units, Routine)	E440A.Ti	1527879	2	9	22.2	5.0	✔
Laboratory Control Samples (LCS)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570463	6	29	20.6	25.0	✖
Mercury in Biota by CVAAS (WET units, Micro)	E511A	1534022	2	13	15.3	10.0	✔
Mercury in Biota by CVAAS (WET units, Routine)	E510A	1527880	4	9	44.4	10.0	✔
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A	1534023	2	13	15.3	10.0	✔
Metals in Biota by CRC ICPMS (WET units, Routine)	E440A	1527877	4	9	44.4	10.0	✔
Moisture Content by Gravimetry	E144	1500780	1	9	11.1	5.0	✔
Moisture Content by Gravimetry (Micro)	E144-H	1534017	1	13	7.6	5.0	✔
PAHs by GC-MS (Wet Weight)	E642A.A	1566417	1	16	6.2	5.0	✔
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag	1534020	2	13	15.3	10.0	✔
Silver in Biota by CRC ICPMS (WET units, Routine)	E440A.Ag	1527878	4	9	44.4	10.0	✔
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti	1534021	2	13	15.3	10.0	✔
Titanium in Biota by CRC ICPMS (WET units, Routine)	E440A.Ti	1527879	4	9	44.4	10.0	✔
Method Blanks (MB)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570463	2	29	6.9	5.0	✔
Mercury in Biota by CVAAS (WET units, Micro)	E511A	1534022	1	13	7.6	5.0	✔
Mercury in Biota by CVAAS (WET units, Routine)	E510A	1527880	2	9	22.2	5.0	✔
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A	1534023	1	13	7.6	5.0	✔
Metals in Biota by CRC ICPMS (WET units, Routine)	E440A	1527877	2	9	22.2	5.0	✔
Moisture Content by Gravimetry	E144	1500780	1	9	11.1	5.0	✔
Moisture Content by Gravimetry (Micro)	E144-H	1534017	1	13	7.6	5.0	✔
PAHs by GC-MS (Wet Weight)	E642A.A	1566417	1	16	6.2	5.0	✔
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag	1534020	1	13	7.6	5.0	✔



Matrix: **Biota** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
<i>Analytical Methods</i>							
<i>Method Blanks (MB) - Continued</i>							
Silver in Biota by CRC ICPMS (WET units, Routine)	E440A.Ag	1527878	2	9	22.2	5.0	✔
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti	1534021	1	13	7.6	5.0	✔
Titanium in Biota by CRC ICPMS (WET units, Routine)	E440A.Ti	1527879	2	9	22.2	5.0	✔
<i>Matrix Spikes (MS)</i>							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570463	2	29	6.9	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Moisture Content by Gravimetry	E144 ALS Environmental - Vancouver	Biota	Puget Sound Water Quality Authority/CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Moisture Content by Gravimetry (Micro)	E144-H ALS Environmental - Vancouver	Biota	Puget Sound Water Quality Authority/BC MOE Lab Manual	Moisture is measured gravimetrically by drying the sample at <60°C for a minimum of 3 days to constant weight. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of soil, expressed as a percentage.
Metals in Biota by CRC ICPMS (WET units, Routine)	E440A ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Silver in Biota by CRC ICPMS (WET units, Routine)	E440A.Ag ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Titanium in Biota by CRC ICPMS (WET units, Routine)	E440A.Ti ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by High Resolution ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Mercury in Biota by CVAAS (WET units, Routine)	E510A ALS Environmental - Vancouver	Biota	EPA 200.3/1631 Appendix (mod)	Samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by CVAAS.
Mercury in Biota by CVAAS (WET units, Micro)	E511A ALS Environmental - Vancouver	Biota	EPA 200.3/1631 Appendix (mod)	Samples are homogenized and sub-sampled prior to hotblock digestion with nitric acid, hydrochloric acid, and hydrogen peroxide. Analysis is by CVAAS.
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A ALS Environmental - Vancouver	Biota	CFIA SOM-DAR-CHE-053-04, Oct 2012	Instrumental analysis of Speciated Arsenic (As) is by Anion Exchange HPLC-CRC ICPMS. The results reported for arsenic species represent those forms available to analysis using the particular enzymatic digestion and chromatographic conditions of the method. Total arsenic content is best measured using a more rigorous acid/peroxide digestion. Species concentrations will almost always be lower than those measured using the 'total' digestion. The proportion of total arsenic represented in the species concentrations varies considerably with sample matrix characteristics: plant vs. animal, lipid content, etc.
PAHs by GC-MS (Wet Weight)	E642A.A ALS Environmental - Calgary	Biota	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are analyzed by GC-MS.
Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals and Mercury Biota Digestion	EP440 ALS Environmental - Vancouver	Biota	EPA 200.3	This method uses a heated strong acid digestion with HNO ₃ , HCl, and H ₂ O ₂ and is intended to provide a conservative estimate of bio-available metals.



<i>Preparation Methods</i>	<i>Method / Lab</i>	<i>Matrix</i>	<i>Method Reference</i>	<i>Method Descriptions</i>
Metals and Mercury Biota Digestion (Micro)	EP472 ALS Environmental - Vancouver	Biota	EPA 200.3	This method, designed for small sample amounts, uses a heated strong acid digestion with HNO ₃ , HCl, and H ₂ O ₂ and is intended to provide a conservative estimate of bio-available metals.
Arsenic Species Extraction in Biota Preparation	EP539 ALS Environmental - Vancouver	Biota	CFIA SOM-DAR-CHE-053-0 4, Oct 2012	Tissue Samples are homogenized and extracted using a methanol/enzymatic extraction procedure. Samples are extracted at 37 °C using Protease, Alpha amylase and Lipase in 25% methanol solution.
PAHs DCM-Acetone Tumbler Extraction	EP642 ALS Environmental - Calgary	Biota	EPA 3570 (mod)	Samples are subsampled and PAHs are extracted with 1:1 DCM:acetone using a rotary extractor.

QUALITY CONTROL REPORT

Work Order	: WP2414182	Page	: 1 of 22
Client	: Great Bear Resources Ltd	Laboratory	: ALS Environmental - Winnipeg
Contact	: Ashley Moncrief	Account Manager	: Judy Dalmaijer
Address	: Great Bear Resources Ltd. 117 Forestry Road Red Lake ON Canada P0V 2M0	Address	: 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4
Telephone	: 807 630 0203	Telephone	: +1 204 255 9720
Project	: PPR-022-3	Date Samples Received	: 04-Jun-2024 09:20
PO	: PPR-022-3	Date Analysis Commenced	: 18-Jun-2024
C-O-C number	: ----	Issue Date	: 06-Aug-2024 16:47
Sampler	: ----		
Site	: ----		
Quote number	: 2024 Standing offer_V2		
No. of samples received	: 22		
No. of samples analysed	: 22		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Dan Gebert	Laboratory Analyst	Vancouver Metals, Burnaby, British Columbia
Ilnaz Badbezanchi	Supervisor - Metals Prep & Mercury	Vancouver Metals, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Vancouver Metals, Burnaby, British Columbia
Maya Urquhart	Lab Analyst	Vancouver Metals, Burnaby, British Columbia
Sam Silveira	Analyst	Vancouver Metals, Burnaby, British Columbia
Sorina Motea	Laboratory Analyst	Calgary Organics, Calgary, Alberta



General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Biota					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Physical Tests (QC Lot: 1500780)											
WP2414182-001	CF01	Moisture	----	E144	0.50	%	57.4	59.9	4.28%	20%	----
Physical Tests (QC Lot: 1534017)											
WP2414182-021	CF26	Moisture	----	E144-H	2.0	%	46.5	47.2	1.54%	20%	----
Metals (QC Lot: 1527877)											
WP2414182-002	CF02	Aluminum	7429-90-5	E440A	0.40	mg/kg wwt	5.28	4.78	9.85%	40%	----
		Antimony	7440-36-0	E440A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Arsenic	7440-38-2	E440A	0.0040	mg/kg wwt	0.0110	0.0104	0.0006	Diff <2x LOR	----
		Barium	7440-39-3	E440A	0.010	mg/kg wwt	2.82	2.89	2.35%	40%	----
		Beryllium	7440-41-7	E440A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Bismuth	7440-69-9	E440A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Boron	7440-42-8	E440A	0.20	mg/kg wwt	0.66	0.63	0.03	Diff <2x LOR	----
		Cadmium	7440-43-9	E440A	0.0010	mg/kg wwt	<0.0010	0.0013	0.0003	Diff <2x LOR	----
		Calcium	7440-70-2	E440A	4.0	mg/kg wwt	807	874	7.96%	60%	----
		Cesium	7440-46-2	E440A	0.0010	mg/kg wwt	0.265	0.267	0.798%	40%	----
		Chromium	7440-47-3	E440A	0.010	mg/kg wwt	<0.010	<0.010	0	Diff <2x LOR	----
		Cobalt	7440-48-4	E440A	0.0040	mg/kg wwt	<0.0040	<0.0040	0	Diff <2x LOR	----
		Copper	7440-50-8	E440A	0.020	mg/kg wwt	0.228	0.221	3.26%	40%	----
		Iron	7439-89-6	E440A	0.60	mg/kg wwt	1.70	1.60	0.10	Diff <2x LOR	----
		Lead	7439-92-1	E440A	0.0040	mg/kg wwt	<0.0040	<0.0040	0	Diff <2x LOR	----
		Lithium	7439-93-2	E440A	0.10	mg/kg wwt	<0.10	<0.10	0	Diff <2x LOR	----
		Magnesium	7439-95-4	E440A	0.40	mg/kg wwt	169	174	3.37%	40%	----
		Manganese	7439-96-5	E440A	0.010	mg/kg wwt	1.21	1.18	2.66%	40%	----
		Molybdenum	7439-98-7	E440A	0.0040	mg/kg wwt	0.0255	0.0281	9.65%	40%	----
		Nickel	7440-02-0	E440A	0.040	mg/kg wwt	0.044	0.045	0.001	Diff <2x LOR	----
		Phosphorus	7723-14-0	E440A	2.0	mg/kg wwt	164	169	2.62%	40%	----
		Potassium	7440-09-7	E440A	4.0	mg/kg wwt	1090	1110	1.46%	40%	----
		Rubidium	7440-17-7	E440A	0.010	mg/kg wwt	9.91	10.2	2.47%	40%	----
		Selenium	7782-49-2	E440A	0.010	mg/kg wwt	<0.010	<0.010	0	Diff <2x LOR	----
		Sodium	7440-23-5	E440A	4.0	mg/kg wwt	5.2	5.4	0.2	Diff <2x LOR	----
		Strontium	7440-24-6	E440A	0.010	mg/kg wwt	4.26	4.48	5.02%	60%	----



Sub-Matrix: Biota					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1527877) - continued											
WP2414182-002	CF02	Tellurium	13494-80-9	E440A	0.0040	mg/kg wwt	<0.0040	<0.0040	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440A	0.00040	mg/kg wwt	<0.00040	<0.00040	0	Diff <2x LOR	----
		Tin	7440-31-5	E440A	0.020	mg/kg wwt	<0.020	<0.020	0	Diff <2x LOR	----
		Uranium	7440-61-1	E440A	0.00040	mg/kg wwt	<0.00040	<0.00040	0	Diff <2x LOR	----
		Vanadium	7440-62-2	E440A	0.020	mg/kg wwt	<0.020	<0.020	0	Diff <2x LOR	----
		Zinc	7440-66-6	E440A	0.10	mg/kg wwt	0.76	0.73	3.20%	40%	----
		Zirconium	7440-67-7	E440A	0.040	mg/kg wwt	<0.040	<0.040	0	Diff <2x LOR	----
Metals (QC Lot: 1527878)											
WP2414182-002	CF02	Silver	7440-22-4	E440A.Ag	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
Metals (QC Lot: 1527879)											
WP2414182-002	CF02	Titanium	7440-32-6	E440A.Ti	0.050	mg/kg wwt	<0.050	<0.050	0	Diff <2x LOR	----
Metals (QC Lot: 1527880)											
WP2414182-002	CF02	Mercury	7439-97-6	E510A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
Metals (QC Lot: 1533419)											
WP2414182-001	CF01	Silver	7440-22-4	E440A.Ag	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
Metals (QC Lot: 1533420)											
WP2414182-001	CF01	Titanium	7440-32-6	E440A.Ti	0.050	mg/kg wwt	0.499	0.534	6.82%	40%	----
Metals (QC Lot: 1533421)											
WP2414182-001	CF01	Aluminum	7429-90-5	E440A	0.40	mg/kg wwt	11.1	11.9	6.85%	40%	----
		Antimony	7440-36-0	E440A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Arsenic	7440-38-2	E440A	0.0040	mg/kg wwt	0.0323	0.0366	12.3%	40%	----
		Barium	7440-39-3	E440A	0.010	mg/kg wwt	31.6	28.9	8.94%	40%	----
		Beryllium	7440-41-7	E440A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Bismuth	7440-69-9	E440A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Boron	7440-42-8	E440A	0.20	mg/kg wwt	8.49	8.29	2.45%	40%	----
		Cadmium	7440-43-9	E440A	0.0010	mg/kg wwt	0.0012	0.0029	0.0016	Diff <2x LOR	----
		Calcium	7440-70-2	E440A	4.0	mg/kg wwt	1930	1940	0.359%	60%	----
		Cesium	7440-46-2	E440A	0.0010	mg/kg wwt	0.123	0.115	7.30%	40%	----
		Chromium	7440-47-3	E440A	0.010	mg/kg wwt	0.032	0.051	0.019	Diff <2x LOR	----
		Cobalt	7440-48-4	E440A	0.0040	mg/kg wwt	0.0160	0.0148	0.0012	Diff <2x LOR	----
		Copper	7440-50-8	E440A	0.020	mg/kg wwt	1.77	1.67	6.05%	40%	----
		Iron	7439-89-6	E440A	0.60	mg/kg wwt	21.4	21.2	0.947%	40%	----
		Lead	7439-92-1	E440A	0.0040	mg/kg wwt	0.0189	0.0132	0.0058	Diff <2x LOR	----
Lithium	7439-93-2	E440A	0.10	mg/kg wwt	<0.10	<0.10	0	Diff <2x LOR	----		



Sub-Matrix: Biota					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1533421) - continued											
WP2414182-001	CF01	Magnesium	7439-95-4	E440A	0.40	mg/kg wwt	749	702	6.44%	40%	----
		Manganese	7439-96-5	E440A	0.010	mg/kg wwt	254	242	4.79%	40%	----
		Molybdenum	7439-98-7	E440A	0.0040	mg/kg wwt	0.0151	0.0148	0.0002	Diff <2x LOR	----
		Nickel	7440-02-0	E440A	0.040	mg/kg wwt	0.168	0.201	0.033	Diff <2x LOR	----
		Phosphorus	7723-14-0	E440A	2.0	mg/kg wwt	611	570	7.02%	40%	----
		Potassium	7440-09-7	E440A	4.0	mg/kg wwt	1810	1690	6.80%	40%	----
		Rubidium	7440-17-7	E440A	0.010	mg/kg wwt	14.0	13.3	5.33%	40%	----
		Selenium	7782-49-2	E440A	0.010	mg/kg wwt	<0.010	<0.010	0	Diff <2x LOR	----
		Sodium	7440-23-5	E440A	4.0	mg/kg wwt	10.9	10.1	0.8	Diff <2x LOR	----
		Strontium	7440-24-6	E440A	0.010	mg/kg wwt	6.20	5.64	9.46%	60%	----
		Tellurium	13494-80-9	E440A	0.0040	mg/kg wwt	<0.0040	<0.0040	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440A	0.00040	mg/kg wwt	<0.00040	<0.00040	0	Diff <2x LOR	----
		Tin	7440-31-5	E440A	0.020	mg/kg wwt	<0.020	<0.020	0	Diff <2x LOR	----
		Uranium	7440-61-1	E440A	0.00040	mg/kg wwt	0.00074	0.00056	0.00018	Diff <2x LOR	----
		Vanadium	7440-62-2	E440A	0.020	mg/kg wwt	<0.020	0.021	0.0007	Diff <2x LOR	----
Zinc	7440-66-6	E440A	0.10	mg/kg wwt	9.86	8.98	9.36%	40%	----		
Zirconium	7440-67-7	E440A	0.060	mg/kg wwt	<0.060	<0.060	0	Diff <2x LOR	----		
Metals (QC Lot: 1533422)											
WP2414182-001	CF01	Mercury	7439-97-6	E510A	0.0014	mg/kg wwt	0.0028	0.0030	0.0002	Diff <2x LOR	----
Metals (QC Lot: 1534020)											
WP2414182-021	CF26	Silver	7440-22-4	E472A.Ag	0.0010	mg/kg wwt	0.0010	<0.0010	0.00003	Diff <2x LOR	----
Metals (QC Lot: 1534021)											
WP2414182-021	CF26	Titanium	7440-32-6	E472A.Ti	0.10	mg/kg wwt	3.49	3.94	12.2%	40%	----
Metals (QC Lot: 1534022)											
WP2414182-021	CF26	Mercury	7439-97-6	E511A	0.0010	mg/kg wwt	0.0057	0.0050	12.7%	40%	----
Metals (QC Lot: 1534023)											
WP2414182-021	CF26	Aluminum	7429-90-5	E472A	1.0	mg/kg wwt	40.6	40.4	0.354%	40%	----
		Antimony	7440-36-0	E472A	0.0020	mg/kg wwt	0.0023	0.0022	0.0001	Diff <2x LOR	----
		Arsenic	7440-38-2	E472A	0.0060	mg/kg wwt	0.0510	0.0520	1.86%	40%	----
		Barium	7440-39-3	E472A	0.010	mg/kg wwt	18.6	18.3	2.00%	40%	----
		Beryllium	7440-41-7	E472A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Bismuth	7440-69-9	E472A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Boron	7440-42-8	E472A	0.20	mg/kg wwt	6.36	6.41	0.730%	40%	----
		Cadmium	7440-43-9	E472A	0.0020	mg/kg wwt	0.0226	0.0244	7.49%	40%	----



Sub-Matrix: Biota

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1534023) - continued											
WP2414182-021	CF26	Calcium	7440-70-2	E472A	4.0	mg/kg wwt	5270	5370	1.75%	60%	---
		Cesium	7440-46-2	E472A	0.0010	mg/kg wwt	0.0242	0.0233	3.91%	40%	---
		Chromium	7440-47-3	E472A	0.040	mg/kg wwt	0.079	0.067	0.011	Diff <2x LOR	---
		Cobalt	7440-48-4	E472A	0.0040	mg/kg wwt	0.0383	0.0396	3.31%	40%	---
		Copper	7440-50-8	E472A	0.040	mg/kg wwt	1.06	1.09	3.30%	40%	---
		Iron	7439-89-6	E472A	1.0	mg/kg wwt	48.6	48.4	0.542%	40%	---
		Lead	7439-92-1	E472A	0.010	mg/kg wwt	0.059	0.056	5.00%	40%	---
		Lithium	7439-93-2	E472A	0.10	mg/kg wwt	<0.10	<0.10	0	Diff <2x LOR	---
		Magnesium	7439-95-4	E472A	0.40	mg/kg wwt	599	630	5.07%	40%	---
		Manganese	7439-96-5	E472A	0.010	mg/kg wwt	116	122	4.68%	40%	---
		Molybdenum	7439-98-7	E472A	0.0080	mg/kg wwt	0.319	0.327	2.37%	40%	---
		Nickel	7440-02-0	E472A	0.040	mg/kg wwt	0.169	0.169	0.00010	Diff <2x LOR	---
		Phosphorus	7723-14-0	E472A	2.0	mg/kg wwt	959	1000	4.27%	40%	---
		Potassium	7440-09-7	E472A	4.0	mg/kg wwt	3280	3310	0.839%	40%	---
		Rubidium	7440-17-7	E472A	0.010	mg/kg wwt	4.25	4.32	1.60%	40%	---
		Selenium	7782-49-2	E472A	0.020	mg/kg wwt	<0.020	<0.020	0	Diff <2x LOR	---
		Sodium	7440-23-5	E472A	4.0	mg/kg wwt	4.5	7.0	2.5	Diff <2x LOR	---
		Strontium	7440-24-6	E472A	0.020	mg/kg wwt	32.6	31.8	2.56%	60%	---
		Tellurium	13494-80-9	E472A	0.0040	mg/kg wwt	<0.0040	<0.0040	0	Diff <2x LOR	---
		Thallium	7440-28-0	E472A	0.00040	mg/kg wwt	0.00150	0.00161	0.00010	Diff <2x LOR	---
Tin	7440-31-5	E472A	0.020	mg/kg wwt	<0.020	<0.020	0	Diff <2x LOR	---		
Uranium	7440-61-1	E472A	0.00040	mg/kg wwt	0.00189	0.00188	0.00001	Diff <2x LOR	---		
Vanadium	7440-62-2	E472A	0.020	mg/kg wwt	0.079	0.080	0.0008	Diff <2x LOR	---		
Zinc	7440-66-6	E472A	0.20	mg/kg wwt	12.5	12.8	2.51%	40%	---		
Zirconium	7440-67-7	E472A	0.080	mg/kg wwt	<0.080	<0.080	0	Diff <2x LOR	---		
Speciated Metals (QC Lot: 1570463)											
WP2414182-001	CF01	Arsenate [As V]	17428-41-0	E539A	0.0050	mg/kg wwt	<0.0050	<0.0050	0	Diff <2x LOR	---
		Arsenite [As III]	22541-54-4	E539A	0.0010	mg/kg wwt	0.0039	0.0039	0.000005	Diff <2x LOR	---
		Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	---
		Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	---
		Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	---
		Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.0010	mg/kg wwt	0.0029	0.0033	0.0005	Diff <2x LOR	---
Speciated Metals (QC Lot: 1570464)											
WP2414182-021	CF26	Arsenate [As V]	17428-41-0	E539A	0.0050	mg/kg wwt	0.0070	0.0073	0.0003	Diff <2x LOR	---



Sub-Matrix: **Biota**

Laboratory Duplicate (DUP) Report

<i>Laboratory sample ID</i>	<i>Client sample ID</i>	<i>Analyte</i>	<i>CAS Number</i>	<i>Method</i>	<i>LOR</i>	<i>Unit</i>	<i>Original Result</i>	<i>Duplicate Result</i>	<i>RPD(%) or Difference</i>	<i>Duplicate Limits</i>	<i>Qualifier</i>
Speciated Metals (QC Lot: 1570464) - continued											
WP2414182-021	CF26	Arsenite [As III]	22541-54-4	E539A	0.0010	mg/kg wwt	0.0012	0.0011	0.00005	Diff <2x LOR	----
		Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.0010	mg/kg wwt	0.0013	0.0013	0.00006	Diff <2x LOR	----
		Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
		Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
		Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----



Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Biota

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1500780)						
Moisture	---	E144	0.5	%	<0.50	---
Physical Tests (QCLot: 1534017)						
Moisture	---	E144-H	2	%	<2.0	---
Metals (QCLot: 1527877)						
Aluminum	7429-90-5	E440A	0.4	mg/kg wwt	<0.40	---
Antimony	7440-36-0	E440A	0.002	mg/kg wwt	<0.0020	---
Arsenic	7440-38-2	E440A	0.004	mg/kg wwt	<0.0040	---
Barium	7440-39-3	E440A	0.01	mg/kg wwt	<0.010	---
Beryllium	7440-41-7	E440A	0.002	mg/kg wwt	<0.0020	---
Bismuth	7440-69-9	E440A	0.002	mg/kg wwt	<0.0020	---
Boron	7440-42-8	E440A	0.2	mg/kg wwt	<0.20	---
Cadmium	7440-43-9	E440A	0.001	mg/kg wwt	<0.0010	---
Calcium	7440-70-2	E440A	4	mg/kg wwt	<4.0	---
Cesium	7440-46-2	E440A	0.001	mg/kg wwt	<0.0010	---
Chromium	7440-47-3	E440A	0.01	mg/kg wwt	<0.010	---
Cobalt	7440-48-4	E440A	0.004	mg/kg wwt	<0.0040	---
Copper	7440-50-8	E440A	0.02	mg/kg wwt	<0.020	---
Iron	7439-89-6	E440A	0.6	mg/kg wwt	<0.60	---
Lead	7439-92-1	E440A	0.004	mg/kg wwt	<0.0040	---
Lithium	7439-93-2	E440A	0.1	mg/kg wwt	<0.10	---
Magnesium	7439-95-4	E440A	0.4	mg/kg wwt	<0.40	---
Manganese	7439-96-5	E440A	0.01	mg/kg wwt	<0.010	---
Molybdenum	7439-98-7	E440A	0.004	mg/kg wwt	<0.0040	---
Nickel	7440-02-0	E440A	0.04	mg/kg wwt	<0.040	---
Phosphorus	7723-14-0	E440A	2	mg/kg wwt	<2.0	---
Potassium	7440-09-7	E440A	4	mg/kg wwt	<4.0	---
Rubidium	7440-17-7	E440A	0.01	mg/kg wwt	<0.010	---
Selenium	7782-49-2	E440A	0.01	mg/kg wwt	<0.010	---
Sodium	7440-23-5	E440A	4	mg/kg wwt	<4.0	---
Strontium	7440-24-6	E440A	0.01	mg/kg wwt	<0.010	---
Tellurium	13494-80-9	E440A	0.004	mg/kg wwt	<0.0040	---
Thallium	7440-28-0	E440A	0.0004	mg/kg wwt	<0.00040	---



Sub-Matrix: Biota

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1527877) - continued						
Tin	7440-31-5	E440A	0.02	mg/kg wwt	<0.020	---
Uranium	7440-61-1	E440A	0.0004	mg/kg wwt	<0.00040	---
Vanadium	7440-62-2	E440A	0.02	mg/kg wwt	<0.020	---
Zinc	7440-66-6	E440A	0.1	mg/kg wwt	<0.10	---
Zirconium	7440-67-7	E440A	0.04	mg/kg wwt	<0.040	---
Metals (QCLot: 1527878)						
Silver	7440-22-4	E440A.Ag	0.001	mg/kg wwt	<0.0010	---
Metals (QCLot: 1527879)						
Titanium	7440-32-6	E440A.Ti	0.05	mg/kg wwt	<0.050	---
Metals (QCLot: 1527880)						
Mercury	7439-97-6	E510A	0.001	mg/kg wwt	<0.0010	---
Metals (QCLot: 1533419)						
Silver	7440-22-4	E440A.Ag	0.001	mg/kg wwt	<0.0010	---
Metals (QCLot: 1533420)						
Titanium	7440-32-6	E440A.Ti	0.05	mg/kg wwt	<0.050	---
Metals (QCLot: 1533421)						
Aluminum	7429-90-5	E440A	0.4	mg/kg wwt	<0.40	---
Antimony	7440-36-0	E440A	0.002	mg/kg wwt	<0.0020	---
Arsenic	7440-38-2	E440A	0.004	mg/kg wwt	<0.0040	---
Barium	7440-39-3	E440A	0.01	mg/kg wwt	<0.010	---
Beryllium	7440-41-7	E440A	0.002	mg/kg wwt	<0.0020	---
Bismuth	7440-69-9	E440A	0.002	mg/kg wwt	<0.0020	---
Boron	7440-42-8	E440A	0.2	mg/kg wwt	<0.20	---
Cadmium	7440-43-9	E440A	0.001	mg/kg wwt	<0.0010	---
Calcium	7440-70-2	E440A	4	mg/kg wwt	<4.0	---
Cesium	7440-46-2	E440A	0.001	mg/kg wwt	<0.0010	---
Chromium	7440-47-3	E440A	0.01	mg/kg wwt	<0.010	---
Cobalt	7440-48-4	E440A	0.004	mg/kg wwt	<0.0040	---
Copper	7440-50-8	E440A	0.02	mg/kg wwt	<0.020	---
Iron	7439-89-6	E440A	0.6	mg/kg wwt	<0.60	---
Lead	7439-92-1	E440A	0.004	mg/kg wwt	<0.0040	---
Lithium	7439-93-2	E440A	0.1	mg/kg wwt	<0.10	---
Magnesium	7439-95-4	E440A	0.4	mg/kg wwt	<0.40	---
Manganese	7439-96-5	E440A	0.01	mg/kg wwt	<0.010	---
Molybdenum	7439-98-7	E440A	0.004	mg/kg wwt	<0.0040	---



Sub-Matrix: Biota

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1533421) - continued						
Nickel	7440-02-0	E440A	0.04	mg/kg wwt	<0.040	----
Phosphorus	7723-14-0	E440A	2	mg/kg wwt	<2.0	----
Potassium	7440-09-7	E440A	4	mg/kg wwt	<4.0	----
Rubidium	7440-17-7	E440A	0.01	mg/kg wwt	<0.010	----
Selenium	7782-49-2	E440A	0.01	mg/kg wwt	<0.010	----
Sodium	7440-23-5	E440A	4	mg/kg wwt	<4.0	----
Strontium	7440-24-6	E440A	0.01	mg/kg wwt	<0.010	----
Tellurium	13494-80-9	E440A	0.004	mg/kg wwt	<0.0040	----
Thallium	7440-28-0	E440A	0.0004	mg/kg wwt	<0.00040	----
Tin	7440-31-5	E440A	0.02	mg/kg wwt	<0.020	----
Uranium	7440-61-1	E440A	0.0004	mg/kg wwt	<0.00040	----
Vanadium	7440-62-2	E440A	0.02	mg/kg wwt	<0.020	----
Zinc	7440-66-6	E440A	0.1	mg/kg wwt	<0.10	----
Zirconium	7440-67-7	E440A	0.04	mg/kg wwt	<0.040	----
Metals (QCLot: 1533422)						
Mercury	7439-97-6	E510A	0.001	mg/kg wwt	<0.0010	----
Metals (QCLot: 1534020)						
Silver	7440-22-4	E472A.Ag	0.001	mg/kg wwt	<0.0010	----
Metals (QCLot: 1534021)						
Titanium	7440-32-6	E472A.Ti	0.1	mg/kg wwt	<0.10	----
Metals (QCLot: 1534022)						
Mercury	7439-97-6	E511A	0.001	mg/kg wwt	<0.0010	----
Metals (QCLot: 1534023)						
Aluminum	7429-90-5	E472A	1	mg/kg wwt	<1.0	----
Antimony	7440-36-0	E472A	0.002	mg/kg wwt	<0.0020	----
Arsenic	7440-38-2	E472A	0.006	mg/kg wwt	<0.0060	----
Barium	7440-39-3	E472A	0.01	mg/kg wwt	<0.010	----
Beryllium	7440-41-7	E472A	0.002	mg/kg wwt	<0.0020	----
Bismuth	7440-69-9	E472A	0.002	mg/kg wwt	<0.0020	----
Boron	7440-42-8	E472A	0.2	mg/kg wwt	<0.20	----
Cadmium	7440-43-9	E472A	0.002	mg/kg wwt	<0.0020	----
Calcium	7440-70-2	E472A	4	mg/kg wwt	<4.0	----
Cesium	7440-46-2	E472A	0.001	mg/kg wwt	<0.0010	----
Chromium	7440-47-3	E472A	0.04	mg/kg wwt	<0.040	----
Cobalt	7440-48-4	E472A	0.004	mg/kg wwt	<0.0040	----



Sub-Matrix: Biota

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1534023) - continued						
Copper	7440-50-8	E472A	0.04	mg/kg wwt	<0.040	---
Iron	7439-89-6	E472A	1	mg/kg wwt	<1.0	---
Lead	7439-92-1	E472A	0.01	mg/kg wwt	<0.010	---
Lithium	7439-93-2	E472A	0.1	mg/kg wwt	<0.10	---
Magnesium	7439-95-4	E472A	0.4	mg/kg wwt	<0.40	---
Manganese	7439-96-5	E472A	0.01	mg/kg wwt	<0.010	---
Molybdenum	7439-98-7	E472A	0.008	mg/kg wwt	<0.0080	---
Nickel	7440-02-0	E472A	0.04	mg/kg wwt	<0.040	---
Phosphorus	7723-14-0	E472A	2	mg/kg wwt	<2.0	---
Potassium	7440-09-7	E472A	4	mg/kg wwt	<4.0	---
Rubidium	7440-17-7	E472A	0.01	mg/kg wwt	<0.010	---
Selenium	7782-49-2	E472A	0.02	mg/kg wwt	<0.020	---
Sodium	7440-23-5	E472A	4	mg/kg wwt	<4.0	---
Strontium	7440-24-6	E472A	0.02	mg/kg wwt	<0.020	---
Tellurium	13494-80-9	E472A	0.004	mg/kg wwt	<0.0040	---
Thallium	7440-28-0	E472A	0.0004	mg/kg wwt	<0.00040	---
Tin	7440-31-5	E472A	0.02	mg/kg wwt	<0.020	---
Uranium	7440-61-1	E472A	0.0004	mg/kg wwt	<0.00040	---
Vanadium	7440-62-2	E472A	0.02	mg/kg wwt	<0.020	---
Zinc	7440-66-6	E472A	0.2	mg/kg wwt	<0.20	---
Zirconium	7440-67-7	E472A	0.04	mg/kg wwt	<0.040	---
Speciated Metals (QCLot: 1570463)						
Arsenate [As V]	17428-41-0	E539A	0.005	mg/kg wwt	<0.0050	---
Arsenite [As III]	22541-54-4	E539A	0.001	mg/kg wwt	<0.0010	---
Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.001	mg/kg wwt	<0.0010	---
Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.001	mg/kg wwt	<0.0010	---
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.001	mg/kg wwt	<0.0010	---
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.001	mg/kg wwt	<0.0010	---
Speciated Metals (QCLot: 1570464)						
Arsenate [As V]	17428-41-0	E539A	0.005	mg/kg wwt	<0.0050	---
Arsenite [As III]	22541-54-4	E539A	0.001	mg/kg wwt	<0.0010	---
Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.001	mg/kg wwt	<0.0010	---
Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.001	mg/kg wwt	<0.0010	---
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.001	mg/kg wwt	<0.0010	---
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.001	mg/kg wwt	<0.0010	---



Sub-Matrix: Biota

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 1566417)						
Acenaphthene	83-32-9	E642A.A	0.01	mg/kg wwt	<0.010	----
Acenaphthylene	208-96-8	E642A.A	0.01	mg/kg wwt	<0.010	----
Anthracene	120-12-7	E642A.A	0.01	mg/kg wwt	<0.010	----
Benz(a)anthracene	56-55-3	E642A.A	0.01	mg/kg wwt	<0.010	----
Benzo(a)pyrene	50-32-8	E642A.A	0.01	mg/kg wwt	<0.010	----
Benzo(b+j)fluoranthene	n/a	E642A.A	0.01	mg/kg wwt	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E642A.A	0.01	mg/kg wwt	<0.010	----
Benzo(k)fluoranthene	207-08-9	E642A.A	0.01	mg/kg wwt	<0.010	----
Chrysene	218-01-9	E642A.A	0.01	mg/kg wwt	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E642A.A	0.01	mg/kg wwt	<0.010	----
Fluoranthene	206-44-0	E642A.A	0.01	mg/kg wwt	<0.010	----
Fluorene	86-73-7	E642A.A	0.01	mg/kg wwt	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E642A.A	0.01	mg/kg wwt	<0.010	----
Methylnaphthalene, 1-	90-12-0	E642A.A	0.01	mg/kg wwt	<0.010	----
Methylnaphthalene, 2-	91-57-6	E642A.A	0.01	mg/kg wwt	<0.010	----
Naphthalene	91-20-3	E642A.A	0.01	mg/kg wwt	<0.010	----
Phenanthrene	85-01-8	E642A.A	0.01	mg/kg wwt	<0.010	----
Pyrene	129-00-0	E642A.A	0.01	mg/kg wwt	<0.010	----



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Biota					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	
Physical Tests (QCLot: 1500780)									
Moisture	---	E144	0.5	%	50 %	100	90.0	110	----
Physical Tests (QCLot: 1534017)									
Moisture	---	E144-H	2	%	50 %	100	90.0	110	----
Metals (QCLot: 1527877)									
Aluminum	7429-90-5	E440A	0.4	mg/kg wwt	20 mg/kg wwt	101	80.0	120	----
Antimony	7440-36-0	E440A	0.002	mg/kg wwt	10 mg/kg wwt	104	80.0	120	----
Arsenic	7440-38-2	E440A	0.004	mg/kg wwt	10 mg/kg wwt	108	80.0	120	----
Barium	7440-39-3	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	105	80.0	120	----
Beryllium	7440-41-7	E440A	0.002	mg/kg wwt	1 mg/kg wwt	98.5	80.0	120	----
Bismuth	7440-69-9	E440A	0.002	mg/kg wwt	10 mg/kg wwt	103	80.0	120	----
Boron	7440-42-8	E440A	0.2	mg/kg wwt	10 mg/kg wwt	99.0	80.0	120	----
Cadmium	7440-43-9	E440A	0.001	mg/kg wwt	1 mg/kg wwt	100	80.0	120	----
Calcium	7440-70-2	E440A	4	mg/kg wwt	500 mg/kg wwt	100	80.0	120	----
Cesium	7440-46-2	E440A	0.001	mg/kg wwt	0.5 mg/kg wwt	103	80.0	120	----
Chromium	7440-47-3	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	102	80.0	120	----
Cobalt	7440-48-4	E440A	0.004	mg/kg wwt	2.5 mg/kg wwt	99.6	80.0	120	----
Copper	7440-50-8	E440A	0.02	mg/kg wwt	2.5 mg/kg wwt	99.8	80.0	120	----
Iron	7439-89-6	E440A	0.6	mg/kg wwt	10 mg/kg wwt	104	80.0	120	----
Lead	7439-92-1	E440A	0.004	mg/kg wwt	5 mg/kg wwt	102	80.0	120	----
Lithium	7439-93-2	E440A	0.1	mg/kg wwt	2.5 mg/kg wwt	99.1	80.0	120	----
Magnesium	7439-95-4	E440A	0.4	mg/kg wwt	500 mg/kg wwt	101	80.0	120	----
Manganese	7439-96-5	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	101	80.0	120	----
Molybdenum	7439-98-7	E440A	0.004	mg/kg wwt	2.5 mg/kg wwt	105	80.0	120	----
Nickel	7440-02-0	E440A	0.04	mg/kg wwt	5 mg/kg wwt	100	80.0	120	----
Phosphorus	7723-14-0	E440A	2	mg/kg wwt	100 mg/kg wwt	113	80.0	120	----
Potassium	7440-09-7	E440A	4	mg/kg wwt	500 mg/kg wwt	103	80.0	120	----
Rubidium	7440-17-7	E440A	0.01	mg/kg wwt	1 mg/kg wwt	104	80.0	120	----
Selenium	7782-49-2	E440A	0.01	mg/kg wwt	10 mg/kg wwt	102	80.0	120	----
Sodium	7440-23-5	E440A	4	mg/kg wwt	500 mg/kg wwt	102	80.0	120	----
Strontium	7440-24-6	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	109	80.0	120	----
Tellurium	13494-80-9	E440A	0.004	mg/kg wwt	1 mg/kg wwt	103	80.0	120	----
Thallium	7440-28-0	E440A	0.0004	mg/kg wwt	10 mg/kg wwt	102	80.0	120	----



Sub-Matrix: Biota

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1527877) - continued									
Tin	7440-31-5	E440A	0.02	mg/kg wwt	5 mg/kg wwt	104	80.0	120	----
Uranium	7440-61-1	E440A	0.0004	mg/kg wwt	0.05 mg/kg wwt	106	80.0	120	----
Vanadium	7440-62-2	E440A	0.02	mg/kg wwt	5 mg/kg wwt	104	80.0	120	----
Zinc	7440-66-6	E440A	0.1	mg/kg wwt	5 mg/kg wwt	97.0	80.0	120	----
Zirconium	7440-67-7	E440A	0.04	mg/kg wwt	1 mg/kg wwt	99.6	80.0	120	----
Metals (QCLot: 1527878)									
Silver	7440-22-4	E440A.Ag	0.001	mg/kg wwt	1 mg/kg wwt	93.7	80.0	120	----
Metals (QCLot: 1527879)									
Titanium	7440-32-6	E440A.Ti	0.05	mg/kg wwt	2.5 mg/kg wwt	101	80.0	120	----
Metals (QCLot: 1527880)									
Mercury	7439-97-6	E510A	0.001	mg/kg wwt	0.02 mg/kg wwt	100	80.0	120	----
Metals (QCLot: 1533419)									
Silver	7440-22-4	E440A.Ag	0.001	mg/kg wwt	1 mg/kg wwt	96.7	80.0	120	----
Metals (QCLot: 1533420)									
Titanium	7440-32-6	E440A.Ti	0.05	mg/kg wwt	2.5 mg/kg wwt	103	80.0	120	----
Metals (QCLot: 1533421)									
Aluminum	7429-90-5	E440A	0.4	mg/kg wwt	20 mg/kg wwt	103	80.0	120	----
Antimony	7440-36-0	E440A	0.002	mg/kg wwt	10 mg/kg wwt	108	80.0	120	----
Arsenic	7440-38-2	E440A	0.004	mg/kg wwt	10 mg/kg wwt	106	80.0	120	----
Barium	7440-39-3	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	102	80.0	120	----
Beryllium	7440-41-7	E440A	0.002	mg/kg wwt	1 mg/kg wwt	105	80.0	120	----
Bismuth	7440-69-9	E440A	0.002	mg/kg wwt	10 mg/kg wwt	107	80.0	120	----
Boron	7440-42-8	E440A	0.2	mg/kg wwt	10 mg/kg wwt	97.4	80.0	120	----
Cadmium	7440-43-9	E440A	0.001	mg/kg wwt	1 mg/kg wwt	99.0	80.0	120	----
Calcium	7440-70-2	E440A	4	mg/kg wwt	500 mg/kg wwt	103	80.0	120	----
Cesium	7440-46-2	E440A	0.001	mg/kg wwt	0.5 mg/kg wwt	109	80.0	120	----
Chromium	7440-47-3	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	102	80.0	120	----
Cobalt	7440-48-4	E440A	0.004	mg/kg wwt	2.5 mg/kg wwt	101	80.0	120	----
Copper	7440-50-8	E440A	0.02	mg/kg wwt	2.5 mg/kg wwt	99.7	80.0	120	----
Iron	7439-89-6	E440A	0.6	mg/kg wwt	10 mg/kg wwt	103	80.0	120	----
Lead	7439-92-1	E440A	0.004	mg/kg wwt	5 mg/kg wwt	104	80.0	120	----
Lithium	7439-93-2	E440A	0.1	mg/kg wwt	2.5 mg/kg wwt	110	80.0	120	----
Magnesium	7439-95-4	E440A	0.4	mg/kg wwt	500 mg/kg wwt	101	80.0	120	----
Manganese	7439-96-5	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	102	80.0	120	----
Molybdenum	7439-98-7	E440A	0.004	mg/kg wwt	2.5 mg/kg wwt	110	80.0	120	----
Nickel	7440-02-0	E440A	0.04	mg/kg wwt	5 mg/kg wwt	99.1	80.0	120	----



Sub-Matrix: Biota

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1533421) - continued									
Phosphorus	7723-14-0	E440A	2	mg/kg wwt	100 mg/kg wwt	110	80.0	120	----
Potassium	7440-09-7	E440A	4	mg/kg wwt	500 mg/kg wwt	98.3	80.0	120	----
Rubidium	7440-17-7	E440A	0.01	mg/kg wwt	1 mg/kg wwt	102	80.0	120	----
Selenium	7782-49-2	E440A	0.01	mg/kg wwt	10 mg/kg wwt	106	80.0	120	----
Sodium	7440-23-5	E440A	4	mg/kg wwt	500 mg/kg wwt	103	80.0	120	----
Strontium	7440-24-6	E440A	0.01	mg/kg wwt	2.5 mg/kg wwt	108	80.0	120	----
Tellurium	13494-80-9	E440A	0.004	mg/kg wwt	1 mg/kg wwt	107	80.0	120	----
Thallium	7440-28-0	E440A	0.0004	mg/kg wwt	10 mg/kg wwt	100	80.0	120	----
Tin	7440-31-5	E440A	0.02	mg/kg wwt	5 mg/kg wwt	102	80.0	120	----
Uranium	7440-61-1	E440A	0.0004	mg/kg wwt	0.05 mg/kg wwt	102	80.0	120	----
Vanadium	7440-62-2	E440A	0.02	mg/kg wwt	5 mg/kg wwt	102	80.0	120	----
Zinc	7440-66-6	E440A	0.1	mg/kg wwt	5 mg/kg wwt	96.8	80.0	120	----
Zirconium	7440-67-7	E440A	0.04	mg/kg wwt	1 mg/kg wwt	104	80.0	120	----
Metals (QCLot: 1533422)									
Mercury	7439-97-6	E510A	0.001	mg/kg wwt	0.02 mg/kg wwt	104	80.0	120	----
Metals (QCLot: 1534020)									
Silver	7440-22-4	E472A.Ag	0.001	mg/kg wwt	1 mg/kg wwt	92.8	80.0	120	----
Metals (QCLot: 1534021)									
Titanium	7440-32-6	E472A.Ti	0.1	mg/kg wwt	2.5 mg/kg wwt	104	80.0	120	----
Metals (QCLot: 1534022)									
Mercury	7439-97-6	E511A	0.001	mg/kg wwt	0.02 mg/kg wwt	89.0	80.0	120	----
Metals (QCLot: 1534023)									
Aluminum	7429-90-5	E472A	1	mg/kg wwt	20 mg/kg wwt	105	80.0	120	----
Antimony	7440-36-0	E472A	0.002	mg/kg wwt	10 mg/kg wwt	99.5	80.0	120	----
Arsenic	7440-38-2	E472A	0.006	mg/kg wwt	10 mg/kg wwt	102	80.0	120	----
Barium	7440-39-3	E472A	0.01	mg/kg wwt	2.5 mg/kg wwt	100	80.0	120	----
Beryllium	7440-41-7	E472A	0.002	mg/kg wwt	1 mg/kg wwt	98.4	80.0	120	----
Bismuth	7440-69-9	E472A	0.002	mg/kg wwt	10 mg/kg wwt	99.9	80.0	120	----
Boron	7440-42-8	E472A	0.2	mg/kg wwt	10 mg/kg wwt	96.7	80.0	120	----
Cadmium	7440-43-9	E472A	0.002	mg/kg wwt	1 mg/kg wwt	98.4	80.0	120	----
Calcium	7440-70-2	E472A	4	mg/kg wwt	500 mg/kg wwt	95.4	80.0	120	----
Cesium	7440-46-2	E472A	0.001	mg/kg wwt	0.5 mg/kg wwt	110	80.0	120	----
Chromium	7440-47-3	E472A	0.04	mg/kg wwt	2.5 mg/kg wwt	104	80.0	120	----
Cobalt	7440-48-4	E472A	0.004	mg/kg wwt	2.5 mg/kg wwt	101	80.0	120	----
Copper	7440-50-8	E472A	0.04	mg/kg wwt	2.5 mg/kg wwt	97.6	80.0	120	----
Iron	7439-89-6	E472A	1	mg/kg wwt	10 mg/kg wwt	98.7	80.0	120	----



Sub-Matrix: Biota

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1534023) - continued									
Lead	7439-92-1	E472A	0.01	mg/kg wwt	5 mg/kg wwt	97.0	80.0	120	----
Lithium	7439-93-2	E472A	0.1	mg/kg wwt	2.5 mg/kg wwt	101	80.0	120	----
Magnesium	7439-95-4	E472A	0.4	mg/kg wwt	500 mg/kg wwt	101	80.0	120	----
Manganese	7439-96-5	E472A	0.01	mg/kg wwt	2.5 mg/kg wwt	104	80.0	120	----
Molybdenum	7439-98-7	E472A	0.008	mg/kg wwt	2.5 mg/kg wwt	107	80.0	120	----
Nickel	7440-02-0	E472A	0.04	mg/kg wwt	5 mg/kg wwt	98.1	80.0	120	----
Phosphorus	7723-14-0	E472A	2	mg/kg wwt	100 mg/kg wwt	107	80.0	120	----
Potassium	7440-09-7	E472A	4	mg/kg wwt	500 mg/kg wwt	99.0	80.0	120	----
Rubidium	7440-17-7	E472A	0.01	mg/kg wwt	1 mg/kg wwt	103	80.0	120	----
Selenium	7782-49-2	E472A	0.02	mg/kg wwt	10 mg/kg wwt	98.4	80.0	120	----
Sodium	7440-23-5	E472A	4	mg/kg wwt	500 mg/kg wwt	104	80.0	120	----
Strontium	7440-24-6	E472A	0.02	mg/kg wwt	2.5 mg/kg wwt	106	80.0	120	----
Tellurium	13494-80-9	E472A	0.004	mg/kg wwt	1 mg/kg wwt	97.3	80.0	120	----
Thallium	7440-28-0	E472A	0.0004	mg/kg wwt	10 mg/kg wwt	93.5	80.0	120	----
Tin	7440-31-5	E472A	0.02	mg/kg wwt	5 mg/kg wwt	102	80.0	120	----
Uranium	7440-61-1	E472A	0.0004	mg/kg wwt	0.05 mg/kg wwt	102	80.0	120	----
Vanadium	7440-62-2	E472A	0.02	mg/kg wwt	5 mg/kg wwt	104	80.0	120	----
Zinc	7440-66-6	E472A	0.2	mg/kg wwt	5 mg/kg wwt	95.1	80.0	120	----
Zirconium	7440-67-7	E472A	0.04	mg/kg wwt	1 mg/kg wwt	108	80.0	120	----
Speciated Metals (QCLot: 1570463)									
Arsenate [As V]	17428-41-0	E539A	0.005	mg/kg wwt	0.094 mg/kg wwt	88.4	80.0	120	----
Arsenite [As III]	22541-54-4	E539A	0.001	mg/kg wwt	0.094 mg/kg wwt	129	70.0	130	----
Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	102	80.0	120	----
Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	105	80.0	120	----
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	107	80.0	120	----
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	104	80.0	120	----
Speciated Metals (QCLot: 1570464)									
Arsenate [As V]	17428-41-0	E539A	0.005	mg/kg wwt	0.094 mg/kg wwt	84.1	80.0	120	----
Arsenite [As III]	22541-54-4	E539A	0.001	mg/kg wwt	0.094 mg/kg wwt	119	70.0	130	----
Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	97.8	80.0	120	----
Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	104	80.0	120	----
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	105	80.0	120	----
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	102	80.0	120	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1566417)									



Sub-Matrix: Biota

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 1566417) - continued									
Acenaphthene	83-32-9	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	103	50.0	150	----
Acenaphthylene	208-96-8	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	98.7	50.0	150	----
Anthracene	120-12-7	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	112	50.0	150	----
Benz(a)anthracene	56-55-3	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	112	50.0	150	----
Benzo(a)pyrene	50-32-8	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	117	50.0	150	----
Benzo(b+j)fluoranthene	n/a	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	100	50.0	150	----
Benzo(g,h,i)perylene	191-24-2	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	103	50.0	150	----
Benzo(k)fluoranthene	207-08-9	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	98.5	50.0	150	----
Chrysene	218-01-9	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	104	50.0	150	----
Dibenz(a,h)anthracene	53-70-3	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	114	50.0	150	----
Fluoranthene	206-44-0	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	109	50.0	150	----
Fluorene	86-73-7	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	108	50.0	150	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	117	50.0	150	----
Methylnaphthalene, 1-	90-12-0	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	95.3	50.0	150	----
Methylnaphthalene, 2-	91-57-6	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	109	50.0	150	----
Naphthalene	91-20-3	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	95.6	50.0	150	----
Phenanthrene	85-01-8	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	110	50.0	150	----
Pyrene	129-00-0	E642A.A	0.01	mg/kg wwt	0.362 mg/kg wwt	109	50.0	150	----



Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: Biota

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Speciated Metals (QCLot: 1570463)										
WP2414182-002	CF02	Arsenate [As V]	17428-41-0	E539A	0.0981 mg/kg wwt	0.094 mg/kg wwt	105	70.0	130	----
		Arsenite [As III]	22541-54-4	E539A	0.108 mg/kg wwt	0.094 mg/kg wwt	115	70.0	130	----
		Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.0219 mg/kg wwt	0.019 mg/kg wwt	117	70.0	130	----
		Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.0220 mg/kg wwt	0.019 mg/kg wwt	118	70.0	130	----
		Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.0225 mg/kg wwt	0.019 mg/kg wwt	120	70.0	130	----
		Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.0224 mg/kg wwt	0.019 mg/kg wwt	120	70.0	130	----
Speciated Metals (QCLot: 1570464)										
WP2414182-022	CF24	Arsenate [As V]	17428-41-0	E539A	0.0958 mg/kg wwt	0.093 mg/kg wwt	103	70.0	130	----
		Arsenite [As III]	22541-54-4	E539A	0.107 mg/kg wwt	0.093 mg/kg wwt	115	70.0	130	----
		Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.0216 mg/kg wwt	0.019 mg/kg wwt	116	70.0	130	----
		Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.0212 mg/kg wwt	0.019 mg/kg wwt	114	70.0	130	----
		Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.0232 mg/kg wwt	0.019 mg/kg wwt	125	70.0	130	----
		Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.0225 mg/kg wwt	0.019 mg/kg wwt	121	70.0	130	----



Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 1527877)									
QC-1527877-003	RM	Aluminum	7429-90-5	E440A	147 mg/kg wwt	94.5	70.0	130	----
QC-1527877-003	RM	Arsenic	7440-38-2	E440A	14.5 mg/kg wwt	96.7	70.0	130	----
QC-1527877-003	RM	Barium	7440-39-3	E440A	0.352 mg/kg wwt	99.3	70.0	130	----
QC-1527877-003	RM	Boron	7440-42-8	E440A	3.47 mg/kg wwt	95.5	70.0	130	----
QC-1527877-003	RM	Cadmium	7440-43-9	E440A	0.153 mg/kg wwt	96.6	70.0	130	----
QC-1527877-003	RM	Calcium	7440-70-2	E440A	2010 mg/kg wwt	101	70.0	130	----
QC-1527877-003	RM	Cesium	7440-46-2	E440A	0.089 mg/kg wwt	97.7	70.0	130	----
QC-1527877-003	RM	Chromium	7440-47-3	E440A	0.453 mg/kg wwt	100	70.0	130	----
QC-1527877-003	RM	Cobalt	7440-48-4	E440A	0.057 mg/kg wwt	103	65.0	135	----
QC-1527877-003	RM	Copper	7440-50-8	E440A	3.3 mg/kg wwt	96.6	70.0	130	----
QC-1527877-003	RM	Iron	7439-89-6	E440A	102 mg/kg wwt	92.2	70.0	130	----
QC-1527877-003	RM	Lead	7439-92-1	E440A	0.058 mg/kg wwt	95.5	70.0	130	----
QC-1527877-003	RM	Magnesium	7439-95-4	E440A	899 mg/kg wwt	92.9	70.0	130	----
QC-1527877-003	RM	Manganese	7439-96-5	E440A	0.948 mg/kg wwt	94.7	70.0	130	----
QC-1527877-003	RM	Molybdenum	7439-98-7	E440A	0.134 mg/kg wwt	95.7	70.0	130	----
QC-1527877-003	RM	Nickel	7440-02-0	E440A	0.33 mg/kg wwt	90.8	40.0	160	----
QC-1527877-003	RM	Phosphorus	7723-14-0	E440A	6700 mg/kg wwt	98.1	70.0	130	----
QC-1527877-003	RM	Potassium	7440-09-7	E440A	11600 mg/kg wwt	96.6	70.0	130	----
QC-1527877-003	RM	Rubidium	7440-17-7	E440A	2.53 mg/kg wwt	100	70.0	130	----
QC-1527877-003	RM	Selenium	7782-49-2	E440A	2.48 mg/kg wwt	97.4	70.0	130	----
QC-1527877-003	RM	Sodium	7440-23-5	E440A	9620 mg/kg wwt	94.0	70.0	130	----
QC-1527877-003	RM	Strontium	7440-24-6	E440A	10.6 mg/kg wwt	95.5	70.0	130	----
QC-1527877-003	RM	Vanadium	7440-62-2	E440A	0.269 mg/kg wwt	93.0	70.0	130	----
QC-1527877-003	RM	Zinc	7440-66-6	E440A	28.7 mg/kg wwt	94.8	70.0	130	----
Metals (QCLot: 1527878)									
QC-1527878-003	RM	Silver	7440-22-4	E440A.Ag	0.139 mg/kg wwt	98.5	70.0	130	----
Metals (QCLot: 1527879)									
QC-1527879-003	RM	Titanium	7440-32-6	E440A.Ti	1.15 mg/kg wwt	101	70.0	130	----
Metals (QCLot: 1527880)									
QC-1527880-003	RM	Mercury	7439-97-6	E510A	0.281 mg/kg wwt	101	70.0	130	----
Metals (QCLot: 1533419)									
QC-1533419-003	RM	Silver	7440-22-4	E440A.Ag	0.139 mg/kg wwt	106	70.0	130	----



Sub-Matrix:


Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 1533420)									
QC-1533420-003	RM	Titanium	7440-32-6	E440A.Ti	1.15 mg/kg wwt	93.4	70.0	130	----
Metals (QCLot: 1533421)									
QC-1533421-003	RM	Aluminum	7429-90-5	E440A	147 mg/kg wwt	94.2	70.0	130	----
QC-1533421-003	RM	Arsenic	7440-38-2	E440A	14.5 mg/kg wwt	97.1	70.0	130	----
QC-1533421-003	RM	Barium	7440-39-3	E440A	0.352 mg/kg wwt	97.6	70.0	130	----
QC-1533421-003	RM	Boron	7440-42-8	E440A	3.47 mg/kg wwt	116	70.0	130	----
QC-1533421-003	RM	Cadmium	7440-43-9	E440A	0.153 mg/kg wwt	95.8	70.0	130	----
QC-1533421-003	RM	Calcium	7440-70-2	E440A	2010 mg/kg wwt	101	70.0	130	----
QC-1533421-003	RM	Cesium	7440-46-2	E440A	0.089 mg/kg wwt	107	70.0	130	----
QC-1533421-003	RM	Chromium	7440-47-3	E440A	0.453 mg/kg wwt	100	70.0	130	----
QC-1533421-003	RM	Cobalt	7440-48-4	E440A	0.057 mg/kg wwt	101	65.0	135	----
QC-1533421-003	RM	Copper	7440-50-8	E440A	3.3 mg/kg wwt	97.6	70.0	130	----
QC-1533421-003	RM	Iron	7439-89-6	E440A	102 mg/kg wwt	96.3	70.0	130	----
QC-1533421-003	RM	Lead	7439-92-1	E440A	0.058 mg/kg wwt	105	70.0	130	----
QC-1533421-003	RM	Magnesium	7439-95-4	E440A	899 mg/kg wwt	97.0	70.0	130	----
QC-1533421-003	RM	Manganese	7439-96-5	E440A	0.948 mg/kg wwt	98.8	70.0	130	----
QC-1533421-003	RM	Molybdenum	7439-98-7	E440A	0.134 mg/kg wwt	104	70.0	130	----
QC-1533421-003	RM	Nickel	7440-02-0	E440A	0.33 mg/kg wwt	99.3	40.0	160	----
QC-1533421-003	RM	Phosphorus	7723-14-0	E440A	6700 mg/kg wwt	99.1	70.0	130	----
QC-1533421-003	RM	Potassium	7440-09-7	E440A	11600 mg/kg wwt	98.4	70.0	130	----
QC-1533421-003	RM	Rubidium	7440-17-7	E440A	2.53 mg/kg wwt	102	70.0	130	----
QC-1533421-003	RM	Selenium	7782-49-2	E440A	2.48 mg/kg wwt	105	70.0	130	----
QC-1533421-003	RM	Sodium	7440-23-5	E440A	9620 mg/kg wwt	99.9	70.0	130	----
QC-1533421-003	RM	Strontium	7440-24-6	E440A	10.6 mg/kg wwt	102	70.0	130	----
QC-1533421-003	RM	Vanadium	7440-62-2	E440A	0.269 mg/kg wwt	94.8	70.0	130	----
QC-1533421-003	RM	Zinc	7440-66-6	E440A	28.7 mg/kg wwt	97.7	70.0	130	----
Metals (QCLot: 1533422)									
QC-1533422-003	RM	Mercury	7439-97-6	E510A	0.281 mg/kg wwt	104	70.0	130	----
Metals (QCLot: 1534020)									
QC-1534020-003	RM	Silver	7440-22-4	E472A.Ag	0.139 mg/kg wwt	105	70.0	130	----
Metals (QCLot: 1534021)									
QC-1534021-003	RM	Titanium	7440-32-6	E472A.Ti	1.15 mg/kg wwt	90.5	70.0	130	----
Metals (QCLot: 1534022)									
QC-1534022-003	RM	Mercury	7439-97-6	E511A	0.281 mg/kg wwt	104	70.0	130	----
Metals (QCLot: 1534023)									
QC-1534023-003	RM	Aluminum	7429-90-5	E472A	147 mg/kg wwt	86.0	70.0	130	----
QC-1534023-003	RM	Arsenic	7440-38-2	E472A	14.5 mg/kg wwt	101	70.0	130	----



Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 1534023) - continued									
QC-1534023-003	RM	Barium	7440-39-3	E472A	0.352 mg/kg wwt	89.2	70.0	130	----
QC-1534023-003	RM	Boron	7440-42-8	E472A	3.47 mg/kg wwt	98.9	70.0	130	----
QC-1534023-003	RM	Cadmium	7440-43-9	E472A	0.153 mg/kg wwt	99.2	70.0	130	----
QC-1534023-003	RM	Calcium	7440-70-2	E472A	2010 mg/kg wwt	91.0	70.0	130	----
QC-1534023-003	RM	Cesium	7440-46-2	E472A	0.089 mg/kg wwt	108	70.0	130	----
QC-1534023-003	RM	Chromium	7440-47-3	E472A	0.453 mg/kg wwt	100.0	50.0	150	----
QC-1534023-003	RM	Cobalt	7440-48-4	E472A	0.057 mg/kg wwt	97.7	65.0	135	----
QC-1534023-003	RM	Copper	7440-50-8	E472A	3.3 mg/kg wwt	97.7	70.0	130	----
QC-1534023-003	RM	Iron	7439-89-6	E472A	102 mg/kg wwt	94.8	70.0	130	----
QC-1534023-003	RM	Lead	7439-92-1	E472A	0.058 mg/kg wwt	100	15.0	185	----
QC-1534023-003	RM	Magnesium	7439-95-4	E472A	899 mg/kg wwt	93.8	70.0	130	----
QC-1534023-003	RM	Manganese	7439-96-5	E472A	0.948 mg/kg wwt	101	70.0	130	----
QC-1534023-003	RM	Molybdenum	7439-98-7	E472A	0.134 mg/kg wwt	107	70.0	130	----
QC-1534023-003	RM	Nickel	7440-02-0	E472A	0.33 mg/kg wwt	97.8	40.0	160	----
QC-1534023-003	RM	Phosphorus	7723-14-0	E472A	6700 mg/kg wwt	103	70.0	130	----
QC-1534023-003	RM	Potassium	7440-09-7	E472A	11600 mg/kg wwt	101	70.0	130	----
QC-1534023-003	RM	Rubidium	7440-17-7	E472A	2.53 mg/kg wwt	100	70.0	130	----
QC-1534023-003	RM	Selenium	7782-49-2	E472A	2.48 mg/kg wwt	107	70.0	130	----
QC-1534023-003	RM	Sodium	7440-23-5	E472A	9620 mg/kg wwt	101	70.0	130	----
QC-1534023-003	RM	Strontium	7440-24-6	E472A	10.6 mg/kg wwt	101	70.0	130	----
QC-1534023-003	RM	Vanadium	7440-62-2	E472A	0.269 mg/kg wwt	92.3	70.0	130	----
QC-1534023-003	RM	Zinc	7440-66-6	E472A	28.7 mg/kg wwt	99.9	70.0	130	----
Speciated Metals (QCLot: 1570463)									
QC-1570463-003	NIST 1568b	Arsenate [As V]	17428-41-0	E539A	0.028 mg/kg wwt	129	70.0	130	----
QC-1570463-003	NIST 1568b	Arsenite [As III]	22541-54-4	E539A	0.058 mg/kg wwt	125	70.0	130	----
QC-1570463-005	DORM5	Arsenobetaine [AsB], (as As)	64436-13-1	E539A	11.8 mg/kg wwt	93.8	60.0	130	----
QC-1570463-003	NIST 1568b	Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.169 mg/kg wwt	88.3	70.0	130	----
QC-1570463-003	NIST 1568b	Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.011 mg/kg wwt	98.0	70.0	130	----
Speciated Metals (QCLot: 1570464)									
QC-1570464-003	NIST 1568b	Arsenate [As V]	17428-41-0	E539A	0.028 mg/kg wwt	123	70.0	130	----
QC-1570464-003	NIST 1568b	Arsenite [As III]	22541-54-4	E539A	0.058 mg/kg wwt	119	70.0	130	----
QC-1570464-005	DORM5	Arsenobetaine [AsB], (as As)	64436-13-1	E539A	11.8 mg/kg wwt	82.7	60.0	130	----
QC-1570464-003	NIST 1568b	Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.169 mg/kg wwt	86.4	70.0	130	----
QC-1570464-003	NIST 1568b	Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.011 mg/kg wwt	93.7	70.0	130	----



Report To		Reports / Recipients			Turnaround Time (TAT) Requested																															
Company:	Kinross - Great Bear Resources	Select Report Format: <input type="checkbox"/> PDF <input type="checkbox"/> EXCEL <input type="checkbox"/> EDD (DIGITAL)			<input checked="" type="checkbox"/> Routine [R] if received by 3pm M-F - no surcharges apply <input type="checkbox"/> 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum <input type="checkbox"/> 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum <input type="checkbox"/> 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum <input type="checkbox"/> 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum <input type="checkbox"/> Same day [E2] if received by 10am M-S - 200% rush surcharge.																															
Contact:	Hannah Hillier	Merge QC/QCI Reports with COA <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A			Additional fees may apply to rush requests on weekends, statutory holidays and for non-routine tests.																															
Phone:	(807) 633-2492	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked			Date and Time Required for all E&P TATs:																															
Street:	19 Young Street	Select Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX			Analysis Request																															
City/Province:	Red Lake, ON	Email 1 ashley.moncrief@kinross.com			<table border="1"> <tr> <th rowspan="2">NUMBER OF CONTAINERS</th> <th rowspan="2">Metals (by CRC ICPMS)</th> <th rowspan="2">Mercury (by CVAAS)</th> <th rowspan="2">PAHs (In Vegetation)</th> <th rowspan="2">Moisture Content (by Gravimetry)</th> <th rowspan="2">Arsenic Speciaes (In Biota by HPLC-CRC ICPMS)</th> <th rowspan="2">Silver (In Biota by CRC ICPMS)</th> <th rowspan="2">Titanium (In Biota by CRC ICPMS)</th> <th colspan="2"></th> <th colspan="2"></th> <th colspan="2"></th> </tr> <tr> <th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th> </tr> </table>										NUMBER OF CONTAINERS	Metals (by CRC ICPMS)	Mercury (by CVAAS)	PAHs (In Vegetation)	Moisture Content (by Gravimetry)	Arsenic Speciaes (In Biota by HPLC-CRC ICPMS)	Silver (In Biota by CRC ICPMS)	Titanium (In Biota by CRC ICPMS)														
NUMBER OF CONTAINERS	Metals (by CRC ICPMS)	Mercury (by CVAAS)	PAHs (In Vegetation)	Moisture Content (by Gravimetry)																			Arsenic Speciaes (In Biota by HPLC-CRC ICPMS)	Silver (In Biota by CRC ICPMS)	Titanium (In Biota by CRC ICPMS)											
Postal Code:	P0V2M0	Email 2 hannah.hillier@kinross.com																																		
Invoice To	Same as Report To <input type="checkbox"/> YES <input type="checkbox"/> NO	Email 3 curtis.bloemberg@kinross.com																																		
	Copy of Invoice with Report <input type="checkbox"/> YES <input type="checkbox"/> NO	Email 4 aaron.peloguin@kinross.com																																		
Company:		Email 5 emily.meek@kinross.com																																		
Contact:		Email 6 jacob.mcfee@kinross.com																																		
Project Information		Invoice Recipients																																		
ALS Account # / Quote #:	PPR-022-3	Select Invoice Distribution: <input checked="" type="checkbox"/> EMAIL <input type="checkbox"/> MAIL <input type="checkbox"/> FAX																																		
Job #:	PPR-022-3	Email 1 invoice@kinross.com																																		
ALS Lab Work Order # (ALS use only):		ALS Contact: Judy Dalmaijer		Sampler:																																
ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type																																
	CF01	18-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF02	18-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF03	18-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF04	21-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF05	21-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF06	21-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF07	21-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF08	21-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF09	28-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF10	28-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF11	28-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF12	28-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF13	30-Aug-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF14	6-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF-DUP-01	6-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF16	7-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF17	7-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF19	7-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF21	9-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF22	9-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF26	12-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
	CF24	11-Sep-23		Biota	1	X	X	X	X	X	X	X	X																							
SHIPPING RELEASE (client use)		INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)																															
Released by:		Time:	Received by:	Date:	Received by:  Time:																															

Environmental Division
 Winnipeg
 Work Order Reference
WP2414182



Telephone : +1 204 265 9720

14.3

JUN 04 2024

920



CERTIFICATE OF ANALYSIS

<p>Work Order : WP2414228</p> <p>Client : Great Bear Resources Ltd</p> <p>Contact : Ashley Moncrief</p> <p>Address : Great Bear Resources Ltd. 117 Forestry Road Red Lake ON Canada P0V 2M0</p> <p>Telephone : 807 630 0203</p> <p>Project : PPR-022-3</p> <p>PO : PPR-022-3</p> <p>C-O-C number : ----</p> <p>Sampler : ----</p> <p>Site : ----</p> <p>Quote number : 2024 Standing offer_V2</p> <p>No. of samples received : 28</p> <p>No. of samples analysed : 28</p>	<p>Page : 1 of 22</p> <p>Laboratory : ALS Environmental - Winnipeg</p> <p>Account Manager : Judy Dalmaijer</p> <p>Address : 1329 Niakwa Road East, Unit 12 Winnipeg MB Canada R2J 3T4</p> <p>Telephone : +1 204 255 9720</p> <p>Date Samples Received : 04-Jun-2024 09:20</p> <p>Date Analysis Commenced : 26-Jun-2024</p> <p>Issue Date : 13-Aug-2024 13:13</p>
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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Laboratory Department</i>
Dan Gebert	Laboratory Analyst	Metals, Burnaby, British Columbia
Ghazaleh Khanmirzaei	Analyst	Metals, Burnaby, British Columbia
Ilnaz Badbezanchi	Supervisor - Metals Prep & Mercury	Metals, Burnaby, British Columbia
Janice Leung	Supervisor - Organics Instrumentation	Organics, Burnaby, British Columbia
Jin Kim	Analyst	Metals, Burnaby, British Columbia
Kevin Duarte	Supervisor - Metals ICP Instrumentation	Metals, Burnaby, British Columbia
Kim Jensen	Department Manager - Metals	Metals, Burnaby, British Columbia
Kinny Wu	Lab Analyst	Metals, Burnaby, British Columbia
Kinny Wu	Lab Analyst	Organics, Burnaby, British Columbia
Salimah Khimani	Lab Assistant	Metals, Burnaby, British Columbia
Sam Silveira	Analyst	Metals, Burnaby, British Columbia
Wingyee Cheng	Analyst- General	Metals, Burnaby, British Columbia



General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Please refer to Quality Control Interpretive report (QCI) for information regarding Holding Time compliance.

Key : CAS Number: Chemical Abstracts Services number is a unique identifier assigned to discrete substances
 LOR: Limit of Reporting (detection limit).

Unit	Description
-	no units
%	percent
µg/kg	micrograms per kilogram
µg/kg ww	micrograms per kilogram wet weight
g	grams
mg/kg	milligrams per kilogram
mg/kg ww	milligrams per kilogram wet weight
mg/L	milligrams per litre
mL	millilitres
pH units	pH units

<: less than.

>: greater than.

Surrogate: An analyte that is similar in behavior to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED on SRN or QCI Report, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Workorder Comments

Due to the adsorptive nature of Sample WP2414228-13 (CFS13), double the normal amounts of acids and water were required to conduct the BC SALM metals soil digestion. Test results are not adversely affected.

For method E452 (IVBA), a new reference material was implemented, which had not been configured in LIMS prior to this file being started. The new RM (NIST 2711A) was processed outside of LIMS, and had acceptable recoveries for arsenic, 109% (linked to samples 1 - 7), 107% (linked to samples 8 - 14), and 113% (linked to samples 15 - 29).

Sample Comments

Sample	Client Id	Comment
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WP2414228-003	CFS03	d9-acridine surrogate recoveries do not meet ALS DQO minimum requirements for CFS03 (WP2414228-003) and CFS22 (WP2414228-019) and confirmed by re-analysis. Acridine results are therefore not reportable. Sample matrix effects are suspected.
WP2414228-019	CFS22	d9-acridine surrogate recoveries do not meet ALS DQO minimum requirements for CFS03 (WP2414228-003) and CFS22 (WP2414228-019) and confirmed by re-analysis. Acridine results are therefore not reportable. Sample matrix effects are suspected.

Qualifiers

Qualifier	Description
ADLI	Acridine Detection Limit was increased due to sample matrix issues which caused low d9-Acridine surrogate or internal std. recoveries (confirmed by re-analysis).
DLCI	Detection Limit Raised: Chromatographic interference due to co-elution.
DLHM	Detection Limit Adjusted: Sample has high moisture content.
DLIS	Detection Limit Adjusted due to insufficient sample.
DLQ	Detection Limit raised due to co-eluting interference. Mass Spectrometry qualifier ion ratio did not meet acceptance criteria.
RRR	Refer to report comments for issues regarding this analysis.
SUR-ND	Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected.



Analytical Results

Sub-Matrix: Biota					Client sample ID				
(Matrix: Biota)					CF31	CF32	CF33	CF34	CF35
Client sampling date / time					06-Feb-2024 00:00	06-Feb-2024 00:00	22-Feb-2024 00:00	22-Feb-2024 00:00	26-Dec-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-022	WP2414228-023	WP2414228-024	WP2414228-025	WP2414228-026
					Result	Result	Result	Result	Result
Physical Tests									
Moisture	----	E144/VA	0.50	%	56.0	35.0	35.4	61.0	68.7
Moisture	----	E144-H/VA	2.0	%	56.0	35.0	35.4	61.0	68.7
Metals									
Aluminum	7429-90-5	E472A/VA	1.0	mg/kg wwt	4.2	2.5	3.1	2.8	<1.0
Antimony	7440-36-0	E472A/VA	0.0020	mg/kg wwt	0.0286	0.0027	0.0611	0.0033	0.0020
Arsenic	7440-38-2	E472A/VA	0.0060	mg/kg wwt	0.0572	0.0456	0.0340	0.0267	0.0592
Barium	7440-39-3	E472A/VA	0.010	mg/kg wwt	2.97	0.071	2.52	1.90	0.126
Beryllium	7440-41-7	E472A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth	7440-69-9	E472A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron	7440-42-8	E472A/VA	0.20	mg/kg wwt	4.18	2.54	12.1	5.50	0.71
Cadmium	7440-43-9	E472A/VA	0.0020	mg/kg wwt	2.69	0.0067	3.16	5.46	0.434
Calcium	7440-70-2	E472A/VA	4.0	mg/kg wwt	125	166	200	172	63.7
Cesium	7440-46-2	E472A/VA	0.0010	mg/kg wwt	0.0442	0.0205	0.0179	0.0341	0.0084
Chromium	7440-47-3	E472A/VA	0.040	mg/kg wwt	0.102	0.172	0.056	0.066	<0.040
Cobalt	7440-48-4	E472A/VA	0.0040	mg/kg wwt	0.0489	0.0191	0.106	0.0506	0.0453
Copper	7440-50-8	E472A/VA	0.040	mg/kg wwt	5.98	10.5	6.39	5.59	5.36
Iron	7439-89-6	E472A/VA	1.0	mg/kg wwt	1960	243	1140	1780	273
Lead	7439-92-1	E472A/VA	0.010	mg/kg wwt	1.10	0.015	1.29	0.051	0.027
Lithium	7439-93-2	E472A/VA	0.10	mg/kg wwt	<0.10	0.34	0.13	<0.10	0.23
Magnesium	7439-95-4	E472A/VA	0.40	mg/kg wwt	300	566	361	257	216
Manganese	7439-96-5	E472A/VA	0.010	mg/kg wwt	23.9	3.77	14.3	12.1	7.85
Mercury	7439-97-6	E511A/VA	0.0010	mg/kg wwt	0.145	0.0056	0.0025	0.0018	0.0034
Molybdenum	7439-98-7	E472A/VA	0.0080	mg/kg wwt	13.7	0.0682	30.0	10.9	2.76
Nickel	7440-02-0	E472A/VA	0.040	mg/kg wwt	0.143	0.164	0.186	0.063	0.055
Phosphorus	7723-14-0	E472A/VA	2.0	mg/kg wwt	4960	6240	6060	4980	3810
Potassium	7440-09-7	E472A/VA	4.0	mg/kg wwt	4140	8740	5300	3850	2840
Rubidium	7440-17-7	E472A/VA	0.010	mg/kg wwt	16.6	7.69	6.82	13.6	4.20
Selenium	7782-49-2	E472A/VA	0.020	mg/kg wwt	0.326	0.648	0.511	0.275	0.468
Silver	7440-22-4	E472A.Ag/VA	0.0010	mg/kg wwt	0.0011	0.0040	0.0010	<0.0010	<0.0010



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF31	CF32	CF33	CF34	CF35
(Matrix: Biota)										
Client sampling date / time					06-Feb-2024 00:00	06-Feb-2024 00:00	22-Feb-2024 00:00	22-Feb-2024 00:00	26-Dec-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-022	WP2414228-023	WP2414228-024	WP2414228-025	WP2414228-026	
					Result	Result	Result	Result	Result	
Metals										
Sodium	7440-23-5	E472A/VA	4.0	mg/kg wwt	1160	3170	2040	1450	1060	
Strontium	7440-24-6	E472A/VA	0.020	mg/kg wwt	0.878	0.119	0.899	0.830	0.040	
Tellurium	13494-80-9	E472A/VA	0.0040	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	
Thallium	7440-28-0	E472A/VA	0.00040	mg/kg wwt	<0.00040	0.00069	<0.00040	<0.00040	0.00041	
Tin	7440-31-5	E472A/VA	0.020	mg/kg wwt	<0.020	<0.020	0.058	<0.020	<0.020	
Titanium	7440-32-6	E472A.Ti/VA	0.10	mg/kg wwt	0.37	0.24	0.32	0.18	<0.10	
Uranium	7440-61-1	E472A/VA	0.00040	mg/kg wwt	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	
Vanadium	7440-62-2	E472A/VA	0.020	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	
Zinc	7440-66-6	E472A/VA	0.20	mg/kg wwt	43.7	64.2	57.4	39.4	44.4	
Zirconium	7440-67-7	E472A/VA	0.040	mg/kg wwt	<0.040	0.042	0.305	<0.040	<0.040	
Speciated Metals										
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	0.0063	0.0141	0.0075	<0.0070 ^{DLIS}	<0.0050	
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	0.0214	0.0085	0.0068	0.0077	0.0195	
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	0.0012	0.0247	<0.0010	<0.0012 ^{DLIS}	0.0154	
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0020 ^{DLIS}	<0.0010	<0.0012 ^{DLIS}	0.0018	
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	<0.0010	0.0035	<0.0010	<0.0012 ^{DLIS}	0.0011	
Methylmercury (as MeHg)	22967-92-6	E538/VA	5.0	µg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	
Methylmercury (as MeHg)	22967-92-6	E538A/VA	1.0	µg/kg wwt	1.2	1.2	2.4	<1.0	<1.0	
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	0.0018	<0.0020 ^{DLIS}	0.0079	0.0016	<0.0010	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF36	CF37	----	----	----
(Matrix: Biota)					Client sampling date / time	15-Dec-2023 00:00	05-Jan-2024 00:00	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-027	WP2414228-028	-----	-----	-----	
					Result	Result	----	----	----	
Physical Tests										
Moisture	---	E144/VA	0.50	%	65.5	66.3	----	----	----	
Moisture	---	E144-H/VA	2.0	%	65.5	66.3	----	----	----	
Metals										
Aluminum	7429-90-5	E472A/VA	1.0	mg/kg wwt	<1.0	1.2	----	----	----	
Antimony	7440-36-0	E472A/VA	0.0020	mg/kg wwt	0.0101	5.61	----	----	----	
Arsenic	7440-38-2	E472A/VA	0.0060	mg/kg wwt	0.0278	0.592	----	----	----	
Barium	7440-39-3	E472A/VA	0.010	mg/kg wwt	0.348	0.595	----	----	----	
Beryllium	7440-41-7	E472A/VA	0.0020	mg/kg wwt	<0.0020	<0.0020	----	----	----	
Bismuth	7440-69-9	E472A/VA	0.0020	mg/kg wwt	<0.0020	0.0143	----	----	----	
Boron	7440-42-8	E472A/VA	0.20	mg/kg wwt	2.16	4.27	----	----	----	
Cadmium	7440-43-9	E472A/VA	0.0020	mg/kg wwt	14.7	2.01	----	----	----	
Calcium	7440-70-2	E472A/VA	4.0	mg/kg wwt	84.7	344	----	----	----	
Cesium	7440-46-2	E472A/VA	0.0010	mg/kg wwt	0.0064	0.0173	----	----	----	
Chromium	7440-47-3	E472A/VA	0.040	mg/kg wwt	<0.040	<0.040	----	----	----	
Cobalt	7440-48-4	E472A/VA	0.0040	mg/kg wwt	0.0624	0.0600	----	----	----	
Copper	7440-50-8	E472A/VA	0.040	mg/kg wwt	5.34	4.19	----	----	----	
Iron	7439-89-6	E472A/VA	1.0	mg/kg wwt	1570	1470	----	----	----	
Lead	7439-92-1	E472A/VA	0.010	mg/kg wwt	0.196	149	----	----	----	
Lithium	7439-93-2	E472A/VA	0.10	mg/kg wwt	<0.10	<0.10	----	----	----	
Magnesium	7439-95-4	E472A/VA	0.40	mg/kg wwt	230	208	----	----	----	
Manganese	7439-96-5	E472A/VA	0.010	mg/kg wwt	3.77	5.32	----	----	----	
Mercury	7439-97-6	E511A/VA	0.0010	mg/kg wwt	0.0049	0.0031	----	----	----	
Molybdenum	7439-98-7	E472A/VA	0.0080	mg/kg wwt	28.5	15.2	----	----	----	
Nickel	7440-02-0	E472A/VA	0.040	mg/kg wwt	0.052	<0.040	----	----	----	
Phosphorus	7723-14-0	E472A/VA	2.0	mg/kg wwt	4050	4260	----	----	----	
Potassium	7440-09-7	E472A/VA	4.0	mg/kg wwt	2840	2560	----	----	----	
Rubidium	7440-17-7	E472A/VA	0.010	mg/kg wwt	5.66	7.86	----	----	----	
Selenium	7782-49-2	E472A/VA	0.020	mg/kg wwt	0.510	0.270	----	----	----	
Silver	7440-22-4	E472A.Ag/VA	0.0010	mg/kg wwt	<0.0010	0.0086	----	----	----	
Sodium	7440-23-5	E472A/VA	4.0	mg/kg wwt	1090	1380	----	----	----	



Analytical Results

Sub-Matrix: Biota					Client sample ID	CF36	CF37	---	---	---
(Matrix: Biota)					Client sampling date / time	15-Dec-2023 00:00	05-Jan-2024 00:00	---	---	---
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-027	WP2414228-028	-----	-----	-----	
					Result	Result	---	---	---	
Metals										
Strontium	7440-24-6	E472A/VA	0.020	mg/kg wwt	0.194	0.914	---	---	---	
Tellurium	13494-80-9	E472A/VA	0.0040	mg/kg wwt	<0.0040	<0.0040	---	---	---	
Thallium	7440-28-0	E472A/VA	0.00040	mg/kg wwt	<0.00040	0.00075	---	---	---	
Tin	7440-31-5	E472A/VA	0.020	mg/kg wwt	<0.020	1.12	---	---	---	
Titanium	7440-32-6	E472A.Ti/VA	0.10	mg/kg wwt	0.10	<0.10	---	---	---	
Uranium	7440-61-1	E472A/VA	0.00040	mg/kg wwt	<0.00040	<0.00040	---	---	---	
Vanadium	7440-62-2	E472A/VA	0.020	mg/kg wwt	<0.020	<0.020	---	---	---	
Zinc	7440-66-6	E472A/VA	0.20	mg/kg wwt	34.8	28.9	---	---	---	
Zirconium	7440-67-7	E472A/VA	0.040	mg/kg wwt	<0.040	<0.040	---	---	---	
Speciated Metals										
Arsenate [As V]	17428-41-0	E539A/VA	0.0050	mg/kg wwt	0.0056	<0.0050	---	---	---	
Arsenite [As III]	22541-54-4	E539A/VA	0.0010	mg/kg wwt	0.0091	0.0169	---	---	---	
Arsenobetaine [AsB], (as As)	64436-13-1	E539A/VA	0.0010	mg/kg wwt	0.0036	0.0014	---	---	---	
Arsenocholine [AsC], (as As)	39895-81-3	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	---	---	---	
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A/VA	0.0010	mg/kg wwt	<0.0010	<0.0010	---	---	---	
Methylmercury (as MeHg)	22967-92-6	E538/VA	5.0	µg/kg	<5.0	<5.0	---	---	---	
Methylmercury (as MeHg)	22967-92-6	E538A/VA	1.0	µg/kg wwt	1.2	<1.0	---	---	---	
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A/VA	0.0010	mg/kg wwt	0.0036	0.0014	---	---	---	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS01	CFS02	CFS03	CFS04	CFS05
(Matrix: Soil/Solid)					Client sampling date / time	18-Aug-2023 00:00	18-Aug-2023 00:00	18-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-001	WP2414228-002	WP2414228-003	WP2414228-004	WP2414228-005	
					Result	Result	Result	Result	Result	
Sample Preparation										
pH, IVBA Initial	---	EP452/VA	0.01	pH units	1.46	1.50	1.48	1.49	1.48	
pH, IVBA final	---	EP452/VA	0.01	pH units	1.51	1.50	1.50	1.52	1.51	
Weight, extraction (dry)	---	EP452/VA	0.01	g	0.941	0.913	0.926	0.930	1.052	
Final volume	---	EP452/VA	1	mL	100	100	100	100	100	
Physical Tests										
Moisture	---	E144/VA	0.25	%	8.08	17.3	15.1	19.3	17.2	
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg	3710	3750	4400	3580	2500	
Antimony	7440-36-0	E440/VA	0.10	mg/kg	0.12	0.24	<0.10	0.26	<0.10	
Arsenic	7440-38-2	E440B/VA	0.050	mg/kg	8.10	7.48	1.98	5.97	4.41	
Arsenic	7440-38-2	E440/VA	0.10	mg/kg	3.73	4.38	1.79	4.29	3.64	
Barium	7440-39-3	E440/VA	0.50	mg/kg	17.0	20.4	19.7	51.7	10.5	
Beryllium	7440-41-7	E440/VA	0.10	mg/kg	<0.10	0.14	<0.10	0.18	<0.10	
Bismuth	7440-69-9	E440/VA	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	
Boron	7440-42-8	E440/VA	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	
Cadmium	7440-43-9	E440/VA	0.020	mg/kg	0.040	0.119	0.024	0.146	0.028	
Calcium	7440-70-2	E440/VA	50	mg/kg	878	1610	1040	3310	474	
Chromium	7440-47-3	E440/VA	0.50	mg/kg	5.29	4.21	9.63	4.43	2.60	
Cobalt	7440-48-4	E440/VA	0.10	mg/kg	0.76	1.12	1.41	2.13	0.30	
Copper	7440-50-8	E440/VA	0.50	mg/kg	1.49	3.26	1.76	6.18	1.42	
Iron	7439-89-6	E440/VA	50	mg/kg	4530	3900	6220	4680	1160	
Lead	7439-92-1	E440/VA	0.50	mg/kg	3.60	6.97	5.84	8.88	3.33	
Lithium	7439-93-2	E440/VA	2.0	mg/kg	2.2	5.4	5.8	3.7	<2.0	
Magnesium	7439-95-4	E440/VA	20	mg/kg	567	733	1430	879	250	
Manganese	7439-96-5	E440/VA	1.0	mg/kg	28.0	32.1	45.7	185	10.9	
Mercury	7439-97-6	E510/VA	0.0050	mg/kg	0.0147	0.0282	0.0113	0.0402	0.0133	
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg	0.18	0.29	0.33	0.31	0.26	
Nickel	7440-02-0	E440/VA	0.50	mg/kg	1.79	2.35	3.08	2.54	0.69	
Phosphorus	7723-14-0	E440/VA	50	mg/kg	98	121	106	227	54	
Potassium	7440-09-7	E440/VA	100	mg/kg	210	250	370	320	120	



Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	CFS01	CFS02	CFS03	CFS04	CFS05
Client sampling date / time					18-Aug-2023 00:00	18-Aug-2023 00:00	18-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-001	WP2414228-002	WP2414228-003	WP2414228-004	WP2414228-005	
					Result	Result	Result	Result	Result	
Metals										
Selenium	7782-49-2	E440/VA	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	
Silver	7440-22-4	E440/VA	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	
Sodium	7440-23-5	E440/VA	50	mg/kg	58	60	59	71	<50	
Strontium	7440-24-6	E440/VA	0.50	mg/kg	10.9	13.2	10.9	18.4	6.70	
Sulfur	7704-34-9	E440/VA	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	
Thallium	7440-28-0	E440/VA	0.050	mg/kg	<0.050	<0.050	0.058	0.068	<0.050	
Tin	7440-31-5	E440/VA	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	
Titanium	7440-32-6	E440/VA	1.0	mg/kg	269	284	728	302	282	
Tungsten	7440-33-7	E440/VA	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Uranium	7440-61-1	E440/VA	0.050	mg/kg	0.170	0.537	0.478	0.841	0.166	
Vanadium	7440-62-2	E440/VA	0.20	mg/kg	11.2	8.68	18.4	10.2	6.38	
Zinc	7440-66-6	E440/VA	2.0	mg/kg	10.8	8.2	9.5	17.0	2.9	
Zirconium	7440-67-7	E440/VA	1.0	mg/kg	<1.0	1.1	2.1	<1.0	<1.0	
Arsenic, IVBA (leachate)	7440-38-2	EC452A/VA	10	mg/kg	1.18	1.00	<0.50	1.41	<0.50	
Leachable Metals										
Arsenic, IVBA (%)	7440-38-2	EC452/VA	1	%	---	---	27.3	---	10.8	
Arsenic, IVBA (%)	7440-38-2	EC452/VA	1.0	%	14.6	13.3	---	23.6	---	
Arsenic, IVBA (leachate)	7440-38-2	E452/VA	0.100	mg/L	0.0111	0.0091	<0.0050	0.0131	<0.0050	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Acenaphthylene	208-96-8	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Acridine	260-94-6	E641A-L/VA	0.01	mg/kg	---	---	NR ^{RRR}	---	---	
Acridine	260-94-6	E641A-L/VA	0.010	mg/kg	<0.100 ^{ADLI}	<0.040 ^{ADLI}	---	<0.040 ^{ADLI}	<0.140 ^{ADLI}	
Anthracene	120-12-7	E641A-L/VA	0.0040	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	
Benz(a)anthracene	56-55-3	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(a)pyrene	50-32-8	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(b+j)fluoranthene	n/a	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(b+j+k)fluoranthene	n/a	E641A-L/VA	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	
Benzo(g,h,i)perylene	191-24-2	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(k)fluoranthene	207-08-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	



Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	CFS01	CFS02	CFS03	CFS04	CFS05
Client sampling date / time					18-Aug-2023 00:00	18-Aug-2023 00:00	18-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-001	WP2414228-002	WP2414228-003	WP2414228-004	WP2414228-005	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Chrysene	218-01-9	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Dibenz(a,h)anthracene	53-70-3	E641A-LVA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Fluoranthene	206-44-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Fluorene	86-73-7	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 1-	90-12-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 1+2-	----	E641A-LVA	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	
Methylnaphthalene, 2-	91-57-6	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Naphthalene	91-20-3	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Perylene	198-55-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Phenanthrene	85-01-8	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Pyrene	129-00-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Quinoline	91-22-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
B(a)P total potency equivalents [B(a)P TPE]	----	E641A-LVA	0.020	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	
IACR (CCME)	----	E641A-LVA	0.150	-	<0.150	<0.150	<0.150	<0.150	<0.150	
Polycyclic Aromatic Hydrocarbons Surrogates										
Acridine-d9	34749-75-2	E641A-LVA	0.1	%	10.7 ^{ADLI}	26.3 ^{ADLI}	Not ^{RRR} Determined	25.7 ^{ADLI}	7.3 ^{ADLI}	
Chrysene-d12	1719-03-5	E641A-LVA	0.1	%	108	109	78.7	81.5	82.7	
Naphthalene-d8	1146-65-2	E641A-LVA	0.1	%	117	117	98.0	94.1	92.8	
Phenanthrene-d10	1517-22-2	E641A-LVA	0.1	%	118	118	95.9	93.0	94.6	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS06	CFS07	CFS08	CFS09	CFS10
(Matrix: Soil/Solid)					Client sampling date / time	21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-006	WP2414228-007	WP2414228-008	WP2414228-009	WP2414228-010	
					Result	Result	Result	Result	Result	
Sample Preparation										
pH, IVBA Initial	----	EP452/VA	0.01	pH units	1.50	1.50	1.49	1.52	1.53	
pH, IVBA final	----	EP452/VA	0.01	pH units	1.54	1.53	1.49	1.54	1.54	
Weight, extraction (dry)	----	EP452/VA	0.01	g	0.970	0.930	1.088	0.916	0.995	
Final volume	----	EP452/VA	1	mL	100	100	100	100	100	
Physical Tests										
Moisture	----	E144/VA	0.25	%	11.2	15.5	9.63	5.25	17.9	
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg	3860	4110	12600	9090	10000	
Antimony	7440-36-0	E440/VA	0.10	mg/kg	0.11	<0.10	0.22	<0.10	<0.10	
Arsenic	7440-38-2	E440B/VA	0.050	mg/kg	3.82	5.72	3.75	6.78	2.43	
Arsenic	7440-38-2	E440/VA	0.10	mg/kg	2.37	1.83	8.60	1.37	1.69	
Barium	7440-39-3	E440/VA	0.50	mg/kg	23.6	12.2	39.0	27.6	48.1	
Beryllium	7440-41-7	E440/VA	0.10	mg/kg	0.10	<0.10	0.26	0.21	0.25	
Bismuth	7440-69-9	E440/VA	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	
Boron	7440-42-8	E440/VA	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	
Cadmium	7440-43-9	E440/VA	0.020	mg/kg	0.072	0.055	0.096	0.043	0.114	
Calcium	7440-70-2	E440/VA	50	mg/kg	2460	2220	2760	1780	4910	
Chromium	7440-47-3	E440/VA	0.50	mg/kg	7.48	7.32	21.3	14.9	26.6	
Cobalt	7440-48-4	E440/VA	0.10	mg/kg	1.19	2.23	3.40	4.14	7.03	
Copper	7440-50-8	E440/VA	0.50	mg/kg	2.51	2.51	5.61	6.20	21.6	
Iron	7439-89-6	E440/VA	50	mg/kg	3260	5410	12600	12600	15400	
Lead	7439-92-1	E440/VA	0.50	mg/kg	4.49	3.03	9.68	2.89	4.34	
Lithium	7439-93-2	E440/VA	2.0	mg/kg	3.3	9.4	7.5	12.2	16.2	
Magnesium	7439-95-4	E440/VA	20	mg/kg	1040	2030	2990	2840	5510	
Manganese	7439-96-5	E440/VA	1.0	mg/kg	58.8	77.9	158	104	224	
Mercury	7439-97-6	E510/VA	0.0050	mg/kg	0.0245	0.0214	0.0412	0.0082	0.0148	
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg	0.14	0.16	0.78	0.13	0.44	
Nickel	7440-02-0	E440/VA	0.50	mg/kg	3.33	5.25	9.08	9.34	17.1	
Phosphorus	7723-14-0	E440/VA	50	mg/kg	165	278	320	613	636	
Potassium	7440-09-7	E440/VA	100	mg/kg	300	340	820	630	2140	



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS06	CFS07	CFS08	CFS09	CFS10
(Matrix: Soil/Solid)					Client sampling date / time	21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-006	WP2414228-007	WP2414228-008	WP2414228-009	WP2414228-010	
					Result	Result	Result	Result	Result	
Metals										
Selenium	7782-49-2	E440/VA	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	
Silver	7440-22-4	E440/VA	0.10	mg/kg	<0.10	<0.10	0.15	<0.10	<0.10	
Sodium	7440-23-5	E440/VA	50	mg/kg	56	59	129	74	157	
Strontium	7440-24-6	E440/VA	0.50	mg/kg	13.1	13.6	21.2	12.0	19.1	
Sulfur	7704-34-9	E440/VA	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	
Thallium	7440-28-0	E440/VA	0.050	mg/kg	0.059	<0.050	0.108	<0.050	0.134	
Tin	7440-31-5	E440/VA	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	
Titanium	7440-32-6	E440/VA	1.0	mg/kg	287	514	760	552	760	
Tungsten	7440-33-7	E440/VA	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Uranium	7440-61-1	E440/VA	0.050	mg/kg	0.587	0.509	0.498	0.458	0.678	
Vanadium	7440-62-2	E440/VA	0.20	mg/kg	7.70	11.7	33.2	21.8	29.2	
Zinc	7440-66-6	E440/VA	2.0	mg/kg	9.6	15.8	30.1	33.2	37.9	
Zirconium	7440-67-7	E440/VA	1.0	mg/kg	<1.0	1.5	1.9	2.6	3.2	
Arsenic, IVBA (leachate)	7440-38-2	EC452A/VA	10	mg/kg	0.82	1.88	0.93	1.97	0.81	
Leachable Metals										
Arsenic, IVBA (%)	7440-38-2	EC452/VA	1.0	%	21.6	32.9	24.8	29.0	33.5	
Arsenic, IVBA (leachate)	7440-38-2	E452/VA	0.100	mg/L	0.0080	0.0175	0.0101	0.0180	0.0081	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Acenaphthylene	208-96-8	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Acridine	260-94-6	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.130 ^{ADLI}	<0.010	<0.010	
Anthracene	120-12-7	E641A-L/VA	0.0040	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	
Benz(a)anthracene	56-55-3	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(a)pyrene	50-32-8	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(b+j)fluoranthene	n/a	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(b+j+k)fluoranthene	n/a	E641A-L/VA	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	
Benzo(g,h,i)perylene	191-24-2	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(k)fluoranthene	207-08-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Chrysene	218-01-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Dibenz(a,h)anthracene	53-70-3	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	



Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	CFS06	CFS07	CFS08	CFS09	CFS10
Client sampling date / time					21-Aug-2023 00:00	21-Aug-2023 00:00	21-Aug-2023 00:00	28-Aug-2023 00:00	28-Aug-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-006	WP2414228-007	WP2414228-008	WP2414228-009	WP2414228-010	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Fluoranthene	206-44-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Fluorene	86-73-7	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.011 ^{DLCI}	<0.010	<0.010	
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 1-	90-12-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 1+2-	----	E641A-LVA	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	
Methylnaphthalene, 2-	91-57-6	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Naphthalene	91-20-3	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Perylene	198-55-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Phenanthrene	85-01-8	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Pyrene	129-00-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Quinoline	91-22-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
B(a)P total potency equivalents [B(a)P TPE]	----	E641A-LVA	0.020	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	
IACR (CCME)	----	E641A-LVA	0.150	-	<0.150	<0.150	<0.150	<0.150	<0.150	
Polycyclic Aromatic Hydrocarbons Surrogates										
Acridine-d9	34749-75-2	E641A-LVA	0.1	%	60.6	102	7.7 ^{ADLI}	106	102	
Chrysene-d12	1719-03-5	E641A-LVA	0.1	%	99.3	105	89.2	106	102	
Naphthalene-d8	1146-65-2	E641A-LVA	0.1	%	117	120	98.0	123	121	
Phenanthrene-d10	1517-22-2	E641A-LVA	0.1	%	115	119	100	121	120	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS11	CFS12	CFS13	CFS14	CFS-DUP-01
(Matrix: Soil/Solid)					Client sampling date / time	28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-011	WP2414228-012	WP2414228-013	WP2414228-014	WP2414228-015	
					Result	Result	Result	Result	Result	
Sample Preparation										
pH, IVBA Initial	----	EP452/VA	0.01	pH units	1.52	1.52	1.53	1.54	1.50	
pH, IVBA final	----	EP452/VA	0.01	pH units	1.54	1.50	1.53	1.55	1.55	
Weight, extraction (dry)	----	EP452/VA	0.01	g	1.064	0.999	0.502	1.086	0.907	
Final volume	----	EP452/VA	1	mL	100	100	100	100	100	
Physical Tests										
Moisture	----	E144/VA	0.25	%	6.24	14.0	87.2	7.62	9.01	
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg	7160	3770	2770	4860	4850	
Antimony	7440-36-0	E440/VA	0.10	mg/kg	<0.10	0.11	1.44	0.14	0.12	
Arsenic	7440-38-2	E440B/VA	0.050	mg/kg	1.93	11.6	14.6	17.9	17.8	
Arsenic	7440-38-2	E440/VA	0.10	mg/kg	2.22	4.20	19.5	4.52	4.45	
Barium	7440-39-3	E440/VA	0.50	mg/kg	32.7	13.0	46.1	44.6	38.5	
Beryllium	7440-41-7	E440/VA	0.10	mg/kg	0.23	<0.10	<0.10	0.11	0.11	
Bismuth	7440-69-9	E440/VA	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	
Boron	7440-42-8	E440/VA	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	
Cadmium	7440-43-9	E440/VA	0.020	mg/kg	0.049	0.044	0.676	0.117	0.092	
Calcium	7440-70-2	E440/VA	50	mg/kg	2880	732	2660	2840	2760	
Chromium	7440-47-3	E440/VA	0.50	mg/kg	17.1	7.40	3.55	14.7	9.30	
Cobalt	7440-48-4	E440/VA	0.10	mg/kg	5.27	1.07	2.66	3.81	3.80	
Copper	7440-50-8	E440/VA	0.50	mg/kg	4.52	1.38	4.81	8.57	8.71	
Iron	7439-89-6	E440/VA	50	mg/kg	10000	8040	2840	9760	8960	
Lead	7439-92-1	E440/VA	0.50	mg/kg	3.43	3.88	15.1	6.58	6.08	
Lithium	7439-93-2	E440/VA	2.0	mg/kg	11.6	3.5	<2.0	9.7	10.5	
Magnesium	7439-95-4	E440/VA	20	mg/kg	3510	626	732	2910	2970	
Manganese	7439-96-5	E440/VA	1.0	mg/kg	305	75.2	24.9	252	209	
Mercury	7439-97-6	E510/VA	0.0050	mg/kg	0.0060	0.0064	0.191	0.0156	0.0115	
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg	0.22	0.14	0.88	0.12	<0.10	
Nickel	7440-02-0	E440/VA	0.50	mg/kg	10.0	2.47	3.36	8.05	7.25	
Phosphorus	7723-14-0	E440/VA	50	mg/kg	369	128	759	338	388	
Potassium	7440-09-7	E440/VA	100	mg/kg	970	150	670	770	870	



Analytical Results

Sub-Matrix: Soil (Matrix: Soil/Solid)					Client sample ID	CFS11	CFS12	CFS13	CFS14	CFS-DUP-01
Client sampling date / time					28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00	
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-011	WP2414228-012	WP2414228-013	WP2414228-014	WP2414228-015	
					Result	Result	Result	Result	Result	
Metals										
Selenium	7782-49-2	E440/VA	0.20	mg/kg	<0.20	<0.20	0.49	<0.20	<0.20	
Silver	7440-22-4	E440/VA	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	
Sodium	7440-23-5	E440/VA	50	mg/kg	119	<50	172	62	58	
Strontium	7440-24-6	E440/VA	0.50	mg/kg	14.8	5.85	21.2	12.6	14.6	
Sulfur	7704-34-9	E440/VA	1000	mg/kg	<1000	<1000	1200	<1000	<1000	
Thallium	7440-28-0	E440/VA	0.050	mg/kg	0.076	<0.050	0.084	0.084	0.089	
Tin	7440-31-5	E440/VA	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	
Titanium	7440-32-6	E440/VA	1.0	mg/kg	622	384	77.6	447	530	
Tungsten	7440-33-7	E440/VA	0.50	mg/kg	<0.50	<0.50	1.11	<0.50	<0.50	
Uranium	7440-61-1	E440/VA	0.050	mg/kg	0.443	0.308	0.229	0.631	0.574	
Vanadium	7440-62-2	E440/VA	0.20	mg/kg	20.6	16.8	4.75	15.2	15.8	
Zinc	7440-66-6	E440/VA	2.0	mg/kg	25.2	8.5	21.3	32.3	29.5	
Zirconium	7440-67-7	E440/VA	1.0	mg/kg	2.3	<1.0	<1.0	<1.0	1.3	
Arsenic, IVBA (leachate)	7440-38-2	EC452A/VA	10	mg/kg	0.69	2.10	2.25	4.64	5.38	
Leachable Metals										
Arsenic, IVBA (%)	7440-38-2	EC452/VA	1.0	%	35.5	18.1	15.4	25.9	30.2	
Arsenic, IVBA (leachate)	7440-38-2	E452/VA	0.100	mg/L	0.0073	0.0210	0.0113	0.0504	0.0488	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0650 ^{DLCL}	<0.0050	<0.0050	
Acenaphthylene	208-96-8	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0252 ^{DLHM}	<0.0050	<0.0050	
Acridine	260-94-6	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.110 ^{ADLI}	<0.010	<0.010	
Anthracene	120-12-7	E641A-L/VA	0.0040	mg/kg	<0.0040	<0.0040	<0.0252 ^{DLHM}	<0.0040	<0.0040	
Benz(a)anthracene	56-55-3	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Benzo(a)pyrene	50-32-8	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Benzo(b+j)fluoranthene	n/a	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	0.071	<0.010	<0.010	
Benzo(b+j+k)fluoranthene	n/a	E641A-L/VA	0.015	mg/kg	<0.015	<0.015	0.071	<0.015	<0.015	
Benzo(g,h,i)perylene	191-24-2	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Benzo(k)fluoranthene	207-08-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Chrysene	218-01-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	0.052	<0.010	<0.010	
Dibenz(a,h)anthracene	53-70-3	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0252 ^{DLHM}	<0.0050	<0.0050	



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS11	CFS12	CFS13	CFS14	CFS-DUP-01
(Matrix: Soil/Solid)					Client sampling date / time	28-Aug-2023 00:00	28-Aug-2023 00:00	30-Aug-2023 00:00	06-Sep-2023 00:00	06-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-011	WP2414228-012	WP2414228-013	WP2414228-014	WP2414228-015	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Fluoranthene	206-44-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.065 ^{DLO}	<0.010	<0.010	
Fluorene	86-73-7	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.312 ^{DLO}	<0.010	<0.010	
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.030 ^{DLO}	<0.010	<0.010	
Methylnaphthalene, 1-	90-12-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Methylnaphthalene, 1+2-	----	E641A-LVA	0.015	mg/kg	<0.015	<0.015	<0.035	<0.015	<0.015	
Methylnaphthalene, 2-	91-57-6	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Naphthalene	91-20-3	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Perylene	198-55-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
Phenanthrene	85-01-8	E641A-LVA	0.010	mg/kg	<0.010	<0.010	0.100	<0.010	<0.010	
Pyrene	129-00-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	0.100	<0.010	<0.010	
Quinoline	91-22-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.025 ^{DLHM}	<0.010	<0.010	
B(a)P total potency equivalents [B(a)P TPE]	----	E641A-LVA	0.020	mg/kg	<0.020	<0.020	0.037	<0.020	<0.020	
IACR (CCME)	----	E641A-LVA	0.150	-	<0.150	<0.150	0.680	<0.150	<0.150	
Polycyclic Aromatic Hydrocarbons Surrogates										
Acridine-d9	34749-75-2	E641A-LVA	0.1	%	86.0	83.4	9.1 ^{ADLI}	88.8	93.9	
Chrysene-d12	1719-03-5	E641A-LVA	0.1	%	106	94.7	90.3	100	101	
Naphthalene-d8	1146-65-2	E641A-LVA	0.1	%	121	114	100	116	121	
Phenanthrene-d10	1517-22-2	E641A-LVA	0.1	%	118	113	103	115	119	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS16	CFS17	CFS19	CFS22	CFS26
(Matrix: Soil/Solid)					Client sampling date / time	07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	12-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-016	WP2414228-017	WP2414228-018	WP2414228-019	WP2414228-020	
					Result	Result	Result	Result	Result	
Sample Preparation										
pH, IVBA Initial	---	EP452/VA	0.01	pH units	1.51	1.53	1.52	1.52	1.51	
pH, IVBA final	---	EP452/VA	0.01	pH units	1.57	1.56	1.55	1.57	1.57	
Weight, extraction (dry)	---	EP452/VA	0.01	g	0.967	1.041	1.090	0.964	1.016	
Final volume	---	EP452/VA	1	mL	100	100	100	100	100	
Physical Tests										
Moisture	---	E144/VA	0.25	%	33.2	16.8	14.3	24.8	13.7	
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg	4370	13400	13800	3570	8040	
Antimony	7440-36-0	E440/VA	0.10	mg/kg	<0.10	<0.10	0.37	0.33	0.14	
Arsenic	7440-38-2	E440B/VA	0.050	mg/kg	4.77	3.17	7.25	6.74	9.14	
Arsenic	7440-38-2	E440/VA	0.10	mg/kg	1.37	4.03	14.0	6.30	7.26	
Barium	7440-39-3	E440/VA	0.50	mg/kg	14.0	64.0	96.4	30.2	36.2	
Beryllium	7440-41-7	E440/VA	0.10	mg/kg	0.12	0.43	0.32	<0.10	0.18	
Bismuth	7440-69-9	E440/VA	0.20	mg/kg	<0.20	<0.20	0.20	<0.20	<0.20	
Boron	7440-42-8	E440/VA	5.0	mg/kg	<5.0	<5.0	5.3	<5.0	<5.0	
Cadmium	7440-43-9	E440/VA	0.020	mg/kg	0.051	0.078	0.202	0.167	0.063	
Calcium	7440-70-2	E440/VA	50	mg/kg	1550	2830	3960	1350	1290	
Chromium	7440-47-3	E440/VA	0.50	mg/kg	7.85	27.3	27.2	6.34	12.6	
Cobalt	7440-48-4	E440/VA	0.10	mg/kg	2.04	11.5	12.0	1.19	2.30	
Copper	7440-50-8	E440/VA	0.50	mg/kg	3.34	14.1	9.47	2.75	2.54	
Iron	7439-89-6	E440/VA	50	mg/kg	4370	17800	18100	6630	11000	
Lead	7439-92-1	E440/VA	0.50	mg/kg	2.83	9.21	16.6	6.28	6.21	
Lithium	7439-93-2	E440/VA	2.0	mg/kg	7.8	16.6	10.0	<2.0	7.3	
Magnesium	7439-95-4	E440/VA	20	mg/kg	1640	4910	4190	584	1150	
Manganese	7439-96-5	E440/VA	1.0	mg/kg	57.3	743	1490	28.4	75.0	
Mercury	7439-97-6	E510/VA	0.0050	mg/kg	0.0136	0.0162	0.0688	0.0476	0.0203	
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg	0.13	0.75	1.49	0.15	0.24	
Nickel	7440-02-0	E440/VA	0.50	mg/kg	5.42	14.6	13.1	2.91	6.01	
Phosphorus	7723-14-0	E440/VA	50	mg/kg	259	362	478	320	330	
Potassium	7440-09-7	E440/VA	100	mg/kg	320	1870	1940	270	260	



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS16	CFS17	CFS19	CFS22	CFS26
(Matrix: Soil/Solid)					Client sampling date / time	07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	12-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-016	WP2414228-017	WP2414228-018	WP2414228-019	WP2414228-020	
					Result	Result	Result	Result	Result	
Metals										
Selenium	7782-49-2	E440/VA	0.20	mg/kg	<0.20	<0.20	0.26	0.22	<0.20	
Silver	7440-22-4	E440/VA	0.10	mg/kg	<0.10	0.14	0.24	<0.10	<0.10	
Sodium	7440-23-5	E440/VA	50	mg/kg	<50	107	146	<50	55	
Strontium	7440-24-6	E440/VA	0.50	mg/kg	8.56	18.4	25.8	14.7	11.3	
Sulfur	7704-34-9	E440/VA	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	
Thallium	7440-28-0	E440/VA	0.050	mg/kg	<0.050	0.156	0.182	<0.050	<0.050	
Tin	7440-31-5	E440/VA	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	
Titanium	7440-32-6	E440/VA	1.0	mg/kg	470	681	953	242	507	
Tungsten	7440-33-7	E440/VA	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	
Uranium	7440-61-1	E440/VA	0.050	mg/kg	0.490	0.851	0.528	0.210	0.265	
Vanadium	7440-62-2	E440/VA	0.20	mg/kg	8.98	40.2	45.4	12.2	21.3	
Zinc	7440-66-6	E440/VA	2.0	mg/kg	19.9	38.5	59.3	8.1	15.4	
Zirconium	7440-67-7	E440/VA	1.0	mg/kg	1.6	2.3	1.5	<1.0	<1.0	
Arsenic, IVBA (leachate)	7440-38-2	EC452A/VA	10	mg/kg	1.64	0.52	1.38	1.34	1.99	
Leachable Metals										
Arsenic, IVBA (%)	7440-38-2	EC452/VA	1.0	%	34.2	16.4	19.0	19.8	21.8	
Arsenic, IVBA (leachate)	7440-38-2	E452/VA	0.100	mg/L	0.0158	0.0054	0.0150	0.0129	0.0202	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0530 ^{DLCI}	<0.0050	
Acenaphthylene	208-96-8	E641A-L/VA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Acridine	260-94-6	E641A-L/VA	0.01	mg/kg	----	----	----	NR ^{RRR}	----	
Acridine	260-94-6	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	----	<0.010	
Anthracene	120-12-7	E641A-L/VA	0.0040	mg/kg	<0.0049 ^{DLHM}	<0.0040	<0.0040	<0.0041 ^{DLHM}	<0.0040	
Benz(a)anthracene	56-55-3	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(a)pyrene	50-32-8	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(b+j)fluoranthene	n/a	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.045 ^{DLCI}	<0.010	
Benzo(b+j+k)fluoranthene	n/a	E641A-L/VA	0.015	mg/kg	<0.015	<0.015	<0.015	<0.046	<0.015	
Benzo(g,h,i)perylene	191-24-2	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Benzo(k)fluoranthene	207-08-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Chrysene	218-01-9	E641A-L/VA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.046 ^{DLCI}	<0.010	



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS16	CFS17	CFS19	CFS22	CFS26
(Matrix: Soil/Solid)					Client sampling date / time	07-Sep-2023 00:00	07-Sep-2023 00:00	07-Sep-2023 00:00	09-Sep-2023 00:00	12-Sep-2023 00:00
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-016	WP2414228-017	WP2414228-018	WP2414228-019	WP2414228-020	
					Result	Result	Result	Result	Result	
Polycyclic Aromatic Hydrocarbons										
Dibenz(a,h)anthracene	53-70-3	E641A-LVA	0.0050	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	
Fluoranthene	206-44-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Fluorene	86-73-7	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.018 ^{DLO}	<0.010	
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 1-	90-12-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Methylnaphthalene, 1+2-	----	E641A-LVA	0.015	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	
Methylnaphthalene, 2-	91-57-6	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Naphthalene	91-20-3	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
Perylene	198-55-0	E641A-LVA	0.010	mg/kg	0.018	<0.010	<0.010	<0.010	<0.010	
Phenanthrene	85-01-8	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	0.015	<0.010	
Pyrene	129-00-0	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.015 ^{DLO}	<0.010	
Quinoline	91-22-5	E641A-LVA	0.010	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	
B(a)P total potency equivalents [B(a)P TPE]	----	E641A-LVA	0.020	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	
IACR (CCME)	----	E641A-LVA	0.150	-	<0.150	<0.150	<0.150	0.225	<0.150	
Polycyclic Aromatic Hydrocarbons Surrogates										
Acridine-d9	34749-75-2	E641A-LVA	0.1	%	99.5	70.4	79.6	Not ^{RRR} Determined	80.8	
Chrysene-d12	1719-03-5	E641A-LVA	0.1	%	95.1	99.0	103	82.4	112	
Naphthalene-d8	1146-65-2	E641A-LVA	0.1	%	115	119	120	95.1	123	
Phenanthrene-d10	1517-22-2	E641A-LVA	0.1	%	112	118	119	93.2	124	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS21	----	----	----	----
(Matrix: Soil/Solid)					Client sampling date / time	09-Sep-2023 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-029	-----	-----	-----	-----	
					Result	---	---	---	---	
Sample Preparation										
pH, IVBA Initial	---	EP452/VA	0.01	pH units	1.51	---	---	---	---	
pH, IVBA final	---	EP452/VA	0.01	pH units	1.58	---	---	---	---	
Weight, extraction (dry)	---	EP452/VA	0.01	g	1.088	---	---	---	---	
Final volume	---	EP452/VA	1	mL	100	---	---	---	---	
Physical Tests										
Moisture	---	E144/VA	0.25	%	7.65	---	---	---	---	
Metals										
Aluminum	7429-90-5	E440/VA	50	mg/kg	2600	---	---	---	---	
Antimony	7440-36-0	E440/VA	0.10	mg/kg	<0.10	---	---	---	---	
Arsenic	7440-38-2	E440B/VA	0.050	mg/kg	1.79	---	---	---	---	
Arsenic	7440-38-2	E440/VA	0.10	mg/kg	1.74	---	---	---	---	
Barium	7440-39-3	E440/VA	0.50	mg/kg	14.9	---	---	---	---	
Beryllium	7440-41-7	E440/VA	0.10	mg/kg	<0.10	---	---	---	---	
Bismuth	7440-69-9	E440/VA	0.20	mg/kg	<0.20	---	---	---	---	
Boron	7440-42-8	E440/VA	5.0	mg/kg	<5.0	---	---	---	---	
Cadmium	7440-43-9	E440/VA	0.020	mg/kg	0.026	---	---	---	---	
Calcium	7440-70-2	E440/VA	50	mg/kg	623	---	---	---	---	
Chromium	7440-47-3	E440/VA	0.50	mg/kg	3.46	---	---	---	---	
Cobalt	7440-48-4	E440/VA	0.10	mg/kg	0.57	---	---	---	---	
Copper	7440-50-8	E440/VA	0.50	mg/kg	1.26	---	---	---	---	
Iron	7439-89-6	E440/VA	50	mg/kg	2590	---	---	---	---	
Lead	7439-92-1	E440/VA	0.50	mg/kg	2.48	---	---	---	---	
Lithium	7439-93-2	E440/VA	2.0	mg/kg	2.1	---	---	---	---	
Magnesium	7439-95-4	E440/VA	20	mg/kg	374	---	---	---	---	
Manganese	7439-96-5	E440/VA	1.0	mg/kg	53.6	---	---	---	---	
Mercury	7439-97-6	E510/VA	0.0050	mg/kg	0.0074	---	---	---	---	
Molybdenum	7439-98-7	E440/VA	0.10	mg/kg	0.10	---	---	---	---	
Nickel	7440-02-0	E440/VA	0.50	mg/kg	1.20	---	---	---	---	
Phosphorus	7723-14-0	E440/VA	50	mg/kg	215	---	---	---	---	
Potassium	7440-09-7	E440/VA	100	mg/kg	230	---	---	---	---	



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS21	----	----	----	----
(Matrix: Soil/Solid)					Client sampling date / time	09-Sep-2023 00:00	---	---	---	---
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-029	-----	-----	-----	-----	
					Result	---	---	---	---	
Metals										
Selenium	7782-49-2	E440/VA	0.20	mg/kg	<0.20	---	---	---	---	
Silver	7440-22-4	E440/VA	0.10	mg/kg	<0.10	---	---	---	---	
Sodium	7440-23-5	E440/VA	50	mg/kg	<50	---	---	---	---	
Strontium	7440-24-6	E440/VA	0.50	mg/kg	5.75	---	---	---	---	
Sulfur	7704-34-9	E440/VA	1000	mg/kg	<1000	---	---	---	---	
Thallium	7440-28-0	E440/VA	0.050	mg/kg	<0.050	---	---	---	---	
Tin	7440-31-5	E440/VA	2.0	mg/kg	<2.0	---	---	---	---	
Titanium	7440-32-6	E440/VA	1.0	mg/kg	218	---	---	---	---	
Tungsten	7440-33-7	E440/VA	0.50	mg/kg	<0.50	---	---	---	---	
Uranium	7440-61-1	E440/VA	0.050	mg/kg	0.157	---	---	---	---	
Vanadium	7440-62-2	E440/VA	0.20	mg/kg	5.87	---	---	---	---	
Zinc	7440-66-6	E440/VA	2.0	mg/kg	9.8	---	---	---	---	
Zirconium	7440-67-7	E440/VA	1.0	mg/kg	<1.0	---	---	---	---	
Arsenic, IVBA (leachate)	7440-38-2	EC452A/VA	10	mg/kg	0.85	---	---	---	---	
Leachable Metals										
Arsenic, IVBA (%)	7440-38-2	EC452/VA	1.0	%	47.2	---	---	---	---	
Arsenic, IVBA (leachate)	7440-38-2	E452/VA	0.100	mg/L	0.0092	---	---	---	---	
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	83-32-9	E641A-L/VA	0.0050	mg/kg	<0.0050	---	---	---	---	
Acenaphthylene	208-96-8	E641A-L/VA	0.0050	mg/kg	<0.0050	---	---	---	---	
Acridine	260-94-6	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Anthracene	120-12-7	E641A-L/VA	0.0040	mg/kg	<0.0040	---	---	---	---	
Benz(a)anthracene	56-55-3	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Benzo(a)pyrene	50-32-8	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Benzo(b+j)fluoranthene	n/a	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Benzo(b+j+k)fluoranthene	n/a	E641A-L/VA	0.015	mg/kg	<0.015	---	---	---	---	
Benzo(g,h,i)perylene	191-24-2	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Benzo(k)fluoranthene	207-08-9	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Chrysene	218-01-9	E641A-L/VA	0.010	mg/kg	<0.010	---	---	---	---	
Dibenz(a,h)anthracene	53-70-3	E641A-L/VA	0.0050	mg/kg	<0.0050	---	---	---	---	



Analytical Results

Sub-Matrix: Soil					Client sample ID	CFS21	----	----	----	----
(Matrix: Soil/Solid)					Client sampling date / time	09-Sep-2023 00:00	----	----	----	----
Analyte	CAS Number	Method/Lab	LOR	Unit	WP2414228-029	-----	-----	-----	-----	
					Result	----	----	----	----	
Polycyclic Aromatic Hydrocarbons										
Fluoranthene	206-44-0	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Fluorene	86-73-7	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Methylnaphthalene, 1-	90-12-0	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Methylnaphthalene, 1+2-	----	E641A-LVA	0.015	mg/kg	<0.015	----	----	----	----	
Methylnaphthalene, 2-	91-57-6	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Naphthalene	91-20-3	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Perylene	198-55-0	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Phenanthrene	85-01-8	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Pyrene	129-00-0	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
Quinoline	91-22-5	E641A-LVA	0.010	mg/kg	<0.010	----	----	----	----	
B(a)P total potency equivalents [B(a)P TPE]	----	E641A-LVA	0.020	mg/kg	<0.020	----	----	----	----	
IACR (CCME)	----	E641A-LVA	0.150	-	<0.150	----	----	----	----	
Polycyclic Aromatic Hydrocarbons Surrogates										
Acridine-d9	34749-75-2	E641A-LVA	0.1	%	40.4 ^{SUR-ND}	----	----	----	----	
Chrysene-d12	1719-03-5	E641A-LVA	0.1	%	86.9	----	----	----	----	
Naphthalene-d8	1146-65-2	E641A-LVA	0.1	%	104	----	----	----	----	
Phenanthrene-d10	1517-22-2	E641A-LVA	0.1	%	99.6	----	----	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.



QUALITY CONTROL INTERPRETIVE REPORT

<p>Work Order : WP2414228</p> <p>Client : Great Bear Resources Ltd</p> <p>Contact : Ashley Moncrief</p> <p>Address : Great Bear Resources Ltd. 117 Forestry Road Red Lake ON Canada P0V 2M0</p> <p>Telephone : 807 630 0203</p> <p>Project : PPR-022-3</p> <p>PO : PPR-022-3</p> <p>C-O-C number : ----</p> <p>Sampler : ----</p> <p>Site : ----</p> <p>Quote number : 2024 Standing offer_V2</p> <p>No. of samples received : 28</p> <p>No. of samples analysed : 28</p>	<p>Page : 1 of 32</p> <p>Laboratory : ALS Environmental - Winnipeg</p> <p>Account Manager : Judy Dalmajjer</p> <p>Address : 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4</p> <p>Telephone : +1 204 255 9720</p> <p>Date Samples Received : 04-Jun-2024 09:20</p> <p>Issue Date : 13-Aug-2024 13:15</p>
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This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

- Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
- CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
- DQO: Data Quality Objective.
- LOR: Limit of Reporting (detection limit).
- RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- Method Blank value outliers occur - please see following pages for full details.
- Duplicate outliers occur - please see following pages for full details.
- Laboratory Control Sample (LCS) outliers occur - please see following pages for full details.
- Matrix Spike outliers occur - please see following pages for full details.
- Test sample Surrogate recovery outliers exist for all regular sample matrices - please see following pages for full details.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- Analysis Holding Time Outliers exist - please see following pages for full details.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: Biota

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Duplicate (DUP) RPDs								
Metals	WP2414228-024	CF33	Arsenic	7440-38-2	E472A	124 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.
Metals	WP2414228-024	CF33	Barium	7440-39-3	E472A	51.8 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.
Metals	WP2414228-024	CF33	Chromium	7440-47-3	E472A	0.121 % DUP-H, J	Diff <2x LOR	Low Level DUP DQO exceeded (difference > 2 LOR).
Metals	WP2414228-024	CF33	Manganese	7439-96-5	E472A	42.1 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.
Metals	WP2414228-024	CF33	Zirconium	7440-67-7	E472A	40.6 % DUP-H	40%	Duplicate RPD does not meet the DQO for this test.

Result Qualifiers

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.



Matrix: Soil/Solid

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Method Blank (MB) Values								
Metals	QC-MRG2-1514447 001	----	Magnesium	7439-95-4	E440	26 mg/kg ^B	20 mg/kg	Blank result exceeds permitted value

Result Qualifiers

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.

Duplicate (DUP) RPDs								
Polycyclic Aromatic Hydrocarbons	Anonymous	Anonymous	Acenaphthene	83-32-9	E641A-L	87.4 % ^{DUP-H}	50%	Duplicate RPD does not meet the DQO for this test.
Polycyclic Aromatic Hydrocarbons	Anonymous	Anonymous	Anthracene	120-12-7	E641A-L	85.6 % ^{DUP-H}	50%	Duplicate RPD does not meet the DQO for this test.
Polycyclic Aromatic Hydrocarbons	Anonymous	Anonymous	Fluoranthene	206-44-0	E641A-L	63.7 % ^{DUP-H}	50%	Duplicate RPD does not meet the DQO for this test.
Polycyclic Aromatic Hydrocarbons	Anonymous	Anonymous	Fluorene	86-73-7	E641A-L	96.3 % ^{DUP-H}	50%	Duplicate RPD does not meet the DQO for this test.
Polycyclic Aromatic Hydrocarbons	Anonymous	Anonymous	Phenanthrene	85-01-8	E641A-L	78.2 % ^{DUP-H}	50%	Duplicate RPD does not meet the DQO for this test.
Polycyclic Aromatic Hydrocarbons	Anonymous	Anonymous	Pyrene	129-00-0	E641A-L	52.0 % ^{DUP-H}	50%	Duplicate RPD does not meet the DQO for this test.

Result Qualifiers

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.

Laboratory Control Sample (LCS) Recoveries								
Metals	QC-MRG2-1533469 002	----	Phosphorus	7723-14-0	E440	123 % ^{MES}	80.0-120%	Recovery greater than upper control limit
Metals	QC-MRG2-1514447 002	----	Silver	7440-22-4	E440	78.9 % ^{MES}	80.0-120%	Recovery less than lower control limit

Result Qualifiers

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).

Matrix Spike (MS) Recoveries



Matrix: **Soil/Solid**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Method	Result	Limits	Comment
Matrix Spike (MS) Recoveries - Continued								
Polycyclic Aromatic Hydrocarbons	WP2414228-002	CFS02	Acridine	260-94-6	E641A-L	24.9 % ^K	50.0-140%	Recovery less than lower data quality objective

Result Qualifiers

Qualifier	Description
K	Matrix Spike recovery outside ALS DQO due to sample matrix effects.

Regular Sample Surrogates

Sub-Matrix: **Soil**

Analyte Group	Laboratory sample ID	Client/Ref Sample ID	Analyte	CAS Number	Result	Limits	Comment
Samples Submitted							
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-001	CFS01	Acridine-d9	34749-75-2	10.7 %	60.0-130 %	Recovery less than lower data quality objective
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-002	CFS02	Acridine-d9	34749-75-2	26.3 %	60.0-130 %	Recovery less than lower data quality objective
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-004	CFS04	Acridine-d9	34749-75-2	25.7 %	60.0-130 %	Recovery less than lower data quality objective
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-005	CFS05	Acridine-d9	34749-75-2	7.3 %	60.0-130 %	Recovery less than lower data quality objective
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-029	CFS21	Acridine-d9	34749-75-2	40.4 %	60.0-130 %	Recovery less than lower data quality objective
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-008	CFS08	Acridine-d9	34749-75-2	7.7 %	60.0-130 %	Recovery less than lower data quality objective
Polycyclic Aromatic Hydrocarbons Surrogates	WP2414228-013	CFS13	Acridine-d9	34749-75-2	9.1 %	60.0-130 %	Recovery less than lower data quality objective



Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF33	E511A	22-Feb-2024	18-Jul-2024	365 days	148 days	✔	21-Jul-2024	365 days	151 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF34	E511A	22-Feb-2024	18-Jul-2024	365 days	148 days	✔	21-Jul-2024	365 days	151 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF31	E511A	06-Feb-2024	18-Jul-2024	365 days	164 days	✔	21-Jul-2024	365 days	167 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF32	E511A	06-Feb-2024	18-Jul-2024	365 days	164 days	✔	21-Jul-2024	365 days	167 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF37	E511A	05-Jan-2024	18-Jul-2024	365 days	196 days	✔	21-Jul-2024	365 days	199 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF35	E511A	26-Dec-2023	18-Jul-2024	365 days	206 days	✔	21-Jul-2024	365 days	209 days	✔
Metals : Mercury in Biota by CVAAS (WET units, Micro)										
LDPE bag CF36	E511A	15-Dec-2023	18-Jul-2024	365 days	217 days	✔	21-Jul-2024	365 days	220 days	✔



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF33	E472A	22-Feb-2024	18-Jul-2024	730 days	148 days	✓	18-Jul-2024	730 days	148 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF34	E472A	22-Feb-2024	18-Jul-2024	730 days	148 days	✓	18-Jul-2024	730 days	148 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF31	E472A	06-Feb-2024	18-Jul-2024	730 days	164 days	✓	18-Jul-2024	730 days	164 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF32	E472A	06-Feb-2024	18-Jul-2024	730 days	164 days	✓	18-Jul-2024	730 days	164 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF37	E472A	05-Jan-2024	18-Jul-2024	730 days	196 days	✓	18-Jul-2024	730 days	196 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF35	E472A	26-Dec-2023	18-Jul-2024	730 days	206 days	✓	18-Jul-2024	730 days	206 days	✓	
Metals : Metals in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF36	E472A	15-Dec-2023	18-Jul-2024	730 days	217 days	✓	18-Jul-2024	730 days	217 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF33	E472A.Ag	22-Feb-2024	18-Jul-2024	730 days	148 days	✓	18-Jul-2024	730 days	148 days	✓	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF34	E472A.Ag	22-Feb-2024	18-Jul-2024	730 days	148 days	✓	18-Jul-2024	730 days	148 days	✓	



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF31	E472A.Ag	06-Feb-2024	18-Jul-2024	730 days	164 days	✔	18-Jul-2024	730 days	164 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF32	E472A.Ag	06-Feb-2024	18-Jul-2024	730 days	164 days	✔	18-Jul-2024	730 days	164 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF37	E472A.Ag	05-Jan-2024	18-Jul-2024	730 days	196 days	✔	18-Jul-2024	730 days	196 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF35	E472A.Ag	26-Dec-2023	18-Jul-2024	730 days	206 days	✔	18-Jul-2024	730 days	206 days	✔	
Metals : Silver in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF36	E472A.Ag	15-Dec-2023	18-Jul-2024	730 days	217 days	✔	18-Jul-2024	730 days	217 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF33	E472A.Ti	22-Feb-2024	18-Jul-2024	730 days	148 days	✔	18-Jul-2024	730 days	148 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF34	E472A.Ti	22-Feb-2024	18-Jul-2024	730 days	148 days	✔	18-Jul-2024	730 days	148 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF31	E472A.Ti	06-Feb-2024	18-Jul-2024	730 days	164 days	✔	18-Jul-2024	730 days	164 days	✔	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF32	E472A.Ti	06-Feb-2024	18-Jul-2024	730 days	164 days	✔	18-Jul-2024	730 days	164 days	✔	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF37	E472A.Ti	05-Jan-2024	18-Jul-2024	730 days	196 days	✓	18-Jul-2024	730 days	196 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF35	E472A.Ti	26-Dec-2023	18-Jul-2024	730 days	206 days	✓	18-Jul-2024	730 days	206 days	✓	
Metals : Titanium in Biota by CRC ICPMS (WET units, Micro)											
LDPE bag CF36	E472A.Ti	15-Dec-2023	18-Jul-2024	730 days	217 days	✓	18-Jul-2024	730 days	217 days	✓	
Physical Tests : Moisture Content by Gravimetry (Micro)											
LDPE bag CF33	E144-H	22-Feb-2024	----	----	----		18-Jul-2024	----	147 days		
Physical Tests : Moisture Content by Gravimetry (Micro)											
LDPE bag CF34	E144-H	22-Feb-2024	----	----	----		18-Jul-2024	----	147 days		
Physical Tests : Moisture Content by Gravimetry (Micro)											
LDPE bag CF31	E144-H	06-Feb-2024	----	----	----		18-Jul-2024	----	163 days		
Physical Tests : Moisture Content by Gravimetry (Micro)											
LDPE bag CF32	E144-H	06-Feb-2024	----	----	----		18-Jul-2024	----	163 days		
Physical Tests : Moisture Content by Gravimetry (Micro)											
LDPE bag CF37	E144-H	05-Jan-2024	----	----	----		18-Jul-2024	----	195 days		
Physical Tests : Moisture Content by Gravimetry (Micro)											
LDPE bag CF35	E144-H	26-Dec-2023	----	----	----		18-Jul-2024	----	205 days		



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry (Micro)										
LDPE bag CF36	E144-H	15-Dec-2023	----	----	----		18-Jul-2024	----	216 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF33	E144	22-Feb-2024	----	----	----		30-Jul-2024	----	160 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF34	E144	22-Feb-2024	----	----	----		30-Jul-2024	----	160 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF31	E144	06-Feb-2024	----	----	----		30-Jul-2024	----	176 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF32	E144	06-Feb-2024	----	----	----		30-Jul-2024	----	176 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF37	E144	05-Jan-2024	----	----	----		30-Jul-2024	----	208 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF35	E144	26-Dec-2023	----	----	----		30-Jul-2024	----	218 days	
Physical Tests : Moisture Content by Gravimetry										
LDPE bag CF36	E144	15-Dec-2023	----	----	----		30-Jul-2024	----	229 days	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF33	E539A	22-Feb-2024	31-Jul-2024	730 days	161 days	✔	01-Aug-2024	730 days	162 days	✔



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF34	E539A	22-Feb-2024	31-Jul-2024	730 days	161 days	✔	01-Aug-2024	730 days	162 days	✔
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF31	E539A	06-Feb-2024	31-Jul-2024	730 days	177 days	✔	01-Aug-2024	730 days	178 days	✔
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF32	E539A	06-Feb-2024	31-Jul-2024	730 days	177 days	✔	01-Aug-2024	730 days	178 days	✔
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF37	E539A	05-Jan-2024	31-Jul-2024	730 days	209 days	✔	01-Aug-2024	730 days	210 days	✔
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF35	E539A	26-Dec-2023	31-Jul-2024	730 days	219 days	✔	01-Aug-2024	730 days	220 days	✔
Speciated Metals : Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)										
LDPE bag CF36	E539A	15-Dec-2023	31-Jul-2024	730 days	230 days	✔	01-Aug-2024	730 days	231 days	✔
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)										
LDPE bag CF33	E538	22-Feb-2024	10-Jul-2024	365 days	139 days	✔	11-Jul-2024	365 days	1 days	✔
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)										
LDPE bag CF34	E538	22-Feb-2024	10-Jul-2024	365 days	139 days	✔	11-Jul-2024	365 days	1 days	✔
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)										
LDPE bag CF31	E538	06-Feb-2024	10-Jul-2024	365 days	155 days	✔	11-Jul-2024	365 days	1 days	✔



Matrix: **Biota** Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)											
LDPE bag CF32	E538	06-Feb-2024	10-Jul-2024	365 days	155 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)											
LDPE bag CF37	E538	05-Jan-2024	10-Jul-2024	365 days	187 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)											
LDPE bag CF35	E538	26-Dec-2023	10-Jul-2024	365 days	197 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (DRY units, Routine)											
LDPE bag CF36	E538	15-Dec-2023	10-Jul-2024	365 days	208 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF33	E538A	22-Feb-2024	10-Jul-2024	365 days	139 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF34	E538A	22-Feb-2024	10-Jul-2024	365 days	139 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF31	E538A	06-Feb-2024	10-Jul-2024	365 days	155 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF32	E538A	06-Feb-2024	10-Jul-2024	365 days	155 days	✔	11-Jul-2024	365 days	1 days	✔	
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF37	E538A	05-Jan-2024	10-Jul-2024	365 days	187 days	✔	11-Jul-2024	365 days	1 days	✔	



Matrix: **Biota** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF35	E538A	26-Dec-2023	10-Jul-2024	365 days	197 days	✓	11-Jul-2024	365 days	1 days	✓	
Speciated Metals : Methylmercury in Biota by GCAFS (WET units, Routine)											
LDPE bag CF36	E538A	15-Dec-2023	10-Jul-2024	365 days	208 days	✓	11-Jul-2024	365 days	1 days	✓	

Matrix: **Soil/Solid** Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS26	E452	12-Sep-2023	26-Jul-2024	180 days	317 days	* EHTR	08-Aug-2024	180 days	13 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS21	E452	09-Sep-2023	26-Jul-2024	180 days	320 days	* EHTR	08-Aug-2024	180 days	13 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS22	E452	09-Sep-2023	26-Jul-2024	180 days	320 days	* EHTR	08-Aug-2024	180 days	13 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS16	E452	07-Sep-2023	26-Jul-2024	180 days	322 days	* EHTR	08-Aug-2024	180 days	13 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS17	E452	07-Sep-2023	26-Jul-2024	180 days	322 days	* EHTR	08-Aug-2024	180 days	13 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS19	E452	07-Sep-2023	26-Jul-2024	180 days	322 days	* EHTR	08-Aug-2024	180 days	13 days	✓	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS-DUP-01	E452	06-Sep-2023	26-Jul-2024	180 days	323 days	* EHTR	08-Aug-2024	180 days	13 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS14	E452	06-Sep-2023	26-Jul-2024	180 days	323 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS13	E452	30-Aug-2023	26-Jul-2024	180 days	330 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS09	E452	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS10	E452	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS11	E452	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS12	E452	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS08	E452	21-Aug-2023	26-Jul-2024	180 days	339 days	* EHTR	09-Aug-2024	180 days	14 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS04	E452	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	08-Aug-2024	180 days	10 days	✓	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS05	E452	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	08-Aug-2024	180 days	10 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS06	E452	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	08-Aug-2024	180 days	10 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS07	E452	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	08-Aug-2024	180 days	10 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS01	E452	18-Aug-2023	29-Jul-2024	180 days	345 days	* EHTR	08-Aug-2024	180 days	10 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS02	E452	18-Aug-2023	29-Jul-2024	180 days	345 days	* EHTR	08-Aug-2024	180 days	10 days	✓	
Leachable Metals : IVBA (In Vitro Bioaccessibility) for As and Pb											
Glass soil jar/Teflon lined cap CFS03	E452	18-Aug-2023	29-Jul-2024	180 days	345 days	* EHTR	08-Aug-2024	180 days	10 days	✓	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS26	E440B	12-Sep-2023	26-Jul-2024	180 days	317 days	* EHTR	31-Jul-2024	180 days	323 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS21	E440B	09-Sep-2023	26-Jul-2024	180 days	320 days	* EHTR	31-Jul-2024	180 days	326 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS22	E440B	09-Sep-2023	26-Jul-2024	180 days	320 days	* EHTR	31-Jul-2024	180 days	326 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS16	E440B	07-Sep-2023	26-Jul-2024	180 days	322 days	* EHTR	31-Jul-2024	180 days	328 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS17	E440B	07-Sep-2023	26-Jul-2024	180 days	322 days	* EHTR	31-Jul-2024	180 days	328 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS19	E440B	07-Sep-2023	26-Jul-2024	180 days	322 days	* EHTR	31-Jul-2024	180 days	328 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS14	E440B	06-Sep-2023	26-Jul-2024	180 days	323 days	* EHTR	31-Jul-2024	180 days	329 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS-DUP-01	E440B	06-Sep-2023	26-Jul-2024	180 days	323 days	* EHTR	31-Jul-2024	180 days	329 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS13	E440B	30-Aug-2023	26-Jul-2024	180 days	330 days	* EHTR	31-Jul-2024	180 days	336 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS09	E440B	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	31-Jul-2024	180 days	338 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS10	E440B	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	31-Jul-2024	180 days	338 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS11	E440B	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	31-Jul-2024	180 days	338 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS12	E440B	28-Aug-2023	26-Jul-2024	180 days	332 days	* EHTR	31-Jul-2024	180 days	338 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS08	E440B	21-Aug-2023	26-Jul-2024	180 days	339 days	* EHTR	31-Jul-2024	180 days	345 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS04	E440B	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	31-Jul-2024	180 days	345 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS05	E440B	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	31-Jul-2024	180 days	345 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS06	E440B	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	31-Jul-2024	180 days	345 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS07	E440B	21-Aug-2023	29-Jul-2024	180 days	342 days	* EHTR	31-Jul-2024	180 days	345 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS01	E440B	18-Aug-2023	29-Jul-2024	180 days	345 days	* EHTR	31-Jul-2024	180 days	348 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS02	E440B	18-Aug-2023	29-Jul-2024	180 days	345 days	* EHTR	31-Jul-2024	180 days	348 days	* EHTR	
Metals : As and Lead in Soils by CRC ICPMS (<150 µm)											
Glass soil jar/Teflon lined cap CFS03	E440B	18-Aug-2023	29-Jul-2024	180 days	345 days	* EHTR	31-Jul-2024	180 days	348 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS26	E510	12-Sep-2023	27-Jun-2024	28 days	288 days	* EHTR	02-Jul-2024	28 days	294 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS22	E510	09-Sep-2023	27-Jun-2024	28 days	291 days	* EHTR	02-Jul-2024	28 days	297 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS16	E510	07-Sep-2023	27-Jun-2024	28 days	293 days	* EHTR	02-Jul-2024	28 days	299 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS17	E510	07-Sep-2023	27-Jun-2024	28 days	293 days	* EHTR	02-Jul-2024	28 days	299 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS19	E510	07-Sep-2023	27-Jun-2024	28 days	293 days	* EHTR	02-Jul-2024	28 days	299 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS14	E510	06-Sep-2023	27-Jun-2024	28 days	294 days	* EHTR	02-Jul-2024	28 days	300 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS-DUP-01	E510	06-Sep-2023	27-Jun-2024	28 days	294 days	* EHTR	02-Jul-2024	28 days	300 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS13	E510	30-Aug-2023	27-Jun-2024	28 days	301 days	* EHTR	02-Jul-2024	28 days	307 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS21	E510	09-Sep-2023	09-Jul-2024	28 days	303 days	* EHTR	10-Jul-2024	28 days	305 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS09	E510	28-Aug-2023	27-Jun-2024	28 days	303 days	* EHTR	02-Jul-2024	28 days	309 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS10	E510	28-Aug-2023	27-Jun-2024	28 days	303 days	* EHTR	02-Jul-2024	28 days	309 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS11	E510	28-Aug-2023	27-Jun-2024	28 days	303 days	* EHTR	02-Jul-2024	28 days	309 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS12	E510	28-Aug-2023	27-Jun-2024	28 days	303 days	* EHTR	02-Jul-2024	28 days	309 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS04	E510	21-Aug-2023	27-Jun-2024	28 days	310 days	* EHTR	02-Jul-2024	28 days	316 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS05	E510	21-Aug-2023	27-Jun-2024	28 days	310 days	* EHTR	02-Jul-2024	28 days	316 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS06	E510	21-Aug-2023	27-Jun-2024	28 days	310 days	* EHTR	02-Jul-2024	28 days	316 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS07	E510	21-Aug-2023	27-Jun-2024	28 days	310 days	* EHTR	02-Jul-2024	28 days	316 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS08	E510	21-Aug-2023	27-Jun-2024	28 days	310 days	* EHTR	02-Jul-2024	28 days	316 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS01	E510	18-Aug-2023	27-Jun-2024	28 days	313 days	* EHTR	02-Jul-2024	28 days	319 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS02	E510	18-Aug-2023	27-Jun-2024	28 days	313 days	* EHTR	02-Jul-2024	28 days	319 days	* EHTR	
Metals : Mercury in Soil/Solid by CVAAS											
Glass soil jar/Teflon lined cap CFS03	E510	18-Aug-2023	27-Jun-2024	28 days	313 days	* EHTR	02-Jul-2024	28 days	319 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS26	E440	12-Sep-2023	27-Jun-2024	180 days	288 days	* EHTR	02-Jul-2024	180 days	294 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS22	E440	09-Sep-2023	27-Jun-2024	180 days	291 days	* EHTR	02-Jul-2024	180 days	297 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS16	E440	07-Sep-2023	27-Jun-2024	180 days	293 days	* EHTR	02-Jul-2024	180 days	299 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS17	E440	07-Sep-2023	27-Jun-2024	180 days	293 days	* EHTR	02-Jul-2024	180 days	299 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS19	E440	07-Sep-2023	27-Jun-2024	180 days	293 days	* EHTR	02-Jul-2024	180 days	299 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS14	E440	06-Sep-2023	27-Jun-2024	180 days	294 days	* EHTR	02-Jul-2024	180 days	300 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS-DUP-01	E440	06-Sep-2023	27-Jun-2024	180 days	294 days	* EHTR	02-Jul-2024	180 days	300 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS13	E440	30-Aug-2023	27-Jun-2024	180 days	301 days	* EHTR	02-Jul-2024	180 days	307 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS21	E440	09-Sep-2023	09-Jul-2024	180 days	303 days	* EHTR	09-Jul-2024	180 days	304 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS09	E440	28-Aug-2023	27-Jun-2024	180 days	303 days	* EHTR	02-Jul-2024	180 days	309 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS10	E440	28-Aug-2023	27-Jun-2024	180 days	303 days	* EHTR	02-Jul-2024	180 days	309 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS11	E440	28-Aug-2023	27-Jun-2024	180 days	303 days	* EHTR	02-Jul-2024	180 days	309 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS12	E440	28-Aug-2023	27-Jun-2024	180 days	303 days	* EHTR	02-Jul-2024	180 days	309 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS04	E440	21-Aug-2023	27-Jun-2024	180 days	310 days	* EHTR	02-Jul-2024	180 days	316 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS05	E440	21-Aug-2023	27-Jun-2024	180 days	310 days	* EHTR	02-Jul-2024	180 days	316 days	* EHTR	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis				
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval	
				Rec	Actual			Rec	Actual		
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS06	E440	21-Aug-2023	27-Jun-2024	180 days	310 days	* EHTR	02-Jul-2024	180 days	316 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS07	E440	21-Aug-2023	27-Jun-2024	180 days	310 days	* EHTR	02-Jul-2024	180 days	316 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS08	E440	21-Aug-2023	27-Jun-2024	180 days	310 days	* EHTR	02-Jul-2024	180 days	316 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS01	E440	18-Aug-2023	27-Jun-2024	180 days	313 days	* EHTR	02-Jul-2024	180 days	319 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS02	E440	18-Aug-2023	27-Jun-2024	180 days	313 days	* EHTR	02-Jul-2024	180 days	319 days	* EHTR	
Metals : Metals in Soil/Solid by CRC ICPMS											
Glass soil jar/Teflon lined cap CFS03	E440	18-Aug-2023	27-Jun-2024	180 days	313 days	* EHTR	02-Jul-2024	180 days	319 days	* EHTR	
Physical Tests : Moisture Content by Gravimetry											
Glass soil jar/Teflon lined cap CFS26	E144	12-Sep-2023	----	----	----		26-Jun-2024	----	288 days		
Physical Tests : Moisture Content by Gravimetry											
Glass soil jar/Teflon lined cap CFS22	E144	09-Sep-2023	----	----	----		26-Jun-2024	----	291 days		
Physical Tests : Moisture Content by Gravimetry											
Glass soil jar/Teflon lined cap CFS16	E144	07-Sep-2023	----	----	----		26-Jun-2024	----	293 days		



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS17	E144	07-Sep-2023	----	----	----		26-Jun-2024	----	293 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS19	E144	07-Sep-2023	----	----	----		26-Jun-2024	----	293 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS14	E144	06-Sep-2023	----	----	----		26-Jun-2024	----	294 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS-DUP-01	E144	06-Sep-2023	----	----	----		26-Jun-2024	----	294 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS13	E144	30-Aug-2023	----	----	----		26-Jun-2024	----	301 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS09	E144	28-Aug-2023	----	----	----		26-Jun-2024	----	303 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS10	E144	28-Aug-2023	----	----	----		26-Jun-2024	----	303 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS11	E144	28-Aug-2023	----	----	----		26-Jun-2024	----	303 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS12	E144	28-Aug-2023	----	----	----		26-Jun-2024	----	303 days	



Matrix: Soil/Solid

Evaluation: ✖ = Holding time exceedance ; ✔ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS21	E144	09-Sep-2023	----	----	----		08-Jul-2024	----	304 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS04	E144	21-Aug-2023	----	----	----		26-Jun-2024	----	310 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS05	E144	21-Aug-2023	----	----	----		26-Jun-2024	----	310 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS06	E144	21-Aug-2023	----	----	----		26-Jun-2024	----	310 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS07	E144	21-Aug-2023	----	----	----		26-Jun-2024	----	310 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS08	E144	21-Aug-2023	----	----	----		26-Jun-2024	----	310 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS01	E144	18-Aug-2023	----	----	----		26-Jun-2024	----	313 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS02	E144	18-Aug-2023	----	----	----		26-Jun-2024	----	313 days	
Physical Tests : Moisture Content by Gravimetry										
Glass soil jar/Teflon lined cap CFS03	E144	18-Aug-2023	----	----	----		26-Jun-2024	----	313 days	



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS26	E641A-L	12-Sep-2023	26-Jun-2024	14 days	287 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS22	E641A-L	09-Sep-2023	26-Jun-2024	14 days	290 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS16	E641A-L	07-Sep-2023	26-Jun-2024	14 days	292 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS17	E641A-L	07-Sep-2023	26-Jun-2024	14 days	292 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS19	E641A-L	07-Sep-2023	26-Jun-2024	14 days	292 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS14	E641A-L	06-Sep-2023	26-Jun-2024	14 days	293 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS-DUP-01	E641A-L	06-Sep-2023	26-Jun-2024	14 days	293 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS13	E641A-L	30-Aug-2023	26-Jun-2024	14 days	300 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS09	E641A-L	28-Aug-2023	26-Jun-2024	14 days	302 days	* EHTR	28-Jun-2024	40 days	2 days	✓



Matrix: Soil/Solid

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS10	E641A-L	28-Aug-2023	26-Jun-2024	14 days	302 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS11	E641A-L	28-Aug-2023	26-Jun-2024	14 days	302 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS12	E641A-L	28-Aug-2023	26-Jun-2024	14 days	302 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS21	E641A-L	09-Sep-2023	08-Jul-2024	14 days	302 days	* EHTR	10-Jul-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS04	E641A-L	21-Aug-2023	26-Jun-2024	14 days	309 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS05	E641A-L	21-Aug-2023	26-Jun-2024	14 days	309 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS06	E641A-L	21-Aug-2023	26-Jun-2024	14 days	309 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS07	E641A-L	21-Aug-2023	26-Jun-2024	14 days	309 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS08	E641A-L	21-Aug-2023	26-Jun-2024	14 days	309 days	* EHTR	28-Jun-2024	40 days	2 days	✓



Matrix: **Soil/Solid**

Evaluation: * = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times		Eval	Analysis Date	Holding Times		Eval
				Rec	Actual			Rec	Actual	
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS01	E641A-L	18-Aug-2023	26-Jun-2024	14 days	312 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS02	E641A-L	18-Aug-2023	26-Jun-2024	14 days	312 days	* EHTR	28-Jun-2024	40 days	2 days	✓
Polycyclic Aromatic Hydrocarbons : PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)										
Glass soil jar/Teflon lined cap CFS03	E641A-L	18-Aug-2023	26-Jun-2024	14 days	312 days	* EHTR	28-Jun-2024	40 days	2 days	✓

Legend & Qualifier Definitions

EHTR: Exceeded ALS recommended hold time prior to sample receipt.

Rec. HT: ALS recommended hold time (see units).



Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Biota** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570464	1	9	11.1	5.0	✔
Mercury in Biota by CVAAS (WET units, Micro)	E511A	1551541	1	7	14.2	5.0	✔
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A	1551542	1	7	14.2	5.0	✔
Methylmercury in Biota by GCAFS (DRY units, Routine)	E538	1533709	1	13	7.6	5.0	✔
Methylmercury in Biota by GCAFS (WET units, Routine)	E538A	1533708	1	13	7.6	5.0	✔
Moisture Content by Gravimetry	E144	1571677	0	7	0.0	5.0	✖
Moisture Content by Gravimetry (Micro)	E144-H	1551500	0	7	0.0	5.0	✖
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag	1551539	1	7	14.2	5.0	✔
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti	1551540	1	7	14.2	5.0	✔
Laboratory Control Samples (LCS)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570464	3	9	33.3	25.0	✔
Mercury in Biota by CVAAS (WET units, Micro)	E511A	1551541	2	7	28.5	10.0	✔
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A	1551542	2	7	28.5	10.0	✔
Methylmercury in Biota by GCAFS (DRY units, Routine)	E538	1533709	2	13	15.3	10.0	✔
Methylmercury in Biota by GCAFS (WET units, Routine)	E538A	1533708	2	13	15.3	10.0	✔
Moisture Content by Gravimetry	E144	1571677	1	7	14.2	5.0	✔
Moisture Content by Gravimetry (Micro)	E144-H	1551500	1	7	14.2	5.0	✔
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag	1551539	2	7	28.5	10.0	✔
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti	1551540	2	7	28.5	10.0	✔
Method Blanks (MB)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570464	1	9	11.1	5.0	✔
Mercury in Biota by CVAAS (WET units, Micro)	E511A	1551541	1	7	14.2	5.0	✔
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A	1551542	1	7	14.2	5.0	✔
Methylmercury in Biota by GCAFS (DRY units, Routine)	E538	1533709	1	13	7.6	5.0	✔
Methylmercury in Biota by GCAFS (WET units, Routine)	E538A	1533708	1	13	7.6	5.0	✔
Moisture Content by Gravimetry	E144	1571677	1	7	14.2	5.0	✔
Moisture Content by Gravimetry (Micro)	E144-H	1551500	1	7	14.2	5.0	✔
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag	1551539	1	7	14.2	5.0	✔
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti	1551540	1	7	14.2	5.0	✔
Matrix Spikes (MS)							
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A	1570464	1	9	11.1	5.0	✔

Matrix: **Soil/Solid** Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP)							



Matrix: **Soil/Solid**

Evaluation: ✖ = QC frequency outside specification; ✔ = QC frequency within specification.

Quality Control Sample Type	Method	QC Lot #	Count		Frequency (%)		
			QC	Regular	Actual	Expected	Evaluation
Analytical Methods							
Laboratory Duplicates (DUP) - Continued							
As and Lead in Soils by CRC ICPMS (<150 µm)	E440B	1555994	3	21	14.2	5.0	✔
IVBA (In Vitro Bioaccessibility) for As and Pb	E452	1555995	3	21	14.2	10.0	✔
Mercury in Soil/Solid by CVAAS	E510	1514448	2	31	6.4	5.0	✔
Metals in Soil/Solid by CRC ICPMS	E440	1514447	2	31	6.4	5.0	✔
Moisture Content by Gravimetry	E144	1514449	2	39	5.1	5.0	✔
PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)	E641A-L	1514446	2	27	7.4	5.0	✔
Laboratory Control Samples (LCS)							
As and Lead in Soils by CRC ICPMS (<150 µm)	E440B	1555994	6	21	28.5	10.0	✔
IVBA (In Vitro Bioaccessibility) for As and Pb	E452	1555995	3	21	14.2	20.0	✖
Mercury in Soil/Solid by CVAAS	E510	1514448	4	31	12.9	10.0	✔
Metals in Soil/Solid by CRC ICPMS	E440	1514447	4	31	12.9	10.0	✔
Moisture Content by Gravimetry	E144	1514449	2	39	5.1	5.0	✔
PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)	E641A-L	1514446	2	27	7.4	5.0	✔
Method Blanks (MB)							
As and Lead in Soils by CRC ICPMS (<150 µm)	E440B	1555994	3	21	14.2	5.0	✔
IVBA (In Vitro Bioaccessibility) for As and Pb	E452	1555995	3	21	14.2	10.0	✔
Mercury in Soil/Solid by CVAAS	E510	1514448	2	31	6.4	5.0	✔
Metals in Soil/Solid by CRC ICPMS	E440	1514447	2	31	6.4	5.0	✔
Moisture Content by Gravimetry	E144	1514449	2	39	5.1	5.0	✔
PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)	E641A-L	1514446	2	27	7.4	5.0	✔
Matrix Spikes (MS)							
IVBA (In Vitro Bioaccessibility) for As and Pb	E452	1555995	3	21	14.2	10.0	✔
PAHs in Soil/solid by Hex:Ace GC-MS (Low Level CCME)	E641A-L	1514446	2	27	7.4	5.0	✔



Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Moisture Content by Gravimetry	E144 ALS Environmental - Vancouver	Biota	Puget Sound Water Quality Authority/CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Moisture Content by Gravimetry (Micro)	E144-H ALS Environmental - Vancouver	Biota	Puget Sound Water Quality Authority/BC MOE Lab Manual	Moisture is measured gravimetrically by drying the sample at <60°C for a minimum of 3 days to constant weight. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of soil, expressed as a percentage.
Metals in Biota by CRC ICPMS (WET units, Micro)	E472A ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Silver in Biota by CRC ICPMS (WET units, Micro)	E472A.Ag ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by Collision/Reaction Cell ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Titanium in Biota by CRC ICPMS (WET units, Micro)	E472A.Ti ALS Environmental - Vancouver	Biota	EPA 200.3/6020B (mod)	Tissue samples are homogenized and sub-sampled prior to hotblock digestion with HNO ₃ , HCl, and H ₂ O ₂ . Analysis is by High Resolution ICPMS. Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.
Mercury in Biota by CVAAS (WET units, Micro)	E511A ALS Environmental - Vancouver	Biota	EPA 200.3/1631 Appendix (mod)	Samples are homogenized and sub-sampled prior to hotblock digestion with nitric acid, hydrochloric acid, and hydrogen peroxide. Analysis is by CVAAS.
Methylmercury in Biota by GCAFS (DRY units, Routine)	E538 ALS Environmental - Vancouver	Biota	Liang et al. (1994)/EPA 1630 (mod)	This method follows the procedures published by Liang, Bloom and Horvat in Clinical Chemistry (Vol 40, No 4, 1994). Samples are homogenized and then digested in a methanolic potassium hydroxide solution. An aliquot of the digestate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolyzed to elemental Hg and quantified by cold vapour atomic fluorescence spectroscopy. Results are reported "as MeHg".



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Methylmercury in Biota by GCAFS (WET units, Routine)	E538A ALS Environmental - Vancouver	Biota	Liang et al. (1994) /EPA 1630 (mod)	This method follows the procedures published by Liang, Bloom and Horvat in Clinical Chemistry (Vol 40, No 4, 1994). Samples are homogenized and then digested in a methanolic potassium hydroxide solution. An aliquot of the digestate is analyzed by aqueous phase ethylation, purge and trap, desorption and GC separation. The separated species are then pyrolyzed to elemental Hg and quantified by cold vapour atomic fluorescence spectroscopy. Results are reported "as MeHg".
Arsenic Species in Biota by HPLC-CRC ICPMS (WET units)	E539A ALS Environmental - Vancouver	Biota	CFIA SOM-DAR-CHE-053-0 4, Oct 2012	Instrumental analysis of Speciated Arsenic (As) is by Anion Exchange HPLC-CRC ICPMS. The results reported for arsenic species represent those forms available to analysis using the particular enzymatic digestion and chromatographic conditions of the method. Total arsenic content is best measured using a more rigorous acid/peroxide digestion. Species concentrations will almost always be lower than those measured using the 'total' digestion. The proportion of total arsenic represented in the species concentrations varies considerably with sample matrix characteristics: plant vs. animal, lipid content, etc.
Moisture Content by Gravimetry	E144 ALS Environmental - Vancouver	Soil/Solid	CCME PHC in Soil - Tier 1	Moisture is measured gravimetrically by drying the sample at 105°C. Moisture content is calculated as the weight loss (due to water) divided by the wet weight of the sample, expressed as a percentage.
Metals in Soil/Solid by CRC ICPMS	E440 ALS Environmental - Vancouver	Soil/Solid	EPA 6020B (mod)	This method is intended to liberate metals that may be environmentally available. Samples are dried, then sieved through a 2 mm sieve, and digested with HNO ₃ and HCl. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Silicate minerals are not solubilized. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. This method does not adequately recover elemental sulfur, and is unsuitable for assessment of elemental sulfur standards or guidelines. Analysis is by Collision/Reaction Cell ICPMS.
As and Lead in Soils by CRC ICPMS (<150 µm)	E440B ALS Environmental - Vancouver	Soil/Solid	EPA 6020B (mod)	Samples are sieved through a 150 µm sieve, and digested with HNO ₃ and HCl. Analysis is by Collision/Reaction Cell ICPMS.
IVBA (In Vitro Bioaccessibility) for As and Pb	E452 ALS Environmental - Vancouver	Soil/Solid	BC Laboratory Manual/ EPA 1340 (mod)	Samples extracted using IVBA procedure is analyzed for As and Pb by ICPMS.
Mercury in Soil/Solid by CVAAS	E510 ALS Environmental - Vancouver	Soil/Solid	EPA 200.2/1631 Appendix (mod)	Samples are dried, then sieved through a 2 mm sieve, and digested with HNO ₃ and HCl, followed by CVAAS analysis.



Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
PAHs in Soil/solid by Hex: Ace GC-MS (Low Level CCME)	E641A-L ALS Environmental - Vancouver	Soil/Solid	EPA 8270E (mod)	Polycyclic Aromatic Hydrocarbons (PAHs) are extracted with hexane/acetone and analyzed by GC-MS. If reported, IACR (index of additive cancer risk, unitless) and B(a)P toxic potency equivalent (in soil concentration units) are calculated as per CCME PAH Soil Quality Guidelines fact sheet (2010) or ABT1.
% IVBA Calculation	EC452 ALS Environmental - Vancouver	Soil/Solid	BC Laboratory Manual/ EPA 1340 (mod)	Calc. % of As or Pb Bioavailable.
IVBA (In Vitro Bioaccessibility) for As and Pb (mg/kg reporting)	EC452A ALS Environmental - Vancouver	Soil/Solid	BC Laboratory Manual/ EPA 1340 (mod)	Samples extracted using IVBA procedure is analyzed for As and Pb by ICPMS.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Metals and Mercury Biota Digestion (Micro)	EP472 ALS Environmental - Vancouver	Biota	EPA 200.3	This method, designed for small sample amounts, uses a heated strong acid digestion with HNO ₃ , HCl, and H ₂ O ₂ and is intended to provide a conservative estimate of bio-available metals.
Methylmercury Biota Preparation	EP538 ALS Environmental - Vancouver	Biota	Liang et al. (1994)	This method follows the procedures published by Liang, Bloom and Horvat in Clinical Chemistry (Vol 40, No 4, 1994). Samples are homogenized and then digested in a methanolic potassium hydroxide solution.
Arsenic Species Extraction in Biota Preparation	EP539 ALS Environmental - Vancouver	Biota	CFIA SOM-DAR-CHE-053-04, Oct 2012	Tissue Samples are homogenized and extracted using a methanol/enzymatic extraction procedure. Samples are extracted at 37 °C using Protease, Alpha amylase and Lipase in 25% methanol solution.
Digestion for Metals and Mercury	EP440 ALS Environmental - Vancouver	Soil/Solid	EPA 200.2 (mod)	Samples are dried, then sieved through a 2 mm sieve, and digested with HNO ₃ and HCl. This method is intended to liberate metals that may be environmentally available.
Digestion for Metals (150 µm Sieve)	EP440B ALS Environmental - Vancouver	Soil/Solid	EPA 200.2 (mod)	Samples are dried then sieved through a 150 µm sieve, and digested with HNO ₃ and HCl. This method is intended to liberate metals that may be environmentally available.
IVBA (in-vitro Bioaccessibility) extraction	EP452 ALS Environmental - Vancouver	Soil/Solid	BC Laboratory Manual / EPA 1340	A sieved and dried (< 40C) sample is extracted with a buffered glycine – hydrochloric acid solution using rotary extraction at 37 ± 2°C for 1 hour.
PHCs and PAHs Hexane-Acetone Tumbler Extraction	EP601 ALS Environmental - Vancouver	Soil/Solid	CCME PHC in Soil - Tier 1 (mod)	Samples are subsampled and Petroleum Hydrocarbons (PHC) and PAHs are extracted with 1:1 hexane:acetone using a rotary extractor.

QUALITY CONTROL REPORT

<p>Work Order : WP2414228</p> <p>Client : Great Bear Resources Ltd</p> <p>Contact : Ashley Moncrief</p> <p>Address : Great Bear Resources Ltd. 117 Forestry Road Red Lake ON Canada P0V 2M0</p> <p>Telephone : 807 630 0203</p> <p>Project : PPR-022-3</p> <p>PO : PPR-022-3</p> <p>C-O-C number : ----</p> <p>Sampler : ----</p> <p>Site : ----</p> <p>Quote number : 2024 Standing offer_V2</p> <p>No. of samples received : 28</p> <p>No. of samples analysed : 28</p>	<p>Page : 1 of 29</p> <p>Laboratory : ALS Environmental - Winnipeg</p> <p>Account Manager : Judy Dalmaijer</p> <p>Address : 1329 Niakwa Road East, Unit 12 Winnipeg, Manitoba Canada R2J 3T4</p> <p>Telephone : +1 204 255 9720</p> <p>Date Samples Received : 04-Jun-2024 09:20</p> <p>Date Analysis Commenced : 26-Jun-2024</p> <p>Issue Date : 13-Aug-2024 13:13</p>
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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Reference Material (RM) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

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General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.

CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.

DQO = Data Quality Objective.

LOR = Limit of Reporting (detection limit).

RPD = Relative Percent Difference

= Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.



Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: Biota					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1551539)											
WP2414228-024	CF33	Silver	7440-22-4	E472A.Ag	0.0010	mg/kg wwt	0.0010	<0.0010	0.000005	Diff <2x LOR	----
Metals (QC Lot: 1551540)											
WP2414228-024	CF33	Titanium	7440-32-6	E472A.Ti	0.10	mg/kg wwt	0.32	0.45	0.14	Diff <2x LOR	----
Metals (QC Lot: 1551541)											
WP2414228-024	CF33	Mercury	7439-97-6	E511A	0.0012	mg/kg wwt	0.0025	0.0025	0.000008	Diff <2x LOR	----
Metals (QC Lot: 1551542)											
WP2414228-024	CF33	Aluminum	7429-90-5	E472A	1.0	mg/kg wwt	3.1	4.6	1.5	Diff <2x LOR	----
		Antimony	7440-36-0	E472A	0.0020	mg/kg wwt	0.0611	0.0615	0.687%	40%	----
		Arsenic	7440-38-2	E472A	0.0060	mg/kg wwt	0.0340	0.146	124%	40%	DUP-H
		Barium	7440-39-3	E472A	0.010	mg/kg wwt	2.52	4.28	51.8%	40%	DUP-H
		Beryllium	7440-41-7	E472A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Bismuth	7440-69-9	E472A	0.0020	mg/kg wwt	<0.0020	<0.0020	0	Diff <2x LOR	----
		Boron	7440-42-8	E472A	0.20	mg/kg wwt	12.1	13.6	11.6%	40%	----
		Cadmium	7440-43-9	E472A	0.0020	mg/kg wwt	3.16	3.11	1.50%	40%	----
		Calcium	7440-70-2	E472A	4.0	mg/kg wwt	200	202	1.12%	60%	----
		Cesium	7440-46-2	E472A	0.0010	mg/kg wwt	0.0179	0.0196	9.24%	40%	----
		Chromium	7440-47-3	E472A	0.040	mg/kg wwt	0.056	# 0.177	0.121	Diff <2x LOR	DUP-H,J
		Cobalt	7440-48-4	E472A	0.0040	mg/kg wwt	0.106	0.109	2.56%	40%	----
		Copper	7440-50-8	E472A	0.040	mg/kg wwt	6.39	7.34	13.8%	40%	----
		Iron	7439-89-6	E472A	1.0	mg/kg wwt	1140	1190	3.86%	40%	----
		Lead	7439-92-1	E472A	0.010	mg/kg wwt	1.29	1.38	6.82%	40%	----
		Lithium	7439-93-2	E472A	0.10	mg/kg wwt	0.13	0.14	0.008	Diff <2x LOR	----
		Magnesium	7439-95-4	E472A	0.40	mg/kg wwt	361	412	13.2%	40%	----
		Manganese	7439-96-5	E472A	0.010	mg/kg wwt	14.3	21.9	42.1%	40%	DUP-H
		Molybdenum	7439-98-7	E472A	0.0080	mg/kg wwt	30.0	30.5	1.75%	40%	----
		Nickel	7440-02-0	E472A	0.040	mg/kg wwt	0.186	0.245	27.3%	40%	----
		Phosphorus	7723-14-0	E472A	2.0	mg/kg wwt	6060	6420	5.92%	40%	----
		Potassium	7440-09-7	E472A	4.0	mg/kg wwt	5300	5770	8.49%	40%	----
		Rubidium	7440-17-7	E472A	0.010	mg/kg wwt	6.82	7.30	6.86%	40%	----
		Selenium	7782-49-2	E472A	0.020	mg/kg wwt	0.511	0.518	1.43%	40%	----



Sub-Matrix: Biota					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1551542) - continued											
WP2414228-024	CF33	Sodium	7440-23-5	E472A	4.0	mg/kg wwt	2040	2210	8.38%	40%	----
		Strontium	7440-24-6	E472A	0.020	mg/kg wwt	0.899	1.00	10.8%	60%	----
		Tellurium	13494-80-9	E472A	0.0040	mg/kg wwt	<0.0040	<0.0040	0	Diff <2x LOR	----
		Thallium	7440-28-0	E472A	0.00040	mg/kg wwt	<0.00040	<0.00040	0	Diff <2x LOR	----
		Tin	7440-31-5	E472A	0.020	mg/kg wwt	0.058	0.046	0.012	Diff <2x LOR	----
		Uranium	7440-61-1	E472A	0.00040	mg/kg wwt	<0.00040	0.00040	0.000003	Diff <2x LOR	----
		Vanadium	7440-62-2	E472A	0.020	mg/kg wwt	<0.020	<0.020	0	Diff <2x LOR	----
		Zinc	7440-66-6	E472A	0.20	mg/kg wwt	57.4	62.0	7.66%	40%	----
		Zirconium	7440-67-7	E472A	0.040	mg/kg wwt	0.305	0.202	40.6%	40%	DUP-H
Speciated Metals (QC Lot: 1533708)											
VA24B0679-001	Anonymous	Methylmercury (as MeHg)	22967-92-6	E538A	1.2	µg/kg wwt	629	529	17.3%	30%	----
Speciated Metals (QC Lot: 1533709)											
VA24B0679-001	Anonymous	Methylmercury (as MeHg)	22967-92-6	E538	6.6	µg/kg	3500	2940	17.3%	30%	----
Speciated Metals (QC Lot: 1570464)											
WP2414182-021	Anonymous	Arsenate [As V]	17428-41-0	E539A	0.0050	mg/kg wwt	0.0070	0.0073	0.0003	Diff <2x LOR	----
		Arsenite [As III]	22541-54-4	E539A	0.0010	mg/kg wwt	0.0012	0.0011	0.00005	Diff <2x LOR	----
		Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.0010	mg/kg wwt	0.0013	0.0013	0.00006	Diff <2x LOR	----
		Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
		Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
		Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.0010	mg/kg wwt	<0.0010	<0.0010	0	Diff <2x LOR	----
Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Sample Preparation (QC Lot: 1555995)											
WP2414228-001	CFS01	Final volume	----	EP452	1	mL	100	100		Diff <2x LOR	----
		pH, IVBA final	----	EP452	0.01	pH units	1.51	1.50		Diff <2x LOR	----
		pH, IVBA Initial	----	EP452	0.01	pH units	1.46	1.49		Diff <2x LOR	----
		Weight, extraction (dry)	----	EP452	0.01	g	0.941	0.969		Diff <2x LOR	----
Sample Preparation (QC Lot: 1555997)											
WP2414228-008	CFS08	Final volume	----	EP452	1	mL	100	100		Diff <2x LOR	----
		pH, IVBA final	----	EP452	0.01	pH units	1.49	1.50		Diff <2x LOR	----
		pH, IVBA Initial	----	EP452	0.01	pH units	1.49	1.51		Diff <2x LOR	----
		Weight, extraction (dry)	----	EP452	0.01	g	1.088	0.961		Diff <2x LOR	----
Sample Preparation (QC Lot: 1556002)											



Sub-Matrix: Soil/Solid

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Sample Preparation (QC Lot: 1556002) - continued											
WP2414228-015	CFS-DUP-01	Final volume	----	EP452	1	mL	100	100		Diff <2x LOR	----
		pH, IVBA final	----	EP452	0.01	pH units	1.55	1.58		Diff <2x LOR	----
		pH, IVBA Initial	----	EP452	0.01	pH units	1.50	1.50		Diff <2x LOR	----
		Weight, extraction (dry)	----	EP452	0.01	g	0.907	0.910		Diff <2x LOR	----
Physical Tests (QC Lot: 1514449)											
WP2414228-001	CFS01	Moisture	----	E144	0.25	%	8.08	7.34	9.66%	20%	----
Physical Tests (QC Lot: 1533475)											
VA24B5560-001	Anonymous	Moisture	----	E144	0.25	%	11.6	12.4	6.12%	20%	----
Metals (QC Lot: 1514447)											
WP2414228-001	CFS01	Aluminum	7429-90-5	E440	50	mg/kg	3710	3810	2.66%	40%	----
		Antimony	7440-36-0	E440	0.10	mg/kg	0.12	0.11	0.008	Diff <2x LOR	----
		Arsenic	7440-38-2	E440	0.10	mg/kg	3.73	3.97	6.32%	30%	----
		Barium	7440-39-3	E440	0.50	mg/kg	17.0	18.2	6.65%	40%	----
		Beryllium	7440-41-7	E440	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Bismuth	7440-69-9	E440	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Boron	7440-42-8	E440	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Cadmium	7440-43-9	E440	0.020	mg/kg	0.040	0.053	0.012	Diff <2x LOR	----
		Calcium	7440-70-2	E440	50	mg/kg	878	905	3.04%	30%	----
		Chromium	7440-47-3	E440	0.50	mg/kg	5.29	5.65	6.64%	30%	----
		Cobalt	7440-48-4	E440	0.10	mg/kg	0.76	0.89	16.5%	30%	----
		Copper	7440-50-8	E440	0.50	mg/kg	1.49	1.60	0.11	Diff <2x LOR	----
		Iron	7439-89-6	E440	50	mg/kg	4530	4480	1.09%	30%	----
		Lead	7439-92-1	E440	0.50	mg/kg	3.60	4.01	10.8%	40%	----
		Lithium	7439-93-2	E440	2.0	mg/kg	2.2	2.4	0.2	Diff <2x LOR	----
		Magnesium	7439-95-4	E440	20	mg/kg	567	704	21.4%	30%	----
		Manganese	7439-96-5	E440	1.0	mg/kg	28.0	32.7	15.3%	30%	----
		Molybdenum	7439-98-7	E440	0.10	mg/kg	0.18	0.17	0.006	Diff <2x LOR	----
		Nickel	7440-02-0	E440	0.50	mg/kg	1.79	2.75	0.97	Diff <2x LOR	----
		Phosphorus	7723-14-0	E440	50	mg/kg	98	104	5	Diff <2x LOR	----
		Potassium	7440-09-7	E440	100	mg/kg	210	200	6	Diff <2x LOR	----
Selenium	7782-49-2	E440	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----		
Silver	7440-22-4	E440	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----		
Sodium	7440-23-5	E440	50	mg/kg	58	<50	8	Diff <2x LOR	----		
Strontium	7440-24-6	E440	0.50	mg/kg	10.9	10.2	6.50%	40%	----		



Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1514447) - continued											
WP2414228-001	CFS01	Sulfur	7704-34-9	E440	1000	mg/kg	<1000	<1000	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Tin	7440-31-5	E440	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium	7440-32-6	E440	1.0	mg/kg	269	254	5.96%	40%	----
		Tungsten	7440-33-7	E440	0.50	mg/kg	<0.50	<0.50	0	Diff <2x LOR	----
		Uranium	7440-61-1	E440	0.050	mg/kg	0.170	0.179	0.009	Diff <2x LOR	----
		Vanadium	7440-62-2	E440	0.20	mg/kg	11.2	11.0	1.12%	30%	----
		Zinc	7440-66-6	E440	2.0	mg/kg	10.8	10.4	0.4	Diff <2x LOR	----
		Zirconium	7440-67-7	E440	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----
Metals (QC Lot: 1514448)											
WP2414228-001	CFS01	Mercury	7439-97-6	E510	0.0050	mg/kg	0.0147	0.0150	0.0003	Diff <2x LOR	----
Metals (QC Lot: 1533469)											
VA24B5578-001	Anonymous	Aluminum	7429-90-5	E440	50	mg/kg	20100	19900	0.960%	40%	----
		Antimony	7440-36-0	E440	0.10	mg/kg	0.25	0.27	0.02	Diff <2x LOR	----
		Arsenic	7440-38-2	E440	0.10	mg/kg	3.72	3.84	3.30%	30%	----
		Barium	7440-39-3	E440	0.50	mg/kg	44.3	49.0	10.2%	40%	----
		Beryllium	7440-41-7	E440	0.10	mg/kg	0.21	0.23	0.02	Diff <2x LOR	----
		Bismuth	7440-69-9	E440	0.20	mg/kg	<0.20	<0.20	0	Diff <2x LOR	----
		Boron	7440-42-8	E440	5.0	mg/kg	<5.0	<5.0	0	Diff <2x LOR	----
		Cadmium	7440-43-9	E440	0.020	mg/kg	0.126	0.167	28.0%	30%	----
		Calcium	7440-70-2	E440	50	mg/kg	3400	3660	7.22%	30%	----
		Chromium	7440-47-3	E440	0.50	mg/kg	15.5	18.1	15.5%	30%	----
		Cobalt	7440-48-4	E440	0.10	mg/kg	6.03	5.97	0.990%	30%	----
		Copper	7440-50-8	E440	0.50	mg/kg	30.4	34.4	12.5%	30%	----
		Iron	7439-89-6	E440	50	mg/kg	19500	19000	2.28%	30%	----
		Lead	7439-92-1	E440	0.50	mg/kg	27.0	36.5	30.1%	40%	----
		Lithium	7439-93-2	E440	2.0	mg/kg	6.3	6.4	0.1	Diff <2x LOR	----
		Magnesium	7439-95-4	E440	20	mg/kg	4940	4610	6.86%	30%	----
		Manganese	7439-96-5	E440	1.0	mg/kg	327	361	9.83%	30%	----
		Molybdenum	7439-98-7	E440	0.10	mg/kg	0.40	0.49	0.08	Diff <2x LOR	----
		Nickel	7440-02-0	E440	0.50	mg/kg	12.0	11.8	1.34%	30%	----
		Phosphorus	7723-14-0	E440	50	mg/kg	763	811	6.10%	30%	----
		Potassium	7440-09-7	E440	100	mg/kg	480	440	40	Diff <2x LOR	----
Selenium	7782-49-2	E440	0.20	mg/kg	0.26	0.25	0.01	Diff <2x LOR	----		



Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Metals (QC Lot: 1533469) - continued											
VA24B5578-001	Anonymous	Silver	7440-22-4	E440	0.10	mg/kg	<0.10	<0.10	0	Diff <2x LOR	----
		Sodium	7440-23-5	E440	50	mg/kg	229	244	15	Diff <2x LOR	----
		Strontium	7440-24-6	E440	0.50	mg/kg	22.2	23.7	6.41%	40%	----
		Sulfur	7704-34-9	E440	1000	mg/kg	<1000	<1000	0	Diff <2x LOR	----
		Thallium	7440-28-0	E440	0.050	mg/kg	<0.050	<0.050	0	Diff <2x LOR	----
		Tin	7440-31-5	E440	2.0	mg/kg	<2.0	<2.0	0	Diff <2x LOR	----
		Titanium	7440-32-6	E440	1.0	mg/kg	719	671	6.95%	40%	----
		Tungsten	7440-33-7	E440	0.50	mg/kg	<0.50	<0.50	0	Diff <2x LOR	----
		Uranium	7440-61-1	E440	0.050	mg/kg	0.301	0.306	0.005	Diff <2x LOR	----
		Vanadium	7440-62-2	E440	0.20	mg/kg	60.0	53.0	12.5%	30%	----
		Zinc	7440-66-6	E440	2.0	mg/kg	53.2	52.8	0.706%	30%	----
Zirconium	7440-67-7	E440	1.0	mg/kg	<1.0	<1.0	0	Diff <2x LOR	----		
Metals (QC Lot: 1533470)											
VA24B5578-001	Anonymous	Mercury	7439-97-6	E510	0.0500	mg/kg	<0.0500	0.0553	0.0053	Diff <2x LOR	----
Metals (QC Lot: 1555994)											
WP2414228-001	CFS01	Arsenic	7440-38-2	E440B	0.050	mg/kg	8.10	8.46	4.32%	30%	----
Metals (QC Lot: 1555996)											
WP2414228-008	CFS08	Arsenic	7440-38-2	E440B	0.050	mg/kg	3.75	4.29	13.4%	30%	----
Metals (QC Lot: 1556001)											
WP2414228-015	CFS-DUP-01	Arsenic	7440-38-2	E440B	0.050	mg/kg	17.8	15.9	11.0%	30%	----
Leachable Metals (QC Lot: 1555995)											
WP2414228-001	CFS01	Arsenic, IVBA (leachate)	7440-38-2	E452	0.0050	mg/L	0.0111	0.0120	0.0010	Diff <2x LOR	----
Leachable Metals (QC Lot: 1555997)											
WP2414228-008	CFS08	Arsenic, IVBA (leachate)	7440-38-2	E452	0.0050	mg/L	0.0101	0.0122	0.0021	Diff <2x LOR	----
Leachable Metals (QC Lot: 1556002)											
WP2414228-015	CFS-DUP-01	Arsenic, IVBA (leachate)	7440-38-2	E452	0.0050	mg/L	0.0488	0.0486	0.347%	30%	----
Polycyclic Aromatic Hydrocarbons (QC Lot: 1514446)											
WP2414228-001	CFS01	Acenaphthene	83-32-9	E641A-L	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		Acenaphthylene	208-96-8	E641A-L	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		Acridine	260-94-6	E641A-L	0.055	mg/kg	<0.100	<0.055	0.045	Diff <2x LOR	----
		Anthracene	120-12-7	E641A-L	0.0040	mg/kg	<0.0040	<0.0040	0	Diff <2x LOR	----
		Benz(a)anthracene	56-55-3	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Benzo(a)pyrene	50-32-8	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Benzo(b+j)fluoranthene	n/a	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----



Sub-Matrix: Soil/Solid

Laboratory Duplicate (DUP) Report

Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Polycyclic Aromatic Hydrocarbons (QC Lot: 1514446) - continued											
WP2414228-001	CFS01	Benzo(g,h,i)perylene	191-24-2	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Benzo(k)fluoranthene	207-08-9	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Chrysene	218-01-9	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Dibenz(a,h)anthracene	53-70-3	E641A-L	0.0050	mg/kg	<0.0050	<0.0050	0	Diff <2x LOR	----
		Fluoranthene	206-44-0	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Fluorene	86-73-7	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Methylnaphthalene, 1-	90-12-0	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Methylnaphthalene, 2-	91-57-6	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Naphthalene	91-20-3	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Perylene	198-55-0	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Phenanthrene	85-01-8	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
		Pyrene	129-00-0	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----
Quinoline	91-22-5	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----		
Polycyclic Aromatic Hydrocarbons (QC Lot: 1533467)											
VA24B5560-001	Anonymous	Acenaphthene	83-32-9	E641A-L	0.0050	mg/kg	0.0720	0.184	87.4%	50%	DUP-H
		Acenaphthylene	208-96-8	E641A-L	0.0050	mg/kg	0.0252	0.0316	22.8%	50%	----
		Acridine	260-94-6	E641A-L	0.010	mg/kg	0.058	0.083	35.4%	50%	----
		Anthracene	120-12-7	E641A-L	0.0040	mg/kg	0.144	0.360	85.6%	50%	DUP-H
		Benzo(a)anthracene	56-55-3	E641A-L	0.010	mg/kg	0.238	0.294	21.0%	50%	----
		Benzo(a)pyrene	50-32-8	E641A-L	0.010	mg/kg	0.283	0.301	6.14%	50%	----
		Benzo(b+j)fluoranthene	n/a	E641A-L	0.010	mg/kg	0.410	0.461	11.6%	50%	----
		Benzo(g,h,i)perylene	191-24-2	E641A-L	0.010	mg/kg	0.111	0.113	1.73%	50%	----
		Benzo(k)fluoranthene	207-08-9	E641A-L	0.010	mg/kg	0.126	0.164	26.0%	50%	----
		Chrysene	218-01-9	E641A-L	0.010	mg/kg	0.342	0.350	2.27%	50%	----
		Dibenz(a,h)anthracene	53-70-3	E641A-L	0.0050	mg/kg	0.0359	0.0359	0.0507%	50%	----
		Fluoranthene	206-44-0	E641A-L	0.010	mg/kg	0.438	0.847	63.7%	50%	DUP-H
		Fluorene	86-73-7	E641A-L	0.010	mg/kg	0.112	0.321	96.3%	50%	DUP-H
		Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.010	mg/kg	0.121	0.121	0.109%	50%	----
		Methylnaphthalene, 1-	90-12-0	E641A-L	0.010	mg/kg	0.020	0.028	0.008	Diff <2x LOR	----
		Methylnaphthalene, 2-	91-57-6	E641A-L	0.010	mg/kg	0.029	0.047	0.018	Diff <2x LOR	----
		Naphthalene	91-20-3	E641A-L	0.010	mg/kg	0.066	0.058	12.8%	50%	----
		Perylene	198-55-0	E641A-L	0.010	mg/kg	0.106	0.113	5.90%	50%	----
Phenanthrene	85-01-8	E641A-L	0.010	mg/kg	0.372	0.849	78.2%	50%	DUP-H		



Sub-Matrix: Soil/Solid					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	LOR	Unit	Original Result	Duplicate Result	RPD(%) or Difference	Duplicate Limits	Qualifier
Polycyclic Aromatic Hydrocarbons (QC Lot: 1533467) - continued											
VA24B5560-001	Anonymous	Pyrene	129-00-0	E641A-L	0.010	mg/kg	0.378	0.643	52.0%	50%	DUP-H
		Quinoline	91-22-5	E641A-L	0.010	mg/kg	<0.010	<0.010	0	Diff <2x LOR	----

Qualifiers

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.



Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: Biota

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1551500)						
Moisture	---	E144-H	2	%	<2.0	---
Physical Tests (QCLot: 1571677)						
Moisture	---	E144	0.5	%	<0.50	---
Metals (QCLot: 1551539)						
Silver	7440-22-4	E472A.Ag	0.001	mg/kg wwt	<0.0010	---
Metals (QCLot: 1551540)						
Titanium	7440-32-6	E472A.Ti	0.1	mg/kg wwt	<0.10	---
Metals (QCLot: 1551541)						
Mercury	7439-97-6	E511A	0.001	mg/kg wwt	<0.0010	---
Metals (QCLot: 1551542)						
Aluminum	7429-90-5	E472A	1	mg/kg wwt	<1.0	---
Antimony	7440-36-0	E472A	0.002	mg/kg wwt	<0.0020	---
Arsenic	7440-38-2	E472A	0.006	mg/kg wwt	<0.0060	---
Barium	7440-39-3	E472A	0.01	mg/kg wwt	<0.010	---
Beryllium	7440-41-7	E472A	0.002	mg/kg wwt	<0.0020	---
Bismuth	7440-69-9	E472A	0.002	mg/kg wwt	<0.0020	---
Boron	7440-42-8	E472A	0.2	mg/kg wwt	<0.20	---
Cadmium	7440-43-9	E472A	0.002	mg/kg wwt	<0.0020	---
Calcium	7440-70-2	E472A	4	mg/kg wwt	<4.0	---
Cesium	7440-46-2	E472A	0.001	mg/kg wwt	<0.0010	---
Chromium	7440-47-3	E472A	0.04	mg/kg wwt	<0.040	---
Cobalt	7440-48-4	E472A	0.004	mg/kg wwt	<0.0040	---
Copper	7440-50-8	E472A	0.04	mg/kg wwt	<0.040	---
Iron	7439-89-6	E472A	1	mg/kg wwt	<1.0	---
Lead	7439-92-1	E472A	0.01	mg/kg wwt	<0.010	---
Lithium	7439-93-2	E472A	0.1	mg/kg wwt	<0.10	---
Magnesium	7439-95-4	E472A	0.4	mg/kg wwt	<0.40	---
Manganese	7439-96-5	E472A	0.01	mg/kg wwt	<0.010	---
Molybdenum	7439-98-7	E472A	0.008	mg/kg wwt	<0.0080	---
Nickel	7440-02-0	E472A	0.04	mg/kg wwt	<0.040	---
Phosphorus	7723-14-0	E472A	2	mg/kg wwt	<2.0	---
Potassium	7440-09-7	E472A	4	mg/kg wwt	<4.0	---



Sub-Matrix: **Biota**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1551542) - continued						
Rubidium	7440-17-7	E472A	0.01	mg/kg wwt	<0.010	----
Selenium	7782-49-2	E472A	0.02	mg/kg wwt	<0.020	----
Sodium	7440-23-5	E472A	4	mg/kg wwt	<4.0	----
Strontium	7440-24-6	E472A	0.02	mg/kg wwt	<0.020	----
Tellurium	13494-80-9	E472A	0.004	mg/kg wwt	<0.0040	----
Thallium	7440-28-0	E472A	0.0004	mg/kg wwt	<0.00040	----
Tin	7440-31-5	E472A	0.02	mg/kg wwt	<0.020	----
Uranium	7440-61-1	E472A	0.0004	mg/kg wwt	<0.00040	----
Vanadium	7440-62-2	E472A	0.02	mg/kg wwt	<0.020	----
Zinc	7440-66-6	E472A	0.2	mg/kg wwt	<0.20	----
Zirconium	7440-67-7	E472A	0.04	mg/kg wwt	<0.040	----
Speciated Metals (QCLot: 1533708)						
Methylmercury (as MeHg)	22967-92-6	E538A	1	µg/kg wwt	<1.0	----
Speciated Metals (QCLot: 1533709)						
Methylmercury (as MeHg)	22967-92-6	E538	5	µg/kg	<5.0	----
Speciated Metals (QCLot: 1570464)						
Arsenate [As V]	17428-41-0	E539A	0.005	mg/kg wwt	<0.0050	----
Arsenite [As III]	22541-54-4	E539A	0.001	mg/kg wwt	<0.0010	----
Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.001	mg/kg wwt	<0.0010	----
Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.001	mg/kg wwt	<0.0010	----
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.001	mg/kg wwt	<0.0010	----
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.001	mg/kg wwt	<0.0010	----

Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Sample Preparation (QCLot: 1555995)						
Final volume	----	EP452	1	mL	100	----
pH, IVBA final	----	EP452	0.01	pH units	1.48	----
pH, IVBA Initial	----	EP452	0.01	pH units	1.50	----
Weight, extraction (dry)	----	EP452	0.01	g	1	----
Sample Preparation (QCLot: 1555997)						
Final volume	----	EP452	1	mL	100	----
pH, IVBA final	----	EP452	0.01	pH units	1.46	----
pH, IVBA Initial	----	EP452	0.01	pH units	1.49	----
Weight, extraction (dry)	----	EP452	0.01	g	1	----



Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Sample Preparation (QCLot: 1556002)						
Final volume	---	EP452	1	mL	100	---
pH, IVBA final	---	EP452	0.01	pH units	1.56	---
pH, IVBA Initial	---	EP452	0.01	pH units	1.50	---
Weight, extraction (dry)	---	EP452	0.01	g	1	---
Physical Tests (QCLot: 1514449)						
Moisture	---	E144	0.25	%	<0.25	---
Physical Tests (QCLot: 1533475)						
Moisture	---	E144	0.25	%	<0.25	---
Metals (QCLot: 1514447)						
Aluminum	7429-90-5	E440	50	mg/kg	<50	---
Antimony	7440-36-0	E440	0.1	mg/kg	<0.10	---
Arsenic	7440-38-2	E440	0.1	mg/kg	<0.10	---
Barium	7440-39-3	E440	0.5	mg/kg	<0.50	---
Beryllium	7440-41-7	E440	0.1	mg/kg	<0.10	---
Bismuth	7440-69-9	E440	0.2	mg/kg	<0.20	---
Boron	7440-42-8	E440	5	mg/kg	<5.0	---
Cadmium	7440-43-9	E440	0.02	mg/kg	<0.020	---
Calcium	7440-70-2	E440	50	mg/kg	<50	---
Chromium	7440-47-3	E440	0.5	mg/kg	<0.50	---
Cobalt	7440-48-4	E440	0.1	mg/kg	<0.10	---
Copper	7440-50-8	E440	0.5	mg/kg	<0.50	---
Iron	7439-89-6	E440	50	mg/kg	<50	---
Lead	7439-92-1	E440	0.5	mg/kg	<0.50	---
Lithium	7439-93-2	E440	2	mg/kg	<2.0	---
Magnesium	7439-95-4	E440	20	mg/kg	# 26	B
Manganese	7439-96-5	E440	1	mg/kg	<1.0	---
Molybdenum	7439-98-7	E440	0.1	mg/kg	<0.10	---
Nickel	7440-02-0	E440	0.5	mg/kg	<0.50	---
Phosphorus	7723-14-0	E440	50	mg/kg	<50	---
Potassium	7440-09-7	E440	100	mg/kg	<100	---
Selenium	7782-49-2	E440	0.2	mg/kg	<0.20	---
Silver	7440-22-4	E440	0.1	mg/kg	<0.10	---
Sodium	7440-23-5	E440	50	mg/kg	<50	---
Strontium	7440-24-6	E440	0.5	mg/kg	<0.50	---
Sulfur	7704-34-9	E440	1000	mg/kg	<1000	---



Sub-Matrix: Soil/Solid

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1514447) - continued						
Thallium	7440-28-0	E440	0.05	mg/kg	<0.050	----
Tin	7440-31-5	E440	2	mg/kg	<2.0	----
Titanium	7440-32-6	E440	1	mg/kg	<1.0	----
Tungsten	7440-33-7	E440	0.5	mg/kg	<0.50	----
Uranium	7440-61-1	E440	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440	2	mg/kg	<2.0	----
Zirconium	7440-67-7	E440	1	mg/kg	<1.0	----
Metals (QCLot: 1514448)						
Mercury	7439-97-6	E510	0.005	mg/kg	<0.0050	----
Metals (QCLot: 1533469)						
Aluminum	7429-90-5	E440	50	mg/kg	<50	----
Antimony	7440-36-0	E440	0.1	mg/kg	<0.10	----
Arsenic	7440-38-2	E440	0.1	mg/kg	<0.10	----
Barium	7440-39-3	E440	0.5	mg/kg	<0.50	----
Beryllium	7440-41-7	E440	0.1	mg/kg	<0.10	----
Bismuth	7440-69-9	E440	0.2	mg/kg	<0.20	----
Boron	7440-42-8	E440	5	mg/kg	<5.0	----
Cadmium	7440-43-9	E440	0.02	mg/kg	<0.020	----
Calcium	7440-70-2	E440	50	mg/kg	<50	----
Chromium	7440-47-3	E440	0.5	mg/kg	<0.50	----
Cobalt	7440-48-4	E440	0.1	mg/kg	<0.10	----
Copper	7440-50-8	E440	0.5	mg/kg	<0.50	----
Iron	7439-89-6	E440	50	mg/kg	<50	----
Lead	7439-92-1	E440	0.5	mg/kg	<0.50	----
Lithium	7439-93-2	E440	2	mg/kg	<2.0	----
Magnesium	7439-95-4	E440	20	mg/kg	<20	----
Manganese	7439-96-5	E440	1	mg/kg	<1.0	----
Molybdenum	7439-98-7	E440	0.1	mg/kg	<0.10	----
Nickel	7440-02-0	E440	0.5	mg/kg	<0.50	----
Phosphorus	7723-14-0	E440	50	mg/kg	<50	----
Potassium	7440-09-7	E440	100	mg/kg	<100	----
Selenium	7782-49-2	E440	0.2	mg/kg	<0.20	----
Silver	7440-22-4	E440	0.1	mg/kg	<0.10	----
Sodium	7440-23-5	E440	50	mg/kg	<50	----



Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Metals (QCLot: 1533469) - continued						
Strontium	7440-24-6	E440	0.5	mg/kg	<0.50	----
Sulfur	7704-34-9	E440	1000	mg/kg	<1000	----
Thallium	7440-28-0	E440	0.05	mg/kg	<0.050	----
Tin	7440-31-5	E440	2	mg/kg	<2.0	----
Titanium	7440-32-6	E440	1	mg/kg	<1.0	----
Tungsten	7440-33-7	E440	0.5	mg/kg	<0.50	----
Uranium	7440-61-1	E440	0.05	mg/kg	<0.050	----
Vanadium	7440-62-2	E440	0.2	mg/kg	<0.20	----
Zinc	7440-66-6	E440	2	mg/kg	<2.0	----
Zirconium	7440-67-7	E440	1	mg/kg	<1.0	----
Metals (QCLot: 1533470)						
Mercury	7439-97-6	E510	0.005	mg/kg	<0.0050	----
Metals (QCLot: 1555994)						
Arsenic	7440-38-2	E440B	0.05	mg/kg	<0.050	----
Metals (QCLot: 1555996)						
Arsenic	7440-38-2	E440B	0.05	mg/kg	<0.050	----
Metals (QCLot: 1556001)						
Arsenic	7440-38-2	E440B	0.05	mg/kg	<0.050	----
Leachable Metals (QCLot: 1555995)						
Arsenic, IVBA (leachate)	7440-38-2	E452	0.005	mg/L	<0.0050	----
Leachable Metals (QCLot: 1555997)						
Arsenic, IVBA (leachate)	7440-38-2	E452	0.005	mg/L	<0.0050	----
Leachable Metals (QCLot: 1556002)						
Arsenic, IVBA (leachate)	7440-38-2	E452	0.005	mg/L	<0.0050	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1514446)						
Acenaphthene	83-32-9	E641A-L	0.005	mg/kg	<0.0050	----
Acenaphthylene	208-96-8	E641A-L	0.005	mg/kg	<0.0050	----
Acridine	260-94-6	E641A-L	0.01	mg/kg	<0.010	----
Anthracene	120-12-7	E641A-L	0.004	mg/kg	<0.0040	----
Benzo(a)anthracene	56-55-3	E641A-L	0.01	mg/kg	<0.010	----
Benzo(a)pyrene	50-32-8	E641A-L	0.01	mg/kg	<0.010	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	mg/kg	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	mg/kg	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	mg/kg	<0.010	----
Chrysene	218-01-9	E641A-L	0.01	mg/kg	<0.010	----



Sub-Matrix: **Soil/Solid**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 1514446) - continued						
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	mg/kg	<0.0050	----
Fluoranthene	206-44-0	E641A-L	0.01	mg/kg	<0.010	----
Fluorene	86-73-7	E641A-L	0.01	mg/kg	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	mg/kg	<0.010	----
Methylnaphthalene, 1-	90-12-0	E641A-L	0.01	mg/kg	<0.010	----
Methylnaphthalene, 2-	91-57-6	E641A-L	0.01	mg/kg	<0.010	----
Naphthalene	91-20-3	E641A-L	0.01	mg/kg	<0.010	----
Perylene	198-55-0	E641A-L	0.01	mg/kg	<0.010	----
Phenanthrene	85-01-8	E641A-L	0.01	mg/kg	<0.010	----
Pyrene	129-00-0	E641A-L	0.01	mg/kg	<0.010	----
Quinoline	91-22-5	E641A-L	0.01	mg/kg	<0.010	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1533467)						
Acenaphthene	83-32-9	E641A-L	0.005	mg/kg	<0.0050	----
Acenaphthylene	208-96-8	E641A-L	0.005	mg/kg	<0.0050	----
Acridine	260-94-6	E641A-L	0.01	mg/kg	<0.010	----
Anthracene	120-12-7	E641A-L	0.004	mg/kg	<0.0040	----
Benz(a)anthracene	56-55-3	E641A-L	0.01	mg/kg	<0.010	----
Benzo(a)pyrene	50-32-8	E641A-L	0.01	mg/kg	<0.010	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	mg/kg	<0.010	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	mg/kg	<0.010	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	mg/kg	<0.010	----
Chrysene	218-01-9	E641A-L	0.01	mg/kg	<0.010	----
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	mg/kg	<0.0050	----
Fluoranthene	206-44-0	E641A-L	0.01	mg/kg	<0.010	----
Fluorene	86-73-7	E641A-L	0.01	mg/kg	<0.010	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	mg/kg	<0.010	----
Methylnaphthalene, 1-	90-12-0	E641A-L	0.01	mg/kg	<0.010	----
Methylnaphthalene, 2-	91-57-6	E641A-L	0.01	mg/kg	<0.010	----
Naphthalene	91-20-3	E641A-L	0.01	mg/kg	<0.010	----
Perylene	198-55-0	E641A-L	0.01	mg/kg	<0.010	----
Phenanthrene	85-01-8	E641A-L	0.01	mg/kg	<0.010	----
Pyrene	129-00-0	E641A-L	0.01	mg/kg	<0.010	----
Quinoline	91-22-5	E641A-L	0.01	mg/kg	<0.010	----



Qualifiers

<i>Qualifier</i>	<i>Description</i>
B	<i>Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.</i>



Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: Biota					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		Qualifier
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	
Physical Tests (QCLot: 1551500)									
Moisture	---	E144-H	2	%	100 %	99.8	90.0	110	---
Physical Tests (QCLot: 1571677)									
Moisture	---	E144	0.5	%	100 %	99.8	90.0	110	---
Metals (QCLot: 1551539)									
Silver	7440-22-4	E472A.Ag	0.001	mg/kg wwt	1 mg/kg wwt	91.8	80.0	120	---
Metals (QCLot: 1551540)									
Titanium	7440-32-6	E472A.Ti	0.1	mg/kg wwt	2.5 mg/kg wwt	101	80.0	120	---
Metals (QCLot: 1551541)									
Mercury	7439-97-6	E511A	0.001	mg/kg wwt	0.02 mg/kg wwt	86.7	80.0	120	---
Metals (QCLot: 1551542)									
Aluminum	7429-90-5	E472A	1	mg/kg wwt	20 mg/kg wwt	103	80.0	120	---
Antimony	7440-36-0	E472A	0.002	mg/kg wwt	10 mg/kg wwt	102	80.0	120	---
Arsenic	7440-38-2	E472A	0.006	mg/kg wwt	10 mg/kg wwt	104	80.0	120	---
Barium	7440-39-3	E472A	0.01	mg/kg wwt	2.5 mg/kg wwt	103	80.0	120	---
Beryllium	7440-41-7	E472A	0.002	mg/kg wwt	1 mg/kg wwt	92.8	80.0	120	---
Bismuth	7440-69-9	E472A	0.002	mg/kg wwt	10 mg/kg wwt	96.1	80.0	120	---
Boron	7440-42-8	E472A	0.2	mg/kg wwt	10 mg/kg wwt	86.0	80.0	120	---
Cadmium	7440-43-9	E472A	0.002	mg/kg wwt	1 mg/kg wwt	96.3	80.0	120	---
Calcium	7440-70-2	E472A	4	mg/kg wwt	500 mg/kg wwt	92.5	80.0	120	---
Cesium	7440-46-2	E472A	0.001	mg/kg wwt	0.5 mg/kg wwt	103	80.0	120	---
Chromium	7440-47-3	E472A	0.04	mg/kg wwt	2.5 mg/kg wwt	100	80.0	120	---
Cobalt	7440-48-4	E472A	0.004	mg/kg wwt	2.5 mg/kg wwt	97.8	80.0	120	---
Copper	7440-50-8	E472A	0.04	mg/kg wwt	2.5 mg/kg wwt	94.4	80.0	120	---
Iron	7439-89-6	E472A	1	mg/kg wwt	10 mg/kg wwt	98.2	80.0	120	---
Lead	7439-92-1	E472A	0.01	mg/kg wwt	5 mg/kg wwt	96.5	80.0	120	---
Lithium	7439-93-2	E472A	0.1	mg/kg wwt	2.5 mg/kg wwt	94.3	80.0	120	---
Magnesium	7439-95-4	E472A	0.4	mg/kg wwt	500 mg/kg wwt	94.5	80.0	120	---
Manganese	7439-96-5	E472A	0.01	mg/kg wwt	2.5 mg/kg wwt	99.8	80.0	120	---
Molybdenum	7439-98-7	E472A	0.008	mg/kg wwt	2.5 mg/kg wwt	107	80.0	120	---
Nickel	7440-02-0	E472A	0.04	mg/kg wwt	5 mg/kg wwt	95.7	80.0	120	---
Phosphorus	7723-14-0	E472A	2	mg/kg wwt	100 mg/kg wwt	107	80.0	120	---



Sub-Matrix: **Biota**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Metals (QCLot: 1551542) - continued									
Potassium	7440-09-7	E472A	4	mg/kg wwt	500 mg/kg wwt	101	80.0	120	----
Rubidium	7440-17-7	E472A	0.01	mg/kg wwt	1 mg/kg wwt	99.6	80.0	120	----
Selenium	7782-49-2	E472A	0.02	mg/kg wwt	10 mg/kg wwt	95.5	80.0	120	----
Sodium	7440-23-5	E472A	4	mg/kg wwt	500 mg/kg wwt	99.7	80.0	120	----
Strontium	7440-24-6	E472A	0.02	mg/kg wwt	2.5 mg/kg wwt	103	80.0	120	----
Tellurium	13494-80-9	E472A	0.004	mg/kg wwt	1 mg/kg wwt	101	80.0	120	----
Thallium	7440-28-0	E472A	0.0004	mg/kg wwt	10 mg/kg wwt	98.3	80.0	120	----
Tin	7440-31-5	E472A	0.02	mg/kg wwt	5 mg/kg wwt	99.0	80.0	120	----
Uranium	7440-61-1	E472A	0.0004	mg/kg wwt	0.05 mg/kg wwt	101	80.0	120	----
Vanadium	7440-62-2	E472A	0.02	mg/kg wwt	5 mg/kg wwt	101	80.0	120	----
Zinc	7440-66-6	E472A	0.2	mg/kg wwt	5 mg/kg wwt	92.7	80.0	120	----
Zirconium	7440-67-7	E472A	0.04	mg/kg wwt	1 mg/kg wwt	104	80.0	120	----
Speciated Metals (QCLot: 1533708)									
Methylmercury (as MeHg)	22967-92-6	E538A	1	µg/kg wwt	100 µg/kg wwt	112	70.0	130	----
Speciated Metals (QCLot: 1533709)									
Methylmercury (as MeHg)	22967-92-6	E538	5	µg/kg	100 µg/kg	112	70.0	130	----
Speciated Metals (QCLot: 1570464)									
Arsenate [As V]	17428-41-0	E539A	0.005	mg/kg wwt	0.094 mg/kg wwt	84.1	80.0	120	----
Arsenite [As III]	22541-54-4	E539A	0.001	mg/kg wwt	0.094 mg/kg wwt	119	70.0	130	----
Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	97.8	80.0	120	----
Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	104	80.0	120	----
Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	105	80.0	120	----
Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.001	mg/kg wwt	0.023 mg/kg wwt	102	80.0	120	----

Sub-Matrix: **Soil/Solid**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Target Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1514449)									
Moisture	----	E144	0.25	%	50 %	101	90.0	110	----
Physical Tests (QCLot: 1533475)									
Moisture	----	E144	0.25	%	50 %	96.6	90.0	110	----
Metals (QCLot: 1514447)									
Aluminum	7429-90-5	E440	50	mg/kg	200 mg/kg	90.4	80.0	120	----



Sub-Matrix: Soil/Solid

Laboratory Control Sample (LCS) Report

Analyte	CAS Number	Method	LOR	Unit	Spike	Recovery (%)	Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High	
Metals (QCLot: 1514447) - continued									
Antimony	7440-36-0	E440	0.1	mg/kg	100 mg/kg	87.0	80.0	120	----
Arsenic	7440-38-2	E440	0.1	mg/kg	100 mg/kg	93.2	80.0	120	----
Barium	7440-39-3	E440	0.5	mg/kg	25 mg/kg	89.8	80.0	120	----
Beryllium	7440-41-7	E440	0.1	mg/kg	10 mg/kg	97.4	80.0	120	----
Bismuth	7440-69-9	E440	0.2	mg/kg	100 mg/kg	85.7	80.0	120	----
Boron	7440-42-8	E440	5	mg/kg	100 mg/kg	97.9	80.0	120	----
Cadmium	7440-43-9	E440	0.02	mg/kg	10 mg/kg	88.5	80.0	120	----
Calcium	7440-70-2	E440	50	mg/kg	5000 mg/kg	92.7	80.0	120	----
Chromium	7440-47-3	E440	0.5	mg/kg	25 mg/kg	88.8	80.0	120	----
Cobalt	7440-48-4	E440	0.1	mg/kg	25 mg/kg	87.6	80.0	120	----
Copper	7440-50-8	E440	0.5	mg/kg	25 mg/kg	86.7	80.0	120	----
Iron	7439-89-6	E440	50	mg/kg	100 mg/kg	90.4	80.0	120	----
Lead	7439-92-1	E440	0.5	mg/kg	50 mg/kg	90.3	80.0	120	----
Lithium	7439-93-2	E440	2	mg/kg	25 mg/kg	95.8	80.0	120	----
Magnesium	7439-95-4	E440	20	mg/kg	5000 mg/kg	95.4	80.0	120	----
Manganese	7439-96-5	E440	1	mg/kg	25 mg/kg	87.1	80.0	120	----
Molybdenum	7439-98-7	E440	0.1	mg/kg	25 mg/kg	89.9	80.0	120	----
Nickel	7440-02-0	E440	0.5	mg/kg	50 mg/kg	87.3	80.0	120	----
Phosphorus	7723-14-0	E440	50	mg/kg	1000 mg/kg	92.5	80.0	120	----
Potassium	7440-09-7	E440	100	mg/kg	5000 mg/kg	88.2	80.0	120	----
Selenium	7782-49-2	E440	0.2	mg/kg	100 mg/kg	93.8	80.0	120	----
Silver	7440-22-4	E440	0.1	mg/kg	10 mg/kg	# 78.9	80.0	120	MES
Sodium	7440-23-5	E440	50	mg/kg	5000 mg/kg	90.8	80.0	120	----
Strontium	7440-24-6	E440	0.5	mg/kg	25 mg/kg	87.9	80.0	120	----
Sulfur	7704-34-9	E440	1000	mg/kg	5000 mg/kg	90.5	80.0	120	----
Thallium	7440-28-0	E440	0.05	mg/kg	100 mg/kg	85.3	80.0	120	----
Tin	7440-31-5	E440	2	mg/kg	50 mg/kg	87.1	80.0	120	----
Titanium	7440-32-6	E440	1	mg/kg	25 mg/kg	84.3	80.0	120	----
Tungsten	7440-33-7	E440	0.5	mg/kg	10 mg/kg	89.8	80.0	120	----
Uranium	7440-61-1	E440	0.05	mg/kg	0.5 mg/kg	95.8	80.0	120	----
Vanadium	7440-62-2	E440	0.2	mg/kg	50 mg/kg	88.4	80.0	120	----
Zinc	7440-66-6	E440	2	mg/kg	50 mg/kg	86.7	80.0	120	----
Zirconium	7440-67-7	E440	1	mg/kg	10 mg/kg	89.8	80.0	120	----
Metals (QCLot: 1514448)									
Mercury	7439-97-6	E510	0.005	mg/kg	0.1 mg/kg	102	80.0	120	----
Metals (QCLot: 1533469)									



Sub-Matrix: Soil/Solid

Laboratory Control Sample (LCS) Report

Analyte	CAS Number	Method	LOR	Unit	Recovery (%)				Qualifier
					Spike Target Concentration	LCS	Recovery Limits (%) Low	High	
Metals (QCLot: 1533469) - continued									
Aluminum	7429-90-5	E440	50	mg/kg	200 mg/kg	115	80.0	120	----
Antimony	7440-36-0	E440	0.1	mg/kg	100 mg/kg	109	80.0	120	----
Arsenic	7440-38-2	E440	0.1	mg/kg	100 mg/kg	114	80.0	120	----
Barium	7440-39-3	E440	0.5	mg/kg	25 mg/kg	111	80.0	120	----
Beryllium	7440-41-7	E440	0.1	mg/kg	10 mg/kg	108	80.0	120	----
Bismuth	7440-69-9	E440	0.2	mg/kg	100 mg/kg	106	80.0	120	----
Boron	7440-42-8	E440	5	mg/kg	100 mg/kg	105	80.0	120	----
Cadmium	7440-43-9	E440	0.02	mg/kg	10 mg/kg	107	80.0	120	----
Calcium	7440-70-2	E440	50	mg/kg	5000 mg/kg	108	80.0	120	----
Chromium	7440-47-3	E440	0.5	mg/kg	25 mg/kg	109	80.0	120	----
Cobalt	7440-48-4	E440	0.1	mg/kg	25 mg/kg	109	80.0	120	----
Copper	7440-50-8	E440	0.5	mg/kg	25 mg/kg	108	80.0	120	----
Iron	7439-89-6	E440	50	mg/kg	100 mg/kg	111	80.0	120	----
Lead	7439-92-1	E440	0.5	mg/kg	50 mg/kg	109	80.0	120	----
Lithium	7439-93-2	E440	2	mg/kg	25 mg/kg	115	80.0	120	----
Magnesium	7439-95-4	E440	20	mg/kg	5000 mg/kg	114	80.0	120	----
Manganese	7439-96-5	E440	1	mg/kg	25 mg/kg	110	80.0	120	----
Molybdenum	7439-98-7	E440	0.1	mg/kg	25 mg/kg	108	80.0	120	----
Nickel	7440-02-0	E440	0.5	mg/kg	50 mg/kg	108	80.0	120	----
Phosphorus	7723-14-0	E440	50	mg/kg	1000 mg/kg	# 123	80.0	120	MES
Potassium	7440-09-7	E440	100	mg/kg	5000 mg/kg	110	80.0	120	----
Selenium	7782-49-2	E440	0.2	mg/kg	100 mg/kg	111	80.0	120	----
Silver	7440-22-4	E440	0.1	mg/kg	10 mg/kg	96.2	80.0	120	----
Sodium	7440-23-5	E440	50	mg/kg	5000 mg/kg	112	80.0	120	----
Strontium	7440-24-6	E440	0.5	mg/kg	25 mg/kg	107	80.0	120	----
Sulfur	7704-34-9	E440	1000	mg/kg	5000 mg/kg	111	80.0	120	----
Thallium	7440-28-0	E440	0.05	mg/kg	100 mg/kg	109	80.0	120	----
Tin	7440-31-5	E440	2	mg/kg	50 mg/kg	109	80.0	120	----
Titanium	7440-32-6	E440	1	mg/kg	25 mg/kg	107	80.0	120	----
Tungsten	7440-33-7	E440	0.5	mg/kg	10 mg/kg	112	80.0	120	----
Uranium	7440-61-1	E440	0.05	mg/kg	0.5 mg/kg	117	80.0	120	----
Vanadium	7440-62-2	E440	0.2	mg/kg	50 mg/kg	110	80.0	120	----
Zinc	7440-66-6	E440	2	mg/kg	50 mg/kg	106	80.0	120	----
Zirconium	7440-67-7	E440	1	mg/kg	10 mg/kg	113	80.0	120	----
Metals (QCLot: 1533470)									
Mercury	7439-97-6	E510	0.005	mg/kg	0.1 mg/kg	104	80.0	120	----



Sub-Matrix: Soil/Solid

Laboratory Control Sample (LCS) Report

Analyte	CAS Number	Method	LOR	Unit	Spike		Recovery (%)		Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High			
Metals (QCLot: 1555994)											
Arsenic	7440-38-2	E440B	0.05	mg/kg	200 mg/kg	105	80.0	120	---		
Metals (QCLot: 1555996)											
Arsenic	7440-38-2	E440B	0.05	mg/kg	200 mg/kg	105	80.0	120	---		
Metals (QCLot: 1556001)											
Arsenic	7440-38-2	E440B	0.05	mg/kg	200 mg/kg	104	80.0	120	---		
Leachable Metals (QCLot: 1555995)											
Arsenic, IVBA (leachate)	7440-38-2	E452	0.005	mg/L	2 mg/L	105	85.0	115	---		
Leachable Metals (QCLot: 1555997)											
Arsenic, IVBA (leachate)	7440-38-2	E452	0.005	mg/L	2 mg/L	109	85.0	115	---		
Leachable Metals (QCLot: 1556002)											
Arsenic, IVBA (leachate)	7440-38-2	E452	0.005	mg/L	2 mg/L	110	85.0	115	---		
Polycyclic Aromatic Hydrocarbons (QCLot: 1514446)											
Acenaphthene	83-32-9	E641A-L	0.005	mg/kg	0.5 mg/kg	101	60.0	130	---		
Acenaphthylene	208-96-8	E641A-L	0.005	mg/kg	0.5 mg/kg	102	60.0	130	---		
Acridine	260-94-6	E641A-L	0.01	mg/kg	0.5 mg/kg	91.2	60.0	130	---		
Anthracene	120-12-7	E641A-L	0.004	mg/kg	0.5 mg/kg	107	60.0	130	---		
Benz(a)anthracene	56-55-3	E641A-L	0.01	mg/kg	0.5 mg/kg	100	60.0	130	---		
Benzo(a)pyrene	50-32-8	E641A-L	0.01	mg/kg	0.5 mg/kg	104	60.0	130	---		
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	mg/kg	0.5 mg/kg	102	60.0	130	---		
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	mg/kg	0.5 mg/kg	98.8	60.0	130	---		
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	mg/kg	0.5 mg/kg	106	60.0	130	---		
Chrysene	218-01-9	E641A-L	0.01	mg/kg	0.5 mg/kg	103	60.0	130	---		
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	mg/kg	0.5 mg/kg	106	60.0	130	---		
Fluoranthene	206-44-0	E641A-L	0.01	mg/kg	0.5 mg/kg	106	60.0	130	---		
Fluorene	86-73-7	E641A-L	0.01	mg/kg	0.5 mg/kg	106	60.0	130	---		
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	mg/kg	0.5 mg/kg	103	60.0	130	---		
Methylnaphthalene, 1-	90-12-0	E641A-L	0.01	mg/kg	0.5 mg/kg	95.2	60.0	130	---		
Methylnaphthalene, 2-	91-57-6	E641A-L	0.01	mg/kg	0.5 mg/kg	106	60.0	130	---		
Naphthalene	91-20-3	E641A-L	0.01	mg/kg	0.5 mg/kg	96.2	50.0	130	---		
Perylene	198-55-0	E641A-L	0.01	mg/kg	0.5 mg/kg	103	60.0	130	---		
Phenanthrene	85-01-8	E641A-L	0.01	mg/kg	0.5 mg/kg	107	60.0	130	---		
Pyrene	129-00-0	E641A-L	0.01	mg/kg	0.5 mg/kg	106	60.0	130	---		
Quinoline	91-22-5	E641A-L	0.01	mg/kg	0.5 mg/kg	94.8	60.0	130	---		

Polycyclic Aromatic Hydrocarbons (QCLot: 1533467)



Sub-Matrix: Soil/Solid

Laboratory Control Sample (LCS) Report

Analyte	CAS Number	Method	LOR	Unit	Spike		Recovery Limits (%)		Qualifier
					Target Concentration	LCS	Low	High	
Polycyclic Aromatic Hydrocarbons (QCLot: 1533467) - continued									
Acenaphthene	83-32-9	E641A-L	0.005	mg/kg	0.5 mg/kg	96.4	60.0	130	----
Acenaphthylene	208-96-8	E641A-L	0.005	mg/kg	0.5 mg/kg	85.8	60.0	130	----
Acridine	260-94-6	E641A-L	0.01	mg/kg	0.5 mg/kg	67.2	60.0	130	----
Anthracene	120-12-7	E641A-L	0.004	mg/kg	0.5 mg/kg	84.8	60.0	130	----
Benz(a)anthracene	56-55-3	E641A-L	0.01	mg/kg	0.5 mg/kg	77.0	60.0	130	----
Benzo(a)pyrene	50-32-8	E641A-L	0.01	mg/kg	0.5 mg/kg	78.8	60.0	130	----
Benzo(b+j)fluoranthene	n/a	E641A-L	0.01	mg/kg	0.5 mg/kg	77.2	60.0	130	----
Benzo(g,h,i)perylene	191-24-2	E641A-L	0.01	mg/kg	0.5 mg/kg	85.8	60.0	130	----
Benzo(k)fluoranthene	207-08-9	E641A-L	0.01	mg/kg	0.5 mg/kg	76.2	60.0	130	----
Chrysene	218-01-9	E641A-L	0.01	mg/kg	0.5 mg/kg	82.6	60.0	130	----
Dibenz(a,h)anthracene	53-70-3	E641A-L	0.005	mg/kg	0.5 mg/kg	77.6	60.0	130	----
Fluoranthene	206-44-0	E641A-L	0.01	mg/kg	0.5 mg/kg	85.5	60.0	130	----
Fluorene	86-73-7	E641A-L	0.01	mg/kg	0.5 mg/kg	92.6	60.0	130	----
Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.01	mg/kg	0.5 mg/kg	82.2	60.0	130	----
Methylnaphthalene, 1-	90-12-0	E641A-L	0.01	mg/kg	0.5 mg/kg	88.0	60.0	130	----
Methylnaphthalene, 2-	91-57-6	E641A-L	0.01	mg/kg	0.5 mg/kg	98.7	60.0	130	----
Naphthalene	91-20-3	E641A-L	0.01	mg/kg	0.5 mg/kg	84.4	50.0	130	----
Perylene	198-55-0	E641A-L	0.01	mg/kg	0.5 mg/kg	81.3	60.0	130	----
Phenanthrene	85-01-8	E641A-L	0.01	mg/kg	0.5 mg/kg	87.3	60.0	130	----
Pyrene	129-00-0	E641A-L	0.01	mg/kg	0.5 mg/kg	88.4	60.0	130	----
Quinoline	91-22-5	E641A-L	0.01	mg/kg	0.5 mg/kg	66.7	60.0	130	----

Qualifiers

Qualifier	Description
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).



Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Biota**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Speciated Metals (QCLot: 1570464)										
WP2414182-022	Anonymous	Arsenate [As V]	17428-41-0	E539A	0.0958 mg/kg wwt	0.093 mg/kg wwt	103	70.0	130	----
		Arsenite [As III]	22541-54-4	E539A	0.107 mg/kg wwt	0.093 mg/kg wwt	115	70.0	130	----
		Arsenobetaine [AsB], (as As)	64436-13-1	E539A	0.0216 mg/kg wwt	0.019 mg/kg wwt	116	70.0	130	----
		Arsenocholine [AsC], (as As)	39895-81-3	E539A	0.0212 mg/kg wwt	0.019 mg/kg wwt	114	70.0	130	----
		Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.0232 mg/kg wwt	0.019 mg/kg wwt	125	70.0	130	----
		Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.0225 mg/kg wwt	0.019 mg/kg wwt	121	70.0	130	----

Sub-Matrix: **Soil/Solid**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Sample Preparation (QCLot: 1555995)										
WP2414228-002	CFS02	Final volume	----	EP452	----	----		0	0	----
		pH, IVBA final	----	EP452	----	----		0	0	----
		pH, IVBA Initial	----	EP452	----	----		0	0	----
		Weight, extraction (dry)	----	EP452	----	----		0	0	----
Sample Preparation (QCLot: 1555997)										
WP2414228-009	CFS09	Final volume	----	EP452	----	----		0	0	----
		pH, IVBA final	----	EP452	----	----		0	0	----
		pH, IVBA Initial	----	EP452	----	----		0	0	----
		Weight, extraction (dry)	----	EP452	----	----		0	0	----
Sample Preparation (QCLot: 1556002)										
WP2414228-016	CFS16	Final volume	----	EP452	----	----		0	0	----
		pH, IVBA final	----	EP452	----	----		0	0	----
		pH, IVBA Initial	----	EP452	----	----		0	0	----
		Weight, extraction (dry)	----	EP452	----	----		0	0	----
Leachable Metals (QCLot: 1555995)										
WP2414228-002	CFS02	Arsenic, IVBA (leachate)	7440-38-2	E452	21.0 mg/L	20 mg/L	105	75.0	125	----
Leachable Metals (QCLot: 1555997)										
WP2414228-009	CFS09	Arsenic, IVBA (leachate)	7440-38-2	E452	18.4 mg/L	20 mg/L	92.0	75.0	125	----
Leachable Metals (QCLot: 1556002)										
WP2414228-016	CFS16	Arsenic, IVBA (leachate)	7440-38-2	E452	21.0 mg/L	20 mg/L	105	75.0	125	----



Sub-Matrix: Soil/Solid

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Polycyclic Aromatic Hydrocarbons (QCLot: 1514446)										
WP2414228-002	CFS02	Acenaphthene	83-32-9	E641A-L	0.456 mg/kg	0.427 mg/kg	107	50.0	140	----
		Acenaphthylene	208-96-8	E641A-L	0.451 mg/kg	0.427 mg/kg	106	50.0	140	----
		Acridine	260-94-6	E641A-L	0.106 mg/kg	0.427 mg/kg	24.9	50.0	140	K
		Anthracene	120-12-7	E641A-L	0.478 mg/kg	0.427 mg/kg	112	50.0	140	----
		Benz(a)anthracene	56-55-3	E641A-L	0.450 mg/kg	0.427 mg/kg	105	50.0	140	----
		Benzo(a)pyrene	50-32-8	E641A-L	0.419 mg/kg	0.427 mg/kg	98.1	50.0	140	----
		Benzo(b+j)fluoranthene	n/a	E641A-L	0.432 mg/kg	0.427 mg/kg	101	50.0	140	----
		Benzo(g,h,i)perylene	191-24-2	E641A-L	0.401 mg/kg	0.427 mg/kg	93.9	50.0	140	----
		Benzo(k)fluoranthene	207-08-9	E641A-L	0.442 mg/kg	0.427 mg/kg	103	50.0	140	----
		Chrysene	218-01-9	E641A-L	0.444 mg/kg	0.427 mg/kg	104	50.0	140	----
		Dibenz(a,h)anthracene	53-70-3	E641A-L	0.428 mg/kg	0.427 mg/kg	100	50.0	140	----
		Fluoranthene	206-44-0	E641A-L	0.465 mg/kg	0.427 mg/kg	109	50.0	140	----
		Fluorene	86-73-7	E641A-L	0.473 mg/kg	0.427 mg/kg	111	50.0	140	----
		Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.422 mg/kg	0.427 mg/kg	98.8	50.0	140	----
		Methylnaphthalene, 1-	90-12-0	E641A-L	0.442 mg/kg	0.427 mg/kg	104	50.0	140	----
		Methylnaphthalene, 2-	91-57-6	E641A-L	0.487 mg/kg	0.427 mg/kg	114	50.0	140	----
		Naphthalene	91-20-3	E641A-L	0.454 mg/kg	0.427 mg/kg	106	50.0	140	----
		Perylene	198-55-0	E641A-L	0.425 mg/kg	0.427 mg/kg	99.5	50.0	140	----
		Phenanthrene	85-01-8	E641A-L	0.480 mg/kg	0.427 mg/kg	112	50.0	140	----
		Pyrene	129-00-0	E641A-L	0.469 mg/kg	0.427 mg/kg	110	50.0	140	----
		Quinoline	91-22-5	E641A-L	0.224 mg/kg	0.427 mg/kg	52.4	50.0	140	----
Polycyclic Aromatic Hydrocarbons (QCLot: 1533467)										
VA24B5578-001	Anonymous	Acenaphthene	83-32-9	E641A-L	0.400 mg/kg	0.424 mg/kg	94.4	50.0	140	----
		Acenaphthylene	208-96-8	E641A-L	0.348 mg/kg	0.424 mg/kg	82.0	50.0	140	----
		Acridine	260-94-6	E641A-L	0.225 mg/kg	0.424 mg/kg	53.0	50.0	140	----
		Anthracene	120-12-7	E641A-L	0.360 mg/kg	0.424 mg/kg	85.1	50.0	140	----
		Benz(a)anthracene	56-55-3	E641A-L	0.321 mg/kg	0.424 mg/kg	75.7	50.0	140	----
		Benzo(a)pyrene	50-32-8	E641A-L	0.285 mg/kg	0.424 mg/kg	67.2	50.0	140	----
		Benzo(b+j)fluoranthene	n/a	E641A-L	0.291 mg/kg	0.424 mg/kg	68.6	50.0	140	----
		Benzo(g,h,i)perylene	191-24-2	E641A-L	0.289 mg/kg	0.424 mg/kg	68.2	50.0	140	----
		Benzo(k)fluoranthene	207-08-9	E641A-L	0.289 mg/kg	0.424 mg/kg	68.2	50.0	140	----
		Chrysene	218-01-9	E641A-L	0.336 mg/kg	0.424 mg/kg	79.2	50.0	140	----
		Dibenz(a,h)anthracene	53-70-3	E641A-L	0.280 mg/kg	0.424 mg/kg	66.0	50.0	140	----
		Fluoranthene	206-44-0	E641A-L	0.344 mg/kg	0.424 mg/kg	81.3	50.0	140	----
		Fluorene	86-73-7	E641A-L	0.387 mg/kg	0.424 mg/kg	91.3	50.0	140	----
		Indeno(1,2,3-c,d)pyrene	193-39-5	E641A-L	0.280 mg/kg	0.424 mg/kg	66.2	50.0	140	----
		Methylnaphthalene, 1-	90-12-0	E641A-L	0.355 mg/kg	0.424 mg/kg	83.7	50.0	140	----
		Methylnaphthalene, 2-	91-57-6	E641A-L	0.402 mg/kg	0.424 mg/kg	94.8	50.0	140	----
		Naphthalene	91-20-3	E641A-L	0.342 mg/kg	0.424 mg/kg	80.8	50.0	140	----
		Perylene	198-55-0	E641A-L	0.301 mg/kg	0.424 mg/kg	70.9	50.0	140	----
		Phenanthrene	85-01-8	E641A-L	0.364 mg/kg	0.424 mg/kg	85.9	50.0	140	----
		Pyrene	129-00-0	E641A-L	0.360 mg/kg	0.424 mg/kg	84.8	50.0	140	----
		Quinoline	91-22-5	E641A-L	0.241 mg/kg	0.424 mg/kg	56.8	50.0	140	----



Qualifiers

<i>Qualifier</i>	<i>Description</i>
K	<i>Matrix Spike recovery outside ALS DQO due to sample matrix effects.</i>



Reference Material (RM) Report

A Reference Material (RM) is a homogenous material with known and well-established analyte concentrations. RMs are processed in an identical manner to test samples, and are used to monitor and control the accuracy and precision of a test method for a typical sample matrix. RM results are expressed as percent recovery of the target analyte concentration. RM targets may be certified target concentrations provided by the RM supplier, or may be ALS long-term mean values (for empirical test methods).

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
					Low	High			
Metals (QCLot: 1551539)									
QC-1551539-003	RM	Silver	7440-22-4	E472A.Ag	0.139 mg/kg wwt	101	70.0	130	----
Metals (QCLot: 1551540)									
QC-1551540-003	RM	Titanium	7440-32-6	E472A.Ti	1.15 mg/kg wwt	85.6	70.0	130	----
Metals (QCLot: 1551541)									
QC-1551541-003	RM	Mercury	7439-97-6	E511A	0.281 mg/kg wwt	91.8	70.0	130	----
Metals (QCLot: 1551542)									
QC-1551542-003	RM	Aluminum	7429-90-5	E472A	147 mg/kg wwt	86.2	70.0	130	----
QC-1551542-003	RM	Arsenic	7440-38-2	E472A	14.5 mg/kg wwt	97.6	70.0	130	----
QC-1551542-003	RM	Barium	7440-39-3	E472A	0.352 mg/kg wwt	91.2	70.0	130	----
QC-1551542-003	RM	Boron	7440-42-8	E472A	3.47 mg/kg wwt	94.2	70.0	130	----
QC-1551542-003	RM	Cadmium	7440-43-9	E472A	0.153 mg/kg wwt	92.6	70.0	130	----
QC-1551542-003	RM	Calcium	7440-70-2	E472A	2010 mg/kg wwt	97.4	70.0	130	----
QC-1551542-003	RM	Cesium	7440-46-2	E472A	0.089 mg/kg wwt	99.8	70.0	130	----
QC-1551542-003	RM	Chromium	7440-47-3	E472A	0.453 mg/kg wwt	97.5	50.0	150	----
QC-1551542-003	RM	Cobalt	7440-48-4	E472A	0.057 mg/kg wwt	93.5	65.0	135	----
QC-1551542-003	RM	Copper	7440-50-8	E472A	3.3 mg/kg wwt	90.6	70.0	130	----
QC-1551542-003	RM	Iron	7439-89-6	E472A	102 mg/kg wwt	91.7	70.0	130	----
QC-1551542-003	RM	Lead	7439-92-1	E472A	0.058 mg/kg wwt	96.6	15.0	185	----
QC-1551542-003	RM	Magnesium	7439-95-4	E472A	899 mg/kg wwt	90.4	70.0	130	----
QC-1551542-003	RM	Manganese	7439-96-5	E472A	0.948 mg/kg wwt	93.3	70.0	130	----
QC-1551542-003	RM	Molybdenum	7439-98-7	E472A	0.134 mg/kg wwt	104	70.0	130	----
QC-1551542-003	RM	Nickel	7440-02-0	E472A	0.33 mg/kg wwt	99.4	40.0	160	----
QC-1551542-003	RM	Phosphorus	7723-14-0	E472A	6700 mg/kg wwt	103	70.0	130	----
QC-1551542-003	RM	Potassium	7440-09-7	E472A	11600 mg/kg wwt	96.7	70.0	130	----
QC-1551542-003	RM	Rubidium	7440-17-7	E472A	2.53 mg/kg wwt	97.8	70.0	130	----
QC-1551542-003	RM	Selenium	7782-49-2	E472A	2.48 mg/kg wwt	98.8	70.0	130	----
QC-1551542-003	RM	Sodium	7440-23-5	E472A	9620 mg/kg wwt	97.0	70.0	130	----
QC-1551542-003	RM	Strontium	7440-24-6	E472A	10.6 mg/kg wwt	95.8	70.0	130	----
QC-1551542-003	RM	Vanadium	7440-62-2	E472A	0.269 mg/kg wwt	86.7	70.0	130	----
QC-1551542-003	RM	Zinc	7440-66-6	E472A	28.7 mg/kg wwt	94.9	70.0	130	----
Speciated Metals (QCLot: 1533708)									
QC-1533708-003	RM	Methylmercury (as MeHg)	22967-92-6	E538A	340 µg/kg wwt	79.7	70.0	130	----



Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Speciated Metals (QCLot: 1533709)									
QC-1533709-003	RM	Methylmercury (as MeHg)	22967-92-6	E538	340 µg/kg	79.7	70.0	130	----
Speciated Metals (QCLot: 1570464)									
QC-1570464-003	NIST 1568b	Arsenate [As V]	17428-41-0	E539A	0.028 mg/kg wwt	123	70.0	130	----
QC-1570464-003	NIST 1568b	Arsenite [As III]	22541-54-4	E539A	0.058 mg/kg wwt	119	70.0	130	----
QC-1570464-005	DORM5	Arsenobetaine [AsB], (as As)	64436-13-1	E539A	11.8 mg/kg wwt	82.7	60.0	130	----
QC-1570464-003	NIST 1568b	Dimethylarsinic acid [DMA], (as As)	75-60-5	E539A	0.169 mg/kg wwt	86.4	70.0	130	----
QC-1570464-003	NIST 1568b	Monomethylarsonic acid [MMA], (as As)	2163-80-6	E539A	0.011 mg/kg wwt	93.7	70.0	130	----

Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 1514447)									
QC-1514447-003	MRCA-21	Aluminum	7429-90-5	E440	22500 mg/kg	107	70.0	130	----
QC-1514447-003	MRCA-21	Antimony	7440-36-0	E440	24.8 mg/kg	89.2	70.0	130	----
QC-1514447-003	MRCA-21	Arsenic	7440-38-2	E440	21.2 mg/kg	98.2	70.0	130	----
QC-1514447-003	MRCA-21	Barium	7440-39-3	E440	788 mg/kg	99.4	70.0	130	----
QC-1514447-003	MRCA-21	Beryllium	7440-41-7	E440	1.82 mg/kg	116	70.0	130	----
QC-1514447-003	MRCA-21	Bismuth	7440-69-9	E440	1.78 mg/kg	93.4	70.0	130	----
QC-1514447-003	MRCA-21	Cadmium	7440-43-9	E440	2.15 mg/kg	98.7	70.0	130	----
QC-1514447-003	MRCA-21	Calcium	7440-70-2	E440	4900 mg/kg	110	70.0	130	----
QC-1514447-003	MRCA-21	Chromium	7440-47-3	E440	56.9 mg/kg	98.3	70.0	130	----
QC-1514447-003	MRCA-21	Cobalt	7440-48-4	E440	32 mg/kg	97.6	70.0	130	----
QC-1514447-003	MRCA-21	Copper	7440-50-8	E440	969 mg/kg	97.3	70.0	130	----
QC-1514447-003	MRCA-21	Iron	7439-89-6	E440	32700 mg/kg	104	70.0	130	----
QC-1514447-003	MRCA-21	Lead	7439-92-1	E440	919 mg/kg	95.8	70.0	130	----
QC-1514447-003	MRCA-21	Lithium	7439-93-2	E440	47.3 mg/kg	116	70.0	130	----
QC-1514447-003	MRCA-21	Magnesium	7439-95-4	E440	7780 mg/kg	105	70.0	130	----
QC-1514447-003	MRCA-21	Manganese	7439-96-5	E440	8640 mg/kg	96.7	70.0	130	----
QC-1514447-003	MRCA-21	Molybdenum	7439-98-7	E440	25.1 mg/kg	97.8	70.0	130	----
QC-1514447-003	MRCA-21	Nickel	7440-02-0	E440	1000 mg/kg	99.2	70.0	130	----
QC-1514447-003	MRCA-21	Phosphorus	7723-14-0	E440	660 mg/kg	100	70.0	130	----
QC-1514447-003	MRCA-21	Potassium	7440-09-7	E440	10800 mg/kg	100	70.0	130	----
QC-1514447-003	MRCA-21	Selenium	7782-49-2	E440	1.04 mg/kg	106	60.0	140	----
QC-1514447-003	MRCA-21	Silver	7440-22-4	E440	8.98 mg/kg	97.0	70.0	130	----
QC-1514447-003	MRCA-21	Sodium	7440-23-5	E440	1770 mg/kg	111	70.0	130	----
QC-1514447-003	MRCA-21	Strontium	7440-24-6	E440	41 mg/kg	102	70.0	130	----
QC-1514447-003	MRCA-21	Sulfur	7704-34-9	E440	3940 mg/kg	94.5	50.0	150	----



Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 1514447) - continued									
QC-1514447-003	MRCA-21	Thallium	7440-28-0	E440	0.907 mg/kg	97.5	70.0	130	----
QC-1514447-003	MRCA-21	Tin	7440-31-5	E440	3.79 mg/kg	96.7	40.0	160	----
QC-1514447-003	MRCA-21	Titanium	7440-32-6	E440	2790 mg/kg	100	70.0	130	----
QC-1514447-003	MRCA-21	Tungsten	7440-33-7	E440	6.99 mg/kg	109	70.0	130	----
QC-1514447-003	MRCA-21	Uranium	7440-61-1	E440	3.97 mg/kg	110	70.0	130	----
QC-1514447-003	MRCA-21	Vanadium	7440-62-2	E440	66.2 mg/kg	96.5	70.0	130	----
QC-1514447-003	MRCA-21	Zinc	7440-66-6	E440	828 mg/kg	95.6	70.0	130	----
QC-1514447-003	MRCA-21	Zirconium	7440-67-7	E440	6.91 mg/kg	109	70.0	130	----
Metals (QCLot: 1514448)									
QC-1514448-003	MRCA-21	Mercury	7439-97-6	E510	0.068 mg/kg	102	70.0	130	----
Metals (QCLot: 1533469)									
QC-1533469-003	MRCA-21	Aluminum	7429-90-5	E440	22500 mg/kg	116	70.0	130	----
QC-1533469-003	MRCA-21	Antimony	7440-36-0	E440	24.8 mg/kg	98.6	70.0	130	----
QC-1533469-003	MRCA-21	Arsenic	7440-38-2	E440	21.2 mg/kg	105	70.0	130	----
QC-1533469-003	MRCA-21	Barium	7440-39-3	E440	788 mg/kg	104	70.0	130	----
QC-1533469-003	MRCA-21	Beryllium	7440-41-7	E440	1.82 mg/kg	110	70.0	130	----
QC-1533469-003	MRCA-21	Bismuth	7440-69-9	E440	1.78 mg/kg	97.2	70.0	130	----
QC-1533469-003	MRCA-21	Cadmium	7440-43-9	E440	2.15 mg/kg	108	70.0	130	----
QC-1533469-003	MRCA-21	Calcium	7440-70-2	E440	4900 mg/kg	106	70.0	130	----
QC-1533469-003	MRCA-21	Chromium	7440-47-3	E440	56.9 mg/kg	102	70.0	130	----
QC-1533469-003	MRCA-21	Cobalt	7440-48-4	E440	32 mg/kg	103	70.0	130	----
QC-1533469-003	MRCA-21	Copper	7440-50-8	E440	969 mg/kg	101	70.0	130	----
QC-1533469-003	MRCA-21	Iron	7439-89-6	E440	32700 mg/kg	107	70.0	130	----
QC-1533469-003	MRCA-21	Lead	7439-92-1	E440	919 mg/kg	95.0	70.0	130	----
QC-1533469-003	MRCA-21	Lithium	7439-93-2	E440	47.3 mg/kg	109	70.0	130	----
QC-1533469-003	MRCA-21	Magnesium	7439-95-4	E440	7780 mg/kg	106	70.0	130	----
QC-1533469-003	MRCA-21	Manganese	7439-96-5	E440	8640 mg/kg	104	70.0	130	----
QC-1533469-003	MRCA-21	Molybdenum	7439-98-7	E440	25.1 mg/kg	94.4	70.0	130	----
QC-1533469-003	MRCA-21	Nickel	7440-02-0	E440	1000 mg/kg	104	70.0	130	----
QC-1533469-003	MRCA-21	Phosphorus	7723-14-0	E440	660 mg/kg	112	70.0	130	----
QC-1533469-003	MRCA-21	Potassium	7440-09-7	E440	10800 mg/kg	104	70.0	130	----
QC-1533469-003	MRCA-21	Selenium	7782-49-2	E440	1.04 mg/kg	96.6	60.0	140	----
QC-1533469-003	MRCA-21	Silver	7440-22-4	E440	8.98 mg/kg	95.3	70.0	130	----
QC-1533469-003	MRCA-21	Sodium	7440-23-5	E440	1770 mg/kg	114	70.0	130	----
QC-1533469-003	MRCA-21	Strontium	7440-24-6	E440	41 mg/kg	97.0	70.0	130	----
QC-1533469-003	MRCA-21	Sulfur	7704-34-9	E440	3940 mg/kg	105	50.0	150	----
QC-1533469-003	MRCA-21	Thallium	7440-28-0	E440	0.907 mg/kg	97.8	70.0	130	----



Sub-Matrix:

Laboratory sample ID	Reference Material ID	Analyte	CAS Number	Method	Reference Material (RM) Report				
					RM Target Concentration	Recovery (%) RM	Recovery Limits (%)		Qualifier
							Low	High	
Metals (QCLot: 1533469) - continued									
QC-1533469-003	MRCA-21	Tin	7440-31-5	E440	3.79 mg/kg	97.5	40.0	160	----
QC-1533469-003	MRCA-21	Titanium	7440-32-6	E440	2790 mg/kg	106	70.0	130	----
QC-1533469-003	MRCA-21	Tungsten	7440-33-7	E440	6.99 mg/kg	122	70.0	130	----
QC-1533469-003	MRCA-21	Uranium	7440-61-1	E440	3.97 mg/kg	112	70.0	130	----
QC-1533469-003	MRCA-21	Vanadium	7440-62-2	E440	66.2 mg/kg	101	70.0	130	----
QC-1533469-003	MRCA-21	Zinc	7440-66-6	E440	828 mg/kg	101	70.0	130	----
QC-1533469-003	MRCA-21	Zirconium	7440-67-7	E440	6.91 mg/kg	107	70.0	130	----
Metals (QCLot: 1533470)									
QC-1533470-003	MRCA-21	Mercury	7439-97-6	E510	0.068 mg/kg	101	70.0	130	----
Metals (QCLot: 1555994)									
QC-1555994-003	MRCA-21	Arsenic	7440-38-2	E440B	21.2 mg/kg	106	70.0	130	----
Metals (QCLot: 1555996)									
QC-1555996-003	MRCA-21	Arsenic	7440-38-2	E440B	21.2 mg/kg	97.5	70.0	130	----
Metals (QCLot: 1556001)									
QC-1556001-003	MRCA-21	Arsenic	7440-38-2	E440B	21.2 mg/kg	97.9	70.0	130	----

Environmental Division
 Winnipeg
 Work Order Reference
WP2414228



Telephone : +1 204 256 9720

Report To		Reports / Recipients				Turnaround Time (TAT)											
Company:	Kinross - Great Bear Resources	Select Report Format:	<input checked="" type="checkbox"/> PDF	<input type="checkbox"/> EXCEL	<input type="checkbox"/> EDD (DIGITAL)	<input checked="" type="checkbox"/> Routine [R] if received by 3pm M-F - no surcharge	<input type="checkbox"/> 4 day [P4] if received by 3pm M-F - 20%	<input type="checkbox"/> 3 day [P3] if received by 3pm M-F - 25%	<input type="checkbox"/> 2 day [P2] if received by 3pm M-F - 50%	<input type="checkbox"/> 1 day [E] if received by 3pm M-F - 100%	<input type="checkbox"/> Same day [E2] if received by 10am M-S - 150%	Additional fees may apply to rush request and for non-routine			Date and Time Required		
Contact:	Hannah Hillier	Merge QC/QCI Reports with COA	<input type="checkbox"/> YES	<input type="checkbox"/> NO	<input type="checkbox"/> N/A												
Phone:	(807) 633-2492	<input type="checkbox"/> Compare Results to Criteria on Report - provide details below if box checked															
Street:	19 Young Street	Select Distribution:	<input checked="" type="checkbox"/> EMAIL	<input type="checkbox"/> MAIL	<input type="checkbox"/> FAX												
City/Province:	Red Lake, ON	Email 1	ashley.moncrief@kinross.com														
Postal Code:	P0V2M0	Email 2	hannah.hillier@kinross.com														
Invoice To:	Same as Report To <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Email 3	curtis.bloemberg@kinross.com														
Company:	Copy of Invoice with Report <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Email 4	aaron.peloquin@kinross.com														
Contact:		Email 5	emily.meek@kinross.com														
		Email 6	jacob.mcfee@kinross.com														
		Email 7	chris.reid@kinross.com														
Project Information		Invoice Recipients				Analysis Request											
ALS Account # / Quote #:	PPR-022-3	Select invoice Distribution:	<input checked="" type="checkbox"/> EMAIL	<input type="checkbox"/> MAIL	<input type="checkbox"/> FAX												
Job #:	PPR-022-3	Email 1	invoice@kinross.com														
ALS Lab Work Order # (ALS use only):		ALS Contact:	Judy Dalmaijer		Sampler:												
ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Metals (by CRC ICPMS)	Mercury (by OVAAS)	PAHs (In soil)	TOC	Conductivity (1:2 Soil:Water Extraction)	PAHs (In Animal Tissue)	Moisture Content (Wet & Dry Weight)	Moisture Content (by Gravimetry)	pH (In soil)	Arsenic Bioavailability	Methylmercury In Biota by GC/AFS (Wet and Dry Units)	
1	CFS01	18-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
2	CFS02	18-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
3	CFS03	18-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
4	CFS04	21-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
5	CFS05	21-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
6	CFS06	21-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
7	CFS07	21-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
8	CFS08	21-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
9	CFS09	28-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
10	CFS10	28-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
11	CFS11	28-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
12	CFS12	28-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
13	CFS13	30-Aug-23		Soil	1	X	X	X	X	X			X	X	X		
14	CFS14	6-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
15	CFS-DUP-01	6-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
16	CFS16	7-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
17	CFS17	7-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
18	CFS19	7-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
19	CFS21	9-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
20	CFS22	9-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
21	CFS26	12-Sep-23		Soil	1	X	X	X	X	X			X	X	X		
22	CF31	6-Feb-24		Biota	1	X	X				X	X				X	
23	CF32	6-Feb-24		Biota	1	X	X				X	X				X	
24	CF33	22-Feb-24		Biota	1	X	X				X	X				X	
25	CF34	22-Feb-24		Biota	1	X	X				X	X				X	
26	CF35	26-Dec-23		Biota	1	X	X				X	X				X	
27	CF36	15-Dec-23		Biota	1	X	X				X	X				X	
28	CF37	5-Jan-24		Biota	1	X	X				X	X				X	
SHIPMENT RELEASE (client use)		INITIAL SHIPMENT RECEPTION (ALS use only)				FINAL SHIPMENT RECEPTION (ALS use only)											
Released by:		Time:	Received by:	Date:	Time:	Received by: Time:											
			<i>[Signature]</i>	JUN 04 2024	12:00												

14.3

Attachment A2-2 Analytical Results



Table A2-2-1: Summary of Co-located Soil and Vegetation Samples

Sample Location	Easting	Northing	Soil ID	Date Collected	Description	Soil Notes	Traditional Food Sample ID	Species	Scientific name	Weight Collected (g)	Collected or Donated	Submitted for Analysis? Yes/No
CF01/ CFS01	452786	5637696	CFS01	18-Aug-23	silty	Lots of organic matter at the surface, silty sand, very dense, light brown/grey in colour	CF01	Bog Labrador Tea	<i>Rhododendron groenlandicum</i>	30	Collected ^(a)	Yes
CF02/ CFS02	455878	5638392	CFS02	18-Aug-23	silty	Mossy overgrowth with thick layer of organic matter. Silty sands, grey/black brown in colour	CF02	Canadian Bunchberry	<i>Cornus canadensis</i>	48	Collected ^(a)	Yes
CF03/ CFS03	457125	5637202	CFS03	18-Agu-23	loamy	Organic matter, sandy clays, brownish grey in colour	CF03	Velvetleaf Blueberry	<i>Vaccinium myrtilloides</i>	50	Collected ^(a)	Yes
CF04/ CFS04	455886	5638386	CFS04	21-Aug-23	peaty	Grass and roots present at surface, rocks present at approx. 20cm down, organic soils with some clay, dark brown in colour	CF04	Mountain Ash	<i>Sorbus americana</i>	40.1	Collected ^(a)	Yes
CF05/ CFS05	455838	5638346	CFS05	21-Aug-23	loamy	Mossy overgrowth, very dense root system, very moist soil. Sandy clays, beige/grey in colour	CF05	Labrador Tea	<i>Rhododendron spp.</i>	37.5	Collected ^(a)	Yes
CF06/ CFS06	454184	5634782	CFS06	21-Aug-23	sandy	Lots of thick roots near surface, dense organic layer, low moisture sand with some clay	CF06	Prickly Wild Rose	<i>Rosa acicularis</i>	30	Collected ^(a)	Yes
CF07/ CFS07	454164	5634651	CFS07	21-Aug-23	sandy	Very shallow soil (2-3 inches), then wet sand underneath, light/dark brown in colour, dense roots	CF07	Wild Mint	<i>Mentha spp.</i>	20	Collected ^(a)	Yes
CF08/ CFS08	455572	5633137	CFS08	21-Aug-23	clay	Mostly dry clays, thin layer of soil on top, roots throughout, loosely packed, grey in colour	CF08	Raspberry	<i>Rubus idaeus</i>	30.2	Collected ^(a)	Yes
CF09/ CFS09	464010	5633034	CFS09	28-Aug-23	sandy	Very sandy, abundance of detritus	CF09	Paper Birch	<i>Betula papyrifera</i>		Collected ^(a)	Yes
CF10/ CFS10	463521	5632145	CFS10	28-Aug-23	loamy	Significant gravel and roots, wet soils, pine needles present on surface layer	CF10	Red-Osier Dogwood	<i>Cornus stolonifera</i>	25	Collected ^(a)	Yes
CF11/ CFS11	458852	5631806	CFS11	28-Aug-23	sandy	Sandy clays, some gravel present, moderately dry	CF11	Chaga	<i>Inonotus obliquus</i>	48.6	Collected ^(a)	Yes
CF12/ CFS12	457074	5637455	CFS12	28-Aug-23	silty	Thin layer of black topsoil, sandy throughout	CF12	Chanterelle	<i>Cantharellus cibarius</i>	29.2	Collected ^(a)	Yes
CF13/ CFS13	454377	5634963	CFS13	30-Aug-23	peaty	Thick layer of moss at surface, loose peaty soils, top is dry, further down becomes very wet, lots of organic matter present	CF13	Tamarack	<i>Larix laricina</i>	24.3	Collected ^(a)	Yes
CF14/ CFS14	454140	5634662	CFS14	06-Sep-23	Loamy	Loamy soils, blackish brown in colour, lots of roots	CF14	Chokecherry	<i>Prunus virginiana</i>	20.3	Collected ^(a)	Yes
CF15	454139	5634661	CFS15	06-Sep-23	Loamy	Loamy, light brown to black mix, organic matter on surface	CF15	Red-Osier Dogwood	<i>Cornus stolonifera</i>	34.8	Collected ^(a)	No
CF16/ CFS16	454223	5634859	CFS16	07-Sep-23	Sandy	Loose sandy soils, very wet, fair amount of root matter, mostly brown in colour with some black spots	CF16	Wild Rice	<i>Zizania palustris</i>	25	Collected ^(a)	Yes
CF17/ CFS17	456897	5633110	CFS17	07-Sep-23	Clay	Clay, lots of organics, deep root penetration	CF17	Rosehips	<i>Rosa spp.</i>	36.8	Collected ^(a)	Yes
CF18	454951	5632324	CFS18	07-Sep-23	Peaty	Peat potting soil, abundance of organics, roots throughout	CF18	Birch Bark	<i>Betula spp.</i>	17.5	Collected ^(a)	No
CF19/ CFS19	454951	5632324	CFS19	07-Sep-23	Peaty	Peat like soils, quite dry	CF19	Turkey Tail Mushroom	<i>Trametes versicolor</i>	18	Collected ^(a)	Yes
CF20	449106	5636104	-	07-Sep-23	-	-	CF20	Lily Pad Bulb	<i>Nymphaeaceae spp.</i>	56.9	Collected ^(a)	No
CF21/ CFS21	453470	5634469	CFS21	09-Sep-23	Sandy	Sandy light, dry soils, greyish to light brown in colour, thick organic layer on top	CF21	Labrador Tea	<i>Rhododendron spp.</i>	11.1	Collected ^(a)	Yes
CF22/ CFS22	453264	5634408	CFS22	09-Sep-23	Sandy	Sandy soils, grey and brown in colour, mix of sand and organic matter, thick moss on top	CF22	Blueberry	<i>Vaccinium spp.</i>	10.7	Collected ^(a)	Yes
CF23	456561	5633185	-	09-Sep-23	-	-	CF23	Tamarack	<i>Larix laricina</i>	39.6	Collected ^(a)	No
CF24	455170	5632704	-	11-Sep-23	-	-	CF24	Cattail	<i>Typha latifolia</i>	12.9	Collected ^(a)	Yes
CF25	457200	5637003	-	11-Sep-23	-	-	CF25	Blueberry	<i>Vaccinium spp.</i>	44.5	Collected ^(a)	No
CF26/ CFS26	457188	5637012	CFS26	12-Sep-23	Sandy	Sandy soils, with black top soil	CF26	Common Juniper	<i>Juniperus communis</i>	13.5	Collected ^(a)	Yes
CF27	454577	5635007	-	12-Sep-23	-	-	CF27	Birch Bark	<i>Betula spp.</i>	16.8	Collected ^(a)	No
CF28	457136	5633139	-	12-Sep-23	-	-	CF28	Cattail	<i>Typha latifolia</i>	10.4	Collected ^(a)	No
CF29	455150	5633680	CFS29	12-Sep-23	clay	Heavy clay soils, minimal top soil	CF29	Alder Bark	<i>Alnus incana</i>	12	Collected ^(a)	No
CF30	457137	5632417	-	12-Sep-23	-	-	CF30	Bog Aster	<i>Oclemena nemoralis</i>	73.7	Collected ^(a)	No
CF31	444000	5630044	-	06-Feb-24	-	-	CF31	Ruffed Grouse (Liver)	<i>Bonasa umbellus</i>	8	Donated ^(b)	Yes
CF32	444000	5630044	-	06-Feb-24	-	-	CF32	Ruffed Grouse (Heart)	<i>Bonasa umbellus</i>	5	Donated ^(b)	Yes
CF33	449611	5633908	-	22-Feb-24	-	-	CF33	Ruffed Grouse (Liver)	<i>Bonasa umbellus</i>	6.5	Donated ^(b)	Yes
CF34	446035	5630447	-	22-Feb-24	-	-	CF34	Ruffed Grouse (Liver)	<i>Bonasa umbellus</i>	8	Donated ^(b)	Yes
CF35	463942	5633081	-	26-Dec-23	-	-	CF35	Spruce Grouse (Liver)	<i>Dendragapus canadensis</i>	7	Donated ^(b)	Yes
CF36	463924	5633264	-	15-Dec-23	-	-	CF36	Ruffed Grouse (Liver)	<i>Bonasa umbellus</i>	9	Donated ^(b)	Yes
CF37	463826	5633876	-	02-Jan-24	-	-	CF37	Ruffed Grouse (Liver)	<i>Bonasa umbellus</i>	10	Donated ^(b)	Yes

Notes: g = grams

(a) Sample collected as part of sampling program in 2023.

(b) Sample donated from Indigenous trappers in 2023/2024.

- = sample not collected

Great Bear Project, Human Health and Ecological Risk Assessment - Attachment A2-2

Project No. OMEMA2303

Great Bear Resources

WSP Canada Inc.

March 2026

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Table A2-2-3: Baseline Vegetation (Berry) Tissue Chemistry Results

Sample ID Date Sampled Lab ID Plant Specie QA/QC	Lowest Detection Limit	Units	CF02	CF03	CF08	CF14	CF-DUP-01	CF17	CF22
			18-Aug-2023	18-Aug-2023	21-Aug-2023	06-Sep-2023	06-Sep-2023	07-Sep-2023	09-Sep-2023
			WP2414182-002	WP2414182-003	WP2414182-008	WP2414182-014	WP2414182-015	WP2414182-017	WP2414182-020
			Canadian Bunchberry	Velvetleaf Blueberry	Raspberry	Chokecherry	Chokecherry	Rosehips	Blueberry
					FDA	FD			
Physical Tests									
Moisture	0.5	%	88.1	83.6	73.6	70.2	66.7	57.7	84.5
Metals									
Aluminum	0.4	mg/kg wwt	5.28	11.6	52.4	2.6	2.2	10.2	11.8
Antimony	0.002	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	0.0172	<0.0020	<0.0020
Arsenic	0.004	mg/kg wwt	0.011	0.0263	0.0219	<0.0060	<0.0060	0.005	0.014
Barium	0.01	mg/kg wwt	2.82	2.6	3.86	0.798	1.08	6.49	2.64
Beryllium	0.002	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth	0.002	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Boron	0.2	mg/kg wwt	0.66	1.03	4.52	1.91	2.28	7.06	1.06
Cadmium	0.001	mg/kg wwt	<0.0010	0.0018	0.055	<0.0020	<0.0020	0.0048	<0.0020
Calcium	4	mg/kg wwt	807	180	822	440	520	2130	213
Cesium	0.001	mg/kg wwt	0.265	0.0496	<0.0010	0.0334	0.0329	0.003	0.0367
Chromium	0.01	mg/kg wwt	<0.010	<0.010	<0.040	<0.040	<0.040	0.041	<0.040
Cobalt	0.004	mg/kg wwt	<0.0040	0.0047	0.0268	0.0522	0.0653	0.0163	<0.0040
Copper	0.02	mg/kg wwt	0.228	0.625	1.81	1.37	1.6	1.17	0.681
Iron	0.6	mg/kg wwt	1.7	2.88	16.5	4	5.3	15.6	3.4
Lead	0.004	mg/kg wwt	<0.0040	<0.0040	<0.010	<0.010	<0.010	0.0061	<0.010
Lithium	0.1	mg/kg wwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium	0.4	mg/kg wwt	169	76.4	448	208	190	810	79.2
Manganese	0.01	mg/kg wwt	1.21	27.3	52.3	6.4	6.29	69	40.7
Mercury	0.001	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Molybdenum	0.004	mg/kg wwt	0.0255	0.115	0.142	0.0154	0.0206	0.13	0.0237
Nickel	0.04	mg/kg wwt	0.044	0.097	0.466	0.205	0.189	0.236	0.12
Phosphorus	2	mg/kg wwt	164	191	902	542	553	1020	180
Potassium	4	mg/kg wwt	1090	835	1720	3280	3150	6130	804
Rubidium	0.01	mg/kg wwt	9.91	3.96	0.649	13.3	12.8	3.72	4.32
Selenium	0.01	mg/kg wwt	<0.010	<0.010	<0.020	<0.020	<0.020	<0.010	<0.020
Silver	0.001	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Sodium	4	mg/kg wwt	5.2	<4.0	6	<4.0	<4.0	<4.0	8.1
Strontium	0.01	mg/kg wwt	4.26	0.302	2.95	1.14	1.52	7.96	0.43
Tellurium	0.004	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium	0.0004	mg/kg wwt	<0.00040	<0.00040	<0.00040	0.00244	0.00235	<0.00040	0.00087
Tin	0.02	mg/kg wwt	<0.020	<0.020	1.53	0.242	0.784	0.261	0.758
Titanium	0.05	mg/kg wwt	<0.050	<0.050	<0.10	<0.10	<0.10	0.703	<0.10
Uranium	0.0004	mg/kg wwt	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	0.00064	<0.00040
Vanadium	0.02	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	0.026	<0.020
Zinc	0.1	mg/kg wwt	0.76	0.94	8	1.6	1.46	2.3	0.76
Zirconium	0.04	mg/kg wwt	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Speciated Metals									
Arsenate [As V]	0.005	mg/kg wwt	0.005	0.0067	<0.0050	<0.0050	<0.0050	<0.0050	0.0052
Arsenite [As III]	0.001	mg/kg wwt	0.0013	0.0114	0.0035	<0.0010	<0.0010	<0.0010	0.0022
Arsenobetaine [AsB], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Arsenocholine [AsC], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dimethylarsinic acid [DMA], (as As)	0.001	mg/kg wwt	0.0011	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010
Monomethylarsonic acid [MMA], (as As)	0.001	mg/kg wwt	0.0019	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0039
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Acenaphthylene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Anthracene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Benz(a)anthracene	0.01	mg/kg wwt	<0.010	<0.010	-	0.034	<0.010	<0.010	-
Benzo(a)pyrene	0.01	mg/kg wwt	<0.010	<0.010	-	0.028	<0.010	<0.010	-
Benzo(b+j)fluoranthene	0.01	mg/kg wwt	<0.010	<0.010	-	0.045	<0.010	<0.010	-
Benzo(b+h+k)fluoranthene	0.015	mg/kg wwt	<0.015	<0.015	-	0.091	<0.015	<0.015	-
Benzo(g,h,i)perylene	0.01	mg/kg wwt	<0.010	<0.010	-	0.037	<0.010	<0.010	-
Benzo(k)fluoranthene	0.01	mg/kg wwt	<0.010	<0.010	-	0.046	<0.010	<0.010	-
Chrysene	0.01	mg/kg wwt	<0.010	<0.010	-	0.043	<0.010	<0.010	-
Dibenz(a,h)anthracene	0.01	mg/kg wwt	<0.010	<0.010	-	0.033	<0.010	<0.010	-
Fluoranthene	0.01	mg/kg wwt	<0.010	<0.010	-	0.037	<0.010	<0.010	-
Fluorene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Indeno(1,2,3-c,d)pyrene	0.01	mg/kg wwt	<0.010	<0.010	-	0.041	<0.010	<0.010	-
Methylnaphthalene, 1-	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Methylnaphthalene, 2-	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Naphthalene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Phenanthrene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.010	<0.010	<0.010	-
Pyrene	0.01	mg/kg wwt	<0.010	<0.010	-	<0.040	<0.010	<0.010	-

Notes:
 Berries samples were collected in conjunction with co-located soil samples.
 Original certificates of analysis can be found in Attachment A2-1
 % = percent; < = less than detection limit; mg/kg wwt = milligrams per kilogram wet weight; As= Arsenic; As V= Arsenate; As III= Arsenite; AsB = Arsenobetaine; AsC = Arsenocholine; FDA = field duplicate original; FD = field duplicate
 - = analyte was not measured

Table A2-2-5: Baseline Wild Game Tissue Chemistry Results

Sample ID	Lowest Detection Limit	Units	CF31	CF32	CF33	CF34	CF35	CF36	CF37
			06-Feb-2024	06-Feb-2024	22-Feb-2024	22-Feb-2024	26-Dec-2023	15-Dec-2023	05-Jan-2024
Date Sampled	Lab ID	Wild Game Specie	WP2414228-022	WP2414228-023	WP2414228-024	WP2414228-025	WP2414228-026	WP2414228-027	WP2414228-028
			Ruffed Grouse (Liver)	Ruffed Grouse (Heart)	Ruffed Grouse (Liver)	Ruffed Grouse (Liver)	Spruce Grouse (Liver)	Ruffed Grouse (Liver)	Ruffed Grouse (Liver)
Physical Tests									
Moisture	0.5	%	56	35	35.4	61	68.7	65.5	66.3
Metals									
Aluminum	1	mg/kg wwt	4.2	2.5	3.1	2.8	<1.0	<1.0	1.2
Antimony	0.002	mg/kg wwt	0.0286	0.0027	0.0611	0.0033	0.002	0.0101	5.61
Arsenic	0.006	mg/kg wwt	0.0572	0.0456	0.034	0.0267	0.0592	0.0278	0.592
Barium	0.01	mg/kg wwt	2.97	0.071	2.52	1.9	0.126	0.348	0.595
Beryllium	0.002	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Bismuth	0.002	mg/kg wwt	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0143
Boron	0.2	mg/kg wwt	4.18	2.54	12.1	5.5	0.71	2.16	4.27
Cadmium	0.002	mg/kg wwt	2.69	0.0067	3.16	5.46	0.434	14.7	2.01
Calcium	4	mg/kg wwt	125	166	200	172	63.7	84.7	344
Cesium	0.001	mg/kg wwt	0.0442	0.0205	0.0179	0.0341	0.0084	0.0064	0.0173
Chromium	0.04	mg/kg wwt	0.102	0.172	0.056	0.066	<0.040	<0.040	<0.040
Cobalt	0.004	mg/kg wwt	0.0489	0.0191	0.106	0.0506	0.0453	0.0624	0.06
Copper	0.04	mg/kg wwt	5.98	10.5	6.39	5.59	5.36	5.34	4.19
Iron	1	mg/kg wwt	1960	243	1140	1780	273	1570	1470
Lead	0.01	mg/kg wwt	1.1	0.015	1.29	0.051	0.027	0.196	149
Lithium	0.1	mg/kg wwt	<0.10	0.34	0.13	<0.10	0.23	<0.10	<0.10
Magnesium	0.4	mg/kg wwt	300	566	361	257	216	230	208
Manganese	0.01	mg/kg wwt	23.9	3.77	14.3	12.1	7.85	3.77	5.32
Mercury	0.001	mg/kg wwt	0.145	0.0056	0.0025	0.0018	0.0034	0.0049	0.0031
Molybdenum	0.008	mg/kg wwt	13.7	0.0682	30	10.9	2.76	28.5	15.2
Nickel	0.04	mg/kg wwt	0.143	0.164	0.186	0.063	0.055	0.052	<0.040
Phosphorus	2	mg/kg wwt	4960	6240	6060	4980	3810	4050	4260
Potassium	4	mg/kg wwt	4140	8740	5300	3850	2840	2840	2560
Rubidium	0.01	mg/kg wwt	16.6	7.69	6.82	13.6	4.2	5.66	7.86
Selenium	0.02	mg/kg wwt	0.326	0.648	0.511	0.275	0.468	0.510	0.27
Silver	0.001	mg/kg wwt	0.0011	0.004	0.001	<0.0010	<0.0010	<0.0010	0.0086
Sodium	4	mg/kg wwt	1160	3170	2040	1450	1060	1090	1380
Strontium	0.02	mg/kg wwt	0.878	0.119	0.899	0.83	0.04	0.194	0.914
Tellurium	0.004	mg/kg wwt	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Thallium	0.0004	mg/kg wwt	<0.00040	0.00069	<0.00040	<0.00040	0.00041	<0.00040	0.00075
Tin	0.02	mg/kg wwt	<0.020	<0.020	0.058	<0.020	<0.020	<0.020	1.12
Titanium	0.1	mg/kg wwt	0.37	0.24	0.32	0.18	<0.10	0.10	<0.10
Uranium	0.0004	mg/kg wwt	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
Vanadium	0.02	mg/kg wwt	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc	0.2	mg/kg wwt	43.7	64.2	57.4	39.4	44.4	34.8	28.9
Zirconium	0.04	mg/kg wwt	<0.040	0.042	0.305	<0.040	<0.040	<0.040	<0.040
Speciated Metals									
Arsenate [As V]	0.005	mg/kg wwt	0.0063	0.0141	0.0075	<0.0070	<0.0050	0.0056	<0.0050
Arsenite [As III]	0.001	mg/kg wwt	0.0214	0.0085	0.0068	0.0077	0.0195	0.0091	0.0169
Arsenobetaine [AsB], (as As)	0.001	mg/kg wwt	0.0012	0.0247	<0.0010	<0.0012	0.0154	0.0036	0.0014
Arsenocholine [AsC], (as As)	0.001	mg/kg wwt	<0.0010	<0.0020	<0.0010	<0.0012	0.0018	<0.0010	<0.0010
Dimethylarsinic acid [DMA], (as As)	0.001	mg/kg wwt	<0.0010	0.0035	<0.0010	<0.0012	0.0011	<0.0010	<0.0010
Monomethylarsonic acid [MMA], (as As)	0.001	mg/kg wwt	0.0018	<0.0020	0.0079	0.0016	<0.0010	0.0036	0.0014
Methylmercury (as MeHg)	5.0	µg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methylmercury (as MeHg)	1.0	µg/kg wwt	1.2	1.2	2.4	<1.0	<1.0	1.2	<1.0

Notes:

Original certificates of analysis can be found in Attachment A2-1.

% = percent; < = less than detection limit; mg/kg wwt = milligrams per kilogram wet weight; µg/kg wwt = micrograms per kilogram wet weight; As= Arsenic; As V= Arsenate; As III= Arsenite; AsB = Arsenobetaine; AsC = Arsenocholine; DMA = Dimethylarsinic acid; MMA = Monomethylarsonic acid; MeHg = methylmercury

Attachment A2-3
Field QA/QC - RPD Results



Table A2-3-1: Relative Percent Difference Calculations - Soil Samples						
Parameter	Sample ID	Lowest Detection Limit	Units	CFS14	CFS-DUP-01	RPD (%)
	Date Sampled			06-Sep-23		
	Lab Sample ID			WP2414182-014	WP2414182-015	
	QA/QC			FDA	FD	
Physical Tests						
Moisture		0.25	%	7.62	9.01	17%
Metals (Matrix: Soil/Solid)						
Aluminum		50	mg/kg	4860	4850	0%
Antimony		0.1	mg/kg	0.14	0.12	NC
Arsenic ^(a)		0.05	mg/kg	17.9	17.8	1%
Arsenic ^(b)		0.1	mg/kg	4.52	4.45	2%
Barium		0.5	mg/kg	44.6	38.5	15%
Beryllium		0.1	mg/kg	0.11	0.11	NC
Bismuth		0.2	mg/kg	<0.20	<0.20	NC
Boron		5	mg/kg	<5.0	<5.0	NC
Cadmium		0.02	mg/kg	0.117	0.092	NC
Calcium		50	mg/kg	2840	2760	3%
Chromium		0.5	mg/kg	14.7	9.3	45%
Cobalt		0.1	mg/kg	3.81	3.8	0%
Copper		0.5	mg/kg	8.57	8.71	2%
Iron		50	mg/kg	9760	8960	9%
Lead		0.5	mg/kg	6.58	6.08	8%
Lithium		2	mg/kg	9.7	10.5	NC
Magnesium		20	mg/kg	2910	2970	2%
Manganese		1	mg/kg	252	209	19%
Mercury		0.005	mg/kg	0.0156	0.0115	NC
Molybdenum		0.1	mg/kg	0.12	<0.10	NC
Nickel		0.5	mg/kg	8.05	7.25	10%
Phosphorus		50	mg/kg	338	388	14%
Potassium		100	mg/kg	770	870	12%
Selenium		0.2	mg/kg	<0.20	<0.20	NC
Silver		0.1	mg/kg	<0.10	<0.10	NC
Sodium		50	mg/kg	62	58	NC
Strontium		0.5	mg/kg	12.6	14.6	15%
Sulfur		1000	mg/kg	<1000	<1000	NC
Thallium		0.05	mg/kg	0.084	0.089	NC
Tin		2	mg/kg	<2.0	<2.0	NC
Titanium		1	mg/kg	447	530	17%
Tungsten		0.5	mg/kg	<0.50	<0.50	NC
Uranium		0.05	mg/kg	0.631	0.574	9%
Vanadium		0.2	mg/kg	15.2	15.8	4%
Zinc		2	mg/kg	32.3	29.5	9%
Zirconium		1	mg/kg	<1.0	1.3	NC
Polycyclic Aromatic Hydrocarbons (Matrix: Soil/Solid)						
Acenaphthene		0.005	mg/kg	<0.0050	<0.0050	NC
Acenaphthylene		0.005	mg/kg	<0.0050	<0.0050	NC
Acridine		0.01	mg/kg	<0.010	<0.010	NC
Anthracene		0.004	mg/kg	<0.0040	<0.0040	NC
Benz(a)anthracene		0.01	mg/kg	<0.010	<0.010	NC
Benzo(a)pyrene		0.01	mg/kg	<0.010	<0.010	NC
Benzo(b+j)fluoranthene		0.01	mg/kg	<0.010	<0.010	NC
Benzo(b+j+k)fluoranthene		0.015	mg/kg	<0.015	<0.015	NC
Benzo(g,h,i)perylene		0.01	mg/kg	<0.010	<0.010	NC
Benzo(k)fluoranthene		0.01	mg/kg	<0.010	<0.010	NC
Chrysene		0.01	mg/kg	<0.010	<0.010	NC
Dibenz(a,h)anthracene		0.005	mg/kg	<0.0050	<0.0050	NC
Fluoranthene		0.01	mg/kg	<0.010	<0.010	NC

Table A2-3-1: Relative Percent Difference Calculations - Soil Samples					
Sample ID	Lowest Detection Limit	Units	CFS14	CFS-DUP-01	RPD (%)
Date Sampled			06-Sep-23		
Lab Sample ID			WP2414182-014	WP2414182-015	
QA/QC			FDA	FD	
Parameter					
Fluorene	0.01	mg/kg	<0.010	<0.010	NC
Indeno(1,2,3-c,d)pyrene	0.01	mg/kg	<0.010	<0.010	NC
Methylnaphthalene, 1+2-	0.015	mg/kg	<0.015	<0.015	NC
Methylnaphthalene, 1-	0.01	mg/kg	<0.010	<0.010	NC
Methylnaphthalene, 2-	0.01	mg/kg	<0.010	<0.010	NC
Naphthalene	0.01	mg/kg	<0.010	<0.010	NC
Perylene	0.01	mg/kg	<0.010	<0.010	NC
Phenanthrene	0.01	mg/kg	<0.010	<0.010	NC
Pyrene	0.01	mg/kg	<0.010	<0.010	NC
Quinoline	0.01	mg/kg	<0.010	<0.010	NC

Notes:

(a) = E440 method used to assess arsenic in soil

(b) = E440B method used to assess arsenic in soil

< = indicates parameter was below laboratory equipment detection limit; FDA = field duplicate available; FD = field duplicate; mg/kg = milligrams per kilogram; NC = not calculated; % = percent; QA/QC = quality assurance/quality control; RPD = relative percent difference.

Lowest detection limit was used for all calculations.

RPD not calculated if both values are < 5x the lowest detection limit

Value	= exceeds the acceptable RPD value in soil of 40% for moisture, 60% for metals (with the exception of silver, aluminum, barium, mercury, potassium, molybdenum, sodium, lead, strontium, and tin at 80%, chromium = 70%); Polycyclic Aromatic Hydrocarbons = 100%
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Table A2-3-2: Relative Percent Difference Calculations - Traditional Plant (Berry) Samples					
Sample ID	Lowest Detection Limit	Units	CF14	CF-DUP-01	RPD (%)
Date Sampled			06-Sep-23		
Lab Sample ID			WP2414182-014	WP2414182-015	
QA/QC			FDA	FD	
Parameter					
Physical Tests					
Moisture	0.5	%	79.2	77.0	3%
Metals					
Aluminum	0.4	mg/kg wwt	2.6	2.2	17%
Antimony	0.002	mg/kg wwt	<0.0020	0.0172	NC
Arsenic	0.004	mg/kg wwt	<0.0060	<0.0060	NC
Barium	0.01	mg/kg wwt	0.798	1.08	30%
Beryllium	0.002	mg/kg wwt	<0.0020	<0.0020	NC
Bismuth	0.002	mg/kg wwt	<0.0020	<0.0020	NC
Boron	0.2	mg/kg wwt	1.91	2.28	18%
Cadmium	0.001	mg/kg wwt	<0.0020	<0.0020	NC
Calcium	4	mg/kg wwt	440	520	17%
Cesium	0.001	mg/kg wwt	0.0334	0.0329	2%
Chromium	0.01	mg/kg wwt	<0.040	<0.040	NC
Cobalt	0.004	mg/kg wwt	0.0522	0.0653	22%
Copper	0.02	mg/kg wwt	1.37	1.6	15%
Iron	0.6	mg/kg wwt	4	5.3	28%
Lead	0.004	mg/kg wwt	<0.010	<0.010	NC
Lithium	0.1	mg/kg wwt	<0.10	<0.10	NC
Magnesium	0.4	mg/kg wwt	208	190	9%
Manganese	0.01	mg/kg wwt	6.4	6.29	2%
Mercury	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Molybdenum	0.004	mg/kg wwt	0.0154	0.0206	NC
Nickel	0.04	mg/kg wwt	0.205	0.189	NC
Phosphorus	2	mg/kg wwt	542	553	2%
Potassium	4	mg/kg wwt	3280	3150	4%
Rubidium	0.01	mg/kg wwt	13.3	12.8	4%
Selenium	0.01	mg/kg wwt	<0.020	<0.020	NC
Silver	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Sodium	4	mg/kg wwt	<4.0	<4.0	NC
Strontium	0.01	mg/kg wwt	1.14	1.52	29%
Tellurium	0.004	mg/kg wwt	<0.0040	<0.0040	NC
Thallium	0.0004	mg/kg wwt	0.00244	0.00235	4%
Tin	0.02	mg/kg wwt	0.242	0.784	106%
Titanium	0.05	mg/kg wwt	<0.10	<0.10	NC
Uranium	0.0004	mg/kg wwt	<0.00040	<0.00040	NC
Vanadium	0.02	mg/kg wwt	<0.020	<0.020	NC
Zinc	0.1	mg/kg wwt	1.6	1.46	9%
Zirconium	0.04	mg/kg wwt	<0.040	<0.040	NC
Speciated Metals (Matrix: Biota)					
Arsenate [As V]	0.005	mg/kg wwt	<0.0050	<0.0050	NC
Arsenite [As III]	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Arsenobetaine [AsB], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Arsenocholine [AsC], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Dimethylarsinic acid [DMA], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Monomethylarsonic acid [MMA], (as As)	0.001	mg/kg wwt	<0.0010	<0.0010	NC
Polycyclic Aromatic Hydrocarbons (Matrix: Biota)					
Acenaphthene	0.01	mg/kg wwt	<0.010	<0.010	NC
Acenaphthylene	0.01	mg/kg wwt	<0.010	<0.010	NC
Anthracene	0.01	mg/kg wwt	<0.010	<0.010	NC
Benz(a)anthracene	0.01	mg/kg wwt	0.034	<0.010	NC
Benzo(a)pyrene	0.01	mg/kg wwt	0.028	<0.010	NC
Benzo(b+j)fluoranthene	0.01	mg/kg wwt	0.045	<0.010	NC
Benzo(b+j+k)fluoranthene	0.015	mg/kg wwt	0.091	<0.015	NC

Table A2-3-2: Relative Percent Difference Calculations - Traditional Plant (Berry) Samples					
Sample ID	Lowest Detection Limit	Units	CF14	CF-DUP-01	RPD (%)
Date Sampled			06-Sep-23		
Lab Sample ID			WP2414182-014	WP2414182-015	
QA/QC			FDA	FD	
Parameter					
Benzo(g,h,i)perylene	0.01	mg/kg wwt	0.037	<0.010	NC
Benzo(k)fluoranthene	0.01	mg/kg wwt	0.046	<0.010	NC
Chrysene	0.01	mg/kg wwt	0.043	<0.010	NC
Dibenz(a,h)anthracene	0.01	mg/kg wwt	0.033	<0.010	NC
Fluoranthene	0.01	mg/kg wwt	0.037	<0.010	NC
Fluorene	0.01	mg/kg wwt	<0.010	<0.010	NC
Indeno(1,2,3-c,d)pyrene	0.01	mg/kg wwt	0.041	<0.010	NC
Methylnaphthalene, 1-	0.01	mg/kg wwt	<0.010	<0.010	NC
Methylnaphthalene, 2-	0.01	mg/kg wwt	<0.010	<0.010	NC
Naphthalene	0.01	mg/kg wwt	<0.010	<0.010	NC
Phenanthrene	0.01	mg/kg wwt	<0.010	<0.010	NC
Pyrene	0.01	mg/kg wwt	<0.040	<0.010	NC
PAHs, total (EPA 16)	0.04	mg/kg wwt	0.344	<0.040	NC

Notes:

< = indicates parameter was below laboratory equipment detection limit; FDA = field duplicate available; FD = field duplicate; mg/kg = milligrams per kilogram; NC = not calculated; % = percent; QA/QC = quality assurance/quality control; RPD = relative percent difference; wwt = wet weight.

Lowest detection limit was used for all calculations.

RPD not calculated if both values are < 5x the lowest detection limit

Value	= exceeds the acceptable RPD value in tissue of 40% for moisture, 60% for metals (with the exception of silver, aluminum, barium, mercury, potassium, molybdenum, sodium, lead, strontium, and tin at 80%, chromium = 70%); Polycyclic Aromatic Hydrocarbons = 100%
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Sub-Attachment A3

ProUCL Outputs



UCL Statistics for Baseline Soil Samples

User Selected Options
 Date/Time of Computation ProUCL 5.2 2025-05-01 11:43:52 AM
 From File [GBP] Soil UCL inputs 2025_05_01 (1).xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

pH, IVBA Initial

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	1.46	Mean	1.507
Maximum	1.53	Median	1.51
SD	0.0192	Std. Error of Mean	0.0043
Coefficient of Variation	0.0128	Skewness	-0.859

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.909	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.201	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.514	95% Adjusted-CLT UCL (Chen-1995)	1.513
		95% Modified-t UCL (Johnson-1978)	1.514

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.716	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.74	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.206	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.193		

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics			
k hat (MLE)	6427	k star (bias corrected MLE)	5463
Theta hat (MLE)	2.3449E-4	Theta star (bias corrected MLE)	2.7587E-4
nu hat (MLE)	257068	nu star (bias corrected)	218509
MLE Mean (bias corrected)	1.507	MLE Sd (bias corrected)	0.0204
		Approximate Chi Square Value (0.05)	217423
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	217337

Assuming Gamma Distribution			
95% Approximate Gamma UCL	1.515	95% Adjusted Gamma UCL	1.515

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.907	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.201	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	0.378	Mean of logged Data	0.41
Maximum of Logged Data	0.425	SD of logged Data	0.0128

Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	1.52
95% Chebyshev (MVUE) UCL	1.526	97.5% Chebyshev (MVUE) UCL	1.534
99% Chebyshev (MVUE) UCL	1.55		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	1.514	95% BCA Bootstrap UCL	1.513
95% Standard Bootstrap UCL	1.514	95% Bootstrap-t UCL	1.514
95% Hall's Bootstrap UCL	1.513	95% Percentile Bootstrap UCL	1.514
90% Chebyshev(Mean, Sd) UCL	1.52	95% Chebyshev(Mean, Sd) UCL	1.526
97.5% Chebyshev(Mean, Sd) UCL	1.534	99% Chebyshev(Mean, Sd) UCL	1.55

UCL Statistics for Baseline Soil Samples

Suggested UCL to Use

95% Student's-t UCL 1.514

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Soil Samples

pH, IVBA final

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	1.49	Mean	1.535
Maximum	1.58	Median	1.54
SD	0.0272	Std. Error of Mean	0.00609
Coefficient of Variation	0.0177	Skewness	-0.0347
Normal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.123	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.546	95% Adjusted-CLT UCL (Chen-1995)	1.545
		95% Modified-t UCL (Johnson-1978)	1.546
Gamma GOF Test			
A-D Test Statistic	0.419	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3340	k star (bias corrected MLE)	2839
Theta hat (MLE)	4.5956E-4	Theta star (bias corrected MLE)	5.4065E-4
nu hat (MLE)	133607	nu star (bias corrected)	113567
MLE Mean (bias corrected)	1.535	MLE Sd (bias corrected)	0.0288
		Approximate Chi Square Value (0.05)	112784
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	112723
Assuming Gamma Distribution			
95% Approximate Gamma UCL	1.546	95% Adjusted Gamma UCL	1.546
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.399	Mean of logged Data	0.428
Maximum of Logged Data	0.457	SD of logged Data	0.0178
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	1.553
95% Chebyshev (MVUE) UCL	1.562	97.5% Chebyshev (MVUE) UCL	1.573
99% Chebyshev (MVUE) UCL	1.596		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.545	95% BCA Bootstrap UCL	1.544
95% Standard Bootstrap UCL	1.545	95% Bootstrap-t UCL	1.546
95% Hall's Bootstrap UCL	1.545	95% Percentile Bootstrap UCL	1.545
90% Chebyshev(Mean, Sd) UCL	1.553	95% Chebyshev(Mean, Sd) UCL	1.562
97.5% Chebyshev(Mean, Sd) UCL	1.573	99% Chebyshev(Mean, Sd) UCL	1.596
Suggested UCL to Use			
95% Student's-t UCL	1.546		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Soil Samples

Weight, extraction (dry)

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	0.502	Mean	0.969
Maximum	1.09	Median	0.983
SD	0.125	Std. Error of Mean	0.028
Coefficient of Variation	0.129	Skewness	-2.843
Normal GOF Test			
Shapiro Wilk Test Statistic	0.692	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.276	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.018	95% Adjusted-CLT UCL (Chen-1995)	0.996
		95% Modified-t UCL (Johnson-1978)	1.015

Gamma GOF Test			
A-D Test Statistic	2.187	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.193	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	46.41	k star (bias corrected MLE)	39.48
Theta hat (MLE)	0.0209	Theta star (bias corrected MLE)	0.0246
nu hat (MLE)	1856	nu star (bias corrected)	1579
MLE Mean (bias corrected)	0.969	MLE Sd (bias corrected)	0.154
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	1488
		Adjusted Chi Square Value	1481

Assuming Gamma Distribution			
95% Approximate Gamma UCL	1.029	95% Adjusted Gamma UCL	1.034

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.581	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.332	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	-0.689	Mean of logged Data	-0.0419
Maximum of Logged Data	0.0862	SD of logged Data	0.164

Assuming Lognormal Distribution			
95% H-UCL	1.039	90% Chebyshev (MVUE) UCL	1.078
95% Chebyshev (MVUE) UCL	1.127	97.5% Chebyshev (MVUE) UCL	1.194
99% Chebyshev (MVUE) UCL	1.327		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	1.016	95% BCA Bootstrap UCL	1
95% Standard Bootstrap UCL	1.015	95% Bootstrap-t UCL	1.005
95% Hall's Bootstrap UCL	1.003	95% Percentile Bootstrap UCL	1.009
90% Chebyshev(Mean, Sd) UCL	1.053	95% Chebyshev(Mean, Sd) UCL	1.092
97.5% Chebyshev(Mean, Sd) UCL	1.144	99% Chebyshev(Mean, Sd) UCL	1.248

Suggested UCL to Use	
95% Student's-t UCL	1.018

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Soil Samples

UCL Statistics for Baseline Soil Samples

Final volume

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
		Number of Missing Observations	0
Minimum	100	Mean	100
Maximum	100	Median	100

**Warning: There is only one distinct observation value in this data set - resulting in '0' variance!
 ProUCL (or any other software) should not be used on such a data set!
 The data set for variable Final volume was not processed!**

**If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.
 The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

Moisture

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	5.25	Mean	18.13
Maximum	87.2	Median	14.7
SD	17.55	Std. Error of Mean	3.923
Coefficient of Variation	0.968	Skewness	3.519

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.57	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.323	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	27.89
95% Student's-t UCL	24.92	95% Modified-t UCL (Johnson-1978)	25.43

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.045	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.751	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.226	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.196		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	2.314	k star (bias corrected MLE)	2
Theta hat (MLE)	7.836	Theta star (bias corrected MLE)	9.065
nu hat (MLE)	92.57	nu star (bias corrected)	80.02
MLE Mean (bias corrected)	18.13	MLE Sd (bias corrected)	12.82
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	60.4
		Adjusted Chi Square Value	59.06

Assuming Gamma Distribution			
95% Approximate Gamma UCL	24.02	95% Adjusted Gamma UCL	24.57

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.922	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.169	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	1.658	Mean of logged Data	2.666
Maximum of Logged Data	4.468	SD of logged Data	0.626

Assuming Lognormal Distribution			
95% H-UCL	23.84	90% Chebyshev (MVUE) UCL	24.97
95% Chebyshev (MVUE) UCL	28.45	97.5% Chebyshev (MVUE) UCL	33.27
99% Chebyshev (MVUE) UCL	42.74		

**Nonparametric Distribution Free UCL Statistics
 Data appear to follow a Discernible Distribution**

UCL Statistics for Baseline Soil Samples

Nonparametric Distribution Free UCLs			
95% CLT UCL	24.59	95% BCA Bootstrap UCL	29.28
95% Standard Bootstrap UCL	24.56	95% Bootstrap-t UCL	35.71
95% Hall's Bootstrap UCL	52.8	95% Percentile Bootstrap UCL	25.64
90% Chebyshev(Mean, Sd) UCL	29.9	95% Chebyshev(Mean, Sd) UCL	35.23
97.5% Chebyshev(Mean, Sd) UCL	42.63	99% Chebyshev(Mean, Sd) UCL	57.17
Suggested UCL to Use			
95% H-UCL	23.84		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Aluminum

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	2500	Mean	6097
Maximum	13800	Median	4240
SD	3742	Std. Error of Mean	836.6
Coefficient of Variation	0.614	Skewness	1.103
Normal GOF Test			
Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.28	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7543	95% Adjusted-CLT UCL (Chen-1995)	7693
		95% Modified-t UCL (Johnson-1978)	7578

Gamma GOF Test			
A-D Test Statistic	1.186	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.247	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.342	k star (bias corrected MLE)	2.874
Theta hat (MLE)	1824	Theta star (bias corrected MLE)	2121
nu hat (MLE)	133.7	nu star (bias corrected)	115
MLE Mean (bias corrected)	6097	MLE Sd (bias corrected)	3596
		Approximate Chi Square Value (0.05)	91.22
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	89.54

Assuming Gamma Distribution			
95% Approximate Gamma UCL	7684	95% Adjusted Gamma UCL	7828

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.219	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	7.824	Mean of logged Data	8.559
Maximum of Logged Data	9.532	SD of logged Data	0.557

Assuming Lognormal Distribution			
95% H-UCL	7932	90% Chebyshev (MVUE) UCL	8385
95% Chebyshev (MVUE) UCL	9450	97.5% Chebyshev (MVUE) UCL	10930
99% Chebyshev (MVUE) UCL	13836		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	7473	95% BCA Bootstrap UCL	7561
95% Standard Bootstrap UCL	7437	95% Bootstrap-t UCL	7964
95% Hall's Bootstrap UCL	7511	95% Percentile Bootstrap UCL	7460
90% Chebyshev(Mean, Sd) UCL	8607	95% Chebyshev(Mean, Sd) UCL	9744
97.5% Chebyshev(Mean, Sd) UCL	11322	99% Chebyshev(Mean, Sd) UCL	14421

Suggested UCL to Use
95% Student's-t UCL 7543

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Antimony

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	0.1
Maximum Detect	1.44	Maximum Non-Detect	0.1
Variance Detects	0.147	Percent Non-Detects	45%
Mean Detects	0.315	SD Detects	0.384
Median Detects	0.22	CV Detects	1.217
Skewness Detects	2.991	Kurtosis Detects	9.399
Mean of Logged Detects	-1.506	SD of Logged Detects	0.762

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.555	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.792	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.353	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.291	Detected Data Not Normal at 1% Significance Level	
Detected Data Not Normal at 1% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.219	KM Standard Error of Mean	0.0684
90KM SD	0.292	95% KM (BCA) UCL	0.357
95% KM (t) UCL	0.337	95% KM (Percentile Bootstrap) UCL	0.346
95% KM (z) UCL	0.331	95% KM Bootstrap t UCL	0.619
90% KM Chebyshev UCL	0.424	95% KM Chebyshev UCL	0.517
97.5% KM Chebyshev UCL	0.646	99% KM Chebyshev UCL	0.899

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.042	Anderson-Darling GOF Test	
5% A-D Critical Value	0.742	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.228	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.26	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.565	k star (bias corrected MLE)	1.199
Theta hat (MLE)	0.202	Theta star (bias corrected MLE)	0.263
nu hat (MLE)	34.42	nu star (bias corrected)	26.37
Mean (detects)	0.315		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.178
Maximum	1.44	Median	0.11
SD	0.319	CV	1.793
k hat (MLE)	0.535	k star (bias corrected MLE)	0.488
Theta hat (MLE)	0.333	Theta star (bias corrected MLE)	0.365
nu hat (MLE)	21.4	nu star (bias corrected)	19.53
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (19.53, α)	10.5	Adjusted Chi Square Value (19.53, β)	9.981
95% Gamma Approximate UCL	0.331	95% Gamma Adjusted UCL	0.348

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.219	SD (KM)	0.292
Variance (KM)	0.0852	SE of Mean (KM)	0.0684
k hat (KM)	0.561	k star (KM)	0.51
nu hat (KM)	22.42	nu star (KM)	20.39
theta hat (KM)	0.39	theta star (KM)	0.429
80% gamma percentile (KM)	0.359	90% gamma percentile (KM)	0.589
95% gamma percentile (KM)	0.834	99% gamma percentile (KM)	1.434

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (20.39, α)	11.14	Adjusted Chi Square Value (20.39, β)	10.6
95% KM Approximate Gamma UCL	0.4	95% KM Adjusted Gamma UCL	0.42

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.839	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.876	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.181	Lilliefors GOF Test	

UCL Statistics for Baseline Soil Samples
 10% Lilliefors Critical Value 0.231 Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.189	Mean in Log Scale	-2.432
SD in Original Scale	0.314	SD in Log Scale	1.26
95% t UCL (assumes normality of ROS data)	0.31	95% Percentile Bootstrap UCL	0.31
95% BCA Bootstrap UCL	0.384	95% Bootstrap t UCL	0.499
95% H-UCL (Log ROS)	0.467		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.865	KM Geo Mean	0.155
KM SD (logged)	0.669	95% Critical H Value (KM-Log)	2.2
KM Standard Error of Mean (logged)	0.157	95% H-UCL (KM -Log)	0.272
KM SD (logged)	0.669	95% Critical H Value (KM-Log)	2.2
KM Standard Error of Mean (logged)	0.157		

DL/2 Normal	DL/2 Statistics	DL/2 Log-Transformed	
Mean in Original Scale	0.196	Mean in Log Scale	-2.176
SD in Original Scale	0.31	SD in Log Scale	0.94
95% t UCL (Assumes normality)	0.316	95% H-Stat UCL	0.306

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	0.42	95% GROS Adjusted Gamma UCL	0.348
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**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
 Please verify the data were collected from random locations.
 If the data were collected using judgmental or other non-random methods,
 then contact a statistician to correctly calculate UCLs.**

**When a data set follows an approximate distribution passing only one of the GOF tests,
 it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Arsenic

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	1.79	Mean	6.464
Maximum	17.85	Median	5.845
SD	4.266	Std. Error of Mean	0.954
Coefficient of Variation	0.66	Skewness	1.308
Normal GOF Test			
Shapiro Wilk Test Statistic	0.883	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.156	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.113	95% Adjusted-CLT UCL (Chen-1995)	8.331
		95% Modified-t UCL (Johnson-1978)	8.16
Gamma GOF Test			
A-D Test Statistic	0.219	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0794	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.663	k star (bias corrected MLE)	2.297
Theta hat (MLE)	2.428	Theta star (bias corrected MLE)	2.815
nu hat (MLE)	106.5	nu star (bias corrected)	91.86
MLE Mean (bias corrected)	6.464	MLE Sd (bias corrected)	4.265
		Approximate Chi Square Value (0.05)	70.76
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	69.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL	8.392	95% Adjusted Gamma UCL	8.569
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.969	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0966	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.582	Mean of logged Data	1.667
Maximum of Logged Data	2.882	SD of logged Data	0.659
Assuming Lognormal Distribution			
95% H-UCL	9.164	90% Chebyshev (MVUE) UCL	9.544
95% Chebyshev (MVUE) UCL	10.92	97.5% Chebyshev (MVUE) UCL	12.84
99% Chebyshev (MVUE) UCL	16.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.033	95% BCA Bootstrap UCL	8.385
95% Standard Bootstrap UCL	8.058	95% Bootstrap-t UCL	8.768
95% Hall's Bootstrap UCL	9.029	95% Percentile Bootstrap UCL	8.167
90% Chebyshev(Mean, Sd) UCL	9.326	95% Chebyshev(Mean, Sd) UCL	10.62
97.5% Chebyshev(Mean, Sd) UCL	12.42	99% Chebyshev(Mean, Sd) UCL	15.95
Suggested UCL to Use			
95% Student's-t UCL	8.113		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

UCL Statistics for Baseline Soil Samples

Barium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	10.5	Mean	32.94
Maximum	96.4	Median	28.9
SD	21.27	Std. Error of Mean	4.756
Coefficient of Variation	0.646	Skewness	1.511
Normal GOF Test			
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.146	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	41.17	95% Adjusted-CLT UCL (Chen-1995)	42.48
		95% Modified-t UCL (Johnson-1978)	41.43
Gamma GOF Test			
A-D Test Statistic	0.268	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.112	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.952	k star (bias corrected MLE)	2.542
Theta hat (MLE)	11.16	Theta star (bias corrected MLE)	12.96
nu hat (MLE)	118.1	nu star (bias corrected)	101.7
MLE Mean (bias corrected)	32.94	MLE Sd (bias corrected)	20.66
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	79.43
		Adjusted Chi Square Value	77.87
Assuming Gamma Distribution			
95% Approximate Gamma UCL	42.18	95% Adjusted Gamma UCL	43.02
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.972	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0925	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.351	Mean of logged Data	3.316
Maximum of Logged Data	4.569	SD of logged Data	0.612
Assuming Lognormal Distribution			
95% H-UCL	44.81	90% Chebyshev (MVUE) UCL	47.05
95% Chebyshev (MVUE) UCL	53.48	97.5% Chebyshev (MVUE) UCL	62.4
99% Chebyshev (MVUE) UCL	79.93		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	40.76	95% BCA Bootstrap UCL	42.88
95% Standard Bootstrap UCL	40.57	95% Bootstrap-t UCL	43.38
95% Hall's Bootstrap UCL	45.44	95% Percentile Bootstrap UCL	40.97
90% Chebyshev(Mean, Sd) UCL	47.21	95% Chebyshev(Mean, Sd) UCL	53.67
97.5% Chebyshev(Mean, Sd) UCL	62.64	99% Chebyshev(Mean, Sd) UCL	80.26
Suggested UCL to Use			
95% Student's-t UCL	41.17		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Beryllium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	12	Number of Non-Detects	8
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	0.43	Maximum Non-Detect	0.1
Variance Detects	0.00926	Percent Non-Detects	40%
Mean Detects	0.211	SD Detects	0.0962
Median Detects	0.195	CV Detects	0.456
Skewness Detects	1.036	Kurtosis Detects	1.122
Mean of Logged Detects	-1.648	SD of Logged Detects	0.445

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.805	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.138	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.281	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.167	KM Standard Error of Mean	0.0209
90KM SD	0.0897	95% KM (BCA) UCL	0.202
95% KM (t) UCL	0.203	95% KM (Percentile Bootstrap) UCL	0.2
95% KM (z) UCL	0.201	95% KM Bootstrap t UCL	0.214
90% KM Chebyshev UCL	0.229	95% KM Chebyshev UCL	0.258
97.5% KM Chebyshev UCL	0.297	99% KM Chebyshev UCL	0.375

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.198	Anderson-Darling GOF Test	
5% A-D Critical Value	0.732	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.112	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.246	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	5.652	k star (bias corrected MLE)	4.295
Theta hat (MLE)	0.0373	Theta star (bias corrected MLE)	0.0491
nu hat (MLE)	135.7	nu star (bias corrected)	103.1
Mean (detects)	0.211		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.137
Maximum	0.43	Median	0.115
SD	0.119	CV	0.869
k hat (MLE)	1.003	k star (bias corrected MLE)	0.886
Theta hat (MLE)	0.136	Theta star (bias corrected MLE)	0.154
nu hat (MLE)	40.13	nu star (bias corrected)	35.44
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (35.44, α)	22.82	Adjusted Chi Square Value (35.44, β)	22.02
95% Gamma Approximate UCL	0.213	95% Gamma Adjusted UCL	0.22

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.167	SD (KM)	0.0897
Variance (KM)	0.00804	SE of Mean (KM)	0.0209
k hat (KM)	3.447	k star (KM)	2.963
nu hat (KM)	137.9	nu star (KM)	118.5
theta hat (KM)	0.0483	theta star (KM)	0.0562
80% gamma percentile (KM)	0.238	90% gamma percentile (KM)	0.296
95% gamma percentile (KM)	0.351	99% gamma percentile (KM)	0.469

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (118.53, α)	94.39	Adjusted Chi Square Value (118.53, β)	92.69
95% KM Approximate Gamma UCL	0.209	95% KM Adjusted Gamma UCL	0.213

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.971	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.883	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.107	Lilliefors GOF Test	

UCL Statistics for Baseline Soil Samples

10% Lilliefors Critical Value 0.223 Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.151	Mean in Log Scale	-2.123
SD in Original Scale	0.105	SD in Log Scale	0.719
95% t UCL (assumes normality of ROS data)	0.192	95% Percentile Bootstrap UCL	0.191
95% BCA Bootstrap UCL	0.196	95% Bootstrap t UCL	0.199
95% H-UCL (Log ROS)	0.225		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.91	KM Geo Mean	0.148
KM SD (logged)	0.46	95% Critical H Value (KM-Log)	1.982
KM Standard Error of Mean (logged)	0.107	95% H-UCL (KM -Log)	0.203
KM SD (logged)	0.46	95% Critical H Value (KM-Log)	1.982
KM Standard Error of Mean (logged)	0.107		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.147	Mean in Log Scale	-2.187
SD in Original Scale	0.109	SD in Log Scale	0.757
95% t UCL (Assumes normality)	0.189	95% H-Stat UCL	0.223

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.203

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Bismuth

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Bismuth was not processed!

Boron

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Boron was not processed!

Cadmium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.024	Mean	0.11
Maximum	0.676	Median	0.0675
SD	0.142	Std. Error of Mean	0.0318
Coefficient of Variation	1.293	Skewness	3.65

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.54	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.274	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	0.19
95% Student's-t UCL	0.165	95% Modified-t UCL (Johnson-1978)	0.169

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.909	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.759	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.153	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.198		

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1.439	k star (bias corrected MLE)	1.256
Theta hat (MLE)	0.0764	Theta star (bias corrected MLE)	0.0874
nu hat (MLE)	57.56	nu star (bias corrected)	50.26
MLE Mean (bias corrected)	0.11	MLE Sd (bias corrected)	0.098
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	34.98
		Adjusted Chi Square Value	33.97

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.158	95% Adjusted Gamma UCL	0.163

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.942	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0981	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

UCL Statistics for Baseline Soil Samples

Minimum of Logged Data	-3.73	Mean of logged Data	-2.595
Maximum of Logged Data	-0.392	SD of logged Data	0.805

Assuming Lognormal Distribution

95% H-UCL	0.16	90% Chebyshev (MVUE) UCL	0.16
95% Chebyshev (MVUE) UCL	0.187	97.5% Chebyshev (MVUE) UCL	0.224
99% Chebyshev (MVUE) UCL	0.297		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.162	95% BCA Bootstrap UCL	0.203
95% Standard Bootstrap UCL	0.162	95% Bootstrap-t UCL	0.258
95% Hall's Bootstrap UCL	0.364	95% Percentile Bootstrap UCL	0.17
90% Chebyshev(Mean, Sd) UCL	0.205	95% Chebyshev(Mean, Sd) UCL	0.248
97.5% Chebyshev(Mean, Sd) UCL	0.308	99% Chebyshev(Mean, Sd) UCL	0.426

Suggested UCL to Use

95% Adjusted Gamma UCL 0.163

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Calcium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	474	Mean	2106
Maximum	4910	Median	2000
SD	1181	Std. Error of Mean	264.2
Coefficient of Variation	0.561	Skewness	0.613
Normal GOF Test			
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	2579
95% Student's-t UCL	2563	95% Modified-t UCL (Johnson-1978)	2569

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.285	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.747	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.13	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.024	k star (bias corrected MLE)	2.603
Theta hat (MLE)	696.5	Theta star (bias corrected MLE)	808.9
nu hat (MLE)	120.9	nu star (bias corrected)	104.1
MLE Mean (bias corrected)	2106	MLE Sd (bias corrected)	1305
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	81.59
		Adjusted Chi Square Value	80.01

Assuming Gamma Distribution		95% Adjusted Gamma UCL	
95% Approximate Gamma UCL	2688		2741

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.956	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.146	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	6.161	Mean of logged Data	7.478
Maximum of Logged Data	8.499	SD of logged Data	0.643

Assuming Lognormal Distribution			
95% H-UCL	2995	90% Chebyshev (MVUE) UCL	3129
95% Chebyshev (MVUE) UCL	3573	97.5% Chebyshev (MVUE) UCL	4189
99% Chebyshev (MVUE) UCL	5399		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	2540	95% BCA Bootstrap UCL	2565
95% Standard Bootstrap UCL	2525	95% Bootstrap-t UCL	2612
95% Hall's Bootstrap UCL	2626	95% Percentile Bootstrap UCL	2536
90% Chebyshev(Mean, Sd) UCL	2898	95% Chebyshev(Mean, Sd) UCL	3257
97.5% Chebyshev(Mean, Sd) UCL	3756	99% Chebyshev(Mean, Sd) UCL	4734

Suggested UCL to Use
95% Student's-t UCL 2563

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

UCL Statistics for Baseline Soil Samples

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
Minimum	2.6	Number of Missing Observations	0
Maximum	27.3	Mean	11.43
SD	8.294	Median	7.665
Coefficient of Variation	0.726	Std. Error of Mean	1.855
		Skewness	0.983

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.847	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.217	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.63	95% Adjusted-CLT UCL (Chen-1995)	14.91
		95% Modified-t UCL (Johnson-1978)	14.7

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.48	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.752	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.162	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.196		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	2.16	k star (bias corrected MLE)	1.869
Theta hat (MLE)	5.291	Theta star (bias corrected MLE)	6.114
nu hat (MLE)	86.39	nu star (bias corrected)	74.76
MLE Mean (bias corrected)	11.43	MLE Sd (bias corrected)	8.359
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	55.85
		Adjusted Chi Square Value	54.56

Assuming Gamma Distribution			
95% Approximate Gamma UCL	15.3	95% Adjusted Gamma UCL	15.66

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.952	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.119	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	0.956	Mean of logged Data	2.187
Maximum of Logged Data	3.307	SD of logged Data	0.732

Assuming Lognormal Distribution			
95% H-UCL	17.06	90% Chebyshev (MVUE) UCL	17.49
95% Chebyshev (MVUE) UCL	20.22	97.5% Chebyshev (MVUE) UCL	24.01
99% Chebyshev (MVUE) UCL	31.46		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	14.48	95% BCA Bootstrap UCL	14.69
95% Standard Bootstrap UCL	14.4	95% Bootstrap-t UCL	15.39
95% Hall's Bootstrap UCL	14.7	95% Percentile Bootstrap UCL	14.45
90% Chebyshev(Mean, Sd) UCL	16.99	95% Chebyshev(Mean, Sd) UCL	19.51
97.5% Chebyshev(Mean, Sd) UCL	23.01	99% Chebyshev(Mean, Sd) UCL	29.88

Suggested UCL to Use
95% Student's-t UCL 14.63

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Cobalt

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
Minimum	0.3	Number of Missing Observations	0
Maximum	12	Mean	3.306
SD	3.343	Median	2.18
Coefficient of Variation	1.011	Std. Error of Mean	0.747
		Skewness	1.8
Normal GOF Test			
Shapiro Wilk Test Statistic	0.762	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.227	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.598	95% Adjusted-CLT UCL (Chen-1995)	4.857
		95% Modified-t UCL (Johnson-1978)	4.648
Gamma GOF Test			
A-D Test Statistic	0.425	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.137	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.321	k star (bias corrected MLE)	1.156
Theta hat (MLE)	2.502	Theta star (bias corrected MLE)	2.859
nu hat (MLE)	52.85	nu star (bias corrected)	46.26
MLE Mean (bias corrected)	3.306	MLE Sd (bias corrected)	3.074
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	31.65
		Adjusted Chi Square Value	30.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL	4.831	95% Adjusted Gamma UCL	4.981
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.982	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0833	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.204	Mean of logged Data	0.772
Maximum of Logged Data	2.485	SD of logged Data	0.96
Assuming Lognormal Distribution			
95% H-UCL	6.048	90% Chebyshev (MVUE) UCL	5.701
95% Chebyshev (MVUE) UCL	6.779	97.5% Chebyshev (MVUE) UCL	8.274
99% Chebyshev (MVUE) UCL	11.21		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	4.535	95% BCA Bootstrap UCL	4.877
95% Standard Bootstrap UCL	4.5	95% Bootstrap-t UCL	5.485
95% Hall's Bootstrap UCL	5.769	95% Percentile Bootstrap UCL	4.553
90% Chebyshev(Mean, Sd) UCL	5.548	95% Chebyshev(Mean, Sd) UCL	6.564
97.5% Chebyshev(Mean, Sd) UCL	7.974	99% Chebyshev(Mean, Sd) UCL	10.74
Suggested UCL to Use			
95% Adjusted Gamma UCL	4.981		

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

UCL Statistics for Baseline Soil Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1.26	Mean	5.268
Maximum	21.6	Median	3.3
SD	5.056	Std. Error of Mean	1.131
Coefficient of Variation	0.96	Skewness	2.167
Normal GOF Test			
Shapiro Wilk Test Statistic	0.748	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.227	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.222	95% Adjusted-CLT UCL (Chen-1995)	7.712
		95% Modified-t UCL (Johnson-1978)	7.314
Gamma GOF Test			
A-D Test Statistic	0.569	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.159	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.658	k star (bias corrected MLE)	1.443
Theta hat (MLE)	3.177	Theta star (bias corrected MLE)	3.651
nu hat (MLE)	66.32	nu star (bias corrected)	57.71
MLE Mean (bias corrected)	5.268	MLE Sd (bias corrected)	4.385
		Approximate Chi Square Value (0.05)	41.24
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	40.15
Assuming Gamma Distribution			
95% Approximate Gamma UCL	7.37	95% Adjusted Gamma UCL	7.572
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.112	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.231	Mean of logged Data	1.331
Maximum of Logged Data	3.073	SD of logged Data	0.804
Assuming Lognormal Distribution			
95% H-UCL	8.09	90% Chebyshev (MVUE) UCL	8.121
95% Chebyshev (MVUE) UCL	9.479	97.5% Chebyshev (MVUE) UCL	11.36
99% Chebyshev (MVUE) UCL	15.07		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.127	95% BCA Bootstrap UCL	7.852
95% Standard Bootstrap UCL	7.075	95% Bootstrap-t UCL	8.819
95% Hall's Bootstrap UCL	15.55	95% Percentile Bootstrap UCL	7.155
90% Chebyshev(Mean, Sd) UCL	8.659	95% Chebyshev(Mean, Sd) UCL	10.2
97.5% Chebyshev(Mean, Sd) UCL	12.33	99% Chebyshev(Mean, Sd) UCL	16.52
Suggested UCL to Use			
95% Adjusted Gamma UCL	7.572		

UCL Statistics for Baseline Soil Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Iron

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1160	Mean	8025
Maximum	18100	Median	6425
SD	5129	Std. Error of Mean	1147
Coefficient of Variation	0.639	Skewness	0.706
Normal GOF Test			
Shapiro Wilk Test Statistic	0.918	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.157	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10008	95% Adjusted-CLT UCL (Chen-1995)	10105
		95% Modified-t UCL (Johnson-1978)	10038
Gamma GOF Test			
A-D Test Statistic	0.222	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.107	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.196	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.412	k star (bias corrected MLE)	2.083
Theta hat (MLE)	3328	Theta star (bias corrected MLE)	3852
nu hat (MLE)	96.46	nu star (bias corrected)	83.33
MLE Mean (bias corrected)	8025	MLE Sd (bias corrected)	5560
		Approximate Chi Square Value (0.05)	63.29
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	61.91
Assuming Gamma Distribution			
95% Approximate Gamma UCL	10565	95% Adjusted Gamma UCL	10801
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0976	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.056	Mean of logged Data	8.769
Maximum of Logged Data	9.804	SD of logged Data	0.725
Assuming Lognormal Distribution			
95% H-UCL	12196	90% Chebyshev (MVUE) UCL	12522
95% Chebyshev (MVUE) UCL	14465	97.5% Chebyshev (MVUE) UCL	17162
99% Chebyshev (MVUE) UCL	22461		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9911	95% BCA Bootstrap UCL	10063
95% Standard Bootstrap UCL	9879	95% Bootstrap-t UCL	10358
95% Hall's Bootstrap UCL	10130	95% Percentile Bootstrap UCL	9848
90% Chebyshev(Mean, Sd) UCL	11465	95% Chebyshev(Mean, Sd) UCL	13024
97.5% Chebyshev(Mean, Sd) UCL	15187	99% Chebyshev(Mean, Sd) UCL	19437
Suggested UCL to Use			
95% Student's-t UCL	10008		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Soil Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	2.48	Mean	6.27
Maximum	16.6	Median	5.165
SD	3.954	Std. Error of Mean	0.884
Coefficient of Variation	0.631	Skewness	1.526
Normal GOF Test			
Shapiro Wilk Test Statistic	0.82	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.194	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.799	95% Adjusted-CLT UCL (Chen-1995)	8.046
		95% Modified-t UCL (Johnson-1978)	7.849
Gamma GOF Test			
A-D Test Statistic	0.608	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.152	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.34	k star (bias corrected MLE)	2.873
Theta hat (MLE)	1.877	Theta star (bias corrected MLE)	2.183
nu hat (MLE)	133.6	nu star (bias corrected)	114.9
MLE Mean (bias corrected)	6.27	MLE Sd (bias corrected)	3.699
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	91.16
		Adjusted Chi Square Value	89.49
Assuming Gamma Distribution			
95% Approximate Gamma UCL	7.903	95% Adjusted Gamma UCL	8.051
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.908	Mean of logged Data	1.679
Maximum of Logged Data	2.809	SD of logged Data	0.556
Assuming Lognormal Distribution			
95% H-UCL	8.149	90% Chebyshev (MVUE) UCL	8.615
95% Chebyshev (MVUE) UCL	9.709	97.5% Chebyshev (MVUE) UCL	11.23
99% Chebyshev (MVUE) UCL	14.21		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.724	95% BCA Bootstrap UCL	8.088
95% Standard Bootstrap UCL	7.712	95% Bootstrap-t UCL	8.407
95% Hall's Bootstrap UCL	8.917	95% Percentile Bootstrap UCL	7.785
90% Chebyshev(Mean, Sd) UCL	8.922	95% Chebyshev(Mean, Sd) UCL	10.12
97.5% Chebyshev(Mean, Sd) UCL	11.79	99% Chebyshev(Mean, Sd) UCL	15.07
Suggested UCL to Use			
95% Student's-t UCL	7.799		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Soil Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Lithium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	18
Number of Detects	17	Number of Non-Detects	3
Number of Distinct Detects	17	Number of Distinct Non-Detects	1
Minimum Detect	2.1	Minimum Non-Detect	2
Maximum Detect	16.6	Maximum Non-Detect	2
Variance Detects	20.23	Percent Non-Detects	15%
Mean Detects	7.924	SD Detects	4.498
Median Detects	7.5	CV Detects	0.568
Skewness Detects	0.544	Kurtosis Detects	-0.462
Mean of Logged Detects	1.893	SD of Logged Detects	0.646

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.937	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.851	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.12	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.241	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	7.035	KM Standard Error of Mean	1.048
90KM SD	4.545	95% KM (BCA) UCL	8.795
95% KM (t) UCL	8.847	95% KM (Percentile Bootstrap) UCL	8.755
95% KM (z) UCL	8.758	95% KM Bootstrap t UCL	9.105
90% KM Chebyshev UCL	10.18	95% KM Chebyshev UCL	11.6
97.5% KM Chebyshev UCL	13.58	99% KM Chebyshev UCL	17.46

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.266	Anderson-Darling GOF Test	
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.211	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	2.992	k star (bias corrected MLE)	2.503
Theta hat (MLE)	2.649	Theta star (bias corrected MLE)	3.166
nu hat (MLE)	101.7	nu star (bias corrected)	85.1
Mean (detects)	7.924		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	6.815
Maximum	16.6	Median	6.55
SD	4.94	CV	0.725
k hat (MLE)	1.009	k star (bias corrected MLE)	0.891
Theta hat (MLE)	6.752	Theta star (bias corrected MLE)	7.647
nu hat (MLE)	40.37	nu star (bias corrected)	35.65
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (35.65, α)	22.99	Adjusted Chi Square Value (35.65, β)	22.18
95% Gamma Approximate UCL	10.57	95% Gamma Adjusted UCL	10.95

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	7.035	SD (KM)	4.545
Variance (KM)	20.66	SE of Mean (KM)	1.048
k hat (KM)	2.395	k star (KM)	2.069
nu hat (KM)	95.82	nu star (KM)	82.78
theta hat (KM)	2.937	theta star (KM)	3.399
80% gamma percentile (KM)	10.49	90% gamma percentile (KM)	13.57
95% gamma percentile (KM)	16.51	99% gamma percentile (KM)	23

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (82.78, α)	62.81	Adjusted Chi Square Value (82.78, β)	61.44
95% KM Approximate Gamma UCL	9.271	95% KM Adjusted Gamma UCL	9.479

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.91	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.146	Lilliefors GOF Test	

UCL Statistics for Baseline Soil Samples

10% Lilliefors Critical Value 0.19 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.964	Mean in Log Scale	1.67
SD in Original Scale	4.748	SD in Log Scale	0.81
95% t UCL (assumes normality of ROS data)	8.8	95% Percentile Bootstrap UCL	8.739
95% BCA Bootstrap UCL	8.794	95% Bootstrap t UCL	8.916
95% H-UCL (Log ROS)	11.46		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.713	KM Geo Mean	5.548
KM SD (logged)	0.719	95% Critical H Value (KM-Log)	2.259
KM Standard Error of Mean (logged)	0.166	95% H-UCL (KM -Log)	10.43
KM SD (logged)	0.719	95% Critical H Value (KM-Log)	2.259
KM Standard Error of Mean (logged)	0.166		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.885	Mean in Log Scale	1.609
SD in Original Scale	4.845	SD in Log Scale	0.912
95% t UCL (Assumes normality)	8.758	95% H-Stat UCL	12.82

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 8.847

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Magnesium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	250	Mean	1946
Maximum	5510	Median	1290
SD	1599	Std. Error of Mean	357.6
Coefficient of Variation	0.822	Skewness	0.955
Normal GOF Test			
Shapiro Wilk Test Statistic	0.87	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.191	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2565	95% Adjusted-CLT UCL (Chen-1995)	2616
		95% Modified-t UCL (Johnson-1978)	2577
Gamma GOF Test			
A-D Test Statistic	0.428	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.128	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.56	k star (bias corrected MLE)	1.359
Theta hat (MLE)	1247	Theta star (bias corrected MLE)	1432
nu hat (MLE)	62.41	nu star (bias corrected)	54.38
MLE Mean (bias corrected)	1946	MLE Sd (bias corrected)	1669
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	38.44
		Adjusted Chi Square Value	37.38
Assuming Gamma Distribution			
95% Approximate Gamma UCL	2754	95% Adjusted Gamma UCL	2832
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.142	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.521	Mean of logged Data	7.22
Maximum of Logged Data	8.614	SD of logged Data	0.9
Assuming Lognormal Distribution			
95% H-UCL	3429	90% Chebyshev (MVUE) UCL	3322
95% Chebyshev (MVUE) UCL	3923	97.5% Chebyshev (MVUE) UCL	4757
99% Chebyshev (MVUE) UCL	6396		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2534	95% BCA Bootstrap UCL	2593
95% Standard Bootstrap UCL	2518	95% Bootstrap-t UCL	2693
95% Hall's Bootstrap UCL	2614	95% Percentile Bootstrap UCL	2531
90% Chebyshev(Mean, Sd) UCL	3019	95% Chebyshev(Mean, Sd) UCL	3505
97.5% Chebyshev(Mean, Sd) UCL	4180	99% Chebyshev(Mean, Sd) UCL	5504
Suggested UCL to Use			
95% Student's-t UCL	2565		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Manganese

UCL Statistics for Baseline Soil Samples

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
Minimum	10.9	Number of Missing Observations	0
Maximum	1490	Mean	200.4
SD	345.5	Median	75.1
Coefficient of Variation	1.724	Std. Error of Mean	77.26
		Skewness	3.204

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.543	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.315	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	333.9	95% Adjusted-CLT UCL (Chen-1995)	386.6
		95% Modified-t UCL (Johnson-1978)	343.2

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.108	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.779	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.218	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.201		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	0.752	k star (bias corrected MLE)	0.673
Theta hat (MLE)	266.4	Theta star (bias corrected MLE)	297.9
nu hat (MLE)	30.08	nu star (bias corrected)	26.9
MLE Mean (bias corrected)	200.4	MLE Sd (bias corrected)	244.3
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	16.07
		Adjusted Chi Square Value	15.41

Assuming Gamma Distribution			
95% Approximate Gamma UCL	335.3	95% Adjusted Gamma UCL	349.7

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.964	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.149	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	2.389	Mean of logged Data	4.504
Maximum of Logged Data	7.307	SD of logged Data	1.202

Assuming Lognormal Distribution			
95% H-UCL	418.9	90% Chebyshev (MVUE) UCL	339.5
95% Chebyshev (MVUE) UCL	413.6	97.5% Chebyshev (MVUE) UCL	516.4
99% Chebyshev (MVUE) UCL	718.4		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	327.4	95% BCA Bootstrap UCL	400.4
95% Standard Bootstrap UCL	323.9	95% Bootstrap-t UCL	649
95% Hall's Bootstrap UCL	881	95% Percentile Bootstrap UCL	331.6
90% Chebyshev(Mean, Sd) UCL	432.1	95% Chebyshev(Mean, Sd) UCL	537.1
97.5% Chebyshev(Mean, Sd) UCL	682.8	99% Chebyshev(Mean, Sd) UCL	969

Suggested UCL to Use
95% H-UCL 418.9

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

**Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.**

UCL Statistics for Baseline Soil Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Mercury

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.006	Mean	0.0304
Maximum	0.191	Median	0.0155
SD	0.0411	Std. Error of Mean	0.00919
Coefficient of Variation	1.351	Skewness	3.467
Normal GOF Test			
Shapiro Wilk Test Statistic	0.556	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.276	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0463	95% Adjusted-CLT UCL (Chen-1995)	0.0532
		95% Modified-t UCL (Johnson-1978)	0.0475
Gamma GOF Test			
A-D Test Statistic	1.037	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.181	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.279	k star (bias corrected MLE)	1.12
Theta hat (MLE)	0.0238	Theta star (bias corrected MLE)	0.0272
nu hat (MLE)	51.15	nu star (bias corrected)	44.81
MLE Mean (bias corrected)	0.0304	MLE Sd (bias corrected)	0.0288
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	30.45
		Adjusted Chi Square Value	29.52
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0448	95% Adjusted Gamma UCL	0.0462
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.138	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.116	Mean of logged Data	-3.932
Maximum of Logged Data	-1.655	SD of logged Data	0.861
Assuming Lognormal Distribution			
95% H-UCL	0.046	90% Chebyshev (MVUE) UCL	0.0453
95% Chebyshev (MVUE) UCL	0.0532	97.5% Chebyshev (MVUE) UCL	0.0642
99% Chebyshev (MVUE) UCL	0.0859		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0456	95% BCA Bootstrap UCL	0.0569
95% Standard Bootstrap UCL	0.0455	95% Bootstrap-t UCL	0.0739
95% Hall's Bootstrap UCL	0.104	95% Percentile Bootstrap UCL	0.0475
90% Chebyshev(Mean, Sd) UCL	0.058	95% Chebyshev(Mean, Sd) UCL	0.0705
97.5% Chebyshev(Mean, Sd) UCL	0.0878	99% Chebyshev(Mean, Sd) UCL	0.122
Suggested UCL to Use			
95% Adjusted Gamma UCL	0.0462		

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

When a data set follows an approximate distribution passing only one of the GOF tests,

UCL Statistics for Baseline Soil Samples

it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	0.1	Mean	0.362
Maximum	1.49	Median	0.23
SD	0.354	Std. Error of Mean	0.0791
Coefficient of Variation	0.977	Skewness	2.108
Normal GOF Test			
Shapiro Wilk Test Statistic	0.714	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.286	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.499	95% Adjusted-CLT UCL (Chen-1995)	0.532
		95% Modified-t UCL (Johnson-1978)	0.505
Gamma GOF Test			
A-D Test Statistic	1.152	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.194	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.698	k star (bias corrected MLE)	1.477
Theta hat (MLE)	0.213	Theta star (bias corrected MLE)	0.245
nu hat (MLE)	67.92	nu star (bias corrected)	59.06
MLE Mean (bias corrected)	0.362	MLE Sd (bias corrected)	0.298
		Approximate Chi Square Value (0.05)	42.39
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	41.28
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.504	95% Adjusted Gamma UCL	0.518
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.906	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.14	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.303	Mean of logged Data	-1.339
Maximum of Logged Data	0.399	SD of logged Data	0.767
Assuming Lognormal Distribution			
95% H-UCL	0.529	90% Chebyshev (MVUE) UCL	0.537
95% Chebyshev (MVUE) UCL	0.624	97.5% Chebyshev (MVUE) UCL	0.745
99% Chebyshev (MVUE) UCL	0.982		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.492	95% BCA Bootstrap UCL	0.546
95% Standard Bootstrap UCL	0.49	95% Bootstrap-t UCL	0.588
95% Hall's Bootstrap UCL	0.553	95% Percentile Bootstrap UCL	0.501
90% Chebyshev(Mean, Sd) UCL	0.599	95% Chebyshev(Mean, Sd) UCL	0.707
97.5% Chebyshev(Mean, Sd) UCL	0.856	99% Chebyshev(Mean, Sd) UCL	1.149
Suggested UCL to Use			
	95% Adjusted Gamma UCL	0.518	

UCL Statistics for Baseline Soil Samples

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Nickel

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.69	Mean	6.064
Maximum	17.1	Median	4.305
SD	4.739	Std. Error of Mean	1.06
Coefficient of Variation	0.782	Skewness	1.019
Normal GOF Test			
Shapiro Wilk Test Statistic	0.882	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.216	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.896	95% Adjusted-CLT UCL (Chen-1995)	8.064
		95% Modified-t UCL (Johnson-1978)	7.936
Gamma GOF Test			
A-D Test Statistic	0.315	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.17	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.725	k star (bias corrected MLE)	1.499
Theta hat (MLE)	3.515	Theta star (bias corrected MLE)	4.044
nu hat (MLE)	68.99	nu star (bias corrected)	59.98
MLE Mean (bias corrected)	6.064	MLE Sd (bias corrected)	4.952
		Approximate Chi Square Value (0.05)	43.17
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	42.04
Assuming Gamma Distribution			
95% Approximate Gamma UCL	8.424	95% Adjusted Gamma UCL	8.65
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.97	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.371	Mean of logged Data	1.485
Maximum of Logged Data	2.839	SD of logged Data	0.862
Assuming Lognormal Distribution			
95% H-UCL	10.38	90% Chebyshev (MVUE) UCL	10.21
95% Chebyshev (MVUE) UCL	12	97.5% Chebyshev (MVUE) UCL	14.49
99% Chebyshev (MVUE) UCL	19.37		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.806	95% BCA Bootstrap UCL	7.975
95% Standard Bootstrap UCL	7.757	95% Bootstrap-t UCL	8.339
95% Hall's Bootstrap UCL	8.16	95% Percentile Bootstrap UCL	7.794
90% Chebyshev(Mean, Sd) UCL	9.242	95% Chebyshev(Mean, Sd) UCL	10.68
97.5% Chebyshev(Mean, Sd) UCL	12.68	99% Chebyshev(Mean, Sd) UCL	16.61
Suggested UCL to Use			
95% Student's-t UCL	7.896		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Phosphorus

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	54	Mean	310.1
Maximum	759	Median	299
SD	191.8	Std. Error of Mean	42.89
Coefficient of Variation	0.619	Skewness	0.878
Normal GOF Test			
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.179	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	384.2	95% Adjusted-CLT UCL (Chen-1995)	389.6
		95% Modified-t UCL (Johnson-1978)	385.6
Gamma GOF Test			
A-D Test Statistic	0.236	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.11	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.62	k star (bias corrected MLE)	2.261
Theta hat (MLE)	118.3	Theta star (bias corrected MLE)	137.2
nu hat (MLE)	104.8	nu star (bias corrected)	90.42
MLE Mean (bias corrected)	310.1	MLE Sd (bias corrected)	206.2
		Approximate Chi Square Value (0.05)	69.5
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	68.05
Assuming Gamma Distribution			
95% Approximate Gamma UCL	403.4	95% Adjusted Gamma UCL	412
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.133	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.989	Mean of logged Data	5.534
Maximum of Logged Data	6.632	SD of logged Data	0.692
Assuming Lognormal Distribution			
95% H-UCL	458.2	90% Chebyshev (MVUE) UCL	474.1
95% Chebyshev (MVUE) UCL	545.2	97.5% Chebyshev (MVUE) UCL	643.8
99% Chebyshev (MVUE) UCL	837.7		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	380.6	95% BCA Bootstrap UCL	390.5
95% Standard Bootstrap UCL	379.5	95% Bootstrap-t UCL	398.8
95% Hall's Bootstrap UCL	399.3	95% Percentile Bootstrap UCL	379.7
90% Chebyshev(Mean, Sd) UCL	438.7	95% Chebyshev(Mean, Sd) UCL	497
97.5% Chebyshev(Mean, Sd) UCL	577.9	99% Chebyshev(Mean, Sd) UCL	736.8
Suggested UCL to Use			
95% Student's-t UCL	384.2		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Potassium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	120	Mean	650
Maximum	2140	Median	330
SD	624.3	Std. Error of Mean	139.6
Coefficient of Variation	0.96	Skewness	1.571
Normal GOF Test			
Shapiro Wilk Test Statistic	0.745	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.273	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	891.4	95% Adjusted-CLT UCL (Chen-1995)	932
		95% Modified-t UCL (Johnson-1978)	899.6
Gamma GOF Test			
A-D Test Statistic	1.016	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.238	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.197	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.521	k star (bias corrected MLE)	1.326
Theta hat (MLE)	427.5	Theta star (bias corrected MLE)	490.3
nu hat (MLE)	60.82	nu star (bias corrected)	53.03
MLE Mean (bias corrected)	650	MLE Sd (bias corrected)	564.5
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	37.3
		Adjusted Chi Square Value	36.26
Assuming Gamma Distribution			
95% Approximate Gamma UCL	924.1	95% Adjusted Gamma UCL	950.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.929	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.193	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data Not Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.787	Mean of logged Data	6.113
Maximum of Logged Data	7.669	SD of logged Data	0.846
Assuming Lognormal Distribution			
95% H-UCL	1033	90% Chebyshev (MVUE) UCL	1022
95% Chebyshev (MVUE) UCL	1199	97.5% Chebyshev (MVUE) UCL	1445
99% Chebyshev (MVUE) UCL	1928		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	879.6	95% BCA Bootstrap UCL	944
95% Standard Bootstrap UCL	873.2	95% Bootstrap-t UCL	1002
95% Hall's Bootstrap UCL	883.6	95% Percentile Bootstrap UCL	886.5
90% Chebyshev(Mean, Sd) UCL	1069	95% Chebyshev(Mean, Sd) UCL	1259
97.5% Chebyshev(Mean, Sd) UCL	1522	99% Chebyshev(Mean, Sd) UCL	2039
Suggested UCL to Use			
95% H-UCL	1033		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

UCL Statistics for Baseline Soil Samples

General Statistics

Total Number of Observations	20	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	17
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.22	Minimum Non-Detect	0.2
Maximum Detect	0.49	Maximum Non-Detect	0.2
Variance Detects	0.0212	Percent Non-Detects	85%
Mean Detects	0.323	SD Detects	0.146
Median Detects	0.26	CV Detects	0.451
Skewness Detects	1.586	Kurtosis Detects	N/A
Mean of Logged Detects	-1.192	SD of Logged Detects	0.422

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.858	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.335	Lilliefors GOF Test
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.219	KM Standard Error of Mean	0.0175
90KM SD	0.0637	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.249	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.247	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.271	95% KM Chebyshev UCL	0.295
97.5% KM Chebyshev UCL	0.328	99% KM Chebyshev UCL	0.392

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.412	Anderson-Darling GOF Test
5% A-D Critical Value	0.636	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.352	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.433	Detected data appear Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	8.17	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0396	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	49.02	nu star (bias corrected)	N/A
Mean (detects)	0.323		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0581
Maximum	0.49	Median	0.01
SD	0.124	CV	2.132
k hat (MLE)	0.529	k star (bias corrected MLE)	0.483
Theta hat (MLE)	0.11	Theta star (bias corrected MLE)	0.12
nu hat (MLE)	21.17	nu star (bias corrected)	19.33
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (19.33, α)	10.36	Adjusted Chi Square Value (19.33, β)	9.84
95% Gamma Approximate UCL	0.108	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.219	SD (KM)	0.0637
Variance (KM)	0.00406	SE of Mean (KM)	0.0175
k hat (KM)	11.75	k star (KM)	10.02
nu hat (KM)	470	nu star (KM)	400.9
theta hat (KM)	0.0186	theta star (KM)	0.0218
80% gamma percentile (KM)	0.273	90% gamma percentile (KM)	0.31
95% gamma percentile (KM)	0.343	99% gamma percentile (KM)	0.41

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (400.87, α)	355.5	Adjusted Chi Square Value (400.87, β)	352.1
95% KM Approximate Gamma UCL	0.246	95% KM Adjusted Gamma UCL	0.249

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Soil Samples

Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.789	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.31	Lilliefors GOF Test
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0814	Mean in Log Scale	-3.316
SD in Original Scale	0.119	SD in Log Scale	1.334
95% t UCL (assumes normality of ROS data)	0.127	95% Percentile Bootstrap UCL	0.128
95% BCA Bootstrap UCL	0.141	95% Bootstrap t UCL	0.169
95% H-UCL (Log ROS)	0.232		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.547	KM Geo Mean	0.213
KM SD (logged)	0.2	95% Critical H Value (KM-Log)	1.786
KM Standard Error of Mean (logged)	0.0549	95% H-UCL (KM -Log)	0.236
KM SD (logged)	0.2	95% Critical H Value (KM-Log)	1.786
KM Standard Error of Mean (logged)	0.0549		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.134	Mean in Log Scale	-2.136
SD in Original Scale	0.0945	SD in Log Scale	0.429
95% t UCL (Assumes normality)	0.17	95% H-Stat UCL	0.157

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.249

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Silver

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	17
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.14	Minimum Non-Detect	0.1
Maximum Detect	0.24	Maximum Non-Detect	0.1
Variance Detects	0.00303	Percent Non-Detects	85%
Mean Detects	0.177	SD Detects	0.0551
Median Detects	0.15	CV Detects	0.312
Skewness Detects	1.668	Kurtosis Detects	N/A
Mean of Logged Detects	-1.763	SD of Logged Detects	0.293

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.824	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.353	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.112	KM Standard Error of Mean	0.00889
90KM SD	0.0324	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.127	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.126	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.138	95% KM Chebyshev UCL	0.15
97.5% KM Chebyshev UCL	0.167	99% KM Chebyshev UCL	0.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.483	Anderson-Darling GOF Test	
5% A-D Critical Value	0.635	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.383	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.432	Detected data appear Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	16.85	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0105	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	101.1	nu star (bias corrected)	N/A
Mean (detects)	0.177		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0396
Maximum	0.24	Median	0.01
SD	0.0632	CV	1.594
k hat (MLE)	0.782	k star (bias corrected MLE)	0.698
Theta hat (MLE)	0.0507	Theta star (bias corrected MLE)	0.0568
nu hat (MLE)	31.27	nu star (bias corrected)	27.91
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (27.91, α)	16.86	Adjusted Chi Square Value (27.91, β)	16.18
95% Gamma Approximate UCL	0.0656	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.112	SD (KM)	0.0324
Variance (KM)	0.00105	SE of Mean (KM)	0.00889
k hat (KM)	11.81	k star (KM)	10.07
nu hat (KM)	472.4	nu star (KM)	402.8
theta hat (KM)	0.00944	theta star (KM)	0.0111
80% gamma percentile (KM)	0.139	90% gamma percentile (KM)	0.158
95% gamma percentile (KM)	0.175	99% gamma percentile (KM)	0.209

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (402.85, α)	357.3	Adjusted Chi Square Value (402.85, β)	353.9
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UCL Statistics for Baseline Soil Samples

95% KM Approximate Gamma UCL 0.126 95% KM Adjusted Gamma UCL 0.127

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.789	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.342	Lilliefors GOF Test
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level
Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0595	Mean in Log Scale	-3.208
SD in Original Scale	0.0582	SD in Log Scale	0.908
95% t UCL (assumes normality of ROS data)	0.082	95% Percentile Bootstrap UCL	0.0818
95% BCA Bootstrap UCL	0.0865	95% Bootstrap t UCL	0.0934
95% H-UCL (Log ROS)	0.103		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.222	KM Geo Mean	0.108
KM SD (logged)	0.214	95% Critical H Value (KM-Log)	1.794
KM Standard Error of Mean (logged)	0.0585	95% H-UCL (KM -Log)	0.121
KM SD (logged)	0.214	95% Critical H Value (KM-Log)	1.794
KM Standard Error of Mean (logged)	0.0585		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 0.069
 SD in Original Scale 0.0497
 95% t UCL (Assumes normality) 0.0882

DL/2 Log-Transformed

Mean in Log Scale -2.811
 SD in Log Scale 0.461
 95% H-Stat UCL 0.0825

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.127

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sodium

General Statistics

Total Number of Observations	20	Number of Distinct Observations	14
Number of Detects	15	Number of Non-Detects	5
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	55	Minimum Non-Detect	50
Maximum Detect	172	Maximum Non-Detect	50
Variance Detects	1763	Percent Non-Detects	25%
Mean Detects	92.13	SD Detects	41.98
Median Detects	71	CV Detects	0.456
Skewness Detects	0.801	Kurtosis Detects	-0.973
Mean of Logged Detects	4.434	SD of Logged Detects	0.429

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.813	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.835	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.267	Lilliefors GOF Test
1% Lilliefors Critical Value	0.255	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	81.6	KM Standard Error of Mean	9.161
90KM SD	39.58	95% KM (BCA) UCL	96.05
95% KM (t) UCL	97.44	95% KM (Percentile Bootstrap) UCL	96.5
95% KM (z) UCL	96.67	95% KM Bootstrap t UCL	101.7
90% KM Chebyshev UCL	109.1	95% KM Chebyshev UCL	121.5
97.5% KM Chebyshev UCL	138.8	99% KM Chebyshev UCL	172.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.197	Anderson-Darling GOF Test
5% A-D Critical Value	0.738	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.259	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.222	Detected Data Not Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Soil Samples
Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.734	k star (bias corrected MLE)	4.632
Theta hat (MLE)	16.07	Theta star (bias corrected MLE)	19.89
nu hat (MLE)	172	nu star (bias corrected)	139
Mean (detects)	92.13		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	72.67
Maximum	172	Median	59.5
SD	50.22	CV	0.691
k hat (MLE)	0.911	k star (bias corrected MLE)	0.808
Theta hat (MLE)	79.78	Theta star (bias corrected MLE)	89.99
nu hat (MLE)	36.44	nu star (bias corrected)	32.3
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (32.30, α)	20.31	Adjusted Chi Square Value (32.30, β)	19.56
95% Gamma Approximate UCL	115.6	95% Gamma Adjusted UCL	120

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	81.6	SD (KM)	39.58
Variance (KM)	1567	SE of Mean (KM)	9.161
k hat (KM)	4.25	k star (KM)	3.646
nu hat (KM)	170	nu star (KM)	145.8
theta hat (KM)	19.2	theta star (KM)	22.38
80% gamma percentile (KM)	113.7	90% gamma percentile (KM)	138.9
95% gamma percentile (KM)	162.2	99% gamma percentile (KM)	212.1

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (145.84, α)	118.9	Adjusted Chi Square Value (145.84, β)	117
95% KM Approximate Gamma UCL	100.1	95% KM Adjusted Gamma UCL	101.7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.828	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.252	Lilliefors GOF Test
10% Lilliefors Critical Value	0.202	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	76.94	Mean in Log Scale	4.181
SD in Original Scale	45.14	SD in Log Scale	0.589
95% t UCL (assumes normality of ROS data)	94.39	95% Percentile Bootstrap UCL	94.07
95% BCA Bootstrap UCL	95.51	95% Bootstrap t UCL	96.25
95% H-UCL (Log ROS)	103.6		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.303	KM Geo Mean	73.93
KM SD (logged)	0.424	95% Critical H Value (KM-Log)	1.949
KM Standard Error of Mean (logged)	0.0981	95% H-UCL (KM -Log)	97.77
KM SD (logged)	0.424	95% Critical H Value (KM-Log)	1.949
KM Standard Error of Mean (logged)	0.0981		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	75.35	Mean in Log Scale	4.13
SD in Original Scale	46.78	SD in Log Scale	0.653
95% t UCL (Assumes normality)	93.44	95% H-Stat UCL	106.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	97.44
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Strontium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	5.75	Mean	13.95
Maximum	25.8	Median	13.4
SD	5.421	Std. Error of Mean	1.212
Coefficient of Variation	0.389	Skewness	0.378
Normal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.138	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	16.05	95% Adjusted-CLT UCL (Chen-1995)	16.06
		95% Modified-t UCL (Johnson-1978)	16.07
Gamma GOF Test			
A-D Test Statistic	0.303	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.118	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.517	k star (bias corrected MLE)	5.573
Theta hat (MLE)	2.141	Theta star (bias corrected MLE)	2.504
nu hat (MLE)	260.7	nu star (bias corrected)	222.9
MLE Mean (bias corrected)	13.95	MLE Sd (bias corrected)	5.911
		Approximate Chi Square Value (0.05)	189.4
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	186.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	16.43	95% Adjusted Gamma UCL	16.64
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.145	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.749	Mean of logged Data	2.557
Maximum of Logged Data	3.25	SD of logged Data	0.422
Assuming Lognormal Distribution			
95% H-UCL	17.02	90% Chebyshev (MVUE) UCL	18.1
95% Chebyshev (MVUE) UCL	19.95	97.5% Chebyshev (MVUE) UCL	22.51
99% Chebyshev (MVUE) UCL	27.54		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.95	95% BCA Bootstrap UCL	16
95% Standard Bootstrap UCL	15.91	95% Bootstrap-t UCL	16.21
95% Hall's Bootstrap UCL	16.15	95% Percentile Bootstrap UCL	15.87
90% Chebyshev(Mean, Sd) UCL	17.59	95% Chebyshev(Mean, Sd) UCL	19.24
97.5% Chebyshev(Mean, Sd) UCL	21.52	99% Chebyshev(Mean, Sd) UCL	26.01
Suggested UCL to Use			
95% Student's-t UCL	16.05		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Sulfur

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Sulfur was not processed!

Thallium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.058	Minimum Non-Detect	0.05
Maximum Detect	0.182	Maximum Non-Detect	0.05
Variance Detects	0.00184	Percent Non-Detects	50%
Mean Detects	0.101	SD Detects	0.0429
Median Detects	0.0853	CV Detects	0.424
Skewness Detects	0.904	Kurtosis Detects	-0.382
Mean of Logged Detects	-2.366	SD of Logged Detects	0.402

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.781	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.234	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.304	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0756	KM Standard Error of Mean	0.00907
90KM SD	0.0385	95% KM (BCA) UCL	0.0906
95% KM (t) UCL	0.0913	95% KM (Percentile Bootstrap) UCL	0.0908
95% KM (z) UCL	0.0905	95% KM Bootstrap t UCL	0.0975
90% KM Chebyshev UCL	0.103	95% KM Chebyshev UCL	0.115
97.5% KM Chebyshev UCL	0.132	99% KM Chebyshev UCL	0.166

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.374	Anderson-Darling GOF Test	
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.206	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.802	k star (bias corrected MLE)	4.828
Theta hat (MLE)	0.0149	Theta star (bias corrected MLE)	0.0209
nu hat (MLE)	136	nu star (bias corrected)	96.56
Mean (detects)	0.101		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0584
Maximum	0.182	Median	0.0466
SD	0.0533	CV	0.912
k hat (MLE)	1.173	k star (bias corrected MLE)	1.03
Theta hat (MLE)	0.0498	Theta star (bias corrected MLE)	0.0567
nu hat (MLE)	46.92	nu star (bias corrected)	41.22
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (41.22, α)	27.5	Adjusted Chi Square Value (41.22, β)	26.62
95% Gamma Approximate UCL	0.0875	95% Gamma Adjusted UCL	0.0904

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0756	SD (KM)	0.0385
Variance (KM)	0.00148	SE of Mean (KM)	0.00907
k hat (KM)	3.855	k star (KM)	3.31

UCL Statistics for Baseline Soil Samples

nu hat (KM)	154.2	nu star (KM)	132.4
theta hat (KM)	0.0196	theta star (KM)	0.0228
80% gamma percentile (KM)	0.107	90% gamma percentile (KM)	0.131
95% gamma percentile (KM)	0.154	99% gamma percentile (KM)	0.204

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (132.41, α)	106.8	Adjusted Chi Square Value (132.41, β)	105
95% KM Approximate Gamma UCL	0.0937	95% KM Adjusted Gamma UCL	0.0953

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.932	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.869	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors GOF Test
10% Lilliefors Critical Value	0.241	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0658	Mean in Log Scale	-2.961
SD in Original Scale	0.0473	SD in Log Scale	0.724
95% t UCL (assumes normality of ROS data)	0.0841	95% Percentile Bootstrap UCL	0.0835
95% BCA Bootstrap UCL	0.0858	95% Bootstrap t UCL	0.0879
95% H-UCL (Log ROS)	0.098		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.681	KM Geo Mean	0.0685
KM SD (logged)	0.415	95% Critical H Value (KM-Log)	1.941
KM Standard Error of Mean (logged)	0.0977	95% H-UCL (KM -Log)	0.0898
KM SD (logged)	0.415	95% Critical H Value (KM-Log)	1.941
KM Standard Error of Mean (logged)	0.0977		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0631	Mean in Log Scale	-3.028
SD in Original Scale	0.049	SD in Log Scale	0.733
95% t UCL (Assumes normality)	0.082	95% H-Stat UCL	0.0929

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0913

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tin

General Statistics

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tin was not processed!

UCL Statistics for Baseline Soil Samples

Titanium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	77.6	Mean	469.1
Maximum	953	Median	479.3
SD	228.8	Std. Error of Mean	51.17
Coefficient of Variation	0.488	Skewness	0.361
Normal GOF Test			
Shapiro Wilk Test Statistic	0.959	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.167	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	557.5	95% Adjusted-CLT UCL (Chen-1995)	557.6
		95% Modified-t UCL (Johnson-1978)	558.2
Gamma GOF Test			
A-D Test Statistic	0.364	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.131	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.753	k star (bias corrected MLE)	3.224
Theta hat (MLE)	125	Theta star (bias corrected MLE)	145.5
nu hat (MLE)	150.1	nu star (bias corrected)	128.9
MLE Mean (bias corrected)	469.1	MLE Sd (bias corrected)	261.2
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	103.7
		Adjusted Chi Square Value	101.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	583.2	95% Adjusted Gamma UCL	593.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.145	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.352	Mean of logged Data	6.012
Maximum of Logged Data	6.86	SD of logged Data	0.589
Assuming Lognormal Distribution			
95% H-UCL	645.7	90% Chebyshev (MVUE) UCL	680
95% Chebyshev (MVUE) UCL	770.3	97.5% Chebyshev (MVUE) UCL	895.6
99% Chebyshev (MVUE) UCL	1142		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	553.2	95% BCA Bootstrap UCL	552.6
95% Standard Bootstrap UCL	550.6	95% Bootstrap-t UCL	564
95% Hall's Bootstrap UCL	558.2	95% Percentile Bootstrap UCL	549.8
90% Chebyshev(Mean, Sd) UCL	622.6	95% Chebyshev(Mean, Sd) UCL	692.1
97.5% Chebyshev(Mean, Sd) UCL	788.6	99% Chebyshev(Mean, Sd) UCL	978.2
Suggested UCL to Use			
95% Student's-t UCL	557.5		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tungsten

UCL Statistics for Baseline Soil Samples

General Statistics

Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tungsten was not processed!

Uranium

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.157	Mean	0.45
Maximum	0.851	Median	0.484
SD	0.21	Std. Error of Mean	0.0469
Coefficient of Variation	0.466	Skewness	0.249

Normal GOF Test

Shapiro Wilk Test Statistic	0.933
1% Shapiro Wilk Critical Value	0.868
Lilliefors Test Statistic	0.136
1% Lilliefors Critical Value	0.223

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.531

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.53
95% Modified-t UCL (Johnson-1978) 0.532

Gamma GOF Test

A-D Test Statistic	0.665
5% A-D Critical Value	0.745
K-S Test Statistic	0.201
5% K-S Critical Value	0.195

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.252
Theta hat (MLE)	0.106
nu hat (MLE)	170.1
MLE Mean (bias corrected)	0.45
Adjusted Level of Significance	0.038

k star (bias corrected MLE)	3.647
Theta star (bias corrected MLE)	0.123
nu star (bias corrected)	145.9
MLE Sd (bias corrected)	0.236
Approximate Chi Square Value (0.05)	119
Adjusted Chi Square Value	117.1

Assuming Gamma Distribution

95% Approximate Gamma UCL 0.552

95% Adjusted Gamma UCL 0.561

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.905
10% Shapiro Wilk Critical Value	0.92
Lilliefors Test Statistic	0.228
10% Lilliefors Critical Value	0.176

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.852
Maximum of Logged Data	-0.161

Mean of logged Data	-0.92
SD of logged Data	0.535

Assuming Lognormal Distribution

95% H-UCL	0.591
95% Chebyshev (MVUE) UCL	0.704
99% Chebyshev (MVUE) UCL	1.021

90% Chebyshev (MVUE) UCL	0.626
97.5% Chebyshev (MVUE) UCL	0.811

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.527
95% Standard Bootstrap UCL	0.524
95% Hall's Bootstrap UCL	0.53

95% BCA Bootstrap UCL	0.528
95% Bootstrap-t UCL	0.531
95% Percentile Bootstrap UCL	0.525

UCL Statistics for Baseline Soil Samples

90% Chebyshev(Mean, Sd) UCL	0.591	95% Chebyshev(Mean, Sd) UCL	0.655
97.5% Chebyshev(Mean, Sd) UCL	0.743	99% Chebyshev(Mean, Sd) UCL	0.917

Suggested UCL to Use

95% Student's-t UCL 0.531

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	4.75	Mean	17.5
Maximum	45.4	Median	13.85
SD	11.58	Std. Error of Mean	2.589
Coefficient of Variation	0.662	Skewness	1.159

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.879	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.177	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	22.48
95% Student's-t UCL	21.98	95% Modified-t UCL (Johnson-1978)	22.09

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.293	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.749	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.136	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.195		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	2.691	k star (bias corrected MLE)	2.321
Theta hat (MLE)	6.504	Theta star (bias corrected MLE)	7.542
nu hat (MLE)	107.6	nu star (bias corrected)	92.83
MLE Mean (bias corrected)	17.5	MLE Sd (bias corrected)	11.49
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	71.61
		Adjusted Chi Square Value	70.14

Assuming Gamma Distribution		Assuming Gamma Distribution	
95% Approximate Gamma UCL	22.69	95% Adjusted Gamma UCL	23.17

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.976	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.92	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.1	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.176		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics		Lognormal Statistics	
Minimum of Logged Data	1.558	Mean of logged Data	2.665
Maximum of Logged Data	3.816	SD of logged Data	0.646

Assuming Lognormal Distribution		Assuming Lognormal Distribution	
95% H-UCL	24.44	90% Chebyshev (MVUE) UCL	25.52
95% Chebyshev (MVUE) UCL	29.15	97.5% Chebyshev (MVUE) UCL	34.2
99% Chebyshev (MVUE) UCL	44.11		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs		Nonparametric Distribution Free UCLs	
95% CLT UCL	21.76	95% BCA Bootstrap UCL	22.25
95% Standard Bootstrap UCL	21.66	95% Bootstrap-t UCL	23.33
95% Hall's Bootstrap UCL	22.75	95% Percentile Bootstrap UCL	21.65
90% Chebyshev(Mean, Sd) UCL	25.27	95% Chebyshev(Mean, Sd) UCL	28.79

UCL Statistics for Baseline Soil Samples

97.5% Chebyshev(Mean, Sd) UCL 33.67

99% Chebyshev(Mean, Sd) UCL 43.27

Suggested UCL to Use

95% Student's-t UCL 21.98

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zinc

UCL Statistics for Baseline Soil Samples

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	2.9	Mean	20.6
Maximum	59.3	Median	16.4
SD	14.11	Std. Error of Mean	3.156
Coefficient of Variation	0.685	Skewness	1.178
Normal GOF Test			
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.156	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	26.05	95% Adjusted-CLT UCL (Chen-1995)	26.67
		95% Modified-t UCL (Johnson-1978)	26.19
Gamma GOF Test			
A-D Test Statistic	0.349	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.145	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.196	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.32	k star (bias corrected MLE)	2.005
Theta hat (MLE)	8.878	Theta star (bias corrected MLE)	10.27
nu hat (MLE)	92.79	nu star (bias corrected)	80.2
MLE Mean (bias corrected)	20.6	MLE Sd (bias corrected)	14.54
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	60.57
		Adjusted Chi Square Value	59.22
Assuming Gamma Distribution			
95% Approximate Gamma UCL	27.27	95% Adjusted Gamma UCL	27.89
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.117	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.065	Mean of logged Data	2.794
Maximum of Logged Data	4.083	SD of logged Data	0.728
Assuming Lognormal Distribution			
95% H-UCL	31.16	90% Chebyshev (MVUE) UCL	31.96
95% Chebyshev (MVUE) UCL	36.94	97.5% Chebyshev (MVUE) UCL	43.85
99% Chebyshev (MVUE) UCL	57.41		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	25.79	95% BCA Bootstrap UCL	26.52
95% Standard Bootstrap UCL	25.65	95% Bootstrap-t UCL	27.42
95% Hall's Bootstrap UCL	27.64	95% Percentile Bootstrap UCL	25.89
90% Chebyshev(Mean, Sd) UCL	30.06	95% Chebyshev(Mean, Sd) UCL	34.35
97.5% Chebyshev(Mean, Sd) UCL	40.3	99% Chebyshev(Mean, Sd) UCL	51.99
Suggested UCL to Use			
95% Student's-t UCL	26.05		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

UCL Statistics for Baseline Soil Samples

General Statistics

Total Number of Observations	20	Number of Distinct Observations	10
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	1
Maximum Detect	3.2	Maximum Non-Detect	1
Variance Detects	0.393	Percent Non-Detects	45%
Mean Detects	1.945	SD Detects	0.627
Median Detects	1.9	CV Detects	0.322
Skewness Detects	0.624	Kurtosis Detects	-0.0416
Mean of Logged Detects	0.619	SD of Logged Detects	0.321

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.955	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.792	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.164	Lilliefors GOF Test
1% Lilliefors Critical Value	0.291	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.52	KM Standard Error of Mean	0.152
90KM SD	0.646	95% KM (BCA) UCL	1.755
95% KM (t) UCL	1.782	95% KM (Percentile Bootstrap) UCL	1.765
95% KM (z) UCL	1.769	95% KM Bootstrap t UCL	1.842
90% KM Chebyshev UCL	1.975	95% KM Chebyshev UCL	2.181
97.5% KM Chebyshev UCL	2.466	99% KM Chebyshev UCL	3.028

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.204	Anderson-Darling GOF Test
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.255	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	10.87	k star (bias corrected MLE)	7.968
Theta hat (MLE)	0.179	Theta star (bias corrected MLE)	0.244
nu hat (MLE)	239.2	nu star (bias corrected)	175.3
Mean (detects)	1.945		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.287
Maximum	3.2	Median	1.2
SD	0.903	CV	0.702
k hat (MLE)	1.124	k star (bias corrected MLE)	0.989
Theta hat (MLE)	1.145	Theta star (bias corrected MLE)	1.301
nu hat (MLE)	44.97	nu star (bias corrected)	39.56
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (39.56, α)	26.15	Adjusted Chi Square Value (39.56, β)	25.29
95% Gamma Approximate UCL	1.947	95% Gamma Adjusted UCL	2.013

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.52	SD (KM)	0.646
Variance (KM)	0.418	SE of Mean (KM)	0.152
k hat (KM)	5.533	k star (KM)	4.736
nu hat (KM)	221.3	nu star (KM)	189.4
theta hat (KM)	0.275	theta star (KM)	0.321
80% gamma percentile (KM)	2.056	90% gamma percentile (KM)	2.455
95% gamma percentile (KM)	2.821	99% gamma percentile (KM)	3.594

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (189.44, α)	158.6	Adjusted Chi Square Value (189.44, β)	156.4
95% KM Approximate Gamma UCL	1.816	95% KM Adjusted Gamma UCL	1.841

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.978	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.876	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.133	Lilliefors GOF Test
10% Lilliefors Critical Value	0.231	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Soil Samples

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.424	Mean in Log Scale	0.218
SD in Original Scale	0.758	SD in Log Scale	0.543
95% t UCL (assumes normality of ROS data)	1.717	95% Percentile Bootstrap UCL	1.711
95% BCA Bootstrap UCL	1.728	95% Bootstrap t UCL	1.742
95% H-UCL (Log ROS)	1.863		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.34	KM Geo Mean	1.405
KM SD (logged)	0.383	95% Critical H Value (KM-Log)	1.914
KM Standard Error of Mean (logged)	0.0897	95% H-UCL (KM -Log)	1.789
KM SD (logged)	0.383	95% Critical H Value (KM-Log)	1.914
KM Standard Error of Mean (logged)	0.0897		

	DL/2 Statistics		
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.295	Mean in Log Scale	0.0284
SD in Original Scale	0.867	SD in Log Scale	0.709
95% t UCL (Assumes normality)	1.63	95% H-Stat UCL	1.906

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 1.782

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Arsenic, IVBA (leachate)

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
Number of Detects	18	Number of Non-Detects	2
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	0.52	Minimum Non-Detect	10
Maximum Detect	5.01	Maximum Non-Detect	10
Variance Detects	1.032	Percent Non-Detects	10%
Mean Detects	1.543	SD Detects	1.016
Median Detects	1.36	CV Detects	0.658
Skewness Detects	2.474	Kurtosis Detects	8.014
Mean of Logged Detects	0.284	SD of Logged Detects	0.539

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.749	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.858	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.188	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.235	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	1.543	KM Standard Error of Mean	0.239
90KM SD	0.987	95% KM (BCA) UCL	1.989
95% KM (t) UCL	1.957	95% KM (Percentile Bootstrap) UCL	1.969
95% KM (z) UCL	1.937	95% KM Bootstrap t UCL	2.222
90% KM Chebyshev UCL	2.261	95% KM Chebyshev UCL	2.586
97.5% KM Chebyshev UCL	3.038	99% KM Chebyshev UCL	3.925

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.433	Anderson-Darling GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.122	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	3.499	k star (bias corrected MLE)	2.953
Theta hat (MLE)	0.441	Theta star (bias corrected MLE)	0.522
nu hat (MLE)	126	nu star (bias corrected)	106.3
Mean (detects)	1.543		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.52	Mean	1.532
Maximum	5.01	Median	1.36
SD	0.971	CV	0.634
k hat (MLE)	3.739	k star (bias corrected MLE)	3.212
Theta hat (MLE)	0.41	Theta star (bias corrected MLE)	0.477
nu hat (MLE)	149.6	nu star (bias corrected)	128.5
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (128.47, α)	103.3	Adjusted Chi Square Value (128.47, β)	101.5
95% Gamma Approximate UCL	1.906	95% Gamma Adjusted UCL	1.94

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	1.543	SD (KM)	0.987
Variance (KM)	0.974	SE of Mean (KM)	0.239
k hat (KM)	2.443	k star (KM)	2.11
nu hat (KM)	97.72	nu star (KM)	84.39
theta hat (KM)	0.632	theta star (KM)	0.731
80% gamma percentile (KM)	2.295	90% gamma percentile (KM)	2.963
95% gamma percentile (KM)	3.598	99% gamma percentile (KM)	5.003

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (84.39, α)	64.22	Adjusted Chi Square Value (84.39, β)	62.83
95% KM Approximate Gamma UCL	2.027	95% KM Adjusted Gamma UCL	2.072

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.963	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.109	Lilliefors GOF Test	

UCL Statistics for Baseline Soil Samples
 10% Lilliefors Critical Value 0.185 Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.526	Mean in Log Scale	0.284
SD in Original Scale	0.969	SD in Log Scale	0.517
95% t UCL (assumes normality of ROS data)	1.9	95% Percentile Bootstrap UCL	1.906
95% BCA Bootstrap UCL	2.071	95% Bootstrap t UCL	2.158
95% H-UCL (Log ROS)	1.933		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.284	KM Geo Mean	1.328
KM SD (logged)	0.524	95% Critical H Value (KM-Log)	2.043
KM Standard Error of Mean (logged)	0.127	95% H-UCL (KM -Log)	1.948
KM SD (logged)	0.524	95% Critical H Value (KM-Log)	2.043
KM Standard Error of Mean (logged)	0.127		

DL/2 Normal	DL/2 Statistics	DL/2 Log-Transformed	
Mean in Original Scale	1.889	Mean in Log Scale	0.416
SD in Original Scale	1.434	SD in Log Scale	0.653
95% t UCL (Assumes normality)	2.443	95% H-Stat UCL	2.603

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use
 95% KM (t) UCL 1.957

When a data set follows an approximate distribution passing only one of the GOF tests,
 it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic, IVBA (%)

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	10.8	Mean	24.34
Maximum	47.2	Median	22.7
SD	9.152	Std. Error of Mean	2.047
Coefficient of Variation	0.376	Skewness	0.714

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.956	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.868	Lilliefors GOF Test	
Lilliefors Test Statistic	0.109	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.223		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	28.06
95% Student's-t UCL	27.88	95% Modified-t UCL (Johnson-1978)	27.94

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.151	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.743	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0897	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.194		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma GOF Test	
k hat (MLE)	7.612	k star (bias corrected MLE)	6.504
Theta hat (MLE)	3.198	Theta star (bias corrected MLE)	3.743
nu hat (MLE)	304.5	nu star (bias corrected)	260.1
MLE Mean (bias corrected)	24.34	MLE Sd (bias corrected)	9.545
		Approximate Chi Square Value (0.05)	223.8
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	221.1

**UCL Statistics for Baseline Soil Samples
Assuming Gamma Distribution**

95% Approximate Gamma UCL 28.3 95% Adjusted Gamma UCL 28.64

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.987	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0842	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.38	Mean of logged Data	3.125
Maximum of Logged Data	3.854	SD of logged Data	0.379

Assuming Lognormal Distribution

95% H-UCL	28.89	90% Chebyshev (MVUE) UCL	30.71
95% Chebyshev (MVUE) UCL	33.58	97.5% Chebyshev (MVUE) UCL	37.56
99% Chebyshev (MVUE) UCL	45.39		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	27.71	95% BCA Bootstrap UCL	28.13
95% Standard Bootstrap UCL	27.55	95% Bootstrap-t UCL	28.33
95% Hall's Bootstrap UCL	28.32	95% Percentile Bootstrap UCL	27.58
90% Chebyshev(Mean, Sd) UCL	30.48	95% Chebyshev(Mean, Sd) UCL	33.26
97.5% Chebyshev(Mean, Sd) UCL	37.12	99% Chebyshev(Mean, Sd) UCL	44.71

Suggested UCL to Use

95% Student's-t UCL 27.88

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic, IVBA (leachate-aqueous?)

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
Number of Detects	18	Number of Non-Detects	2
Number of Distinct Detects	18	Number of Distinct Non-Detects	1
Minimum Detect	0.0054	Minimum Non-Detect	0.1
Maximum Detect	0.0496	Maximum Non-Detect	0.1
Variance Detects	9.7092E-5	Percent Non-Detects	10%
Mean Detects	0.0146	SD Detects	0.00985
Median Detects	0.0121	CV Detects	0.675
Skewness Detects	2.848	Kurtosis Detects	9.908
Mean of Logged Detects	-4.368	SD of Logged Detects	0.508

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.693	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.858	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.202	Lilliefors GOF Test
1% Lilliefors Critical Value	0.235	Detected Data appear Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0146	KM Standard Error of Mean	0.00232
90KM SD	0.00958	95% KM (BCA) UCL	0.0193
95% KM (t) UCL	0.0186	95% KM (Percentile Bootstrap) UCL	0.0189
95% KM (z) UCL	0.0184	95% KM Bootstrap t UCL	0.0225
90% KM Chebyshev UCL	0.0216	95% KM Chebyshev UCL	0.0247
97.5% KM Chebyshev UCL	0.0291	99% KM Chebyshev UCL	0.0377

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.577	Anderson-Darling GOF Test
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.124	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.716	k star (bias corrected MLE)	3.134
Theta hat (MLE)	0.00393	Theta star (bias corrected MLE)	0.00466

UCL Statistics for Baseline Soil Samples

nu hat (MLE)	133.8	nu star (bias corrected)	112.8
Mean (detects)	0.0146		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0054	Mean	0.0145
Maximum	0.0496	Median	0.0121
SD	0.00941	CV	0.648
k hat (MLE)	3.986	k star (bias corrected MLE)	3.422
Theta hat (MLE)	0.00364	Theta star (bias corrected MLE)	0.00424
nu hat (MLE)	159.5	nu star (bias corrected)	136.9
Adjusted Level of Significance (β)	0.038		
Approximate Chi Square Value (136.87, α)	110.8	Adjusted Chi Square Value (136.87, β)	109
95% Gamma Approximate UCL	0.0179	95% Gamma Adjusted UCL	0.0182

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0146	SD (KM)	0.00958
Variance (KM)	9.1698E-5	SE of Mean (KM)	0.00232
k hat (KM)	2.323	k star (KM)	2.008
nu hat (KM)	92.91	nu star (KM)	80.31
theta hat (KM)	0.00628	theta star (KM)	0.00727
80% gamma percentile (KM)	0.0218	90% gamma percentile (KM)	0.0284
95% gamma percentile (KM)	0.0346	99% gamma percentile (KM)	0.0484

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (80.31, α)	60.66	Adjusted Chi Square Value (80.31, β)	59.31
95% KM Approximate Gamma UCL	0.0193	95% KM Adjusted Gamma UCL	0.0198

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948
10% Shapiro Wilk Critical Value	0.914
Lilliefors Test Statistic	0.105
10% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0144	Mean in Log Scale	-4.368
SD in Original Scale	0.00939	SD in Log Scale	0.486
95% t UCL (assumes normality of ROS data)	0.0181	95% Percentile Bootstrap UCL	0.0182
95% BCA Bootstrap UCL	0.0198	95% Bootstrap t UCL	0.0214
95% H-UCL (Log ROS)	0.0179		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.368	KM Geo Mean	0.0127
KM SD (logged)	0.493	95% Critical H Value (KM-Log)	2.013
KM Standard Error of Mean (logged)	0.12	95% H-UCL (KM -Log)	0.018
KM SD (logged)	0.493	95% Critical H Value (KM-Log)	2.013
KM Standard Error of Mean (logged)	0.12		

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0181	Mean in Log Scale	-4.23
SD in Original Scale	0.0143	SD in Log Scale	0.639
95% t UCL (Assumes normality)	0.0237	95% H-Stat UCL	0.0245

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0186

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Acenaphthene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Acenaphthene was not processed!

Acenaphthylene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Acenaphthylene was not processed!

Acridine

General Statistics			
Total Number of Observations	18	Number of Distinct Observations	1
Number of Detects	0	Number of Missing Observations	2
Number of Distinct Detects	0	Number of Non-Detects	18
		Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Acridine was not processed!

Anthracene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Anthracene was not processed!

Benz(a)anthracene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Benz(a)anthracene was not processed!

Benzo(a)pyrene

General Statistics

UCL Statistics for Baseline Soil Samples

Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Benzo(a)pyrene was not processed!

Benzo(b+j)fluoranthene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Benzo(b+j)fluoranthene was not processed!

Benzo(b+j+k)fluoranthene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Benzo(b+j+k)fluoranthene was not processed!

Benzo(g,h,i)perylene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Benzo(g,h,i)perylene was not processed!

Benzo(k)fluoranthene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Benzo(k)fluoranthene was not processed!

Chrysene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

UCL Statistics for Baseline Soil Samples
The data set for variable Chrysene was not processed!

Dibenz(a,h)anthracene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Dibenz(a,h)anthracene was not processed!

Fluoranthene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Fluoranthene was not processed!

Fluorene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Fluorene was not processed!

Indeno(1,2,3-c,d)pyrene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Indeno(1,2,3-c,d)pyrene was not processed!

Methylnaphthalene, 1+2-

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Methylnaphthalene, 1+2- was not processed!

Methylnaphthalene, 1-

UCL Statistics for Baseline Soil Samples

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Methylnaphthalene, 1- was not processed!

Methylnaphthalene, 2-

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Methylnaphthalene, 2- was not processed!

Naphthalene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Naphthalene was not processed!

Perylene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Perylene was not processed!

UCL Statistics for Baseline Soil Samples

Phenanthrene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	18
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.015	Minimum Non-Detect	0.01
Maximum Detect	0.1	Maximum Non-Detect	0.01
Variance Detects	0.00361	Percent Non-Detects	90%
Mean Detects	0.0575	SD Detects	0.0601
Median Detects	0.0575	CV Detects	1.045
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.251	SD of Logged Detects	1.341

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

**Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test**

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0148	KM Standard Error of Mean	0.00619
90KM SD	0.0196	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0255	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0249	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0333	95% KM Chebyshev UCL	0.0418
97.5% KM Chebyshev UCL	0.0534	99% KM Chebyshev UCL	0.0764

**Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test**

Gamma Statistics on Detected Data Only

k hat (MLE)	1.409	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0408	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	5.635	nu star (bias corrected)	N/A
Mean (detects)	0.0575		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0148	SD (KM)	0.0196
Variance (KM)	3.8369E-4	SE of Mean (KM)	0.00619
k hat (KM)	0.567	k star (KM)	0.515
nu hat (KM)	22.68	nu star (KM)	20.61
theta hat (KM)	0.026	theta star (KM)	0.0286
80% gamma percentile (KM)	0.0243	90% gamma percentile (KM)	0.0397
95% gamma percentile (KM)	0.0561	99% gamma percentile (KM)	0.0963

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (20.61, α)	11.3	Adjusted Level of Significance (β)	0.038
95% KM Approximate Gamma UCL	0.0269	Adjusted Chi Square Value (20.61, β)	10.76
		95% KM Adjusted Gamma UCL	0.0283

**Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test**

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00584	Mean in Log Scale	-12.69
SD in Original Scale	0.0224	SD in Log Scale	5.254
95% t UCL (assumes normality of ROS data)	0.0145	95% Percentile Bootstrap UCL	0.0151
95% BCA Bootstrap UCL	0.0216	95% Bootstrap t UCL	0.5
95% H-UCL (Log ROS)	965997		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.47	KM Geo Mean	0.0114
KM SD (logged)	0.505	95% Critical H Value (KM-Log)	2.024
KM Standard Error of Mean (logged)	0.16	95% H-UCL (KM -Log)	0.0164
KM SD (logged)	0.505	95% Critical H Value (KM-Log)	2.024
KM Standard Error of Mean (logged)	0.16		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0103
SD in Original Scale	0.0212
95% t UCL (Assumes normality)	0.0185

DL/2 Log-Transformed

Mean in Log Scale	-5.094
SD in Log Scale	0.701
95% H-Stat UCL	0.0112

DL/2 is not a recommended method, provided for comparisons and historical reasons

UCL Statistics for Baseline Soil Samples

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0255

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Pyrene

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Pyrene was not processed!

Quinoline

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	20
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Quinoline was not processed!

B(a)P total potency equivalents [B(a)P TPE] 1

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable B(a)P total potency equivalents [B(a)P TPE] 1 was not processed!

IACR (CCME) 2

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	18
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.225	Minimum Non-Detect	0.15
Maximum Detect	0.68	Maximum Non-Detect	0.15
Variance Detects	0.104	Percent Non-Detects	90%
Mean Detects	0.453	SD Detects	0.322
Median Detects	0.453	CV Detects	0.711
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-0.939	SD of Logged Detects	0.782

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

UCL Statistics for Baseline Soil Samples
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.18	KM Standard Error of Mean	0.0366
90KM SD	0.116	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.244	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.24	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.29	95% KM Chebyshev UCL	0.34
97.5% KM Chebyshev UCL	0.409	99% KM Chebyshev UCL	0.545

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	3.59	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.126	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	14.36	nu star (bias corrected)	N/A
Mean (detects)	0.453		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.18	SD (KM)	0.116
Variance (KM)	0.0134	SE of Mean (KM)	0.0366
k hat (KM)	2.423	k star (KM)	2.093
nu hat (KM)	96.9	nu star (KM)	83.7
theta hat (KM)	0.0744	theta star (KM)	0.0861
80% gamma percentile (KM)	0.268	90% gamma percentile (KM)	0.347
95% gamma percentile (KM)	0.421	99% gamma percentile (KM)	0.587

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (83.70, α)	63.62	Adjusted Level of Significance (β)	0.038
95% KM Approximate Gamma UCL	0.237	Adjusted Chi Square Value (83.70, β)	62.23
		95% KM Adjusted Gamma UCL	0.242

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0513	Mean in Log Scale	-6.443
SD in Original Scale	0.156	SD in Log Scale	3.063
95% t UCL (assumes normality of ROS data)	0.112	95% Percentile Bootstrap UCL	0.11
95% BCA Bootstrap UCL	0.154	95% Bootstrap t UCL	0.63
95% H-UCL (Log ROS)	14.34		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.801	KM Geo Mean	0.165
KM SD (logged)	0.337	95% Critical H Value (KM-Log)	1.878
KM Standard Error of Mean (logged)	0.106	95% H-UCL (KM -Log)	0.202
KM SD (logged)	0.337	95% Critical H Value (KM-Log)	1.878
KM Standard Error of Mean (logged)	0.106		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.113
SD in Original Scale	0.138
95% t UCL (Assumes normality)	0.166

DL/2 Log-Transformed

Mean in Log Scale	-2.425
SD in Log Scale	0.539
95% H-Stat UCL	0.132

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.244

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Acridine-d9

General Statistics

Total Number of Observations	18	Number of Distinct Observations	17
		Number of Missing Observations	2
Minimum	7.3	Mean	60.49
Maximum	106	Median	75

UCL Statistics for Baseline Soil Samples

SD	37.23	Std. Error of Mean	8.775
Coefficient of Variation	0.615	Skewness	-0.354

Normal GOF Test

Shapiro Wilk Test Statistic	0.867
1% Shapiro Wilk Critical Value	0.858
Lilliefors Test Statistic	0.196
1% Lilliefors Critical Value	0.235

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 75.76

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	74.14
95% Modified-t UCL (Johnson-1978)	75.63

Gamma GOF Test

A-D Test Statistic	1.312
5% A-D Critical Value	0.755
K-S Test Statistic	0.234
5% K-S Critical Value	0.207

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.65
Theta hat (MLE)	36.67
nu hat (MLE)	59.39
MLE Mean (bias corrected)	60.49
Adjusted Level of Significance	0.0357

k star (bias corrected MLE)	1.412
Theta star (bias corrected MLE)	42.85
nu star (bias corrected)	50.83
MLE Sd (bias corrected)	50.91
Approximate Chi Square Value (0.05)	35.45
Adjusted Chi Square Value	34.22

Assuming Gamma Distribution

95% Approximate Gamma UCL 86.72

95% Adjusted Gamma UCL 89.84

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.797
10% Shapiro Wilk Critical Value	0.914
Lilliefors Test Statistic	0.244
10% Lilliefors Critical Value	0.185

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.988
Maximum of Logged Data	4.663

Mean of logged Data	3.77
SD of logged Data	0.988

Assuming Lognormal Distribution

95% H-UCL	132.4
95% Chebyshev (MVUE) UCL	144.6
99% Chebyshev (MVUE) UCL	242.7

90% Chebyshev (MVUE) UCL	120.7
97.5% Chebyshev (MVUE) UCL	177.7

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	74.93
95% Standard Bootstrap UCL	74.54
95% Hall's Bootstrap UCL	73.51
90% Chebyshev(Mean, Sd) UCL	86.82
97.5% Chebyshev(Mean, Sd) UCL	115.3

95% BCA Bootstrap UCL	73.35
95% Bootstrap-t UCL	74.86
95% Percentile Bootstrap UCL	74.25
95% Chebyshev(Mean, Sd) UCL	98.74
99% Chebyshev(Mean, Sd) UCL	147.8

Suggested UCL to Use

95% Student's-t UCL 75.76

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Soil Samples

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	78.7	Mean	96.57
Maximum	112	Median	99.15
SD	10.27	Std. Error of Mean	2.297
Coefficient of Variation	0.106	Skewness	-0.339
Normal GOF Test			
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.144	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	100.5	95% Adjusted-CLT UCL (Chen-1995)	100.2
		95% Modified-t UCL (Johnson-1978)	100.5
Gamma GOF Test			
A-D Test Statistic	0.534	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.157	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.193	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	90.33	k star (bias corrected MLE)	76.81
Theta hat (MLE)	1.069	Theta star (bias corrected MLE)	1.257
nu hat (MLE)	3613	nu star (bias corrected)	3072
MLE Mean (bias corrected)	96.57	MLE Sd (bias corrected)	11.02
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	2945
		Adjusted Chi Square Value	2935
Assuming Gamma Distribution			
95% Approximate Gamma UCL	100.8	95% Adjusted Gamma UCL	101.1
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.16	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.366	Mean of logged Data	4.565
Maximum of Logged Data	4.718	SD of logged Data	0.109
Assuming Lognormal Distribution			
95% H-UCL	100.9	90% Chebyshev (MVUE) UCL	103.6
95% Chebyshev (MVUE) UCL	106.8	97.5% Chebyshev (MVUE) UCL	111.3
99% Chebyshev (MVUE) UCL	120		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	100.3	95% BCA Bootstrap UCL	100
95% Standard Bootstrap UCL	100.4	95% Bootstrap-t UCL	100.5
95% Hall's Bootstrap UCL	100.3	95% Percentile Bootstrap UCL	100.1
90% Chebyshev(Mean, Sd) UCL	103.5	95% Chebyshev(Mean, Sd) UCL	106.6
97.5% Chebyshev(Mean, Sd) UCL	110.9	99% Chebyshev(Mean, Sd) UCL	119.4
Suggested UCL to Use			
95% Student's-t UCL	100.5		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Soil Samples

Naphthalene-d8

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	92.8	Mean	111.4
Maximum	123	Median	117
SD	10.95	Std. Error of Mean	2.448
Coefficient of Variation	0.0983	Skewness	-0.665
Normal GOF Test			
Shapiro Wilk Test Statistic	0.824	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.246	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	115.6	95% Adjusted-CLT UCL (Chen-1995)	115
		95% Modified-t UCL (Johnson-1978)	115.5

Gamma GOF Test			
A-D Test Statistic	1.644	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.257	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.193	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	104.1	k star (bias corrected MLE)	88.53
Theta hat (MLE)	1.07	Theta star (bias corrected MLE)	1.258
nu hat (MLE)	4164	nu star (bias corrected)	3541
MLE Mean (bias corrected)	111.4	MLE Sd (bias corrected)	11.84
		Approximate Chi Square Value (0.05)	3404
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	3393

Assuming Gamma Distribution			
95% Approximate Gamma UCL	115.9	95% Adjusted Gamma UCL	116.2

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.816	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	4.53	Mean of logged Data	4.708
Maximum of Logged Data	4.812	SD of logged Data	0.102

Assuming Lognormal Distribution			
95% H-UCL	116	90% Chebyshev (MVUE) UCL	119
95% Chebyshev (MVUE) UCL	122.5	97.5% Chebyshev (MVUE) UCL	127.2
99% Chebyshev (MVUE) UCL	136.7		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	115.4	95% BCA Bootstrap UCL	115
95% Standard Bootstrap UCL	115.4	95% Bootstrap-t UCL	115.5
95% Hall's Bootstrap UCL	115.1	95% Percentile Bootstrap UCL	115.1
90% Chebyshev(Mean, Sd) UCL	118.7	95% Chebyshev(Mean, Sd) UCL	122
97.5% Chebyshev(Mean, Sd) UCL	126.7	99% Chebyshev(Mean, Sd) UCL	135.7

Suggested UCL to Use
95% Student's-t UCL 115.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Soil Samples

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Phenanthrene-d10

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	93	Mean	110.6
Maximum	124	Median	116
SD	10.71	Std. Error of Mean	2.395
Coefficient of Variation	0.0969	Skewness	-0.628
Normal GOF Test			
Shapiro Wilk Test Statistic	0.84	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.868	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.223	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	114.7	95% Adjusted-CLT UCL (Chen-1995)	114.1
		95% Modified-t UCL (Johnson-1978)	114.7
Gamma GOF Test			
A-D Test Statistic	1.525	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.193	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	107.5	k star (bias corrected MLE)	91.42
Theta hat (MLE)	1.028	Theta star (bias corrected MLE)	1.209
nu hat (MLE)	4300	nu star (bias corrected)	3657
MLE Mean (bias corrected)	110.6	MLE Sd (bias corrected)	11.56
Adjusted Level of Significance	0.038	Approximate Chi Square Value (0.05)	3517
		Adjusted Chi Square Value	3506
Assuming Gamma Distribution			
95% Approximate Gamma UCL	115	95% Adjusted Gamma UCL	115.3
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.83	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.176	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.533	Mean of logged Data	4.701
Maximum of Logged Data	4.82	SD of logged Data	0.1
Assuming Lognormal Distribution			
95% H-UCL	115.1	90% Chebyshev (MVUE) UCL	118
95% Chebyshev (MVUE) UCL	121.4	97.5% Chebyshev (MVUE) UCL	126.1
99% Chebyshev (MVUE) UCL	135.2		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	114.5	95% BCA Bootstrap UCL	114.1
95% Standard Bootstrap UCL	114.6	95% Bootstrap-t UCL	114.7
95% Hall's Bootstrap UCL	114.3	95% Percentile Bootstrap UCL	114.2
90% Chebyshev(Mean, Sd) UCL	117.8	95% Chebyshev(Mean, Sd) UCL	121
97.5% Chebyshev(Mean, Sd) UCL	125.5	99% Chebyshev(Mean, Sd) UCL	134.4
Suggested UCL to Use			
95% Student's-t UCL	114.7		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Soil Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Sediment Samples

User Selected Options
 Date/Time of Computation ProUCL 5.2 2025-11-26 10:02:48 AM
 From File Sed for HH UCL input 20251126_a.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Aluminum

General Statistics

Total Number of Observations	195	Number of Distinct Observations	146
		Number of Missing Observations	0
Minimum	700	Mean	9405
Maximum	31600	Median	8300
SD	5790	Std. Error of Mean	414.6
Coefficient of Variation	0.616	Skewness	1.202

Normal GOF Test

Shapiro Wilk Test Statistic 0.906
 1% Shapiro Wilk P Value 0
 Lilliefors Test Statistic 0.125
 1% Lilliefors Critical Value 0.0739

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 10090

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 10125
 95% Modified-t UCL (Johnson-1978) 10096

Gamma GOF Test

A-D Test Statistic 0.264
 5% A-D Critical Value 0.762
 K-S Test Statistic 0.0453
 5% K-S Critical Value 0.0655

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 2.677
 Theta hat (MLE) 3514
 nu hat (MLE) 1044
 MLE Mean (bias corrected) 9405
 Adjusted Level of Significance 0.0488

k star (bias corrected MLE) 2.639
 Theta star (bias corrected MLE) 3564
 nu star (bias corrected) 1029
 MLE Sd (bias corrected) 5789
 Approximate Chi Square Value (0.05) 955.7
 Adjusted Chi Square Value 955.2

Assuming Gamma Distribution

95% Approximate Gamma UCL 10128

95% Adjusted Gamma UCL 10133

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.969
 10% Shapiro Wilk P Value 0.015
 Lilliefors Test Statistic 0.0668
 10% Lilliefors Critical Value 0.0584

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 6.551
 Maximum of Logged Data 10.36

Mean of logged Data 8.951
 SD of logged Data 0.671

Assuming Lognormal Distribution

95% H-UCL 10595
 95% Chebyshev (MVUE) UCL 11871
 99% Chebyshev (MVUE) UCL 14724

90% Chebyshev (MVUE) UCL 11177
 97.5% Chebyshev (MVUE) UCL 12833

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 10087
 95% Standard Bootstrap UCL 10091
 95% Hall's Bootstrap UCL 10146
 90% Chebyshev(Mean, Sd) UCL 10649
 97.5% Chebyshev(Mean, Sd) UCL 11994

95% BCA Bootstrap UCL 10165
 95% Bootstrap-t UCL 10144
 95% Percentile Bootstrap UCL 10109
 95% Chebyshev(Mean, Sd) UCL 11212
 99% Chebyshev(Mean, Sd) UCL 13530

UCL Statistics for Baseline Sediment Samples

Suggested UCL to Use

95% Approximate Gamma UCL 10128

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Antimony

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	50
Number of Detects	89	Number of Non-Detects	106
Number of Distinct Detects	49	Number of Distinct Non-Detects	3
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	1.35	Maximum Non-Detect	0.8
Variance Detects	0.0993	Percent Non-Detects	54.36%
Mean Detects	0.428	SD Detects	0.315
Median Detects	0.3	CV Detects	0.737
Skewness Detects	1.211	Kurtosis Detects	1.009
Mean of Logged Detects	-1.11	SD of Logged Detects	0.735

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.847	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	4.700E-13		
Lilliefors Test Statistic	0.163	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.109	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.323	KM Standard Error of Mean	0.0232
90KM SD	0.273	95% KM (BCA) UCL	0.362
95% KM (t) UCL	0.361	95% KM (Percentile Bootstrap) UCL	0.362
95% KM (z) UCL	0.361	95% KM Bootstrap t UCL	0.363
90% KM Chebyshev UCL	0.393	95% KM Chebyshev UCL	0.424
97.5% KM Chebyshev UCL	0.468	99% KM Chebyshev UCL	0.554

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.726	Anderson-Darling GOF Test	
5% A-D Critical Value	0.765	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.118	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.096	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.067	k star (bias corrected MLE)	2.005
Theta hat (MLE)	0.207	Theta star (bias corrected MLE)	0.213
nu hat (MLE)	367.9	nu star (bias corrected)	356.8
Mean (detects)	0.428		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.303
Maximum	1.35	Median	0.213
SD	0.289	CV	0.953
k hat (MLE)	0.865	k star (bias corrected MLE)	0.855
Theta hat (MLE)	0.351	Theta star (bias corrected MLE)	0.355
nu hat (MLE)	337.5	nu star (bias corrected)	333.6
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (333.60, α)	292.3	Adjusted Chi Square Value (333.60, β)	292
95% Gamma Approximate UCL	0.346	95% Gamma Adjusted UCL	0.347

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.323	SD (KM)	0.273
Variance (KM)	0.0744	SE of Mean (KM)	0.0232
k hat (KM)	1.401	k star (KM)	1.383
nu hat (KM)	546.5	nu star (KM)	539.4
theta hat (KM)	0.23	theta star (KM)	0.233
80% gamma percentile (KM)	0.504	90% gamma percentile (KM)	0.686
95% gamma percentile (KM)	0.865	99% gamma percentile (KM)	1.269

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (539.38, α)	486.5	Adjusted Chi Square Value (539.38, β)	486.1
95% KM Approximate Gamma UCL	0.358	95% KM Adjusted Gamma UCL	0.358

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Sediment Samples

Shapiro Wilk Approximate Test Statistic	0.927	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	4.4635E-5	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.118	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0861	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.309	Mean in Log Scale	-1.545
SD in Original Scale	0.274	SD in Log Scale	0.889
95% t UCL (assumes normality of ROS data)	0.341	95% Percentile Bootstrap UCL	0.342
95% BCA Bootstrap UCL	0.344	95% Bootstrap t UCL	0.342
95% H-UCL (Log ROS)	0.362		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.443	KM Geo Mean	0.236
KM SD (logged)	0.775	95% Critical H Value (KM-Log)	1.994
KM Standard Error of Mean (logged)	0.0704	95% H-UCL (KM -Log)	0.356
KM SD (logged)	0.775	95% Critical H Value (KM-Log)	1.994
KM Standard Error of Mean (logged)	0.0704		

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.364	Mean in Log Scale	-1.291
SD in Original Scale	0.247	SD in Log Scale	0.846
95% t UCL (Assumes normality)	0.394	95% H-Stat UCL	0.445

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	0.361
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Arsenic

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	149
		Number of Missing Observations	0
Minimum	0.7	Mean	7.605
Maximum	36.7	Median	5.83
SD	5.63	Std. Error of Mean	0.403
Coefficient of Variation	0.74	Skewness	1.512
Normal GOF Test			
Shapiro Wilk Test Statistic	0.883	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.127	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.271	95% Adjusted-CLT UCL (Chen-1995)	8.315
		95% Modified-t UCL (Johnson-1978)	8.279
Gamma GOF Test			
A-D Test Statistic	0.661	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.767	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0545	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0659	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.915	k star (bias corrected MLE)	1.889
Theta hat (MLE)	3.971	Theta star (bias corrected MLE)	4.026
nu hat (MLE)	746.8	nu star (bias corrected)	736.7
MLE Mean (bias corrected)	7.605	MLE Sd (bias corrected)	5.533
Adjusted Level of Significance	0.0488	Approximate Chi Square Value (0.05)	674.7
		Adjusted Chi Square Value	674.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL	8.304	95% Adjusted Gamma UCL	8.309
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.00402	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0721	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.357	Mean of logged Data	1.746
Maximum of Logged Data	3.603	SD of logged Data	0.8
Assuming Lognormal Distribution			
95% H-UCL	8.857	90% Chebyshev (MVUE) UCL	9.417
95% Chebyshev (MVUE) UCL	10.12	97.5% Chebyshev (MVUE) UCL	11.09
99% Chebyshev (MVUE) UCL	12.99		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.268	95% BCA Bootstrap UCL	8.31
95% Standard Bootstrap UCL	8.271	95% Bootstrap-t UCL	8.32
95% Hall's Bootstrap UCL	8.327	95% Percentile Bootstrap UCL	8.291
90% Chebyshev(Mean, Sd) UCL	8.814	95% Chebyshev(Mean, Sd) UCL	9.362
97.5% Chebyshev(Mean, Sd) UCL	10.12	99% Chebyshev(Mean, Sd) UCL	11.62
Suggested UCL to Use			
95% Approximate Gamma UCL	8.304		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Barium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	156
		Number of Missing Observations	0
Minimum	5.6	Mean	64.95
Maximum	203	Median	55
SD	39.88	Std. Error of Mean	2.856
Coefficient of Variation	0.614	Skewness	0.905
Normal GOF Test			
Shapiro Wilk Test Statistic	0.926	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	2.780E-13	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.12	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	69.67	95% Adjusted-CLT UCL (Chen-1995)	69.84
		95% Modified-t UCL (Johnson-1978)	69.7
Gamma GOF Test			
A-D Test Statistic	0.368	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0404	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0656	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.478	k star (bias corrected MLE)	2.444
Theta hat (MLE)	26.21	Theta star (bias corrected MLE)	26.58
nu hat (MLE)	966.6	nu star (bias corrected)	953
MLE Mean (bias corrected)	64.95	MLE Sd (bias corrected)	41.55
		Approximate Chi Square Value (0.05)	882.4
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	881.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	70.15	95% Adjusted Gamma UCL	70.19
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.0059E-5	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0721	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.723	Mean of logged Data	3.958
Maximum of Logged Data	5.313	SD of logged Data	0.71
Assuming Lognormal Distribution			
95% H-UCL	74.42	90% Chebyshev (MVUE) UCL	78.7
95% Chebyshev (MVUE) UCL	83.88	97.5% Chebyshev (MVUE) UCL	91.06
99% Chebyshev (MVUE) UCL	105.2		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	69.65	95% BCA Bootstrap UCL	70.07
95% Standard Bootstrap UCL	69.71	95% Bootstrap-t UCL	69.9
95% Hall's Bootstrap UCL	69.9	95% Percentile Bootstrap UCL	69.88
90% Chebyshev(Mean, Sd) UCL	73.52	95% Chebyshev(Mean, Sd) UCL	77.4
97.5% Chebyshev(Mean, Sd) UCL	82.78	99% Chebyshev(Mean, Sd) UCL	93.36
Suggested UCL to Use			
95% Approximate Gamma UCL	70.15		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Beryllium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	61
Number of Detects	186	Number of Non-Detects	9
Number of Distinct Detects	61	Number of Distinct Non-Detects	1
Minimum Detect	0.02	Minimum Non-Detect	0.1
Maximum Detect	0.82	Maximum Non-Detect	0.1
Variance Detects	0.0256	Percent Non-Detects	4.615%
Mean Detects	0.29	SD Detects	0.16
Median Detects	0.25	CV Detects	0.552
Skewness Detects	0.991	Kurtosis Detects	0.664
Mean of Logged Detects	-1.395	SD of Logged Detects	0.592

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.915	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	6.661E-16		
Lilliefors Test Statistic	0.137	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0756	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.279	KM Standard Error of Mean	0.0117
90KM SD	0.163	95% KM (BCA) UCL	0.298
95% KM (t) UCL	0.299	95% KM (Percentile Bootstrap) UCL	0.299
95% KM (z) UCL	0.299	95% KM Bootstrap t UCL	0.3
90% KM Chebyshev UCL	0.315	95% KM Chebyshev UCL	0.331
97.5% KM Chebyshev UCL	0.353	99% KM Chebyshev UCL	0.396

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.704	Anderson-Darling GOF Test	
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0692	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0677	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.333	k star (bias corrected MLE)	3.282
Theta hat (MLE)	0.0871	Theta star (bias corrected MLE)	0.0884
nu hat (MLE)	1240	nu star (bias corrected)	1221
Mean (detects)	0.29		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.02	Mean	0.279
Maximum	0.82	Median	0.24
SD	0.164	CV	0.586
k hat (MLE)	2.804	k star (bias corrected MLE)	2.764
Theta hat (MLE)	0.0997	Theta star (bias corrected MLE)	0.101
nu hat (MLE)	1093	nu star (bias corrected)	1078
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	1003	Adjusted Chi Square Value (N/A, β)	1002
95% Gamma Approximate UCL	0.3	95% Gamma Adjusted UCL	0.301

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.279	SD (KM)	0.163
Variance (KM)	0.0266	SE of Mean (KM)	0.0117
k hat (KM)	2.931	k star (KM)	2.89
nu hat (KM)	1143	nu star (KM)	1127
theta hat (KM)	0.0953	theta star (KM)	0.0967
80% gamma percentile (KM)	0.4	90% gamma percentile (KM)	0.5
95% gamma percentile (KM)	0.593	99% gamma percentile (KM)	0.795

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1050	Adjusted Chi Square Value (N/A, β)	1049
95% KM Approximate Gamma UCL	0.3	95% KM Adjusted Gamma UCL	0.3

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.969	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0.0168	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0681	Lilliefors GOF Test	

UCL Statistics for Baseline Sediment Samples

10% Lilliefors Critical Value 0.0598 Detected Data Not Lognormal at 10% Significance Level
Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.28	Mean in Log Scale	-1.449
SD in Original Scale	0.163	SD in Log Scale	0.629
95% t UCL (assumes normality of ROS data)	0.3	95% Percentile Bootstrap UCL	0.3
95% BCA Bootstrap UCL	0.3	95% Bootstrap t UCL	0.301
95% H-UCL (Log ROS)	0.312		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.464	KM Geo Mean	0.231
KM SD (logged)	0.661	95% Critical H Value (KM-Log)	1.913
KM Standard Error of Mean (logged)	0.0483	95% H-UCL (KM -Log)	0.315
KM SD (logged)	0.661	95% Critical H Value (KM-Log)	1.913
KM Standard Error of Mean (logged)	0.0483		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.279	Mean in Log Scale	-1.469
SD in Original Scale	0.164	SD in Log Scale	0.669
95% t UCL (Assumes normality)	0.298	95% H-Stat UCL	0.316

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.3	95% GROS Approximate Gamma UCL	0.3
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Bismuth

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	23
Number of Detects	74	Number of Non-Detects	121
Number of Distinct Detects	23	Number of Distinct Non-Detects	3
Minimum Detect	0.09	Minimum Non-Detect	0.09
Maximum Detect	0.34	Maximum Non-Detect	0.3
Variance Detects	0.00592	Percent Non-Detects	62.05%
Mean Detects	0.205	SD Detects	0.0769
Median Detects	0.21	CV Detects	0.375
Skewness Detects	0.0152	Kurtosis Detects	-1.315
Mean of Logged Detects	-1.664	SD of Logged Detects	0.415

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.91	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	1.3865E-5		
Lilliefors Test Statistic	0.119	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.15	KM Standard Error of Mean	0.00602
90KM SD	0.0697	95% KM (BCA) UCL	0.16
95% KM (t) UCL	0.16	95% KM (Percentile Bootstrap) UCL	0.16
95% KM (z) UCL	0.16	95% KM Bootstrap t UCL	0.16
90% KM Chebyshev UCL	0.168	95% KM Chebyshev UCL	0.177
97.5% KM Chebyshev UCL	0.188	99% KM Chebyshev UCL	0.21

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.699	Anderson-Darling GOF Test	
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.104	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.49	k star (bias corrected MLE)	6.235
Theta hat (MLE)	0.0316	Theta star (bias corrected MLE)	0.0329
nu hat (MLE)	960.4	nu star (bias corrected)	922.8
Mean (detects)	0.205		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.143
Maximum	0.34	Median	0.13
SD	0.0787	CV	0.55
k hat (MLE)	2.856	k star (bias corrected MLE)	2.816
Theta hat (MLE)	0.0501	Theta star (bias corrected MLE)	0.0508
nu hat (MLE)	1114	nu star (bias corrected)	1098
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	1022	Adjusted Chi Square Value (N/A, β)	1022
95% Gamma Approximate UCL	0.154	95% Gamma Adjusted UCL	0.154

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.15	SD (KM)	0.0697
Variance (KM)	0.00486	SE of Mean (KM)	0.00602
k hat (KM)	4.648	k star (KM)	4.58
nu hat (KM)	1813	nu star (KM)	1786
theta hat (KM)	0.0323	theta star (KM)	0.0328
80% gamma percentile (KM)	0.204	90% gamma percentile (KM)	0.244
95% gamma percentile (KM)	0.281	99% gamma percentile (KM)	0.36

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1689	Adjusted Chi Square Value (N/A, β)	1688
95% KM Approximate Gamma UCL	0.159	95% KM Adjusted Gamma UCL	0.159

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.895	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	9.3016E-7	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors GOF Test	

UCL Statistics for Baseline Sediment Samples

10% Lilliefors Critical Value 0.0943 Detected Data Not Lognormal at 10% Significance Level
Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.145	Mean in Log Scale	-2.055
SD in Original Scale	0.0738	SD in Log Scale	0.505
95% t UCL (assumes normality of ROS data)	0.154	95% Percentile Bootstrap UCL	0.154
95% BCA Bootstrap UCL	0.154	95% Bootstrap t UCL	0.154
95% H-UCL (Log ROS)	0.155		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.989	KM Geo Mean	0.137
KM SD (logged)	0.42	95% Critical H Value (KM-Log)	1.776
KM Standard Error of Mean (logged)	0.0395	95% H-UCL (KM -Log)	0.158
KM SD (logged)	0.42	95% Critical H Value (KM-Log)	1.776
KM Standard Error of Mean (logged)	0.0395		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.137	Mean in Log Scale	-2.109
SD in Original Scale	0.0733	SD in Log Scale	0.492
95% t UCL (Assumes normality)	0.146	95% H-Stat UCL	0.146

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.16

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Boron

General Statistics

Total Number of Observations	195	Number of Distinct Observations	30
Number of Detects	103	Number of Non-Detects	92
Number of Distinct Detects	29	Number of Distinct Non-Detects	5
Minimum Detect	1	Minimum Non-Detect	1
Maximum Detect	10	Maximum Non-Detect	7.6
Variance Detects	5.294	Percent Non-Detects	47.18%
Mean Detects	5.216	SD Detects	2.301
Median Detects	5	CV Detects	0.441
Skewness Detects	0.0799	Kurtosis Detects	-0.935
Mean of Logged Detects	1.532	SD of Logged Detects	0.529

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.942
 1% Shapiro Wilk P Value 2.9497E-4
 Lilliefors Test Statistic 0.109
 1% Lilliefors Critical Value 0.101

Detected Data Not Normal at 1% Significance Level

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	3.925	KM Standard Error of Mean	0.189
90KM SD	2.324	95% KM (BCA) UCL	4.242
95% KM (t) UCL	4.238	95% KM (Percentile Bootstrap) UCL	4.249
95% KM (z) UCL	4.236	95% KM Bootstrap t UCL	4.243
90% KM Chebyshev UCL	4.493	95% KM Chebyshev UCL	4.749
97.5% KM Chebyshev UCL	5.106	99% KM Chebyshev UCL	5.806

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 2.002
 5% A-D Critical Value 0.756
 K-S Test Statistic 0.122
 5% K-S Critical Value 0.0889

Detected Data Not Gamma Distributed at 5% Significance Level

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE) 4.324 k star (bias corrected MLE) 4.204

UCL Statistics for Baseline Sediment Samples

Theta hat (MLE)	1.206	Theta star (bias corrected MLE)	1.241
nu hat (MLE)	890.7	nu star (bias corrected)	866.1
Mean (detects)	5.216		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.199	Mean	3.979
Maximum	10	Median	3.683
SD	2.284	CV	0.574
k hat (MLE)	2.673	k star (bias corrected MLE)	2.635
Theta hat (MLE)	1.488	Theta star (bias corrected MLE)	1.51
nu hat (MLE)	1043	nu star (bias corrected)	1028
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	954.4	Adjusted Chi Square Value (N/A, β)	953.9
95% Gamma Approximate UCL	4.285	95% Gamma Adjusted UCL	4.287

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.925	SD (KM)	2.324
Variance (KM)	5.401	SE of Mean (KM)	0.189
k hat (KM)	2.853	k star (KM)	2.812
nu hat (KM)	1113	nu star (KM)	1097
theta hat (KM)	1.376	theta star (KM)	1.396
80% gamma percentile (KM)	5.642	90% gamma percentile (KM)	7.063
95% gamma percentile (KM)	8.393	99% gamma percentile (KM)	11.29

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1021	Adjusted Chi Square Value (N/A, β)	1020
95% KM Approximate Gamma UCL	4.217	95% KM Adjusted Gamma UCL	4.219

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.903	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	8.0707E-9	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.151	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.0801	Detected Data Not Lognormal at 10% Significance Level	

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.946	Mean in Log Scale	1.205
SD in Original Scale	2.248	SD in Log Scale	0.596
95% t UCL (assumes normality of ROS data)	4.212	95% Percentile Bootstrap UCL	4.228
95% BCA Bootstrap UCL	4.227	95% Bootstrap t UCL	4.214
95% H-UCL (Log ROS)	4.32		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.169	KM Geo Mean	3.218
KM SD (logged)	0.664	95% Critical H Value (KM-Log)	1.915
KM Standard Error of Mean (logged)	0.0616	95% H-UCL (KM -Log)	4.395
KM SD (logged)	0.664	95% Critical H Value (KM-Log)	1.915
KM Standard Error of Mean (logged)	0.0616		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.887	Mean in Log Scale	1.182
SD in Original Scale	2.238	SD in Log Scale	0.635
95% t UCL (Assumes normality)	4.152	95% H-Stat UCL	4.348

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	4.238
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Cadmium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	130
Number of Detects	185	Number of Non-Detects	10
Number of Distinct Detects	129	Number of Distinct Non-Detects	2
Minimum Detect	0.022	Minimum Non-Detect	0.02
Maximum Detect	6.17	Maximum Non-Detect	0.05
Variance Detects	0.22	Percent Non-Detects	5.128%
Mean Detects	0.234	SD Detects	0.469
Median Detects	0.144	CV Detects	2.005
Skewness Detects	11.16	Kurtosis Detects	140.8
Mean of Logged Detects	-1.884	SD of Logged Detects	0.829

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.311	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0		
Lilliefors Test Statistic	0.326	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0758	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.224	KM Standard Error of Mean	0.0329
90KM SD	0.458	95% KM (BCA) UCL	0.286
95% KM (t) UCL	0.278	95% KM (Percentile Bootstrap) UCL	0.282
95% KM (z) UCL	0.278	95% KM Bootstrap t UCL	0.352
90% KM Chebyshev UCL	0.322	95% KM Chebyshev UCL	0.367
97.5% KM Chebyshev UCL	0.429	99% KM Chebyshev UCL	0.551

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.571	Anderson-Darling GOF Test	
5% A-D Critical Value	0.776	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.11	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0691	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.3	k star (bias corrected MLE)	1.283
Theta hat (MLE)	0.18	Theta star (bias corrected MLE)	0.182
nu hat (MLE)	481.1	nu star (bias corrected)	474.6
Mean (detects)	0.234		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.223
Maximum	6.17	Median	0.136
SD	0.46	CV	2.066
k hat (MLE)	1.097	k star (bias corrected MLE)	1.083
Theta hat (MLE)	0.203	Theta star (bias corrected MLE)	0.205
nu hat (MLE)	427.8	nu star (bias corrected)	422.6
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (422.55, α)	375.9	Adjusted Chi Square Value (422.55, β)	375.6
95% Gamma Approximate UCL	0.25	95% Gamma Adjusted UCL	0.25

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.224	SD (KM)	0.458
Variance (KM)	0.21	SE of Mean (KM)	0.0329
k hat (KM)	0.239	k star (KM)	0.238
nu hat (KM)	93.11	nu star (KM)	93.01
theta hat (KM)	0.937	theta star (KM)	0.938
80% gamma percentile (KM)	0.319	90% gamma percentile (KM)	0.674
95% gamma percentile (KM)	1.098	99% gamma percentile (KM)	2.236

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (93.01, α)	71.77	Adjusted Chi Square Value (93.01, β)	71.63
95% KM Approximate Gamma UCL	0.29	95% KM Adjusted Gamma UCL	0.291

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.977	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0.177	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0531	Lilliefors GOF Test	

UCL Statistics for Baseline Sediment Samples

10% Lilliefors Critical Value 0.06 Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.224	Mean in Log Scale	-1.97
SD in Original Scale	0.459	SD in Log Scale	0.892
95% t UCL (assumes normality of ROS data)	0.278	95% Percentile Bootstrap UCL	0.285
95% BCA Bootstrap UCL	0.316	95% Bootstrap t UCL	0.349
95% H-UCL (Log ROS)	0.237		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.963	KM Geo Mean	0.14
KM SD (logged)	0.878	95% Critical H Value (KM-Log)	2.072
KM Standard Error of Mean (logged)	0.0634	95% H-UCL (KM -Log)	0.235
KM SD (logged)	0.878	95% Critical H Value (KM-Log)	2.072
KM Standard Error of Mean (logged)	0.0634		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.223
SD in Original Scale	0.459
95% t UCL (Assumes normality)	0.278

DL/2 Log-Transformed

Mean in Log Scale	-1.981
SD in Log Scale	0.912
95% H-Stat UCL	0.24

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL 0.235

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics

Total Number of Observations	195	Number of Distinct Observations	159
		Number of Missing Observations	0
Minimum	350	Mean	6444
Maximum	166000	Median	5500
SD	11760	Std. Error of Mean	842.1
Coefficient of Variation	1.825	Skewness	13.01

Normal GOF Test

Shapiro Wilk Test Statistic	0.214
1% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.341
1% Lilliefors Critical Value	0.0739

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 7836

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	8668
95% Modified-t UCL (Johnson-1978)	7967

Gamma GOF Test

A-D Test Statistic	5.128E+28
5% A-D Critical Value	0.765
K-S Test Statistic	0.135
5% K-S Critical Value	0.0657

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.269
Theta hat (MLE)	2840
nu hat (MLE)	884.9
MLE Mean (bias corrected)	6444

k star (bias corrected MLE)	2.238
Theta star (bias corrected MLE)	2880
nu star (bias corrected)	872.6
MLE Sd (bias corrected)	4308

Approximate Chi Square Value (0.05) 805.1

UCL Statistics for Baseline Sediment Samples

Adjusted Level of Significance 0.0488 Adjusted Chi Square Value 804.6

Assuming Gamma Distribution

95% Approximate Gamma UCL 6985 95% Adjusted Gamma UCL 6989

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.931
10% Shapiro Wilk P Value 8.575E-12
Lilliefors Test Statistic 0.0893
10% Lilliefors Critical Value 0.0584

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 5.858 Mean of logged Data 8.535
Maximum of Logged Data 12.02 SD of logged Data 0.585

Assuming Lognormal Distribution

95% H-UCL 6532 90% Chebyshev (MVUE) UCL 6851
95% Chebyshev (MVUE) UCL 7222 97.5% Chebyshev (MVUE) UCL 7736
99% Chebyshev (MVUE) UCL 8747

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 7830 95% BCA Bootstrap UCL 9013
95% Standard Bootstrap UCL 7794 95% Bootstrap-t UCL 11483
95% Hall's Bootstrap UCL 13586 95% Percentile Bootstrap UCL 7991
90% Chebyshev(Mean, Sd) UCL 8971 95% Chebyshev(Mean, Sd) UCL 10115
97.5% Chebyshev(Mean, Sd) UCL 11704 99% Chebyshev(Mean, Sd) UCL 14824

Suggested UCL to Use

95% Student's-t UCL 7836

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Chromium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	136
		Number of Missing Observations	0
Minimum	1.3	Mean	24.21
Maximum	75.2	Median	22.5
SD	13.86	Std. Error of Mean	0.993
Coefficient of Variation	0.572	Skewness	1.087
Normal GOF Test			
Shapiro Wilk Test Statistic	0.92	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	3.220E-15	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	25.85	95% Adjusted-CLT UCL (Chen-1995)	25.93
		95% Modified-t UCL (Johnson-1978)	25.87
Gamma GOF Test			
A-D Test Statistic	1.562	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0929	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0654	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.819	k star (bias corrected MLE)	2.779
Theta hat (MLE)	8.589	Theta star (bias corrected MLE)	8.712
nu hat (MLE)	1100	nu star (bias corrected)	1084
MLE Mean (bias corrected)	24.21	MLE Sd (bias corrected)	14.52
		Approximate Chi Square Value (0.05)	1009
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	1008
Assuming Gamma Distribution			
95% Approximate Gamma UCL	26.03	95% Adjusted Gamma UCL	26.04
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.311E-11	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.135	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.262	Mean of logged Data	2.999
Maximum of Logged Data	4.32	SD of logged Data	0.676
Assuming Lognormal Distribution			
95% H-UCL	27.69	90% Chebyshev (MVUE) UCL	29.22
95% Chebyshev (MVUE) UCL	31.05	97.5% Chebyshev (MVUE) UCL	33.58
99% Chebyshev (MVUE) UCL	38.57		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	25.85	95% BCA Bootstrap UCL	26.09
95% Standard Bootstrap UCL	25.85	95% Bootstrap-t UCL	25.94
95% Hall's Bootstrap UCL	25.94	95% Percentile Bootstrap UCL	25.89
90% Chebyshev(Mean, Sd) UCL	27.19	95% Chebyshev(Mean, Sd) UCL	28.54
97.5% Chebyshev(Mean, Sd) UCL	30.41	99% Chebyshev(Mean, Sd) UCL	34.09
Suggested UCL to Use			
95% Student's-t UCL	25.85		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	151
		Number of Missing Observations	0
Minimum	0.2	Mean	6.729
Maximum	21	Median	5.96
SD	3.817	Std. Error of Mean	0.273
Coefficient of Variation	0.567	Skewness	1.011

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.924	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	8.127E-14	Lilliefors GOF Test	
Lilliefors Test Statistic	0.123	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.0739		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.18	95% Adjusted-CLT UCL (Chen-1995)	7.199
		95% Modified-t UCL (Johnson-1978)	7.184

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.611	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.761	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0582	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.0654		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	2.955	k star (bias corrected MLE)	2.913
Theta hat (MLE)	2.277	Theta star (bias corrected MLE)	2.31
nu hat (MLE)	1152	nu star (bias corrected)	1136
MLE Mean (bias corrected)	6.729	MLE Sd (bias corrected)	3.943
Adjusted Level of Significance	0.0488	Approximate Chi Square Value (0.05)	1059
		Adjusted Chi Square Value	1058

Assuming Gamma Distribution			
95% Approximate Gamma UCL	7.22	95% Adjusted Gamma UCL	7.223

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.942	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	2.0407E-8	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.095	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0584		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	-1.609	Mean of logged Data	1.728
Maximum of Logged Data	3.045	SD of logged Data	0.659

Assuming Lognormal Distribution			
95% H-UCL	7.652	90% Chebyshev (MVUE) UCL	8.066
95% Chebyshev (MVUE) UCL	8.557	97.5% Chebyshev (MVUE) UCL	9.239
99% Chebyshev (MVUE) UCL	10.58		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	7.178	95% BCA Bootstrap UCL	7.255
95% Standard Bootstrap UCL	7.184	95% Bootstrap-t UCL	7.205
95% Hall's Bootstrap UCL	7.202	95% Percentile Bootstrap UCL	7.203
90% Chebyshev(Mean, Sd) UCL	7.549	95% Chebyshev(Mean, Sd) UCL	7.92
97.5% Chebyshev(Mean, Sd) UCL	8.436	99% Chebyshev(Mean, Sd) UCL	9.448

Suggested UCL to Use
95% Approximate Gamma UCL **7.22**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	146
		Number of Missing Observations	0
Minimum	1	Mean	13.63
Maximum	40.8	Median	13.3
SD	7.548	Std. Error of Mean	0.541
Coefficient of Variation	0.554	Skewness	0.46
Normal GOF Test			
Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	3.8636E-4	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0797	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.53	95% Adjusted-CLT UCL (Chen-1995)	14.54
		95% Modified-t UCL (Johnson-1978)	14.53
Gamma GOF Test			
A-D Test Statistic	2.059	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0953	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0656	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.548	k star (bias corrected MLE)	2.512
Theta hat (MLE)	5.351	Theta star (bias corrected MLE)	5.427
nu hat (MLE)	993.7	nu star (bias corrected)	979.8
MLE Mean (bias corrected)	13.63	MLE Sd (bias corrected)	8.602
		Approximate Chi Square Value (0.05)	908.1
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	907.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL	14.71	95% Adjusted Gamma UCL	14.72
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.901	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.12	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0	Mean of logged Data	2.404
Maximum of Logged Data	3.709	SD of logged Data	0.736
Assuming Lognormal Distribution			
95% H-UCL	16.09	90% Chebyshev (MVUE) UCL	17.04
95% Chebyshev (MVUE) UCL	18.2	97.5% Chebyshev (MVUE) UCL	19.82
99% Chebyshev (MVUE) UCL	22.98		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	14.52	95% BCA Bootstrap UCL	14.56
95% Standard Bootstrap UCL	14.52	95% Bootstrap-t UCL	14.54
95% Hall's Bootstrap UCL	14.54	95% Percentile Bootstrap UCL	14.56
90% Chebyshev(Mean, Sd) UCL	15.25	95% Chebyshev(Mean, Sd) UCL	15.99
97.5% Chebyshev(Mean, Sd) UCL	17.01	99% Chebyshev(Mean, Sd) UCL	19.01
Suggested UCL to Use			
95% Student's-t UCL	14.53		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Iron

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	147
		Number of Missing Observations	0
Minimum	533	Mean	14054
Maximum	41700	Median	12700
SD	7644	Std. Error of Mean	547.4
Coefficient of Variation	0.544	Skewness	1.001
Normal GOF Test			
Shapiro Wilk Test Statistic	0.926	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	2.740E-13	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14959	95% Adjusted-CLT UCL (Chen-1995)	14997
		95% Modified-t UCL (Johnson-1978)	14965
Gamma GOF Test			
A-D Test Statistic	1.207	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.069	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0653	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.15	k star (bias corrected MLE)	3.105
Theta hat (MLE)	4461	Theta star (bias corrected MLE)	4526
nu hat (MLE)	1229	nu star (bias corrected)	1211
MLE Mean (bias corrected)	14054	MLE Sd (bias corrected)	7976
		Approximate Chi Square Value (0.05)	1131
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	1131
Assuming Gamma Distribution			
95% Approximate Gamma UCL	15046	95% Adjusted Gamma UCL	15053
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.935	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.957E-10	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.279	Mean of logged Data	9.384
Maximum of Logged Data	10.64	SD of logged Data	0.637
Assuming Lognormal Distribution			
95% H-UCL	15883	90% Chebyshev (MVUE) UCL	16719
95% Chebyshev (MVUE) UCL	17703	97.5% Chebyshev (MVUE) UCL	19069
99% Chebyshev (MVUE) UCL	21752		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	14955	95% BCA Bootstrap UCL	15092
95% Standard Bootstrap UCL	14960	95% Bootstrap-t UCL	14963
95% Hall's Bootstrap UCL	14965	95% Percentile Bootstrap UCL	14982
90% Chebyshev(Mean, Sd) UCL	15696	95% Chebyshev(Mean, Sd) UCL	16440
97.5% Chebyshev(Mean, Sd) UCL	17473	99% Chebyshev(Mean, Sd) UCL	19501
Suggested UCL to Use			
95% Student's-t UCL	14959		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

UCL Statistics for Baseline Sediment Samples

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	156
		Number of Missing Observations	0
Minimum	1.23	Mean	7.111
Maximum	62.9	Median	5.69
SD	5.905	Std. Error of Mean	0.423
Coefficient of Variation	0.83	Skewness	4.73
Normal GOF Test			
Shapiro Wilk Test Statistic	0.707	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.16	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.809	95% Adjusted-CLT UCL (Chen-1995)	7.959
		95% Modified-t UCL (Johnson-1978)	7.833
Gamma GOF Test			
A-D Test Statistic	1.57	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0736	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0656	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.367	k star (bias corrected MLE)	2.334
Theta hat (MLE)	3.004	Theta star (bias corrected MLE)	3.046
nu hat (MLE)	923.3	nu star (bias corrected)	910.4
MLE Mean (bias corrected)	7.111	MLE Sd (bias corrected)	4.654
		Approximate Chi Square Value (0.05)	841.3
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	840.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	7.694	95% Adjusted Gamma UCL	7.698
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.391	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0581	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.207	Mean of logged Data	1.736
Maximum of Logged Data	4.142	SD of logged Data	0.661
Assuming Lognormal Distribution			
95% H-UCL	7.732	90% Chebyshev (MVUE) UCL	8.151
95% Chebyshev (MVUE) UCL	8.65	97.5% Chebyshev (MVUE) UCL	9.342
99% Chebyshev (MVUE) UCL	10.7		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.806	95% BCA Bootstrap UCL	8.007
95% Standard Bootstrap UCL	7.812	95% Bootstrap-t UCL	8.04
95% Hall's Bootstrap UCL	8.382	95% Percentile Bootstrap UCL	7.851
90% Chebyshev(Mean, Sd) UCL	8.379	95% Chebyshev(Mean, Sd) UCL	8.954
97.5% Chebyshev(Mean, Sd) UCL	9.751	99% Chebyshev(Mean, Sd) UCL	11.32
Suggested UCL to Use			
95% H-UCL	7.732		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lithium

UCL Statistics for Baseline Sediment Samples

Total Number of Observations	195	Number of Distinct Observations	99
Number of Detects	189	Number of Non-Detects	6
Number of Distinct Detects	99	Number of Distinct Non-Detects	2
Minimum Detect	2	Minimum Non-Detect	2
Maximum Detect	39.1	Maximum Non-Detect	3
Variance Detects	52.91	Percent Non-Detects	3.077%
Mean Detects	12.79	SD Detects	7.274
Median Detects	11	CV Detects	0.569
Skewness Detects	1.224	Kurtosis Detects	1.419
Mean of Logged Detects	2.395	SD of Logged Detects	0.564

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.892
1% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.125
1% Lilliefors Critical Value	0.075

Normal GOF Test on Detected Observations Only
 Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	12.46	KM Standard Error of Mean	0.53
90KM SD	7.381	95% KM (BCA) UCL	13.24
95% KM (t) UCL	13.33	95% KM (Percentile Bootstrap) UCL	13.36
95% KM (z) UCL	13.33	95% KM Bootstrap t UCL	13.37
90% KM Chebyshev UCL	14.05	95% KM Chebyshev UCL	14.77
97.5% KM Chebyshev UCL	15.77	99% KM Chebyshev UCL	17.73

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.869
5% A-D Critical Value	0.759
K-S Test Statistic	0.0679
5% K-S Critical Value	0.0669

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.424
Theta hat (MLE)	3.734
nu hat (MLE)	1294
Mean (detects)	12.79

k star (bias corrected MLE)	3.374
Theta star (bias corrected MLE)	3.791
nu star (bias corrected)	1275

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.52	Mean	12.43
Maximum	39.1	Median	11
SD	7.438	CV	0.598
k hat (MLE)	2.702	k star (bias corrected MLE)	2.664
Theta hat (MLE)	4.6	Theta star (bias corrected MLE)	4.666
nu hat (MLE)	1054	nu star (bias corrected)	1039
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	965.1	Adjusted Chi Square Value (N/A, β)	964.5
95% Gamma Approximate UCL	13.38	95% Gamma Adjusted UCL	13.39

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	12.46	SD (KM)	7.381
Variance (KM)	54.48	SE of Mean (KM)	0.53
k hat (KM)	2.848	k star (KM)	2.808
nu hat (KM)	1111	nu star (KM)	1095
theta hat (KM)	4.374	theta star (KM)	4.437
80% gamma percentile (KM)	17.91	90% gamma percentile (KM)	22.42
95% gamma percentile (KM)	26.65	99% gamma percentile (KM)	35.84

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1019	Adjusted Chi Square Value (N/A, β)	1019
95% KM Approximate Gamma UCL	13.38	95% KM Adjusted Gamma UCL	13.39

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.98
10% Shapiro Wilk P Value	0.334
Lilliefors Test Statistic	0.0465
10% Lilliefors Critical Value	0.0594

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Sediment Samples

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	12.48	Mean in Log Scale	2.353
SD in Original Scale	7.367	SD in Log Scale	0.604
95% t UCL (assumes normality of ROS data)	13.35	95% Percentile Bootstrap UCL	13.37
95% BCA Bootstrap UCL	13.38	95% Bootstrap t UCL	13.42
95% H-UCL (Log ROS)	13.69		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.343	KM Geo Mean	10.41
KM SD (logged)	0.627	95% Critical H Value (KM-Log)	1.89
KM Standard Error of Mean (logged)	0.045	95% H-UCL (KM -Log)	13.8
KM SD (logged)	0.627	95% Critical H Value (KM-Log)	1.89
KM Standard Error of Mean (logged)	0.045		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	12.43	Mean in Log Scale	2.328
SD in Original Scale	7.434	SD in Log Scale	0.673
95% t UCL (Assumes normality)	13.31	95% H-Stat UCL	14.12

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL 13.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Magnesium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	144
		Number of Missing Observations	0
Minimum	150	Mean	4657
Maximum	85700	Median	3860
SD	6399	Std. Error of Mean	458.3
Coefficient of Variation	1.374	Skewness	10.63

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.381	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0	Lilliefors GOF Test	
Lilliefors Test Statistic	0.247	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.0739		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5414	95% Adjusted-CLT UCL (Chen-1995)	5783
		95% Modified-t UCL (Johnson-1978)	5472

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	2.652	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.768	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.105	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.0659		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1.876	k star (bias corrected MLE)	1.851
Theta hat (MLE)	2482	Theta star (bias corrected MLE)	2516
nu hat (MLE)	731.7	nu star (bias corrected)	721.8
MLE Mean (bias corrected)	4657	MLE Sd (bias corrected)	3423
Adjusted Level of Significance	0.0488	Approximate Chi Square Value (0.05)	660.5
		Adjusted Chi Square Value	660

Assuming Gamma Distribution			
95% Approximate Gamma UCL	5089	95% Adjusted Gamma UCL	5092

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.968	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	0.0107	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0847	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0584		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	5.011	Mean of logged Data	8.156
Maximum of Logged Data	11.36	SD of logged Data	0.749

Assuming Lognormal Distribution			
95% H-UCL	5129	90% Chebyshev (MVUE) UCL	5437
95% Chebyshev (MVUE) UCL	5815	97.5% Chebyshev (MVUE) UCL	6338
99% Chebyshev (MVUE) UCL	7367		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	5410	95% BCA Bootstrap UCL	6045
95% Standard Bootstrap UCL	5394	95% Bootstrap-t UCL	6301
95% Hall's Bootstrap UCL	8546	95% Percentile Bootstrap UCL	5462
90% Chebyshev(Mean, Sd) UCL	6031	95% Chebyshev(Mean, Sd) UCL	6654
97.5% Chebyshev(Mean, Sd) UCL	7518	99% Chebyshev(Mean, Sd) UCL	9216

Suggested UCL to Use
 95% Student's-t UCL 5414

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

UCL Statistics for Baseline Sediment Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Manganese

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	149
		Number of Missing Observations	0
Minimum	7.1	Mean	349.7
Maximum	1780	Median	260
SD	275.8	Std. Error of Mean	19.75
Coefficient of Variation	0.789	Skewness	2.037
Normal GOF Test			
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	382.3	95% Adjusted-CLT UCL (Chen-1995)	385.2
		95% Modified-t UCL (Johnson-1978)	382.8
Gamma GOF Test			
A-D Test Statistic	0.871	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0697	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0658	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.918	k star (bias corrected MLE)	1.892
Theta hat (MLE)	182.3	Theta star (bias corrected MLE)	184.8
nu hat (MLE)	747.9	nu star (bias corrected)	737.8
MLE Mean (bias corrected)	349.7	MLE Sd (bias corrected)	254.2
		Approximate Chi Square Value (0.05)	675.7
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	675.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL	381.8	95% Adjusted Gamma UCL	382
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.968	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.0101	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.068	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.96	Mean of logged Data	5.574
Maximum of Logged Data	7.484	SD of logged Data	0.806
Assuming Lognormal Distribution			
95% H-UCL	410	90% Chebyshev (MVUE) UCL	436.1
95% Chebyshev (MVUE) UCL	468.7	97.5% Chebyshev (MVUE) UCL	514
99% Chebyshev (MVUE) UCL	603.1		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	382.2	95% BCA Bootstrap UCL	386.9
95% Standard Bootstrap UCL	383.1	95% Bootstrap-t UCL	387
95% Hall's Bootstrap UCL	387.7	95% Percentile Bootstrap UCL	384.1
90% Chebyshev(Mean, Sd) UCL	408.9	95% Chebyshev(Mean, Sd) UCL	435.8
97.5% Chebyshev(Mean, Sd) UCL	473	99% Chebyshev(Mean, Sd) UCL	546.2
Suggested UCL to Use			
95% Student's-t UCL	382.3		

UCL Statistics for Baseline Sediment Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	116
Number of Detects	135	Number of Non-Detects	60
Number of Distinct Detects	115	Number of Distinct Non-Detects	2
Minimum Detect	0.0051	Minimum Non-Detect	0.005
Maximum Detect	0.22	Maximum Non-Detect	0.05
Variance Detects	0.00247	Percent Non-Detects	30.77%
Mean Detects	0.0533	SD Detects	0.0497
Median Detects	0.0347	CV Detects	0.933
Skewness Detects	1.458	Kurtosis Detects	1.532
Mean of Logged Detects	-3.344	SD of Logged Detects	0.929

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.807	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0		
Lilliefors Test Statistic	0.193	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0886	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0437	KM Standard Error of Mean	0.00323
90KM SD	0.0442	95% KM (BCA) UCL	0.0495
95% KM (t) UCL	0.049	95% KM (Percentile Bootstrap) UCL	0.0492
95% KM (z) UCL	0.049	95% KM Bootstrap t UCL	0.0494
90% KM Chebyshev UCL	0.0534	95% KM Chebyshev UCL	0.0578
97.5% KM Chebyshev UCL	0.0639	99% KM Chebyshev UCL	0.0759

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.111	Anderson-Darling GOF Test	
5% A-D Critical Value	0.774	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0872	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0822	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.356	k star (bias corrected MLE)	1.331
Theta hat (MLE)	0.0393	Theta star (bias corrected MLE)	0.04
nu hat (MLE)	366.2	nu star (bias corrected)	359.4
Mean (detects)	0.0533		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0051	Mean	0.0446
Maximum	0.22	Median	0.0288
SD	0.0442	CV	0.993
k hat (MLE)	1.377	k star (bias corrected MLE)	1.359
Theta hat (MLE)	0.0324	Theta star (bias corrected MLE)	0.0328
nu hat (MLE)	536.9	nu star (bias corrected)	529.9
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (529.94, α)	477.6	Adjusted Chi Square Value (529.94, β)	477.2
95% Gamma Approximate UCL	0.0495	95% Gamma Adjusted UCL	0.0495

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0437	SD (KM)	0.0442
Variance (KM)	0.00195	SE of Mean (KM)	0.00323
k hat (KM)	0.979	k star (KM)	0.968
nu hat (KM)	381.9	nu star (KM)	377.3
theta hat (KM)	0.0446	theta star (KM)	0.0452
80% gamma percentile (KM)	0.0705	90% gamma percentile (KM)	0.101
95% gamma percentile (KM)	0.132	99% gamma percentile (KM)	0.205

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (377.33, α)	333.3	Adjusted Chi Square Value (377.33, β)	333
95% KM Approximate Gamma UCL	0.0495	95% KM Adjusted Gamma UCL	0.0495

UCL Statistics for Baseline Sediment Samples

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.954	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	8.2702E-4	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0718	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0701	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.044	Mean in Log Scale	-3.543
SD in Original Scale	0.0442	SD in Log Scale	0.921
95% t UCL (assumes normality of ROS data)	0.0492	95% Percentile Bootstrap UCL	0.0493
95% BCA Bootstrap UCL	0.0493	95% Bootstrap t UCL	0.0495
95% H-UCL (Log ROS)	0.0508		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.544	KM Geo Mean	0.0289
KM SD (logged)	0.898	95% Critical H Value (KM-Log)	2.088
KM Standard Error of Mean (logged)	0.0712	95% H-UCL (KM -Log)	0.0495
KM SD (logged)	0.898	95% Critical H Value (KM-Log)	2.088
KM Standard Error of Mean (logged)	0.0712		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0443	Mean in Log Scale	-3.474
SD in Original Scale	0.0435	SD in Log Scale	0.829
95% t UCL (Assumes normality)	0.0495	95% H-Stat UCL	0.0493

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.049

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Molybdenum

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	61
Number of Detects	190	Number of Non-Detects	5
Number of Distinct Detects	61	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	1.44	Maximum Non-Detect	0.1
Variance Detects	0.0832	Percent Non-Detects	2.564%
Mean Detects	0.392	SD Detects	0.288
Median Detects	0.3	CV Detects	0.736
Skewness Detects	1.661	Kurtosis Detects	2.265
Mean of Logged Detects	-1.153	SD of Logged Detects	0.642

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.792	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0		
Lilliefors Test Statistic	0.196	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0748	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.385	KM Standard Error of Mean	0.0207
90KM SD	0.288	95% KM (BCA) UCL	0.422
95% KM (t) UCL	0.419	95% KM (Percentile Bootstrap) UCL	0.421
95% KM (z) UCL	0.419	95% KM Bootstrap t UCL	0.421
90% KM Chebyshev UCL	0.447	95% KM Chebyshev UCL	0.475
97.5% KM Chebyshev UCL	0.514	99% KM Chebyshev UCL	0.59

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.436	Anderson-Darling GOF Test	
5% A-D Critical Value	0.763	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.129	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0669	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.458	k star (bias corrected MLE)	2.423
Theta hat (MLE)	0.159	Theta star (bias corrected MLE)	0.162
nu hat (MLE)	934.2	nu star (bias corrected)	920.8
Mean (detects)	0.392		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.382
Maximum	1.44	Median	0.3
SD	0.291	CV	0.761
k hat (MLE)	1.935	k star (bias corrected MLE)	1.908
Theta hat (MLE)	0.198	Theta star (bias corrected MLE)	0.2
nu hat (MLE)	754.5	nu star (bias corrected)	744.3
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (744.27, α)	682	Adjusted Chi Square Value (744.27, β)	681.5
95% Gamma Approximate UCL	0.417	95% Gamma Adjusted UCL	0.417

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.385	SD (KM)	0.288
Variance (KM)	0.0827	SE of Mean (KM)	0.0207
k hat (KM)	1.787	k star (KM)	1.763
nu hat (KM)	697.1	nu star (KM)	687.7
theta hat (KM)	0.215	theta star (KM)	0.218
80% gamma percentile (KM)	0.584	90% gamma percentile (KM)	0.771
95% gamma percentile (KM)	0.95	99% gamma percentile (KM)	1.35

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (687.68, α)	627.8	Adjusted Chi Square Value (687.68, β)	627.4
95% KM Approximate Gamma UCL	0.421	95% KM Adjusted Gamma UCL	0.422

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.946	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	2.5686E-7	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.109	Lilliefors GOF Test	

UCL Statistics for Baseline Sediment Samples

10% Lilliefors Critical Value 0.0592 Detected Data Not Lognormal at 10% Significance Level
Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.384	Mean in Log Scale	-1.195
SD in Original Scale	0.289	SD in Log Scale	0.683
95% t UCL (assumes normality of ROS data)	0.418	95% Percentile Bootstrap UCL	0.419
95% BCA Bootstrap UCL	0.42	95% Bootstrap t UCL	0.42
95% H-UCL (Log ROS)	0.42		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.183	KM Geo Mean	0.306
KM SD (logged)	0.657	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.0472	95% H-UCL (KM -Log)	0.416
KM SD (logged)	0.657	95% Critical H Value (KM-Log)	1.91
KM Standard Error of Mean (logged)	0.0472		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.383	Mean in Log Scale	-1.201
SD in Original Scale	0.29	SD in Log Scale	0.697
95% t UCL (Assumes normality)	0.418	95% H-Stat UCL	0.423

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.419

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nickel

General Statistics

Total Number of Observations	195	Number of Distinct Observations	131
		Number of Missing Observations	0
Minimum	0.7	Mean	16.97
Maximum	53.8	Median	15
SD	9.895	Std. Error of Mean	0.709
Coefficient of Variation	0.583	Skewness	0.878

Normal GOF Test

Shapiro Wilk Test Statistic	0.934	Shapiro Wilk GOF Test
1% Shapiro Wilk P Value	7.662E-11	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.0879	Lilliefors GOF Test
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	18.14	95% Adjusted-CLT UCL (Chen-1995)	18.18
		95% Modified-t UCL (Johnson-1978)	18.14

Gamma GOF Test

A-D Test Statistic	1.247	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.763	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0618	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.0656	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.516	k star (bias corrected MLE)	2.481
Theta hat (MLE)	6.743	Theta star (bias corrected MLE)	6.839
nu hat (MLE)	981.3	nu star (bias corrected)	967.5
MLE Mean (bias corrected)	16.97	MLE Sd (bias corrected)	10.77
		Approximate Chi Square Value (0.05)	896.3
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	895.8

Assuming Gamma Distribution

95% Approximate Gamma UCL 18.31 95% Adjusted Gamma UCL 18.32

UCL Statistics for Baseline Sediment Samples

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.924	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	7.661E-14	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0929	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0584		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	-0.357	Mean of logged Data	2.62
Maximum of Logged Data	3.985	SD of logged Data	0.732

Assuming Lognormal Distribution			
95% H-UCL	19.89	90% Chebyshev (MVUE) UCL	21.06
95% Chebyshev (MVUE) UCL	22.49	97.5% Chebyshev (MVUE) UCL	24.47
99% Chebyshev (MVUE) UCL	28.36		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	18.13	95% BCA Bootstrap UCL	18.23
95% Standard Bootstrap UCL	18.13	95% Bootstrap-t UCL	18.2
95% Hall's Bootstrap UCL	18.21	95% Percentile Bootstrap UCL	18.15
90% Chebyshev(Mean, Sd) UCL	19.09	95% Chebyshev(Mean, Sd) UCL	20.05
97.5% Chebyshev(Mean, Sd) UCL	21.39	99% Chebyshev(Mean, Sd) UCL	24.02

Suggested UCL to Use
 95% Approximate Gamma UCL **18.31**

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Phosphorus

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	133
		Number of Missing Observations	0
Minimum	45	Mean	638
Maximum	1020	Median	650
SD	165.2	Std. Error of Mean	11.83
Coefficient of Variation	0.259	Skewness	-0.482

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.977	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0.185	Lilliefors GOF Test	
Lilliefors Test Statistic	0.0685	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.0739		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	657.6	95% Adjusted-CLT UCL (Chen-1995)	657.1
		95% Modified-t UCL (Johnson-1978)	657.5

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	3.915	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.751	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.122	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.0648		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	11.14	k star (bias corrected MLE)	10.97
Theta hat (MLE)	57.29	Theta star (bias corrected MLE)	58.16
nu hat (MLE)	4344	nu star (bias corrected)	4278
MLE Mean (bias corrected)	638	MLE Sd (bias corrected)	192.6
Adjusted Level of Significance	0.0488	Approximate Chi Square Value (0.05)	4127
		Adjusted Chi Square Value	4126

Assuming Gamma Distribution

UCL Statistics for Baseline Sediment Samples

95% Approximate Gamma UCL 661.4 95% Adjusted Gamma UCL 661.5

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.824
 10% Shapiro Wilk P Value 0
 Lilliefors Test Statistic 0.151
 10% Lilliefors Critical Value 0.0584

Shapiro Wilk Lognormal GOF Test
 Data Not Lognormal at 10% Significance Level
Lilliefors Lognormal GOF Test
 Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 3.807
 Maximum of Logged Data 6.928

Mean of logged Data 6.413
 SD of logged Data 0.343

Assuming Lognormal Distribution

95% H-UCL 674.9
 95% Chebyshev (MVUE) UCL 717.5
 99% Chebyshev (MVUE) UCL 808.7

90% Chebyshev (MVUE) UCL 695.3
 97.5% Chebyshev (MVUE) UCL 748.3

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 657.5
 95% Standard Bootstrap UCL 657.4
 95% Hall's Bootstrap UCL 656.8
 90% Chebyshev(Mean, Sd) UCL 673.5
 97.5% Chebyshev(Mean, Sd) UCL 711.9

95% BCA Bootstrap UCL 657.8
 95% Bootstrap-t UCL 656.8
 95% Percentile Bootstrap UCL 657.6
 95% Chebyshev(Mean, Sd) UCL 689.6
 99% Chebyshev(Mean, Sd) UCL 755.8

Suggested UCL to Use

95% Student's-t UCL 657.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Sediment Samples

Potassium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	121
		Number of Missing Observations	0
Minimum	86	Mean	1330
Maximum	5330	Median	1130
SD	952	Std. Error of Mean	68.17
Coefficient of Variation	0.716	Skewness	1.629
Normal GOF Test			
Shapiro Wilk Test Statistic	0.863	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.144	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0739	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1443	95% Adjusted-CLT UCL (Chen-1995)	1451
		95% Modified-t UCL (Johnson-1978)	1444
Gamma GOF Test			
A-D Test Statistic	1.092	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0707	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0658	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.018	k star (bias corrected MLE)	1.99
Theta hat (MLE)	659.2	Theta star (bias corrected MLE)	668.3
nu hat (MLE)	787	nu star (bias corrected)	776.2
MLE Mean (bias corrected)	1330	MLE Sd (bias corrected)	942.9
		Approximate Chi Square Value (0.05)	712.6
Adjusted Level of Significance	0.0488	Adjusted Chi Square Value	712.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL	1449	95% Adjusted Gamma UCL	1450
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.937	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	6.021E-10	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.11	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0584	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.454	Mean of logged Data	6.925
Maximum of Logged Data	8.581	SD of logged Data	0.803
Assuming Lognormal Distribution			
95% H-UCL	1577	90% Chebyshev (MVUE) UCL	1677
95% Chebyshev (MVUE) UCL	1802	97.5% Chebyshev (MVUE) UCL	1976
99% Chebyshev (MVUE) UCL	2317		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1442	95% BCA Bootstrap UCL	1457
95% Standard Bootstrap UCL	1442	95% Bootstrap-t UCL	1452
95% Hall's Bootstrap UCL	1453	95% Percentile Bootstrap UCL	1446
90% Chebyshev(Mean, Sd) UCL	1535	95% Chebyshev(Mean, Sd) UCL	1627
97.5% Chebyshev(Mean, Sd) UCL	1756	99% Chebyshev(Mean, Sd) UCL	2009
Suggested UCL to Use			
95% Student's-t UCL	1443		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	46
Number of Detects	75	Number of Non-Detects	120
Number of Distinct Detects	45	Number of Distinct Non-Detects	2
Minimum Detect	0.2	Minimum Non-Detect	0.2
Maximum Detect	1.4	Maximum Non-Detect	0.7
Variance Detects	0.161	Percent Non-Detects	61.54%
Mean Detects	0.649	SD Detects	0.401
Median Detects	0.45	CV Detects	0.618
Skewness Detects	0.399	Kurtosis Detects	-1.498
Mean of Logged Detects	-0.642	SD of Logged Detects	0.667

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.831
1% Shapiro Wilk P Value	9.174E-12
Lilliefors Test Statistic	0.214
1% Lilliefors Critical Value	0.118

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level
Lilliefors GOF Test
Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.392	KM Standard Error of Mean	0.024
90KM SD	0.325	95% KM (BCA) UCL	0.434
95% KM (t) UCL	0.432	95% KM (Percentile Bootstrap) UCL	0.433
95% KM (z) UCL	0.432	95% KM Bootstrap t UCL	0.432
90% KM Chebyshev UCL	0.464	95% KM Chebyshev UCL	0.497
97.5% KM Chebyshev UCL	0.542	99% KM Chebyshev UCL	0.631

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.793	Anderson-Darling GOF Test
5% A-D Critical Value	0.761	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.169	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.104	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.539	k star (bias corrected MLE)	2.446
Theta hat (MLE)	0.256	Theta star (bias corrected MLE)	0.265
nu hat (MLE)	380.9	nu star (bias corrected)	367
Mean (detects)	0.649		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.326
Maximum	1.4	Median	0.21
SD	0.38	CV	1.163
k hat (MLE)	0.584	k star (bias corrected MLE)	0.579
Theta hat (MLE)	0.559	Theta star (bias corrected MLE)	0.564
nu hat (MLE)	227.9	nu star (bias corrected)	225.8
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (225.76, α)	192	Adjusted Chi Square Value (225.76, β)	191.8
95% Gamma Approximate UCL	0.384	95% Gamma Adjusted UCL	0.384

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.392	SD (KM)	0.325
Variance (KM)	0.106	SE of Mean (KM)	0.024
k hat (KM)	1.456	k star (KM)	1.437
nu hat (KM)	567.9	nu star (KM)	560.5
theta hat (KM)	0.269	theta star (KM)	0.273
80% gamma percentile (KM)	0.609	90% gamma percentile (KM)	0.826
95% gamma percentile (KM)	1.036	99% gamma percentile (KM)	1.513

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (560.52, α)	506.6	Adjusted Chi Square Value (560.52, β)	506.2
95% KM Approximate Gamma UCL	0.434	95% KM Adjusted Gamma UCL	0.434

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.858	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	9.499E-10	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.185	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0936	Detected Data Not Lognormal at 10% Significance Level

UCL Statistics for Baseline Sediment Samples

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.354	Mean in Log Scale	-1.488
SD in Original Scale	0.354	SD in Log Scale	0.969
95% t UCL (assumes normality of ROS data)	0.396	95% Percentile Bootstrap UCL	0.396
95% BCA Bootstrap UCL	0.398	95% Bootstrap t UCL	0.399
95% H-UCL (Log ROS)	0.419		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.169	KM Geo Mean	0.311
KM SD (logged)	0.615	95% Critical H Value (KM-Log)	1.883
KM Standard Error of Mean (logged)	0.0473	95% H-UCL (KM -Log)	0.408
KM SD (logged)	0.615	95% Critical H Value (KM-Log)	1.883
KM Standard Error of Mean (logged)	0.0473		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.398	Mean in Log Scale	-1.227
SD in Original Scale	0.332	SD in Log Scale	0.789
95% t UCL (Assumes normality)	0.438	95% H-Stat UCL	0.448

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.432

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Silver

General Statistics

Total Number of Observations	38	Number of Distinct Observations	4
Number of Detects	9	Number of Missing Observations	157
Number of Distinct Detects	4	Number of Non-Detects	29
Minimum Detect	0.1	Number of Distinct Non-Detects	2
Maximum Detect	0.15	Minimum Non-Detect	0.1
Variance Detects	2.5278E-4	Maximum Non-Detect	0.15
Mean Detects	0.114	Percent Non-Detects	76.32%
Median Detects	0.11	SD Detects	0.0159
Skewness Detects	1.449	CV Detects	0.139
Mean of Logged Detects	-2.176	Kurtosis Detects	2.691
		SD of Logged Detects	0.131

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.824	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.764	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.252	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.316	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.103	KM Standard Error of Mean	0.00165
90KM SD	0.00957	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.106	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.106	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.108	95% KM Chebyshev UCL	0.111
97.5% KM Chebyshev UCL	0.114	99% KM Chebyshev UCL	0.12

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.591	Anderson-Darling GOF Test	
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.225	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	63.35	k star (bias corrected MLE)	42.31
Theta hat (MLE)	0.00181	Theta star (bias corrected MLE)	0.00271

UCL Statistics for Baseline Sediment Samples

nu hat (MLE)	1140	nu star (bias corrected)	761.5
Mean (detects)	0.114		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0198	Mean	0.0752
Maximum	0.15	Median	0.0732
SD	0.0289	CV	0.384
k hat (MLE)	6.269	k star (bias corrected MLE)	5.792
Theta hat (MLE)	0.012	Theta star (bias corrected MLE)	0.013
nu hat (MLE)	476.4	nu star (bias corrected)	440.2
Adjusted Level of Significance (β)	0.0434		
Approximate Chi Square Value (440.16, α)	392.5	Adjusted Chi Square Value (440.16, β)	390.7
95% Gamma Approximate UCL	0.0843	95% Gamma Adjusted UCL	0.0847

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.103	SD (KM)	0.00957
Variance (KM)	9.1548E-5	SE of Mean (KM)	0.00165
k hat (KM)	117	k star (KM)	107.7
nu hat (KM)	8889	nu star (KM)	8189
theta hat (KM)	8.8470E-4	theta star (KM)	9.6037E-4
80% gamma percentile (KM)	0.112	90% gamma percentile (KM)	0.116
95% gamma percentile (KM)	0.12	99% gamma percentile (KM)	0.128

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	7980	Adjusted Chi Square Value (N/A, β)	7971
95% KM Approximate Gamma UCL	0.106	95% KM Adjusted Gamma UCL	0.106

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.854	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.859	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.225	Lilliefors GOF Test
10% Lilliefors Critical Value	0.252	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0826	Mean in Log Scale	-2.528
SD in Original Scale	0.0225	SD in Log Scale	0.265
95% t UCL (assumes normality of ROS data)	0.0888	95% Percentile Bootstrap UCL	0.0887
95% BCA Bootstrap UCL	0.0888	95% Bootstrap t UCL	0.0894
95% H-UCL (Log ROS)	0.0893		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.272	KM Geo Mean	0.103
KM SD (logged)	0.0811	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.014	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0811	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.014		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0659	Mean in Log Scale	-2.791
SD in Original Scale	0.0287	SD in Log Scale	0.359
95% t UCL (Assumes normality)	0.0738	95% H-Stat UCL	0.0729

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.106
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Silicon

General Statistics

Total Number of Observations	157	Number of Distinct Observations	37
Number of Detects	86	Number of Non-Detects	71
Number of Distinct Detects	35	Number of Distinct Non-Detects	3
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	3200	Maximum Non-Detect	0.16
Variance Detects	635928	Percent Non-Detects	45.22%
Mean Detects	1668	SD Detects	797.5
Median Detects	1750	CV Detects	0.478
Skewness Detects	-0.476	Kurtosis Detects	-0.274
Mean of Logged Detects	6.643	SD of Logged Detects	2.674

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.946
1% Shapiro Wilk P Value	0.00315
Lilliefors Test Statistic	0.106
1% Lilliefors Critical Value	0.111

Normal GOF Test on Detected Observations Only
 Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	913.7	KM Standard Error of Mean	81.61
90KM SD	1017	95% KM (BCA) UCL	1059
95% KM (t) UCL	1049	95% KM (Percentile Bootstrap) UCL	1051
95% KM (z) UCL	1048	95% KM Bootstrap t UCL	1044
90% KM Chebyshev UCL	1159	95% KM Chebyshev UCL	1269
97.5% KM Chebyshev UCL	1423	99% KM Chebyshev UCL	1726

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	15.13
5% A-D Critical Value	0.793
K-S Test Statistic	0.313
5% K-S Critical Value	0.1

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.768
Theta hat (MLE)	2171
nu hat (MLE)	132.2
Mean (detects)	1668

k star (bias corrected MLE)	0.749
Theta star (bias corrected MLE)	2226
nu star (bias corrected)	128.9

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.1	Mean	1267
Maximum	3200	Median	916.3
SD	739.4	CV	0.584
k hat (MLE)	1.145	k star (bias corrected MLE)	1.127
Theta hat (MLE)	1106	Theta star (bias corrected MLE)	1124
nu hat (MLE)	359.4	nu star (bias corrected)	353.9
Adjusted Level of Significance (β)	0.0485		
Approximate Chi Square Value (353.91, α)	311.3	Adjusted Chi Square Value (353.91, β)	311
95% Gamma Approximate UCL	1440	95% Gamma Adjusted UCL	1442

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	913.7	SD (KM)	1017
Variance (KM)	1033443	SE of Mean (KM)	81.61
k hat (KM)	0.808	k star (KM)	0.797
nu hat (KM)	253.7	nu star (KM)	250.2
theta hat (KM)	1131	theta star (KM)	1147
80% gamma percentile (KM)	1494	90% gamma percentile (KM)	2224
95% gamma percentile (KM)	2969	99% gamma percentile (KM)	4727

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (250.17, α)	214.5	Adjusted Chi Square Value (250.17, β)	214.2
95% KM Approximate Gamma UCL	1065	95% KM Adjusted Gamma UCL	1067

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.441
10% Shapiro Wilk P Value	0

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 10% Significance Level

UCL Statistics for Baseline Sediment Samples

Lilliefors Test Statistic	0.37	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0876	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	930.6	Mean in Log Scale	5.043
SD in Original Scale	1005	SD in Log Scale	2.769
95% t UCL (assumes normality of ROS data)	1063	95% Percentile Bootstrap UCL	1065
95% BCA Bootstrap UCL	1072	95% Bootstrap t UCL	1070
95% H-UCL (Log ROS)	18511		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.598	KM Geo Mean	13.44
KM SD (logged)	4.867	95% Critical H Value (KM-Log)	7.121
KM Standard Error of Mean (logged)	0.391	95% H-UCL (KM -Log)	29984456
KM SD (logged)	4.867	95% Critical H Value (KM-Log)	7.121
KM Standard Error of Mean (logged)	0.391		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	913.7
SD in Original Scale	1020
95% t UCL (Assumes normality)	1048

DL/2 Log-Transformed

Mean in Log Scale	2.306
SD in Log Scale	5.18
95% H-Stat UCL	1.544E+8

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 1049

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Sodium

General Statistics

Total Number of Observations	117
Minimum	28
Maximum	415
SD	79.93
Coefficient of Variation	0.555

Number of Distinct Observations	72
Number of Missing Observations	78
Mean	144
Median	130
Std. Error of Mean	7.389
Skewness	1.326

Normal GOF Test

Shapiro Wilk Test Statistic	0.888
1% Shapiro Wilk P Value	1.328E-12
Lilliefors Test Statistic	0.127
1% Lilliefors Critical Value	0.0951

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	156.3
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95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	157.1
95% Modified-t UCL (Johnson-1978)	156.4

Gamma GOF Test

A-D Test Statistic	0.585
5% A-D Critical Value	0.758
K-S Test Statistic	0.0648
5% K-S Critical Value	0.0855

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.525
Theta hat (MLE)	40.85
nu hat (MLE)	824.9
MLE Mean (bias corrected)	144

k star (bias corrected MLE)	3.441
Theta star (bias corrected MLE)	41.85
nu star (bias corrected)	805.1
MLE Sd (bias corrected)	77.63
Approximate Chi Square Value (0.05)	740.2
Adjusted Chi Square Value	739.5

Adjusted Level of Significance 0.0479

UCL Statistics for Baseline Sediment Samples

Assuming Gamma Distribution
 95% Approximate Gamma UCL 156.6 95% Adjusted Gamma UCL 156.8

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.964	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	0.0268	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0915	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0753		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics		Mean of logged Data	4.821
Minimum of Logged Data	3.332	SD of logged Data	0.565
Maximum of Logged Data	6.028		

Assuming Lognormal Distribution		90% Chebyshev (MVUE) UCL	169.8
95% H-UCL	160.7	97.5% Chebyshev (MVUE) UCL	196.2
95% Chebyshev (MVUE) UCL	180.9		
99% Chebyshev (MVUE) UCL	226.3		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs		95% BCA Bootstrap UCL	157.4
95% CLT UCL	156.2	95% Bootstrap-t UCL	157.6
95% Standard Bootstrap UCL	156.2	95% Percentile Bootstrap UCL	156.3
95% Hall's Bootstrap UCL	157.6	95% Chebyshev(Mean, Sd) UCL	176.2
90% Chebyshev(Mean, Sd) UCL	166.2	99% Chebyshev(Mean, Sd) UCL	217.5
97.5% Chebyshev(Mean, Sd) UCL	190.1		

Suggested UCL to Use
 95% Approximate Gamma UCL 156.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Strontium

General Statistics		Number of Distinct Observations	132
Total Number of Observations	195	Number of Non-Detects	6
Number of Detects	189	Number of Distinct Non-Detects	3
Number of Distinct Detects	129	Minimum Non-Detect	50
Minimum Detect	2.3	Maximum Non-Detect	76
Maximum Detect	1770	Percent Non-Detects	3.077%
Variance Detects	24256	SD Detects	155.7
Mean Detects	93.5	CV Detects	1.666
Median Detects	24.1	Kurtosis Detects	71.12
Skewness Detects	6.91	SD of Logged Detects	1.323
Mean of Logged Detects	3.691		

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.527	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0	Lilliefors GOF Test	
Lilliefors Test Statistic	0.279	Detected Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.075		

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	91.16	KM Standard Error of Mean	11.02
90KM SD	153.5	95% KM (BCA) UCL	109.3
95% KM (t) UCL	109.4	95% KM (Percentile Bootstrap) UCL	109.5
95% KM (z) UCL	109.3	95% KM Bootstrap t UCL	119.8
90% KM Chebyshev UCL	124.2	95% KM Chebyshev UCL	139.2
97.5% KM Chebyshev UCL	160	99% KM Chebyshev UCL	200.8

Gamma GOF Tests on Detected Observations Only		Anderson-Darling GOF Test	
A-D Test Statistic	9.98	Detected Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.8	Kolmogorov-Smirnov GOF	
K-S Test Statistic	0.222	Detected Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.0693		

Detected Data Not Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Sediment Samples

Theta hat (MLE)	131.3	Theta star (bias corrected MLE)	132.8
nu hat (MLE)	269.1	nu star (bias corrected)	266.2
Mean (detects)	93.5		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	91.06
Maximum	1770	Median	24
SD	154	CV	1.691
k hat (MLE)	0.671	k star (bias corrected MLE)	0.664
Theta hat (MLE)	135.7	Theta star (bias corrected MLE)	137.1
nu hat (MLE)	261.7	nu star (bias corrected)	259
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (258.97, α)	222.7	Adjusted Chi Square Value (258.97, β)	222.5
95% Gamma Approximate UCL	105.9	95% Gamma Adjusted UCL	106

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	91.16	SD (KM)	153.5
Variance (KM)	23560	SE of Mean (KM)	11.02
k hat (KM)	0.353	k star (KM)	0.351
nu hat (KM)	137.6	nu star (KM)	136.8
theta hat (KM)	258.5	theta star (KM)	259.9
80% gamma percentile (KM)	144.4	90% gamma percentile (KM)	263.2
95% gamma percentile (KM)	396.1	99% gamma percentile (KM)	735.4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (136.77, α)	110.7	Adjusted Chi Square Value (136.77, β)	110.6
95% KM Approximate Gamma UCL	112.6	95% KM Adjusted Gamma UCL	112.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.904	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.168	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.0594	Detected Data Not Lognormal at 10% Significance Level	

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	91.3	Mean in Log Scale	3.67
SD in Original Scale	153.8	SD in Log Scale	1.31
95% t UCL (assumes normality of ROS data)	109.5	95% Percentile Bootstrap UCL	110.6
95% BCA Bootstrap UCL	116	95% Bootstrap t UCL	118.1
95% H-UCL (Log ROS)	116.7		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.662	KM Geo Mean	38.92
KM SD (logged)	1.313	95% Critical H Value (KM-Log)	2.468
KM Standard Error of Mean (logged)	0.0945	95% H-UCL (KM -Log)	116.3
KM SD (logged)	1.313	95% Critical H Value (KM-Log)	2.468
KM Standard Error of Mean (logged)	0.0945		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	91.52	Mean in Log Scale	3.681
SD in Original Scale	153.7	SD in Log Scale	1.304
95% t UCL (Assumes normality)	109.7	95% H-Stat UCL	116.9

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 109.4

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

UCL Statistics for Baseline Sediment Samples

Sulfur

General Statistics			
Total Number of Observations	116	Number of Distinct Observations	76
Number of Detects	84	Number of Missing Observations	79
Number of Distinct Detects	75	Number of Non-Detects	32
Minimum Detect	6.12	Number of Distinct Non-Detects	2
Maximum Detect	4500	Minimum Non-Detect	1000
Variance Detects	546842	Maximum Non-Detect	1500
Mean Detects	213	Percent Non-Detects	27.59%
Median Detects	22.55	SD Detects	739.5
Skewness Detects	4.184	CV Detects	3.472
Mean of Logged Detects	3.385	Kurtosis Detects	17.94
		SD of Logged Detects	1.314

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.308	Normal GOF Test on Detected Observations Only
1% Shapiro Wilk P Value	0	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.514	Lilliefors GOF Test
1% Lilliefors Critical Value	0.112	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	160.6	KM Standard Error of Mean	58.97
90KM SD	631.3	95% KM (BCA) UCL	273
95% KM (t) UCL	258.3	95% KM (Percentile Bootstrap) UCL	261.6
95% KM (z) UCL	257.6	95% KM Bootstrap t UCL	312.7
90% KM Chebyshev UCL	337.5	95% KM Chebyshev UCL	417.6
97.5% KM Chebyshev UCL	528.8	99% KM Chebyshev UCL	747.3

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	22.22	Anderson-Darling GOF Test
5% A-D Critical Value	0.856	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.464	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.105	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.342	k star (bias corrected MLE)	0.337
Theta hat (MLE)	623.6	Theta star (bias corrected MLE)	631.5
nu hat (MLE)	57.38	nu star (bias corrected)	56.66
Mean (detects)	213		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	191.7
Maximum	4500	Median	21.85
SD	643.8	CV	3.357
k hat (MLE)	0.235	k star (bias corrected MLE)	0.235
Theta hat (MLE)	814.9	Theta star (bias corrected MLE)	816
nu hat (MLE)	54.59	nu star (bias corrected)	54.51
Adjusted Level of Significance (β)	0.0479		
Approximate Chi Square Value (54.51, α)	38.55	Adjusted Chi Square Value (54.51, β)	38.38
95% Gamma Approximate UCL	271.2	95% Gamma Adjusted UCL	272.3

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	160.6	SD (KM)	631.3
Variance (KM)	398514	SE of Mean (KM)	58.97
k hat (KM)	0.0647	k star (KM)	0.0688
nu hat (KM)	15.01	nu star (KM)	15.95
theta hat (KM)	2482	theta star (KM)	2335
80% gamma percentile (KM)	55.16	90% gamma percentile (KM)	341.6
95% gamma percentile (KM)	921.5	99% gamma percentile (KM)	3050

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (15.95, α)	7.929	Adjusted Chi Square Value (15.95, β)	7.858
95% KM Approximate Gamma UCL	323	95% KM Adjusted Gamma UCL	326

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Sediment Samples

Shapiro Wilk Approximate Test Statistic	0.609	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.307	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0886	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	163.9	Mean in Log Scale	3.344
SD in Original Scale	633.5	SD in Log Scale	1.203
95% t UCL (assumes normality of ROS data)	261.5	95% Percentile Bootstrap UCL	263.2
95% BCA Bootstrap UCL	290.4	95% Bootstrap t UCL	320.6
95% H-UCL (Log ROS)	76.6		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.29	KM Geo Mean	26.85
KM SD (logged)	1.146	95% Critical H Value (KM-Log)	2.359
KM Standard Error of Mean (logged)	0.11	95% H-UCL (KM -Log)	66.59
KM SD (logged)	1.146	95% Critical H Value (KM-Log)	2.359
KM Standard Error of Mean (logged)	0.11		

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	294.3	Mean in Log Scale	4.169
SD in Original Scale	642.4	SD in Log Scale	1.696
95% t UCL (Assumes normality)	393.2	95% H-Stat UCL	435

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 258.3

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Thallium

General Statistics

Total Number of Observations	195	Number of Distinct Observations	105
Number of Detects	175	Number of Non-Detects	20
Number of Distinct Detects	102	Number of Distinct Non-Detects	5
Minimum Detect	0.02	Minimum Non-Detect	0.02
Maximum Detect	0.406	Maximum Non-Detect	0.076
Variance Detects	0.00657	Percent Non-Detects	10.26%
Mean Detects	0.141	SD Detects	0.0811
Median Detects	0.121	CV Detects	0.574
Skewness Detects	1.142	Kurtosis Detects	1.05
Mean of Logged Detects	-2.12	SD of Logged Detects	0.59

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.897	Normal GOF Test on Detected Observations Only
1% Shapiro Wilk P Value	0	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.124	Lilliefors GOF Test
1% Lilliefors Critical Value	0.0779	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.13	KM Standard Error of Mean	0.00604
90KM SD	0.084	95% KM (BCA) UCL	0.139
95% KM (t) UCL	0.14	95% KM (Percentile Bootstrap) UCL	0.14
95% KM (z) UCL	0.14	95% KM Bootstrap t UCL	0.14
90% KM Chebyshev UCL	0.148	95% KM Chebyshev UCL	0.156
97.5% KM Chebyshev UCL	0.167	99% KM Chebyshev UCL	0.19

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.57	Anderson-Darling GOF Test
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Sediment Samples

K-S Test Statistic	0.0589	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0705	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	3.234	k star (bias corrected MLE)	3.182
Theta hat (MLE)	0.0437	Theta star (bias corrected MLE)	0.0444
nu hat (MLE)	1132	nu star (bias corrected)	1114
Mean (detects)	0.141		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.129
Maximum	0.406	Median	0.111
SD	0.0848	CV	0.656
k hat (MLE)	2.112	k star (bias corrected MLE)	2.083
Theta hat (MLE)	0.0612	Theta star (bias corrected MLE)	0.062
nu hat (MLE)	823.6	nu star (bias corrected)	812.3
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (812.28, α)	747.1	Adjusted Chi Square Value (812.28, β)	746.7
95% Gamma Approximate UCL	0.14	95% Gamma Adjusted UCL	0.141

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.13	SD (KM)	0.084
Variance (KM)	0.00706	SE of Mean (KM)	0.00604
k hat (KM)	2.38	k star (KM)	2.346
nu hat (KM)	928	nu star (KM)	915.1
theta hat (KM)	0.0545	theta star (KM)	0.0552
80% gamma percentile (KM)	0.19	90% gamma percentile (KM)	0.243
95% gamma percentile (KM)	0.293	99% gamma percentile (KM)	0.402

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (915.06, α)	845.9	Adjusted Chi Square Value (915.06, β)	845.4
95% KM Approximate Gamma UCL	0.14	95% KM Adjusted Gamma UCL	0.14

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.973	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0.0787	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.047	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0617	Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Approximate Lognormal at 10% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.131	Mean in Log Scale	-2.244
SD in Original Scale	0.0831	SD in Log Scale	0.676
95% t UCL (assumes normality of ROS data)	0.14	95% Percentile Bootstrap UCL	0.14
95% BCA Bootstrap UCL	0.14	95% Bootstrap t UCL	0.141
95% H-UCL (Log ROS)	0.146		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.277	KM Geo Mean	0.103
KM SD (logged)	0.734	95% Critical H Value (KM-Log)	1.963
KM Standard Error of Mean (logged)	0.0533	95% H-UCL (KM -Log)	0.149
KM SD (logged)	0.734	95% Critical H Value (KM-Log)	1.963
KM Standard Error of Mean (logged)	0.0533		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.129	Mean in Log Scale	-2.307
SD in Original Scale	0.085	SD in Log Scale	0.805
95% t UCL (Assumes normality)	0.139	95% H-Stat UCL	0.155

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.14	95% GROS Approximate Gamma UCL	0.14
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Sediment Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tin

General Statistics			
Total Number of Observations	117	Number of Distinct Observations	12
Number of Detects	79	Number of Missing Observations	78
Number of Distinct Detects	10	Number of Non-Detects	38
Minimum Detect	0.6	Number of Distinct Non-Detects	2
Maximum Detect	1.6	Minimum Non-Detect	2
Variance Detects	0.0441	Maximum Non-Detect	3
Mean Detects	0.963	Percent Non-Detects	32.48%
Median Detects	1	SD Detects	0.21
Skewness Detects	0.375	CV Detects	0.218
Mean of Logged Detects	-0.0609	Kurtosis Detects	-0.361
		SD of Logged Detects	0.219
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.932	Normal GOF Test on Detected Observations Only	
1% Shapiro Wilk P Value	3.8575E-4	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.136	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.115	Detected Data Not Normal at 1% Significance Level	
Detected Data Not Normal at 1% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.963	KM Standard Error of Mean	0.0236
90KM SD	0.209	95% KM (BCA) UCL	1.006
95% KM (t) UCL	1.002	95% KM (Percentile Bootstrap) UCL	1.005
95% KM (z) UCL	1.002	95% KM Bootstrap t UCL	1.003
90% KM Chebyshev UCL	1.034	95% KM Chebyshev UCL	1.066
97.5% KM Chebyshev UCL	1.111	99% KM Chebyshev UCL	1.199
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.821	Anderson-Darling GOF Test	
5% A-D Critical Value	0.751	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.15	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.1	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	21.46	k star (bias corrected MLE)	20.65
Theta hat (MLE)	0.0449	Theta star (bias corrected MLE)	0.0466
nu hat (MLE)	3391	nu star (bias corrected)	3263
Mean (detects)	0.963		
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.593	Mean	0.963
Maximum	1.6	Median	0.949
SD	0.205	CV	0.213
k hat (MLE)	22.4	k star (bias corrected MLE)	21.84
Theta hat (MLE)	0.043	Theta star (bias corrected MLE)	0.0441
nu hat (MLE)	5243	nu star (bias corrected)	5110
Adjusted Level of Significance (β)	0.0479		
Approximate Chi Square Value (N/A, α)	4944	Adjusted Chi Square Value (N/A, β)	4942
95% Gamma Approximate UCL	0.995	95% Gamma Adjusted UCL	0.995
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.963	SD (KM)	0.209
Variance (KM)	0.0436	SE of Mean (KM)	0.0236
k hat (KM)	21.29	k star (KM)	20.75
nu hat (KM)	4981	nu star (KM)	4855
theta hat (KM)	0.0453	theta star (KM)	0.0464
80% gamma percentile (KM)	1.135	90% gamma percentile (KM)	1.242
95% gamma percentile (KM)	1.335	99% gamma percentile (KM)	1.522
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, α)	4694	Adjusted Chi Square Value (N/A, β)	4692
95% KM Approximate Gamma UCL	0.996	95% KM Adjusted Gamma UCL	0.997

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Sediment Samples

Shapiro Wilk Approximate Test Statistic	0.931	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	3.5153E-4	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.155	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0913	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.962	Mean in Log Scale	-0.0609
SD in Original Scale	0.205	SD in Log Scale	0.213
95% t UCL (assumes normality of ROS data)	0.994	95% Percentile Bootstrap UCL	0.993
95% BCA Bootstrap UCL	0.994	95% Bootstrap t UCL	0.995
95% H-UCL (Log ROS)	0.995		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0609	KM Geo Mean	0.941
KM SD (logged)	0.217	95% Critical H Value (KM-Log)	1.706
KM Standard Error of Mean (logged)	0.0246	95% H-UCL (KM -Log)	0.997
KM SD (logged)	0.217	95% Critical H Value (KM-Log)	1.706
KM Standard Error of Mean (logged)	0.0246		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.979	Mean in Log Scale	-0.0376
SD in Original Scale	0.18	SD in Log Scale	0.186
95% t UCL (Assumes normality)	1.007	95% H-Stat UCL	1.009

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 1.002

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Titanium

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	35
		Number of Missing Observations	157
Minimum	91.2	Mean	776.9
Maximum	1530	Median	708
SD	351.1	Std. Error of Mean	56.96
Coefficient of Variation	0.452	Skewness	0.534
Normal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.916	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.129	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.165	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	873	95% Adjusted-CLT UCL (Chen-1995)	875.8
		95% Modified-t UCL (Johnson-1978)	873.8
Gamma GOF Test			
A-D Test Statistic	0.422	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0889	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.144	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.328	k star (bias corrected MLE)	4.004
Theta hat (MLE)	179.5	Theta star (bias corrected MLE)	194
nu hat (MLE)	329	nu star (bias corrected)	304.3
MLE Mean (bias corrected)	776.9	MLE Sd (bias corrected)	388.2
		Approximate Chi Square Value (0.05)	264.9
		Adjusted Chi Square Value	263.4
Adjusted Level of Significance	0.0434		
Assuming Gamma Distribution			
95% Approximate Gamma UCL	892.5	95% Adjusted Gamma UCL	897.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.905	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.947	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.13	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	4.513	Mean of logged Data	6.535
Maximum of Logged Data	7.333	SD of logged Data	0.547
Assuming Lognormal Distribution			
95% H-UCL	953.6	90% Chebyshev (MVUE) UCL	1020
95% Chebyshev (MVUE) UCL	1122	97.5% Chebyshev (MVUE) UCL	1263
99% Chebyshev (MVUE) UCL	1539		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	870.6	95% BCA Bootstrap UCL	874.2
95% Standard Bootstrap UCL	867.5	95% Bootstrap-t UCL	875.1
95% Hall's Bootstrap UCL	874.1	95% Percentile Bootstrap UCL	872.1
90% Chebyshev(Mean, Sd) UCL	947.8	95% Chebyshev(Mean, Sd) UCL	1025
97.5% Chebyshev(Mean, Sd) UCL	1133	99% Chebyshev(Mean, Sd) UCL	1344
Suggested UCL to Use			
95% Student's-t UCL	873		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	2
Number of Detects	0	Number of Missing Observations	157
Number of Distinct Detects	0	Number of Non-Detects	38
		Number of Distinct Non-Detects	2

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tungsten was not processed!

Uranium

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	78
Number of Detects	115	Number of Non-Detects	80
Number of Distinct Detects	75	Number of Distinct Non-Detects	3
Minimum Detect	0.051	Minimum Non-Detect	0.002
Maximum Detect	4.3	Maximum Non-Detect	3
Variance Detects	0.563	Percent Non-Detects	41.03%
Mean Detects	1.32	SD Detects	0.75
Median Detects	1.06	CV Detects	0.568
Skewness Detects	1.314	Kurtosis Detects	1.917
Mean of Logged Detects	0.12	SD of Logged Detects	0.6

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.895
1% Shapiro Wilk P Value	2.758E-11
Lilliefors Test Statistic	0.155
1% Lilliefors Critical Value	0.0959

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.19	KM Standard Error of Mean	0.0549
90KM SD	0.666	95% KM (BCA) UCL	1.283
95% KM (t) UCL	1.28	95% KM (Percentile Bootstrap) UCL	1.282
95% KM (z) UCL	1.28	95% KM Bootstrap t UCL	1.287
90% KM Chebyshev UCL	1.354	95% KM Chebyshev UCL	1.429
97.5% KM Chebyshev UCL	1.532	99% KM Chebyshev UCL	1.735

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.981
5% A-D Critical Value	0.758
K-S Test Statistic	0.0936
5% K-S Critical Value	0.0861

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.33	k star (bias corrected MLE)	3.249
Theta hat (MLE)	0.397	Theta star (bias corrected MLE)	0.406
nu hat (MLE)	765.9	nu star (bias corrected)	747.2
Mean (detects)	1.32		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.051	Mean	1.194
Maximum	4.3	Median	1.037
SD	0.669	CV	0.56
k hat (MLE)	3.272	k star (bias corrected MLE)	3.225
Theta hat (MLE)	0.365	Theta star (bias corrected MLE)	0.37
nu hat (MLE)	1276	nu star (bias corrected)	1258
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (N/A, α)	1176	Adjusted Chi Square Value (N/A, β)	1176
95% Gamma Approximate UCL	1.276	95% Gamma Adjusted UCL	1.277

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.19	SD (KM)	0.666
Variance (KM)	0.444	SE of Mean (KM)	0.0549

UCL Statistics for Baseline Sediment Samples

k hat (KM)	3.189	k star (KM)	3.143
nu hat (KM)	1244	nu star (KM)	1226
theta hat (KM)	0.373	theta star (KM)	0.378
80% gamma percentile (KM)	1.687	90% gamma percentile (KM)	2.089
95% gamma percentile (KM)	2.463	99% gamma percentile (KM)	3.272

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1145	Adjusted Chi Square Value (N/A, β)	1145
95% KM Approximate Gamma UCL	1.273	95% KM Adjusted Gamma UCL	1.274

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.949	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	7.7152E-4	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0815	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.0759	Detected Data Not Lognormal at 10% Significance Level	

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.185	Mean in Log Scale	0.0238
SD in Original Scale	0.659	SD in Log Scale	0.567
95% t UCL (assumes normality of ROS data)	1.263	95% Percentile Bootstrap UCL	1.267
95% BCA Bootstrap UCL	1.267	95% Bootstrap t UCL	1.271
95% H-UCL (Log ROS)	1.297		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0645	KM Geo Mean	0.938
KM SD (logged)	1.015	95% Critical H Value (KM-Log)	2.188
KM Standard Error of Mean (logged)	0.0954	95% H-UCL (KM -Log)	1.841
KM SD (logged)	1.015	95% Critical H Value (KM-Log)	2.188
KM Standard Error of Mean (logged)	0.0954		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	1.199
SD in Original Scale	0.61
95% t UCL (Assumes normality)	1.271

DL/2 Log-Transformed

Mean in Log Scale	0.0168
SD in Log Scale	0.848
95% H-Stat UCL	1.65

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	1.28
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics

Total Number of Observations	195	Number of Distinct Observations	136
Number of Detects	194	Number of Non-Detects	1
Number of Distinct Detects	135	Number of Distinct Non-Detects	1
Minimum Detect	0.328	Minimum Non-Detect	3
Maximum Detect	71.2	Maximum Non-Detect	3
Variance Detects	256	Percent Non-Detects	0.513%
Mean Detects	15.38	SD Detects	16
Median Detects	12	CV Detects	1.04
Skewness Detects	1.173	Kurtosis Detects	1.137
Mean of Logged Detects	1.891	SD of Logged Detects	1.507

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.832	Normal GOF Test on Detected Observations Only	
1% Shapiro Wilk P Value	0	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.183	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.074	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	15.31	KM Standard Error of Mean	1.145
90KM SD	15.95	95% KM (BCA) UCL	17.25
95% KM (t) UCL	17.2	95% KM (Percentile Bootstrap) UCL	17.19
95% KM (z) UCL	17.19	95% KM Bootstrap t UCL	17.26
90% KM Chebyshev UCL	18.74	95% KM Chebyshev UCL	20.3

UCL Statistics for Baseline Sediment Samples

97.5% KM Chebyshev UCL 22.46 99% KM Chebyshev UCL 26.7

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	7.246	Anderson-Darling GOF Test
5% A-D Critical Value	0.8	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.18	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.068	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.715	k star (bias corrected MLE)	0.708
Theta hat (MLE)	21.51	Theta star (bias corrected MLE)	21.74
nu hat (MLE)	277.5	nu star (bias corrected)	274.5
Mean (detects)	15.38		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.328	Mean	15.32
Maximum	71.2	Median	12
SD	15.98	CV	1.043
k hat (MLE)	0.716	k star (bias corrected MLE)	0.708
Theta hat (MLE)	21.4	Theta star (bias corrected MLE)	21.63
nu hat (MLE)	279.1	nu star (bias corrected)	276.2
Adjusted Level of Significance (β)	0.0488		
Approximate Chi Square Value (276.17, α)	238.7	Adjusted Chi Square Value (276.17, β)	238.4
95% Gamma Approximate UCL	17.73	95% Gamma Adjusted UCL	17.74

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	15.31	SD (KM)	15.95
Variance (KM)	254.4	SE of Mean (KM)	1.145
k hat (KM)	0.921	k star (KM)	0.911
nu hat (KM)	359.3	nu star (KM)	355.1
theta hat (KM)	16.62	theta star (KM)	16.81
80% gamma percentile (KM)	24.81	90% gamma percentile (KM)	36.07
95% gamma percentile (KM)	47.41	99% gamma percentile (KM)	73.93

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (355.10, α)	312.4	Adjusted Chi Square Value (355.10, β)	312.1
95% KM Approximate Gamma UCL	17.4	95% KM Adjusted Gamma UCL	17.41

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.863	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.174	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0586	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	15.31	Mean in Log Scale	1.884
SD in Original Scale	15.99	SD in Log Scale	1.506
95% t UCL (assumes normality of ROS data)	17.2	95% Percentile Bootstrap UCL	17.24
95% BCA Bootstrap UCL	17.28	95% Bootstrap t UCL	17.37
95% H-UCL (Log ROS)	27.28		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.882	KM Geo Mean	6.565
KM SD (logged)	1.505	95% Critical H Value (KM-Log)	2.666
KM Standard Error of Mean (logged)	0.108	95% H-UCL (KM -Log)	27.15
KM SD (logged)	1.505	95% Critical H Value (KM-Log)	2.666
KM Standard Error of Mean (logged)	0.108		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	15.31	Mean in Log Scale	1.883
SD in Original Scale	15.99	SD in Log Scale	1.507
95% t UCL (Assumes normality)	17.2	95% H-Stat UCL	27.3

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

UCL Statistics for Baseline Sediment Samples

Suggested UCL to Use

95% KM (t) UCL 17.2

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Yttrium

General Statistics			
Total Number of Observations	157	Number of Distinct Observations	125
		Number of Missing Observations	0
Minimum	1.1	Mean	16.42
Maximum	68.1	Median	9.35
SD	14.32	Std. Error of Mean	1.143
Coefficient of Variation	0.872	Skewness	1.323
Normal GOF Test			
Shapiro Wilk Test Statistic	0.823	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.227	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0822	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	18.31	95% Adjusted-CLT UCL (Chen-1995)	18.42
		95% Modified-t UCL (Johnson-1978)	18.33
Gamma GOF Test			
A-D Test Statistic	4.235	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.772	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.159	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0762	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.464	k star (bias corrected MLE)	1.44
Theta hat (MLE)	11.21	Theta star (bias corrected MLE)	11.4
nu hat (MLE)	459.7	nu star (bias corrected)	452.3
MLE Mean (bias corrected)	16.42	MLE Sd (bias corrected)	13.68
Adjusted Level of Significance	0.0485	Approximate Chi Square Value (0.05)	404
		Adjusted Chi Square Value	403.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL	18.38	95% Adjusted Gamma UCL	18.4
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.8524E-6	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.116	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0651	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.0953	Mean of logged Data	2.419
Maximum of Logged Data	4.221	SD of logged Data	0.899
Assuming Lognormal Distribution			
95% H-UCL	19.61	90% Chebyshev (MVUE) UCL	21
95% Chebyshev (MVUE) UCL	22.92	97.5% Chebyshev (MVUE) UCL	25.58
99% Chebyshev (MVUE) UCL	30.81		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	18.3	95% BCA Bootstrap UCL	18.52
95% Standard Bootstrap UCL	18.34	95% Bootstrap-t UCL	18.57

UCL Statistics for Baseline Sediment Samples

95% Hall's Bootstrap UCL	18.55	95% Percentile Bootstrap UCL	18.35
90% Chebyshev(Mean, Sd) UCL	19.84	95% Chebyshev(Mean, Sd) UCL	21.4
97.5% Chebyshev(Mean, Sd) UCL	23.55	99% Chebyshev(Mean, Sd) UCL	27.79

Suggested UCL to Use

95% Student's-t UCL 18.31

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Sediment Samples

Zinc

General Statistics			
Total Number of Observations	195	Number of Distinct Observations	152
		Number of Missing Observations	0
Minimum	2.5	Mean	74.06
Maximum	6160	Median	38
SD	438.9	Std. Error of Mean	31.43
Coefficient of Variation	5.926	Skewness	13.89

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.104	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0	Lilliefors GOF Test	
Lilliefors Test Statistic	0.45	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.0739		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	126	95% Adjusted-CLT UCL (Chen-1995)	159.1
		95% Modified-t UCL (Johnson-1978)	131.2

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	5.128E+28	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.794	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.237	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.0674		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	0.797	k star (bias corrected MLE)	0.789
Theta hat (MLE)	92.87	Theta star (bias corrected MLE)	93.91
nu hat (MLE)	311	nu star (bias corrected)	307.6
MLE Mean (bias corrected)	74.06	MLE Sd (bias corrected)	83.39
Adjusted Level of Significance	0.0488	Approximate Chi Square Value (0.05)	267.9
		Adjusted Chi Square Value	267.7

Assuming Gamma Distribution			
95% Approximate Gamma UCL	85.01	95% Adjusted Gamma UCL	85.1

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.936	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	2.731E-10	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0731	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0584		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	0.916	Mean of logged Data	3.56
Maximum of Logged Data	8.726	SD of logged Data	0.808

Assuming Lognormal Distribution			
95% H-UCL	54.79	90% Chebyshev (MVUE) UCL	58.28
95% Chebyshev (MVUE) UCL	62.66	97.5% Chebyshev (MVUE) UCL	68.72
99% Chebyshev (MVUE) UCL	80.64		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	125.8	95% BCA Bootstrap UCL	170.6
95% Standard Bootstrap UCL	124.2	95% Bootstrap-t UCL	660
95% Hall's Bootstrap UCL	384	95% Percentile Bootstrap UCL	135.9
90% Chebyshev(Mean, Sd) UCL	168.3	95% Chebyshev(Mean, Sd) UCL	211
97.5% Chebyshev(Mean, Sd) UCL	270.3	99% Chebyshev(Mean, Sd) UCL	386.8

Suggested UCL to Use
95% Student's-t UCL 126

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner. Please verify the data were collected from random locations. If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

UCL Statistics for Baseline Sediment Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	33
		Number of Missing Observations	157
Number of Detects	36	Number of Non-Detects	2
Number of Distinct Detects	32	Number of Distinct Non-Detects	1
Minimum Detect	2.3	Minimum Non-Detect	1
Maximum Detect	14.4	Maximum Non-Detect	1
Variance Detects	9.367	Percent Non-Detects	5.263%
Mean Detects	6.325	SD Detects	3.061
Median Detects	5.8	CV Detects	0.484
Skewness Detects	0.817	Kurtosis Detects	0.0636
Mean of Logged Detects	1.732	SD of Logged Detects	0.486

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.912	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.152	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.17	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	6.045	KM Standard Error of Mean	0.521
90KM SD	3.169	95% KM (BCA) UCL	6.924
95% KM (t) UCL	6.924	95% KM (Percentile Bootstrap) UCL	6.924
95% KM (z) UCL	6.902	95% KM Bootstrap t UCL	6.956
90% KM Chebyshev UCL	7.609	95% KM Chebyshev UCL	8.317
97.5% KM Chebyshev UCL	9.301	99% KM Chebyshev UCL	11.23

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.411	Anderson-Darling GOF Test	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.147	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	4.589	k star (bias corrected MLE)	4.225
Theta hat (MLE)	1.378	Theta star (bias corrected MLE)	1.497
nu hat (MLE)	330.4	nu star (bias corrected)	304.2
Mean (detects)	6.325		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.75	Mean	6.043
Maximum	14.4	Median	5.75
SD	3.214	CV	0.532
k hat (MLE)	3.258	k star (bias corrected MLE)	3.018
Theta hat (MLE)	1.855	Theta star (bias corrected MLE)	2.002
nu hat (MLE)	247.6	nu star (bias corrected)	229.4
Adjusted Level of Significance (β)	0.0434		
Approximate Chi Square Value (229.38, α)	195.3	Adjusted Chi Square Value (229.38, β)	194
95% Gamma Approximate UCL	7.097	95% Gamma Adjusted UCL	7.145

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	6.045	SD (KM)	3.169
Variance (KM)	10.04	SE of Mean (KM)	0.521
k hat (KM)	3.639	k star (KM)	3.369
nu hat (KM)	276.5	nu star (KM)	256.1
theta hat (KM)	1.661	theta star (KM)	1.794
80% gamma percentile (KM)	8.504	90% gamma percentile (KM)	10.46
95% gamma percentile (KM)	12.28	99% gamma percentile (KM)	16.19

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (256.05, α)	220	Adjusted Chi Square Value (256.05, β)	218.6

UCL Statistics for Baseline Sediment Samples

95% KM Approximate Gamma UCL 7.035 95% KM Adjusted Gamma UCL 7.08

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.966	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.945	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.113	Lilliefors GOF Test
10% Lilliefors Critical Value	0.134	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.084	Mean in Log Scale	1.67
SD in Original Scale	3.152	SD in Log Scale	0.543
95% t UCL (assumes normality of ROS data)	6.947	95% Percentile Bootstrap UCL	6.911
95% BCA Bootstrap UCL	6.926	95% Bootstrap t UCL	7.044
95% H-UCL (Log ROS)	7.323		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.64	KM Geo Mean	5.158
KM SD (logged)	0.606	95% Critical H Value (KM-Log)	2
KM Standard Error of Mean (logged)	0.0997	95% H-UCL (KM -Log)	7.564
KM SD (logged)	0.606	95% Critical H Value (KM-Log)	2
KM Standard Error of Mean (logged)	0.0997		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.018	Mean in Log Scale	1.604
SD in Original Scale	3.256	SD in Log Scale	0.724
95% t UCL (Assumes normality)	6.909	95% H-Stat UCL	8.308

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 6.924

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

User Selected Options
 Date/Time of Computation ProUCL 5.2 2025-12-18 3:38:26 PM
 From File [GBP] Veg UCL inputs 2025_12_18_b.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Moisture

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	4.3	Mean	55.05
Maximum	87.3	Median	54.8
SD	22.48	Std. Error of Mean	6.234
Coefficient of Variation	0.408	Skewness	-0.811

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.933	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.814	Lilliefors GOF Test	
Lilliefors Test Statistic	0.198	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.271		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	66.16	95% Adjusted-CLT UCL (Chen-1995)	63.81
		95% Modified-t UCL (Johnson-1978)	65.93

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.159	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.739	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.308	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.238		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.105	k star (bias corrected MLE)	2.44
Theta hat (MLE)	17.73	Theta star (bias corrected MLE)	22.56
nu hat (MLE)	80.74	nu star (bias corrected)	63.44
MLE Mean (bias corrected)	55.05	MLE Sd (bias corrected)	35.24
		Approximate Chi Square Value (0.05)	46.12
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	44.02

Assuming Gamma Distribution			
95% Approximate Gamma UCL	75.73	95% Adjusted Gamma UCL	79.34

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.664	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.889	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.347	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.215		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	1.459	Mean of logged Data	3.839
Maximum of Logged Data	4.469	SD of logged Data	0.782

Assuming Lognormal Distribution			
95% H-UCL	110.8	90% Chebyshev (MVUE) UCL	103.4
95% Chebyshev (MVUE) UCL	122.5	97.5% Chebyshev (MVUE) UCL	148.9
99% Chebyshev (MVUE) UCL	200.9		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	65.31	95% BCA Bootstrap UCL	63.48
95% Standard Bootstrap UCL	64.62	95% Bootstrap-t UCL	64.4
95% Hall's Bootstrap UCL	64.07	95% Percentile Bootstrap UCL	64.11
90% Chebyshev(Mean, Sd) UCL	73.76	95% Chebyshev(Mean, Sd) UCL	82.23
97.5% Chebyshev(Mean, Sd) UCL	93.98	99% Chebyshev(Mean, Sd) UCL	117.1

UCL Statistics for Baseline Traditional Plant Samples
Suggested UCL to Use
95% Student's-t UCL 66.16

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Traditional Plant Samples

Aluminum

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	1.32	Mean	28.14
Maximum	150	Median	16.9
SD	38.79	Std. Error of Mean	10.76
Coefficient of Variation	1.378	Skewness	2.949
Normal GOF Test			
Shapiro Wilk Test Statistic	0.619	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.297	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	47.31	95% Adjusted-CLT UCL (Chen-1995)	55.24
		95% Modified-t UCL (Johnson-1978)	48.78
Gamma GOF Test			
A-D Test Statistic	0.351	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.16	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.244	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.917	k star (bias corrected MLE)	0.757
Theta hat (MLE)	30.69	Theta star (bias corrected MLE)	37.19
nu hat (MLE)	23.84	nu star (bias corrected)	19.67
MLE Mean (bias corrected)	28.14	MLE Sd (bias corrected)	32.35
		Approximate Chi Square Value (0.05)	10.61
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	9.674
Assuming Gamma Distribution			
95% Approximate Gamma UCL	52.18	95% Adjusted Gamma UCL	57.23
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.145	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.278	Mean of logged Data	2.701
Maximum of Logged Data	5.011	SD of logged Data	1.224
Assuming Lognormal Distribution			
95% H-UCL	99.33	90% Chebyshev (MVUE) UCL	61.06
95% Chebyshev (MVUE) UCL	75.66	97.5% Chebyshev (MVUE) UCL	95.92
99% Chebyshev (MVUE) UCL	135.7		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	45.84	95% BCA Bootstrap UCL	56.98
95% Standard Bootstrap UCL	44.91	95% Bootstrap-t UCL	74.03
95% Hall's Bootstrap UCL	112.6	95% Percentile Bootstrap UCL	48
90% Chebyshev(Mean, Sd) UCL	60.41	95% Chebyshev(Mean, Sd) UCL	75.03
97.5% Chebyshev(Mean, Sd) UCL	95.32	99% Chebyshev(Mean, Sd) UCL	135.2
Suggested UCL to Use			
95% Adjusted Gamma UCL	57.23		

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

UCL Statistics for Baseline Traditional Plant Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	7
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.0023	Minimum Non-Detect	0.002
Maximum Detect	0.0093	Maximum Non-Detect	0.002
Variance Detects	6.4640E-6	Percent Non-Detects	53.85%
Mean Detects	0.0043	SD Detects	0.00254
Median Detects	0.0036	CV Detects	0.591
Skewness Detects	2.059	Kurtosis Detects	4.586
Mean of Logged Detects	-5.56	SD of Logged Detects	0.483

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.752	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.713	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.349	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.373	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00306	KM Standard Error of Mean	5.9232E-4
90KM SD	0.00195	95% KM (BCA) UCL	0.00412
95% KM (t) UCL	0.00412	95% KM (Percentile Bootstrap) UCL	0.00407
95% KM (z) UCL	0.00404	95% KM Bootstrap t UCL	0.00502
90% KM Chebyshev UCL	0.00484	95% KM Chebyshev UCL	0.00564
97.5% KM Chebyshev UCL	0.00676	99% KM Chebyshev UCL	0.00896

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.521	Anderson-Darling GOF Test	
5% A-D Critical Value	0.699	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.292	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	4.67	k star (bias corrected MLE)	2.446
Theta hat (MLE)	9.2086E-4	Theta star (bias corrected MLE)	0.00176
nu hat (MLE)	56.03	nu star (bias corrected)	29.35
Mean (detects)	0.0043		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0023	Mean	0.00737
Maximum	0.01	Median	0.01
SD	0.00338	CV	0.459
k hat (MLE)	3.851	k star (bias corrected MLE)	3.013
Theta hat (MLE)	0.00191	Theta star (bias corrected MLE)	0.00245
nu hat (MLE)	100.1	nu star (bias corrected)	78.35
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (78.35, α)	58.96	Adjusted Chi Square Value (78.35, β)	56.56
95% Gamma Approximate UCL	0.00979	95% Gamma Adjusted UCL	0.0102

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00306	SD (KM)	0.00195
Variance (KM)	3.8008E-6	SE of Mean (KM)	5.9232E-4
k hat (KM)	2.466	k star (KM)	1.948
nu hat (KM)	64.12	nu star (KM)	50.65
theta hat (KM)	0.00124	theta star (KM)	0.00157
80% gamma percentile (KM)	0.0046	90% gamma percentile (KM)	0.00599
95% gamma percentile (KM)	0.00732	99% gamma percentile (KM)	0.0103

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (50.65, α)	35.31	Adjusted Chi Square Value (50.65, β)	33.49
95% KM Approximate Gamma UCL	0.00439	95% KM Adjusted Gamma UCL	0.00463

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.894	Shapiro Wilk GOF Test
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UCL Statistics for Baseline Traditional Plant Samples

10% Shapiro Wilk Critical Value	0.826	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.262	Lilliefors GOF Test
10% Lilliefors Critical Value	0.298	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00249	Mean in Log Scale	-6.371
SD in Original Scale	0.00241	SD in Log Scale	0.915
95% t UCL (assumes normality of ROS data)	0.00369	95% Percentile Bootstrap UCL	0.00362
95% BCA Bootstrap UCL	0.00399	95% Bootstrap t UCL	0.00446
95% H-UCL (Log ROS)	0.00531		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.912	KM Geo Mean	0.00271
KM SD (logged)	0.443	95% Critical H Value (KM-Log)	2.048
KM Standard Error of Mean (logged)	0.135	95% H-UCL (KM -Log)	0.00388
KM SD (logged)	0.443	95% Critical H Value (KM-Log)	2.048
KM Standard Error of Mean (logged)	0.135		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00252
SD in Original Scale	0.00237
95% t UCL (Assumes normality)	0.0037

DL/2 Log-Transformed

Mean in Log Scale	-6.286
SD in Log Scale	0.766
95% H-Stat UCL	0.00431

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00412

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Arsenic

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.0044	Mean	0.04
Maximum	0.119	Median	0.0323
SD	0.0357	Std. Error of Mean	0.00989
Coefficient of Variation	0.891	Skewness	1.374
Normal GOF Test			
Shapiro Wilk Test Statistic	0.838	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.225	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0577	95% Adjusted-CLT UCL (Chen-1995)	0.0603
		95% Modified-t UCL (Johnson-1978)	0.0583
Gamma GOF Test			
A-D Test Statistic	0.258	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.114	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.241	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.39	k star (bias corrected MLE)	1.12
Theta hat (MLE)	0.0288	Theta star (bias corrected MLE)	0.0357
nu hat (MLE)	36.13	nu star (bias corrected)	29.12
MLE Mean (bias corrected)	0.04	MLE Sd (bias corrected)	0.0378
		Approximate Chi Square Value (0.05)	17.81
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	16.55
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0655	95% Adjusted Gamma UCL	0.0704
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.938	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.147	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.426	Mean of logged Data	-3.619
Maximum of Logged Data	-2.129	SD of logged Data	1.012
Assuming Lognormal Distribution			
95% H-UCL	0.103	90% Chebyshev (MVUE) UCL	0.0809
95% Chebyshev (MVUE) UCL	0.0983	97.5% Chebyshev (MVUE) UCL	0.123
99% Chebyshev (MVUE) UCL	0.17		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0563	95% BCA Bootstrap UCL	0.0601
95% Standard Bootstrap UCL	0.0559	95% Bootstrap-t UCL	0.0705
95% Hall's Bootstrap UCL	0.0904	95% Percentile Bootstrap UCL	0.0572
90% Chebyshev(Mean, Sd) UCL	0.0697	95% Chebyshev(Mean, Sd) UCL	0.0832
97.5% Chebyshev(Mean, Sd) UCL	0.102	99% Chebyshev(Mean, Sd) UCL	0.138
Suggested UCL to Use			
95% Student's-t UCL	0.0577		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Barium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.173	Mean	19.51
Maximum	70.6	Median	16.5
SD	18.88	Std. Error of Mean	5.235
Coefficient of Variation	0.967	Skewness	1.757
Normal GOF Test			
Shapiro Wilk Test Statistic	0.842	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.209	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	28.84	95% Adjusted-CLT UCL (Chen-1995)	30.85
		95% Modified-t UCL (Johnson-1978)	29.27
Gamma GOF Test			
A-D Test Statistic	0.27	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.162	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.244	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.892	k star (bias corrected MLE)	0.738
Theta hat (MLE)	21.87	Theta star (bias corrected MLE)	26.45
nu hat (MLE)	23.2	nu star (bias corrected)	19.18
MLE Mean (bias corrected)	19.51	MLE Sd (bias corrected)	22.72
		Approximate Chi Square Value (0.05)	10.25
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	9.328
Assuming Gamma Distribution			
95% Approximate Gamma UCL	36.51	95% Adjusted Gamma UCL	40.11
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.863	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.229	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.754	Mean of logged Data	2.315
Maximum of Logged Data	4.257	SD of logged Data	1.576
Assuming Lognormal Distribution			
95% H-UCL	208.5	90% Chebyshev (MVUE) UCL	72.36
95% Chebyshev (MVUE) UCL	91.81	97.5% Chebyshev (MVUE) UCL	118.8
99% Chebyshev (MVUE) UCL	171.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	28.12	95% BCA Bootstrap UCL	31.45
95% Standard Bootstrap UCL	27.98	95% Bootstrap-t UCL	33.93
95% Hall's Bootstrap UCL	68.59	95% Percentile Bootstrap UCL	28.7
90% Chebyshev(Mean, Sd) UCL	35.22	95% Chebyshev(Mean, Sd) UCL	42.33
97.5% Chebyshev(Mean, Sd) UCL	52.2	99% Chebyshev(Mean, Sd) UCL	71.6
Suggested UCL to Use			
95% Student's-t UCL	28.84		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Beryllium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	11
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0052	Minimum Non-Detect	0.002
Maximum Detect	0.0057	Maximum Non-Detect	0.002
Variance Detects	1.2500E-7	Percent Non-Detects	84.62%
Mean Detects	0.00545	SD Detects	3.5355E-4
Median Detects	0.00545	CV Detects	0.0649
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-5.213	SD of Logged Detects	0.0649

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

**Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test**

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00253	KM Standard Error of Mean	4.8975E-4
90KM SD	0.00125	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0034	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00334	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.004	95% KM Chebyshev UCL	0.00467
97.5% KM Chebyshev UCL	0.00559	99% KM Chebyshev UCL	0.0074

**Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test**

Gamma Statistics on Detected Data Only

k hat (MLE)	474.9	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.1476E-5	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1900	nu star (bias corrected)	N/A
Mean (detects)	0.00545		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00253	SD (KM)	0.00125
Variance (KM)	1.5591E-6	SE of Mean (KM)	4.8975E-4
k hat (KM)	4.108	k star (KM)	3.211
nu hat (KM)	106.8	nu star (KM)	83.5
theta hat (KM)	6.1604E-4	theta star (KM)	7.8806E-4
80% gamma percentile (KM)	0.00358	90% gamma percentile (KM)	0.00442
95% gamma percentile (KM)	0.00521	99% gamma percentile (KM)	0.0069

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (83.50, α)	63.44	Adjusted Level of Significance (β)	0.0301
95% KM Approximate Gamma UCL	0.00333	Adjusted Chi Square Value (83.50, β)	60.95
		95% KM Adjusted Gamma UCL	0.00347

**Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test**

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00389	Mean in Log Scale	-5.574
SD in Original Scale	8.9757E-4	SD in Log Scale	0.227
95% t UCL (assumes normality of ROS data)	0.00433	95% Percentile Bootstrap UCL	0.00429
95% BCA Bootstrap UCL	0.00432	95% Bootstrap t UCL	0.0044
95% H-UCL (Log ROS)	0.0044		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.061	KM Geo Mean	0.00233
KM SD (logged)	0.362	95% Critical H Value (KM-Log)	1.965
KM Standard Error of Mean (logged)	0.142	95% H-UCL (KM -Log)	0.00306
KM SD (logged)	0.362	95% Critical H Value (KM-Log)	1.965
KM Standard Error of Mean (logged)	0.142		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00168	Mean in Log Scale	-6.647
SD in Original Scale	0.00167	SD in Log Scale	0.637
95% t UCL (Assumes normality)	0.00251	95% H-Stat UCL	0.00242

UCL Statistics for Baseline Traditional Plant Samples
DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0034

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Blsmuth

General Statistics

Total Number of Observations	13	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	8
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0026	Minimum Non-Detect	0.002
Maximum Detect	0.0062	Maximum Non-Detect	0.002
Variance Detects	2.1250E-6	Percent Non-Detects	61.54%
Mean Detects	0.0046	SD Detects	0.00146
Median Detects	0.0045	CV Detects	0.317
Skewness Detects	-0.339	Kurtosis Detects	-1.116
Mean of Logged Detects	-5.427	SD of Logged Detects	0.348

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.686	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.195	Lilliefors GOF Test
1% Lilliefors Critical Value	0.396	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.003	KM Standard Error of Mean	4.6553E-4
90KM SD	0.0015	95% KM (BCA) UCL	0.00368
95% KM (t) UCL	0.00383	95% KM (Percentile Bootstrap) UCL	0.00376
95% KM (z) UCL	0.00377	95% KM Bootstrap t UCL	0.00359
90% KM Chebyshev UCL	0.0044	95% KM Chebyshev UCL	0.00503
97.5% KM Chebyshev UCL	0.00591	99% KM Chebyshev UCL	0.00763

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.261	Anderson-Darling GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.217	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	11.16	k star (bias corrected MLE)	4.598
Theta hat (MLE)	4.1210E-4	Theta star (bias corrected MLE)	0.001
nu hat (MLE)	111.6	nu star (bias corrected)	45.98
Mean (detects)	0.0046		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0026	Mean	0.00792
Maximum	0.01	Median	0.01
SD	0.00286	CV	0.361
k hat (MLE)	6.161	k star (bias corrected MLE)	4.791
Theta hat (MLE)	0.00129	Theta star (bias corrected MLE)	0.00165
nu hat (MLE)	160.2	nu star (bias corrected)	124.6
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (124.55, α)	99.78	Adjusted Chi Square Value (124.55, β)	96.62
95% Gamma Approximate UCL	0.00989	95% Gamma Adjusted UCL	0.0102

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.003	SD (KM)	0.0015
Variance (KM)	2.2538E-6	SE of Mean (KM)	4.6553E-4
k hat (KM)	3.993	k star (KM)	3.123
nu hat (KM)	103.8	nu star (KM)	81.2
theta hat (KM)	7.5128E-4	theta star (KM)	9.6063E-4
80% gamma percentile (KM)	0.00426	90% gamma percentile (KM)	0.00528
95% gamma percentile (KM)	0.00622	99% gamma percentile (KM)	0.00827

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (81.20, α)	61.43	Adjusted Chi Square Value (81.20, β)	58.99
95% KM Approximate Gamma UCL	0.00397	95% KM Adjusted Gamma UCL	0.00413

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.933	Shapiro Wilk GOF Test
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UCL Statistics for Baseline Traditional Plant Samples

10% Shapiro Wilk Critical Value	0.806	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.187	Lilliefors GOF Test
10% Lilliefors Critical Value	0.319	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00267	Mean in Log Scale	-6.148
SD in Original Scale	0.00185	SD in Log Scale	0.705
95% t UCL (assumes normality of ROS data)	0.00359	95% Percentile Bootstrap UCL	0.00352
95% BCA Bootstrap UCL	0.00363	95% Bootstrap t UCL	0.00376
95% H-UCL (Log ROS)	0.00445		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.912	KM Geo Mean	0.00271
KM SD (logged)	0.429	95% Critical H Value (KM-Log)	2.033
KM Standard Error of Mean (logged)	0.133	95% H-UCL (KM -Log)	0.00382
KM SD (logged)	0.429	95% Critical H Value (KM-Log)	2.033
KM Standard Error of Mean (logged)	0.133		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00238	Mean in Log Scale	-6.338
SD in Original Scale	0.00201	SD in Log Scale	0.776
95% t UCL (Assumes normality)	0.00338	95% H-Stat UCL	0.00417

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00383

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Boron

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.38	Mean	5.284
Maximum	13.1	Median	4.72
SD	3.583	Std. Error of Mean	0.994
Coefficient of Variation	0.678	Skewness	0.681

Normal GOF Test

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.814	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.106	Lilliefors GOF Test
1% Lilliefors Critical Value	0.271	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.055	95% Adjusted-CLT UCL (Chen-1995)	7.119
		95% Modified-t UCL (Johnson-1978)	7.086

Gamma GOF Test

A-D Test Statistic	0.205	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.113	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.24	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.774	k star (bias corrected MLE)	1.416
Theta hat (MLE)	2.978	Theta star (bias corrected MLE)	3.732
nu hat (MLE)	46.12	nu star (bias corrected)	36.81
MLE Mean (bias corrected)	5.284	MLE Sd (bias corrected)	4.441
		Approximate Chi Square Value (0.05)	23.92
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	22.45

**UCL Statistics for Baseline Traditional Plant Samples
Assuming Gamma Distribution**

95% Approximate Gamma UCL 8.13 95% Adjusted Gamma UCL 8.664

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.911
10% Shapiro Wilk Critical Value 0.889
Lilliefors Test Statistic 0.159
10% Lilliefors Critical Value 0.215

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data -0.968
Maximum of Logged Data 2.573

Mean of logged Data 1.357
SD of logged Data 0.953

Assuming Lognormal Distribution

95% H-UCL 13.11
95% Chebyshev (MVUE) UCL 13.07
99% Chebyshev (MVUE) UCL 22.34

90% Chebyshev (MVUE) UCL 10.81
97.5% Chebyshev (MVUE) UCL 16.19

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 6.918
95% Standard Bootstrap UCL 6.866
95% Hall's Bootstrap UCL 7.408
90% Chebyshev(Mean, Sd) UCL 8.265
97.5% Chebyshev(Mean, Sd) UCL 11.49

95% BCA Bootstrap UCL 7.025
95% Bootstrap-t UCL 7.425
95% Percentile Bootstrap UCL 6.871
95% Chebyshev(Mean, Sd) UCL 9.615
99% Chebyshev(Mean, Sd) UCL 15.17

Suggested UCL to Use

95% Student's-t UCL 7.055

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
Number of Detects	12	Number of Non-Detects	1
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.001
Maximum Detect	5.45	Maximum Non-Detect	0.001
Variance Detects	2.429	Percent Non-Detects	7.692%
Mean Detects	0.516	SD Detects	1.559
Median Detects	0.0134	CV Detects	3.021
Skewness Detects	3.427	Kurtosis Detects	11.81
Mean of Logged Detects	-3.984	SD of Logged Detects	2.697

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.378	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.805	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.443	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.281	Detected Data Not Normal at 1% Significance Level	
Detected Data Not Normal at 1% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.476	KM Standard Error of Mean	0.417
90KM SD	1.44	95% KM (BCA) UCL	1.299
95% KM (t) UCL	1.22	95% KM (Percentile Bootstrap) UCL	1.292
95% KM (z) UCL	1.163	95% KM Bootstrap t UCL	13.18
90% KM Chebyshev UCL	1.728	95% KM Chebyshev UCL	2.295
97.5% KM Chebyshev UCL	3.082	99% KM Chebyshev UCL	4.627

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	1.322	Anderson-Darling GOF Test	
5% A-D Critical Value	0.863	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.274	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.271	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.218	k star (bias corrected MLE)	0.219
Theta hat (MLE)	2.362	Theta star (bias corrected MLE)	2.351
nu hat (MLE)	5.243	nu star (bias corrected)	5.265
Mean (detects)	0.516		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.477
Maximum	5.45	Median	0.01
SD	1.499	CV	3.142
k hat (MLE)	0.22	k star (bias corrected MLE)	0.221
Theta hat (MLE)	2.166	Theta star (bias corrected MLE)	2.162
nu hat (MLE)	5.725	nu star (bias corrected)	5.737
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (5.74, α)	1.507	Adjusted Chi Square Value (5.74, β)	1.221
95% Gamma Approximate UCL	1.816	95% Gamma Adjusted UCL	2.24

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.476	SD (KM)	1.44
Variance (KM)	2.074	SE of Mean (KM)	0.417
k hat (KM)	0.109	k star (KM)	0.135
nu hat (KM)	2.843	nu star (KM)	3.52
theta hat (KM)	4.355	theta star (KM)	3.517
80% gamma percentile (KM)	0.474	90% gamma percentile (KM)	1.388
95% gamma percentile (KM)	2.67	99% gamma percentile (KM)	6.473

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (3.52, α)	0.542	Adjusted Chi Square Value (3.52, β)	0.406
95% KM Approximate Gamma UCL	3.094	95% KM Adjusted Gamma UCL	4.134

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.883	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.213	Lilliefors GOF Test	

UCL Statistics for Baseline Traditional Plant Samples
 10% Lilliefors Critical Value 0.223 Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.476	Mean in Log Scale	-4.485
SD in Original Scale	1.499	SD in Log Scale	3.15
95% t UCL (assumes normality of ROS data)	1.217	95% Percentile Bootstrap UCL	1.29
95% BCA Bootstrap UCL	1.733	95% Bootstrap t UCL	13.21
95% H-UCL (Log ROS)	1197		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.209	KM Geo Mean	0.0149
KM SD (logged)	2.6	95% Critical H Value (KM-Log)	6.081
KM Standard Error of Mean (logged)	0.753	95% H-UCL (KM -Log)	41.97
KM SD (logged)	2.6	95% Critical H Value (KM-Log)	6.081
KM Standard Error of Mean (logged)	0.753		

DL/2 Normal		DL/2 Statistics		DL/2 Log-Transformed	
Mean in Original Scale	0.476	Mean in Log Scale	-4.263	Mean in Log Scale	-4.263
SD in Original Scale	1.499	SD in Log Scale	2.77	SD in Log Scale	2.77
95% t UCL (Assumes normality)	1.217	95% H-Stat UCL	113.4	95% H-Stat UCL	113.4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Lognormal Distributed at 10% Significance Level

Suggested UCL to Use
 KM (t) UCL 1.22

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	27.6	Mean	2800
Maximum	7780	Median	2190
SD	2424	Std. Error of Mean	672.3
Coefficient of Variation	0.866	Skewness	0.975

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.892	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.814	Lilliefors GOF Test	
Lilliefors Test Statistic	0.237	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.271		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	4100
95% Student's-t UCL	3998	95% Modified-t UCL (Johnson-1978)	4028

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.269	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.757	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.125	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.243		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	1.011	k star (bias corrected MLE)	0.829
Theta hat (MLE)	2768	Theta star (bias corrected MLE)	3376
nu hat (MLE)	26.3	nu star (bias corrected)	21.56
MLE Mean (bias corrected)	2800	MLE Sd (bias corrected)	3074
		Approximate Chi Square Value (0.05)	12.01

UCL Statistics for Baseline Traditional Plant Samples

Adjusted Level of Significance 0.0301 Adjusted Chi Square Value 11.01

Assuming Gamma Distribution

95% Approximate Gamma UCL 5026 95% Adjusted Gamma UCL 5485

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.834
10% Shapiro Wilk Critical Value 0.889
Lilliefors Test Statistic 0.192
10% Lilliefors Critical Value 0.215

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 3.318
Maximum of Logged Data 8.959

Mean of logged Data 7.367
SD of logged Data 1.471

Assuming Lognormal Distribution

95% H-UCL 22711
95% Chebyshev (MVUE) UCL 12024
99% Chebyshev (MVUE) UCL 22264

90% Chebyshev (MVUE) UCL 9535
97.5% Chebyshev (MVUE) UCL 15478

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 3906
95% Standard Bootstrap UCL 3870
95% Hall's Bootstrap UCL 4244
90% Chebyshev(Mean, Sd) UCL 4817
97.5% Chebyshev(Mean, Sd) UCL 6998

95% BCA Bootstrap UCL 4038
95% Bootstrap-t UCL 4463
95% Percentile Bootstrap UCL 3910
95% Chebyshev(Mean, Sd) UCL 5730
99% Chebyshev(Mean, Sd) UCL 9489

Suggested UCL to Use

95% Student's-t UCL 3998

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Ceslum

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	0.0018	Mean	0.074
Maximum	0.226	Median	0.0545
SD	0.0636	Std. Error of Mean	0.0176
Coefficient of Variation	0.86	Skewness	1.284
Normal GOF Test			
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.297	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Data Not Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.105	95% Adjusted-CLT UCL (Chen-1995)	0.11
		95% Modified-t UCL (Johnson-1978)	0.107
Gamma GOF Test			
A-D Test Statistic	0.331	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.177	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.242	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.215	k star (bias corrected MLE)	0.986
Theta hat (MLE)	0.0609	Theta star (bias corrected MLE)	0.0751
nu hat (MLE)	31.59	nu star (bias corrected)	25.63
MLE Mean (bias corrected)	0.074	MLE Sd (bias corrected)	0.0745
Adjusted Level of Significance	0.0301	Approximate Chi Square Value (0.05)	15.1
		Adjusted Chi Square Value	13.96
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.126	95% Adjusted Gamma UCL	0.136
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.873	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.225	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-6.32	Mean of logged Data	-3.069
Maximum of Logged Data	-1.487	SD of logged Data	1.233
Assuming Lognormal Distribution			
95% H-UCL	0.318	90% Chebyshev (MVUE) UCL	0.193
95% Chebyshev (MVUE) UCL	0.239	97.5% Chebyshev (MVUE) UCL	0.304
99% Chebyshev (MVUE) UCL	0.43		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.103	95% BCA Bootstrap UCL	0.109
95% Standard Bootstrap UCL	0.102	95% Bootstrap-t UCL	0.12
95% Hall's Bootstrap UCL	0.121	95% Percentile Bootstrap UCL	0.104
90% Chebyshev(Mean, Sd) UCL	0.127	95% Chebyshev(Mean, Sd) UCL	0.151
97.5% Chebyshev(Mean, Sd) UCL	0.184	99% Chebyshev(Mean, Sd) UCL	0.25
Suggested UCL to Use			
95% Student's-t UCL	0.105		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Chromium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	2
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.017	Minimum Non-Detect	0.01
Maximum Detect	0.403	Maximum Non-Detect	0.01
Variance Detects	0.0125	Percent Non-Detects	15.38%
Mean Detects	0.103	SD Detects	0.112
Median Detects	0.074	CV Detects	1.086
Skewness Detects	2.3	Kurtosis Detects	5.562
Mean of Logged Detects	-2.664	SD of Logged Detects	0.894

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.701	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.792	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.34	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.291	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0888	KM Standard Error of Mean	0.0302
90KM SD	0.104	95% KM (BCA) UCL	0.144
95% KM (t) UCL	0.143	95% KM (Percentile Bootstrap) UCL	0.141
95% KM (z) UCL	0.138	95% KM Bootstrap t UCL	0.226
90% KM Chebyshev UCL	0.179	95% KM Chebyshev UCL	0.22
97.5% KM Chebyshev UCL	0.277	99% KM Chebyshev UCL	0.389

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.512	Anderson-Darling GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.26	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.419	k star (bias corrected MLE)	1.093
Theta hat (MLE)	0.0726	Theta star (bias corrected MLE)	0.0943
nu hat (MLE)	31.22	nu star (bias corrected)	24.04
Mean (detects)	0.103		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0888
Maximum	0.403	Median	0.068
SD	0.108	CV	1.217
k hat (MLE)	1.06	k star (bias corrected MLE)	0.866
Theta hat (MLE)	0.0838	Theta star (bias corrected MLE)	0.102
nu hat (MLE)	27.55	nu star (bias corrected)	22.53
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (22.53, α)	12.74	Adjusted Chi Square Value (22.53, β)	11.7
95% Gamma Approximate UCL	0.157	95% Gamma Adjusted UCL	0.171

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0888	SD (KM)	0.104
Variance (KM)	0.0108	SE of Mean (KM)	0.0302
k hat (KM)	0.732	k star (KM)	0.614
nu hat (KM)	19.03	nu star (KM)	15.97
theta hat (KM)	0.121	theta star (KM)	0.145
80% gamma percentile (KM)	0.146	90% gamma percentile (KM)	0.23
95% gamma percentile (KM)	0.317	99% gamma percentile (KM)	0.527

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (15.97, α)	7.941	Adjusted Chi Square Value (15.97, β)	7.148
95% KM Approximate Gamma UCL	0.179	95% KM Adjusted Gamma UCL	0.198

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.876	Detected Data appear Lognormal at 10% Significance Level	

UCL Statistics for Baseline Traditional Plant Samples

Lilliefors Test Statistic	0.174	Lilliefors GOF Test
10% Lilliefors Critical Value	0.231	Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0885	Mean in Log Scale	-2.993
SD in Original Scale	0.108	SD in Log Scale	1.148
95% t UCL (assumes normality of ROS data)	0.142	95% Percentile Bootstrap UCL	0.141
95% BCA Bootstrap UCL	0.159	95% Bootstrap t UCL	0.227
95% H-UCL (Log ROS)	0.272		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.963	KM Geo Mean	0.0517
KM SD (logged)	1.051	95% Critical H Value (KM-Log)	2.938
KM Standard Error of Mean (logged)	0.306	95% H-UCL (KM -Log)	0.219
KM SD (logged)	1.051	95% Critical H Value (KM-Log)	2.938
KM Standard Error of Mean (logged)	0.306		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.088	Mean in Log Scale	-3.069
SD in Original Scale	0.109	SD in Log Scale	1.283
95% t UCL (Assumes normality)	0.142	95% H-Stat UCL	0.367

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	0.198	95% GROS Adjusted Gamma UCL	0.171
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**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
Number of Detects	12	Number of Non-Detects	1
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.0051	Minimum Non-Detect	0.004
Maximum Detect	0.167	Maximum Non-Detect	0.004
Variance Detects	0.00249	Percent Non-Detects	7.692%
Mean Detects	0.04	SD Detects	0.0499
Median Detects	0.0248	CV Detects	1.248
Skewness Detects	2.049	Kurtosis Detects	3.584
Mean of Logged Detects	-3.789	SD of Logged Detects	1.092

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.689	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.805	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.347	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.281	Detected Data Not Normal at 1% Significance Level	
Detected Data Not Normal at 1% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.0372	KM Standard Error of Mean	0.0136
90KM SD	0.0469	95% KM (BCA) UCL	0.0622
95% KM (t) UCL	0.0614	95% KM (Percentile Bootstrap) UCL	0.061
95% KM (z) UCL	0.0595	95% KM Bootstrap t UCL	0.116
90% KM Chebyshev UCL	0.0779	95% KM Chebyshev UCL	0.0964
97.5% KM Chebyshev UCL	0.122	99% KM Chebyshev UCL	0.172

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.564	Anderson-Darling GOF Test	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.218	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.252	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.013	k star (bias corrected MLE)	0.816
Theta hat (MLE)	0.0394	Theta star (bias corrected MLE)	0.049
nu hat (MLE)	24.32	nu star (bias corrected)	19.57
Mean (detects)	0.04		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0051	Mean	0.0376
Maximum	0.167	Median	0.023
SD	0.0485	CV	1.287
k hat (MLE)	1.008	k star (bias corrected MLE)	0.827
Theta hat (MLE)	0.0373	Theta star (bias corrected MLE)	0.0455
nu hat (MLE)	26.21	nu star (bias corrected)	21.49
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (21.49, α)	11.96	Adjusted Chi Square Value (21.49, β)	10.96
95% Gamma Approximate UCL	0.0677	95% Gamma Adjusted UCL	0.0738

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.0372	SD (KM)	0.0469
Variance (KM)	0.0022	SE of Mean (KM)	0.0136
k hat (KM)	0.63	k star (KM)	0.536
nu hat (KM)	16.37	nu star (KM)	13.92
theta hat (KM)	0.0591	theta star (KM)	0.0694
80% gamma percentile (KM)	0.0612	90% gamma percentile (KM)	0.0992
95% gamma percentile (KM)	0.139	99% gamma percentile (KM)	0.238

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (13.92, α)	6.52	Adjusted Chi Square Value (13.92, β)	5.812
95% KM Approximate Gamma UCL	0.0794	95% KM Adjusted Gamma UCL	0.0891

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.883	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.148	Lilliefors GOF Test	

UCL Statistics for Baseline Traditional Plant Samples
 10% Lilliefors Critical Value 0.223 Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.037	Mean in Log Scale	-3.995
SD in Original Scale	0.0489	SD in Log Scale	1.282
95% t UCL (assumes normality of ROS data)	0.0612	95% Percentile Bootstrap UCL	0.0607
95% BCA Bootstrap UCL	0.0674	95% Bootstrap t UCL	0.114
95% H-UCL (Log ROS)	0.145		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.922	KM Geo Mean	0.0198
KM SD (logged)	1.106	95% Critical H Value (KM-Log)	3.034
KM Standard Error of Mean (logged)	0.32	95% H-UCL (KM -Log)	0.0961
KM SD (logged)	1.106	95% Critical H Value (KM-Log)	3.034
KM Standard Error of Mean (logged)	0.32		

DL/2 Normal		DL/2 Statistics		DL/2 Log-Transformed	
Mean in Original Scale	0.037	Mean in Log Scale	-3.975	Mean in Log Scale	-3.975
SD in Original Scale	0.0489	SD in Log Scale	1.244	SD in Log Scale	1.244
95% t UCL (Assumes normality)	0.0612	95% H-Stat UCL	0.132	95% H-Stat UCL	0.132

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Bootstrap t UCL	0.116	95% Hall's Bootstrap	0.0961
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	1.06	Mean	4.007
Maximum	18.5	Median	1.49
SD	5.277	Std. Error of Mean	1.463
Coefficient of Variation	1.317	Skewness	2.272

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.623	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.814	Lilliefors GOF Test	
Lilliefors Test Statistic	0.336	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.271		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.615	95% Adjusted-CLT UCL (Chen-1995)	7.4
		95% Modified-t UCL (Johnson-1978)	6.769

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.333	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.756	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.276	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.243		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1.092	k star (bias corrected MLE)	0.892
Theta hat (MLE)	3.668	Theta star (bias corrected MLE)	4.494
nu hat (MLE)	28.4	nu star (bias corrected)	23.18
MLE Mean (bias corrected)	4.007	MLE Sd (bias corrected)	4.244
		Approximate Chi Square Value (0.05)	13.23

UCL Statistics for Baseline Traditional Plant Samples
 Adjusted Level of Significance 0.0301 Adjusted Chi Square Value 12.17

Assuming Gamma Distribution
 95% Approximate Gamma UCL 7.022 95% Adjusted Gamma UCL 7.634

Lognormal GOF Test
 Shapiro Wilk Test Statistic 0.819
 10% Shapiro Wilk Critical Value 0.889
 Lilliefors Test Statistic 0.236
 10% Lilliefors Critical Value 0.215

Shapiro Wilk Lognormal GOF Test
 Data Not Lognormal at 10% Significance Level
Lilliefors Lognormal GOF Test
 Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics
 Minimum of Logged Data 0.0583 Mean of logged Data 0.865
 Maximum of Logged Data 2.918 SD of logged Data 0.955

Assuming Lognormal Distribution
 95% H-UCL 8.043 90% Chebyshev (MVUE) UCL 6.625
 95% Chebyshev (MVUE) UCL 8.007 97.5% Chebyshev (MVUE) UCL 9.924
 99% Chebyshev (MVUE) UCL 13.69

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs
 95% CLT UCL 6.414 95% BCA Bootstrap UCL 7.558
 95% Standard Bootstrap UCL 6.328 95% Bootstrap-t UCL 13.01
 95% Hall's Bootstrap UCL 18.38 95% Percentile Bootstrap UCL 6.563
 90% Chebyshev(Mean, Sd) UCL 8.397 95% Chebyshev(Mean, Sd) UCL 10.39
 97.5% Chebyshev(Mean, Sd) UCL 13.15 99% Chebyshev(Mean, Sd) UCL 18.57

Suggested UCL to Use
 95% Student's-t UCL 6.615

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
 Please verify the data were collected from random locations.
 If the data were collected using judgmental or other non-random methods,
 then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	4.02	Mean	40.1
Maximum	201	Median	23.3
SD	53.09	Std. Error of Mean	14.72
Coefficient of Variation	1.324	Skewness	2.695
Normal GOF Test			
Shapiro Wilk Test Statistic	0.645	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.285	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	66.35	95% Adjusted-CLT UCL (Chen-1995)	76.08
		95% Modified-t UCL (Johnson-1978)	68.18
Gamma GOF Test			
A-D Test Statistic	0.494	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.2	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.243	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.036	k star (bias corrected MLE)	0.848
Theta hat (MLE)	38.7	Theta star (bias corrected MLE)	47.26
nu hat (MLE)	26.95	nu star (bias corrected)	22.06
MLE Mean (bias corrected)	40.1	MLE Sd (bias corrected)	43.54
Adjusted Level of Significance	0.0301	Approximate Chi Square Value (0.05)	12.38
		Adjusted Chi Square Value	11.36
Assuming Gamma Distribution			
95% Approximate Gamma UCL	71.44	95% Adjusted Gamma UCL	77.87
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.977	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.391	Mean of logged Data	3.137
Maximum of Logged Data	5.303	SD of logged Data	1.068
Assuming Lognormal Distribution			
95% H-UCL	101.6	90% Chebyshev (MVUE) UCL	75.15
95% Chebyshev (MVUE) UCL	91.85	97.5% Chebyshev (MVUE) UCL	115
99% Chebyshev (MVUE) UCL	160.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	64.32	95% BCA Bootstrap UCL	78.4
95% Standard Bootstrap UCL	62.94	95% Bootstrap-t UCL	115.2
95% Hall's Bootstrap UCL	167.9	95% Percentile Bootstrap UCL	66.49
90% Chebyshev(Mean, Sd) UCL	84.28	95% Chebyshev(Mean, Sd) UCL	104.3
97.5% Chebyshev(Mean, Sd) UCL	132.1	99% Chebyshev(Mean, Sd) UCL	186.6
Suggested UCL to Use			
95% Adjusted Gamma UCL	77.87		

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Traditional Plant Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
Number of Detects	10	Number of Non-Detects	3
Number of Distinct Detects	10	Number of Distinct Non-Detects	2
Minimum Detect	0.0088	Minimum Non-Detect	0.004
Maximum Detect	0.205	Maximum Non-Detect	0.01
Variance Detects	0.00362	Percent Non-Detects	23.08%
Mean Detects	0.056	SD Detects	0.0601
Median Detects	0.0355	CV Detects	1.074
Skewness Detects	1.94	Kurtosis Detects	4.18
Mean of Logged Detects	-3.351	SD of Logged Detects	1.027

Normal GOF Test on Detects Only		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.777	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.781	Lilliefors GOF Test	
Lilliefors Test Statistic	0.216	Detected Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.304	Detected Data appear Approximate Normal at 1% Significance Level	

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.0441	KM Standard Error of Mean	0.0159
90KM SD	0.0545	95% KM (BCA) UCL	0.0731
95% KM (t) UCL	0.0725	95% KM (Percentile Bootstrap) UCL	0.0718
95% KM (z) UCL	0.0703	95% KM Bootstrap t UCL	0.0964
90% KM Chebyshev UCL	0.0919	95% KM Chebyshev UCL	0.114
97.5% KM Chebyshev UCL	0.144	99% KM Chebyshev UCL	0.203

Gamma GOF Tests on Detected Observations Only		Anderson-Darling GOF Test	
A-D Test Statistic	0.313	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.745	Kolmogorov-Smirnov GOF	
K-S Test Statistic	0.189	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.273	Detected data appear Gamma Distributed at 5% Significance Level	

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.206	k star (bias corrected MLE)	0.911
Theta hat (MLE)	0.0464	Theta star (bias corrected MLE)	0.0614
nu hat (MLE)	24.12	nu star (bias corrected)	18.22
Mean (detects)	0.056		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0088	Mean	0.0454
Maximum	0.205	Median	0.0189
SD	0.0559	CV	1.231
k hat (MLE)	1.048	k star (bias corrected MLE)	0.857
Theta hat (MLE)	0.0433	Theta star (bias corrected MLE)	0.0529
nu hat (MLE)	27.25	nu star (bias corrected)	22.29
Adjusted Level of Significance (β)	0.0301	Adjusted Chi Square Value (22.29, β)	11.53
Approximate Chi Square Value (22.29, α)	12.56	95% Gamma Adjusted UCL	0.0877
95% Gamma Approximate UCL	0.0805		

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.0441	SD (KM)	0.0545
Variance (KM)	0.00297	SE of Mean (KM)	0.0159
k hat (KM)	0.654	k star (KM)	0.554
nu hat (KM)	17	nu star (KM)	14.41
theta hat (KM)	0.0674	theta star (KM)	0.0796
80% gamma percentile (KM)	0.0727	90% gamma percentile (KM)	0.117
95% gamma percentile (KM)	0.163	99% gamma percentile (KM)	0.277

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (14.41, α)	6.855	Adjusted Chi Square Value (14.41, β)	6.127
95% KM Approximate Gamma UCL	0.0927	95% KM Adjusted Gamma UCL	0.104

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Traditional Plant Samples

Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.869	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.144	Lilliefors GOF Test
10% Lilliefors Critical Value	0.241	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0438	Mean in Log Scale	-3.905
SD in Original Scale	0.057	SD in Log Scale	1.387
95% t UCL (assumes normality of ROS data)	0.072	95% Percentile Bootstrap UCL	0.0711
95% BCA Bootstrap UCL	0.0811	95% Bootstrap t UCL	0.0954
95% H-UCL (Log ROS)	0.219		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.832	KM Geo Mean	0.0217
KM SD (logged)	1.231	95% Critical H Value (KM-Log)	3.263
KM Standard Error of Mean (logged)	0.361	95% H-UCL (KM -Log)	0.147
KM SD (logged)	1.231	95% Critical H Value (KM-Log)	3.263
KM Standard Error of Mean (logged)	0.361		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0438	Mean in Log Scale	-3.942
SD in Original Scale	0.057	SD in Log Scale	1.448
95% t UCL (Assumes normality)	0.0719	95% H-Stat UCL	0.258

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0725

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Lithium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	12
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Lithium was not processed!

Magnesium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	112	Mean	737.5
Maximum	2190	Median	599
SD	586.1	Std. Error of Mean	162.6
Coefficient of Variation	0.795	Skewness	1.591

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.826	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.814	Lilliefors GOF Test	
Lilliefors Test Statistic	0.287	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.271		

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1027	95% Adjusted-CLT UCL (Chen-1995)	1082
		95% Modified-t UCL (Johnson-1978)	1039

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.354	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.745	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.191	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.24		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1.897	k star (bias corrected MLE)	1.51
Theta hat (MLE)	388.9	Theta star (bias corrected MLE)	488.4
nu hat (MLE)	49.31	nu star (bias corrected)	39.27
MLE Mean (bias corrected)	737.5	MLE Sd (bias corrected)	600.2
		Approximate Chi Square Value (0.05)	25.91
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	24.37

Assuming Gamma Distribution

95% Approximate Gamma UCL	1118	95% Adjusted Gamma UCL	1188
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Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.955	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.889	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.194	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.215		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	4.718	Mean of logged Data	6.317
Maximum of Logged Data	7.692	SD of logged Data	0.826

Assuming Lognormal Distribution

95% H-UCL	1434	90% Chebyshev (MVUE) UCL	1303
95% Chebyshev (MVUE) UCL	1552	97.5% Chebyshev (MVUE) UCL	1897
99% Chebyshev (MVUE) UCL	2575		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	1005	95% BCA Bootstrap UCL	1090
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UCL Statistics for Baseline Traditional Plant Samples

95% Standard Bootstrap UCL	1000	95% Bootstrap-t UCL	1284
95% Hall's Bootstrap UCL	2792	95% Percentile Bootstrap UCL	1011
90% Chebyshev(Mean, Sd) UCL	1225	95% Chebyshev(Mean, Sd) UCL	1446
97.5% Chebyshev(Mean, Sd) UCL	1753	99% Chebyshev(Mean, Sd) UCL	2355

Suggested UCL to Use

95% Student's-t UCL 1027

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Manganese

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	2.23	Mean	135.3
Maximum	539	Median	73.6
SD	167.1	Std. Error of Mean	46.33
Coefficient of Variation	1.235	Skewness	1.615

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.782	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.814	Lilliefors GOF Test	
Lilliefors Test Statistic	0.238	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.271		

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	217.9	95% Adjusted-CLT UCL (Chen-1995)	233.7
		95% Modified-t UCL (Johnson-1978)	221.3

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.199	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.777	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.145	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.247		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	0.663	k star (bias corrected MLE)	0.561
Theta hat (MLE)	204	Theta star (bias corrected MLE)	241
nu hat (MLE)	17.24	nu star (bias corrected)	14.59
MLE Mean (bias corrected)	135.3	MLE Sd (bias corrected)	180.6
Adjusted Level of Significance	0.0301	Approximate Chi Square Value (0.05)	6.98
		Adjusted Chi Square Value	6.244

Assuming Gamma Distribution

95% Approximate Gamma UCL	282.9	95% Adjusted Gamma UCL	316.2
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Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.961	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.889	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.166	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.215		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics		Lognormal Statistics	
Minimum of Logged Data	0.802	Mean of logged Data	3.989
Maximum of Logged Data	6.29	SD of logged Data	1.646

Assuming Lognormal Distribution

95% H-UCL	1432	90% Chebyshev (MVUE) UCL	434
95% Chebyshev (MVUE) UCL	552.8	97.5% Chebyshev (MVUE) UCL	717.7
99% Chebyshev (MVUE) UCL	1042		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

UCL Statistics for Baseline Traditional Plant Samples

Nonparametric Distribution Free UCLs

95% CLT UCL	211.5	95% BCA Bootstrap UCL	228.4
95% Standard Bootstrap UCL	206.9	95% Bootstrap-t UCL	274.8
95% Hall's Bootstrap UCL	296.5	95% Percentile Bootstrap UCL	213.2
90% Chebyshev(Mean, Sd) UCL	274.3	95% Chebyshev(Mean, Sd) UCL	337.2
97.5% Chebyshev(Mean, Sd) UCL	424.6	99% Chebyshev(Mean, Sd) UCL	596.3

Suggested UCL to Use

95% Student's-t UCL 217.9

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Mercury

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	10
Number of Detects	10	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	0.0028	Minimum Non-Detect	0.001
Maximum Detect	0.0514	Maximum Non-Detect	0.001
Variance Detects	2.4164E-4	Percent Non-Detects	23.08%
Mean Detects	0.0129	SD Detects	0.0155
Median Detects	0.00565	CV Detects	1.209
Skewness Detects	2.024	Kurtosis Detects	4.124
Mean of Logged Detects	-4.868	SD of Logged Detects	1.006

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.691	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.781	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.354	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.304	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0101	KM Standard Error of Mean	0.00405
90KM SD	0.0139	95% KM (BCA) UCL	0.0173
95% KM (t) UCL	0.0173	95% KM (Percentile Bootstrap) UCL	0.0171
95% KM (z) UCL	0.0168	95% KM Bootstrap t UCL	0.0238
90% KM Chebyshev UCL	0.0223	95% KM Chebyshev UCL	0.0278
97.5% KM Chebyshev UCL	0.0354	99% KM Chebyshev UCL	0.0505

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.887	Anderson-Darling GOF Test	
5% A-D Critical Value	0.746	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.313	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.273	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.11	k star (bias corrected MLE)	0.844
Theta hat (MLE)	0.0116	Theta star (bias corrected MLE)	0.0152
nu hat (MLE)	22.2	nu star (bias corrected)	16.87
Mean (detects)	0.0129		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0028	Mean	0.0122
Maximum	0.0514	Median	0.0067
SD	0.0135	CV	1.108
k hat (MLE)	1.391	k star (bias corrected MLE)	1.121
Theta hat (MLE)	0.00877	Theta star (bias corrected MLE)	0.0109
nu hat (MLE)	36.16	nu star (bias corrected)	29.15
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (29.15, α)	17.83	Adjusted Chi Square Value (29.15, β)	16.57
95% Gamma Approximate UCL	0.02	95% Gamma Adjusted UCL	0.0215

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0101	SD (KM)	0.0139
Variance (KM)	1.9226E-4	SE of Mean (KM)	0.00405
k hat (KM)	0.533	k star (KM)	0.461
nu hat (KM)	13.86	nu star (KM)	11.99
theta hat (KM)	0.019	theta star (KM)	0.0219
80% gamma percentile (KM)	0.0166	90% gamma percentile (KM)	0.0278
95% gamma percentile (KM)	0.04	99% gamma percentile (KM)	0.0702

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.99, α)	5.223	Adjusted Chi Square Value (11.99, β)	4.602
95% KM Approximate Gamma UCL	0.0232	95% KM Adjusted Gamma UCL	0.0264

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.869	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.255	Lilliefors GOF Test	

UCL Statistics for Baseline Traditional Plant Samples
 10% Lilliefors Critical Value 0.241 Detected Data Not Lognormal at 10% Significance Level
Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0101	Mean in Log Scale	-5.425
SD in Original Scale	0.0145	SD in Log Scale	1.385
95% t UCL (assumes normality of ROS data)	0.0172	95% Percentile Bootstrap UCL	0.017
95% BCA Bootstrap UCL	0.0194	95% Bootstrap t UCL	0.0238
95% H-UCL (Log ROS)	0.0477		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.338	KM Geo Mean	0.0048
KM SD (logged)	1.2	95% Critical H Value (KM-Log)	3.206
KM Standard Error of Mean (logged)	0.351	95% H-UCL (KM -Log)	0.03
KM SD (logged)	1.2	95% Critical H Value (KM-Log)	3.206
KM Standard Error of Mean (logged)	0.351		

DL/2 Normal	DL/2 Statistics	DL/2 Log-Transformed	
Mean in Original Scale	0.01	Mean in Log Scale	-5.498
SD in Original Scale	0.0145	SD in Log Scale	1.482
95% t UCL (Assumes normality)	0.0172	95% H-Stat UCL	0.061

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Suggested UCL to Use
 95% KM (t) UCL 0.0173

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
Number of Detects	12	Number of Non-Detects	1
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.0071	Minimum Non-Detect	0.008
Maximum Detect	0.787	Maximum Non-Detect	0.008
Variance Detects	0.0582	Percent Non-Detects	7.692%
Mean Detects	0.158	SD Detects	0.241
Median Detects	0.0421	CV Detects	1.529
Skewness Detects	1.973	Kurtosis Detects	3.673
Mean of Logged Detects	-2.988	SD of Logged Detects	1.627

Normal GOF Test on Detects Only		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.694	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.805	Lilliefors GOF Test	
Lilliefors Test Statistic	0.323	Detected Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.281		

Detected Data Not Normal at 1% Significance Level

Kaplan-Meler (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.146	KM Standard Error of Mean	0.0653
90KM SD	0.226	95% KM (BCA) UCL	0.251
95% KM (t) UCL	0.263	95% KM (Percentile Bootstrap) UCL	0.257
95% KM (z) UCL	0.254	95% KM Bootstrap t UCL	0.399
90% KM Chebyshev UCL	0.342	95% KM Chebyshev UCL	0.431
97.5% KM Chebyshev UCL	0.554	99% KM Chebyshev UCL	0.796

Gamma GOF Tests on Detected Observations Only		Anderson-Darling GOF Test	
A-D Test Statistic	0.683	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.781	Kolmogorov-Smirnov GOF	
K-S Test Statistic	0.22	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.258		

Detected data appear Gamma Distributed at 5% Significance Level

**UCL Statistics for Baseline Traditional Plant Samples
Gamma Statistics on Detected Data Only**

k hat (MLE)	0.548	k star (bias corrected MLE)	0.467
Theta hat (MLE)	0.288	Theta star (bias corrected MLE)	0.338
nu hat (MLE)	13.16	nu star (bias corrected)	11.2
Mean (detects)	0.158		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0071	Mean	0.146
Maximum	0.787	Median	0.0264
SD	0.235	CV	1.602
k hat (MLE)	0.529	k star (bias corrected MLE)	0.458
Theta hat (MLE)	0.277	Theta star (bias corrected MLE)	0.32
nu hat (MLE)	13.74	nu star (bias corrected)	11.9
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (11.90, α)	5.164	Adjusted Chi Square Value (11.90, β)	4.547
95% Gamma Approximate UCL	0.338	95% Gamma Adjusted UCL	0.383

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.146	SD (KM)	0.226
Variance (KM)	0.0509	SE of Mean (KM)	0.0653
k hat (KM)	0.42	k star (KM)	0.375
nu hat (KM)	10.93	nu star (KM)	9.738
theta hat (KM)	0.348	theta star (KM)	0.39
80% gamma percentile (KM)	0.234	90% gamma percentile (KM)	0.418
95% gamma percentile (KM)	0.621	99% gamma percentile (KM)	1.137

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.74, α)	3.778	Adjusted Chi Square Value (9.74, β)	3.267
95% KM Approximate Gamma UCL	0.377	95% KM Adjusted Gamma UCL	0.436

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.883	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.176	Lilliefors GOF Test
10% Lilliefors Critical Value	0.223	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.146	Mean in Log Scale	-3.213
SD in Original Scale	0.235	SD in Log Scale	1.756
95% t UCL (assumes normality of ROS data)	0.262	95% Percentile Bootstrap UCL	0.259
95% BCA Bootstrap UCL	0.293	95% Bootstrap t UCL	0.383
95% H-UCL (Log ROS)	1.612		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.139	KM Geo Mean	0.0433
KM SD (logged)	1.585	95% Critical H Value (KM-Log)	3.939
KM Standard Error of Mean (logged)	0.459	95% H-UCL (KM -Log)	0.922
KM SD (logged)	1.585	95% Critical H Value (KM-Log)	3.939
KM Standard Error of Mean (logged)	0.459		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.146	Mean in Log Scale	-3.183
SD in Original Scale	0.235	SD in Log Scale	1.709
95% t UCL (Assumes normality)	0.262	95% H-Stat UCL	1.387

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Bootstrap t UCL	0.399	95% Hall's Bootstrap	0.922
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Traditional Plant Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Nickel

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	12
Number of Detects	12	Number of Non-Detects	1
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.047	Minimum Non-Detect	0.04
Maximum Detect	0.891	Maximum Non-Detect	0.04
Variance Detects	0.0716	Percent Non-Detects	7.692%
Mean Detects	0.287	SD Detects	0.268
Median Detects	0.169	CV Detects	0.931
Skewness Detects	1.222	Kurtosis Detects	0.812
Mean of Logged Detects	-1.674	SD of Logged Detects	0.999

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.805	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.254	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.281	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.268	KM Standard Error of Mean	0.0738
90KM SD	0.255	95% KM (BCA) UCL	0.391
95% KM (t) UCL	0.4	95% KM (Percentile Bootstrap) UCL	0.388
95% KM (z) UCL	0.39	95% KM Bootstrap t UCL	0.465
90% KM Chebyshev UCL	0.49	95% KM Chebyshev UCL	0.59
97.5% KM Chebyshev UCL	0.729	99% KM Chebyshev UCL	1.003

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.334	Anderson-Darling GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.184	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.251	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.313	k star (bias corrected MLE)	1.041
Theta hat (MLE)	0.219	Theta star (bias corrected MLE)	0.276
nu hat (MLE)	31.52	nu star (bias corrected)	24.98
Mean (detects)	0.287		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.266
Maximum	0.891	Median	0.168
SD	0.267	CV	1.006
k hat (MLE)	1.003	k star (bias corrected MLE)	0.823
Theta hat (MLE)	0.265	Theta star (bias corrected MLE)	0.323
nu hat (MLE)	26.09	nu star (bias corrected)	21.4
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (21.40, α)	11.89	Adjusted Chi Square Value (21.40, β)	10.89
95% Gamma Approximate UCL	0.479	95% Gamma Adjusted UCL	0.523

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.268	SD (KM)	0.255
Variance (KM)	0.0649	SE of Mean (KM)	0.0738
k hat (KM)	1.108	k star (KM)	0.904
nu hat (KM)	28.82	nu star (KM)	23.5
theta hat (KM)	0.242	theta star (KM)	0.297
80% gamma percentile (KM)	0.435	90% gamma percentile (KM)	0.633
95% gamma percentile (KM)	0.833	99% gamma percentile (KM)	1.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (23.50, α)	13.47	Adjusted Chi Square Value (23.50, β)	12.4
95% KM Approximate Gamma UCL	0.468	95% KM Adjusted Gamma UCL	0.508

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.883	Detected Data appear Lognormal at 10% Significance Level	

UCL Statistics for Baseline Traditional Plant Samples

Lilliefors Test Statistic	0.13	Lilliefors GOF Test
10% Lilliefors Critical Value	0.223	Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.266	Mean in Log Scale	-1.864
SD in Original Scale	0.267	SD in Log Scale	1.176
95% t UCL (assumes normality of ROS data)	0.398	95% Percentile Bootstrap UCL	0.39
95% BCA Bootstrap UCL	0.411	95% Bootstrap t UCL	0.443
95% H-UCL (Log ROS)	0.905		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.793	KM Geo Mean	0.166
KM SD (logged)	1.007	95% Critical H Value (KM-Log)	2.86
KM Standard Error of Mean (logged)	0.292	95% H-UCL (KM -Log)	0.635
KM SD (logged)	1.007	95% Critical H Value (KM-Log)	2.86
KM Standard Error of Mean (logged)	0.292		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.267	Mean in Log Scale	-1.846
SD in Original Scale	0.267	SD in Log Scale	1.14
95% t UCL (Assumes normality)	0.399	95% H-Stat UCL	0.838

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Phosphorus

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
Minimum	207	Number of Missing Observations	0
Maximum	3020	Mean	733.4
SD	715.7	Median	596
Coefficient of Variation	0.976	Std. Error of Mean	198.5
		Skewness	3.121

Normal GOF Test

Shapiro Wilk Test Statistic	0.58	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.814	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.342	Lilliefors GOF Test
1% Lilliefors Critical Value	0.271	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1087	95% Adjusted-CLT UCL (Chen-1995)	1243
		95% Modified-t UCL (Johnson-1978)	1116

Gamma GOF Test

A-D Test Statistic	0.931	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.742	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.239	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.231	k star (bias corrected MLE)	1.767
Theta hat (MLE)	328.8	Theta star (bias corrected MLE)	415
nu hat (MLE)	58	nu star (bias corrected)	45.95
MLE Mean (bias corrected)	733.4	MLE Sd (bias corrected)	551.7
		Approximate Chi Square Value (0.05)	31.4
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	29.69

Assuming Gamma Distribution

95% Approximate Gamma UCL	1073	95% Adjusted Gamma UCL	1135
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UCL Statistics for Baseline Traditional Plant Samples

		Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.906		Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889		Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.196		Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215		Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level				

		Lognormal Statistics		
Minimum of Logged Data	5.333		Mean of logged Data	6.357
Maximum of Logged Data	8.013		SD of logged Data	0.646

		Assuming Lognormal Distribution		
95% H-UCL	1090		90% Chebyshev (MVUE) UCL	1087
95% Chebyshev (MVUE) UCL	1264		97.5% Chebyshev (MVUE) UCL	1509
99% Chebyshev (MVUE) UCL	1991			

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

		Nonparametric Distribution Free UCLs		
95% CLT UCL	1060		95% BCA Bootstrap UCL	1297
95% Standard Bootstrap UCL	1045		95% Bootstrap-t UCL	1746
95% Hall's Bootstrap UCL	2520		95% Percentile Bootstrap UCL	1095
90% Chebyshev(Mean, Sd) UCL	1329		95% Chebyshev(Mean, Sd) UCL	1599
97.5% Chebyshev(Mean, Sd) UCL	1973		99% Chebyshev(Mean, Sd) UCL	2708

Suggested UCL to Use
95% H-UCL 1090

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Potassium

		General Statistics		
Total Number of Observations	13		Number of Distinct Observations	13
			Number of Missing Observations	0
Minimum	280		Mean	2255
Maximum	3930		Median	2330
SD	1114		Std. Error of Mean	309
Coefficient of Variation	0.494		Skewness	-0.17

		Normal GOF Test		
Shapiro Wilk Test Statistic	0.966		Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814		Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.139		Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271		Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level				

		Assuming Normal Distribution		
95% Normal UCL			95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2806		95% Adjusted-CLT UCL (Chen-1995)	2748
			95% Modified-t UCL (Johnson-1978)	2803

		Gamma GOF Test		
A-D Test Statistic	0.526		Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.74		Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.213		Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.238		Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level				

		Gamma Statistics		
k hat (MLE)	2.863		k star (bias corrected MLE)	2.254
Theta hat (MLE)	787.6		Theta star (bias corrected MLE)	1001
nu hat (MLE)	74.45		nu star (bias corrected)	58.6
MLE Mean (bias corrected)	2255		MLE Sd (bias corrected)	1502
Adjusted Level of Significance	0.0301		Approximate Chi Square Value (0.05)	42
			Adjusted Chi Square Value	40

		Assuming Gamma Distribution		
95% Approximate Gamma UCL	3146		95% Adjusted Gamma UCL	3303

UCL Statistics for Baseline Traditional Plant Samples

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.834	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.889	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.215	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.635	Mean of logged Data	7.536
Maximum of Logged Data	8.276	SD of logged Data	0.744

Assuming Lognormal Distribution

95% H-UCL	4174	90% Chebyshev (MVUE) UCL	3980
95% Chebyshev (MVUE) UCL	4691	97.5% Chebyshev (MVUE) UCL	5677
99% Chebyshev (MVUE) UCL	7615		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	2763	95% BCA Bootstrap UCL	2735
95% Standard Bootstrap UCL	2741	95% Bootstrap-t UCL	2769
95% Hall's Bootstrap UCL	2741	95% Percentile Bootstrap UCL	2735
90% Chebyshev(Mean, Sd) UCL	3182	95% Chebyshev(Mean, Sd) UCL	3602
97.5% Chebyshev(Mean, Sd) UCL	4185	99% Chebyshev(Mean, Sd) UCL	5329

Suggested UCL to Use

95% Student's-t UCL 2806

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Traditional Plant Samples

Rubidium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.367	Mean	11.68
Maximum	23.6	Median	12.8
SD	8.292	Std. Error of Mean	2.3
Coefficient of Variation	0.71	Skewness	-0.0246
Normal GOF Test			
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.164	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15.78	95% Adjusted-CLT UCL (Chen-1995)	15.45
		95% Modified-t UCL (Johnson-1978)	15.78
Gamma GOF Test			
A-D Test Statistic	0.639	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.755	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.256	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.242	Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.14	k star (bias corrected MLE)	0.929
Theta hat (MLE)	10.24	Theta star (bias corrected MLE)	12.58
nu hat (MLE)	29.65	nu star (bias corrected)	24.14
MLE Mean (bias corrected)	11.68	MLE Sd (bias corrected)	12.12
		Approximate Chi Square Value (0.05)	13.96
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	12.86
Assuming Gamma Distribution			
95% Approximate Gamma UCL	20.21	95% Adjusted Gamma UCL	21.93
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.837	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.275	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.002	Mean of logged Data	1.96
Maximum of Logged Data	3.161	SD of logged Data	1.321
Assuming Lognormal Distribution			
95% H-UCL	62.92	90% Chebyshev (MVUE) UCL	33.74
95% Chebyshev (MVUE) UCL	42.11	97.5% Chebyshev (MVUE) UCL	53.74
99% Chebyshev (MVUE) UCL	76.58		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.47	95% BCA Bootstrap UCL	15.35
95% Standard Bootstrap UCL	15.27	95% Bootstrap-t UCL	15.72
95% Hall's Bootstrap UCL	15.24	95% Percentile Bootstrap UCL	15.35
90% Chebyshev(Mean, Sd) UCL	18.58	95% Chebyshev(Mean, Sd) UCL	21.71
97.5% Chebyshev(Mean, Sd) UCL	26.05	99% Chebyshev(Mean, Sd) UCL	34.57
Suggested UCL to Use			
95% Student's-t UCL	15.78		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Selenium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	6
Number of Detects	4	Number of Non-Detects	9
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	0.03	Minimum Non-Detect	0.01
Maximum Detect	0.08	Maximum Non-Detect	0.02
Variance Detects	5.0892E-4	Percent Non-Detects	69.23%
Mean Detects	0.0468	SD Detects	0.0226
Median Detects	0.0385	CV Detects	0.483
Skewness Detects	1.79	Kurtosis Detects	3.387
Mean of Logged Detects	-3.137	SD of Logged Detects	0.425

Normal GOF Test on Detects Only		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.796	Detected Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.687		
Lilliefors Test Statistic	0.368	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.413	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.0213	KM Standard Error of Mean	0.00645
90KM SD	0.0201	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0328	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0319	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0406	95% KM Chebyshev UCL	0.0494
97.5% KM Chebyshev UCL	0.0616	99% KM Chebyshev UCL	0.0854

Gamma GOF Tests on Detected Observations Only		Anderson-Darling GOF Test	
A-D Test Statistic	0.494	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.658		
K-S Test Statistic	0.357	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.396	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only			
k hat (MLE)	6.914	k star (bias corrected MLE)	1.895
Theta hat (MLE)	0.00676	Theta star (bias corrected MLE)	0.0247
nu hat (MLE)	55.31	nu star (bias corrected)	15.16
Mean (detects)	0.0468		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0213
Maximum	0.08	Median	0.01
SD	0.0209	CV	0.983
k hat (MLE)	1.789	k star (bias corrected MLE)	1.428
Theta hat (MLE)	0.0119	Theta star (bias corrected MLE)	0.0149
nu hat (MLE)	46.52	nu star (bias corrected)	37.12
Adjusted Level of Significance (β)	0.0301	Adjusted Chi Square Value (37.12, β)	22.69
Approximate Chi Square Value (37.12, α)	24.17	95% Gamma Adjusted UCL	N/A
95% Gamma Approximate UCL	0.0327		

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.0213	SD (KM)	0.0201
Variance (KM)	4.0514E-4	SE of Mean (KM)	0.00645
k hat (KM)	1.121	k star (KM)	0.913
nu hat (KM)	29.14	nu star (KM)	23.75
theta hat (KM)	0.019	theta star (KM)	0.0233
80% gamma percentile (KM)	0.0345	90% gamma percentile (KM)	0.0502
95% gamma percentile (KM)	0.0659	99% gamma percentile (KM)	0.103

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (23.75, α)	13.66	Adjusted Chi Square Value (23.75, β)	12.58
95% KM Approximate Gamma UCL	0.0371	95% KM Adjusted Gamma UCL	0.0402

UCL Statistics for Baseline Traditional Plant Samples

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.87	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.792	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.326	Lilliefors GOF Test
10% Lilliefors Critical Value	0.346	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0208	Mean in Log Scale	-4.296
SD in Original Scale	0.0216	SD in Log Scale	0.947
95% t UCL (assumes normality of ROS data)	0.0315	95% Percentile Bootstrap UCL	0.0309
95% BCA Bootstrap UCL	0.0345	95% Bootstrap t UCL	0.0385
95% H-UCL (Log ROS)	0.0453		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.153	KM Geo Mean	0.0157
KM SD (logged)	0.708	95% Critical H Value (KM-Log)	2.382
KM Standard Error of Mean (logged)	0.227	95% H-UCL (KM -Log)	0.0328
KM SD (logged)	0.708	95% Critical H Value (KM-Log)	2.382
KM Standard Error of Mean (logged)	0.227		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0194	Mean in Log Scale	-4.42
SD in Original Scale	0.0222	SD in Log Scale	0.963
95% t UCL (Assumes normality)	0.0304	95% H-Stat UCL	0.0415

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0328

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Silver

General Statistics

Total Number of Observations	13	Number of Distinct Observations	6
Number of Detects	6	Number of Non-Detects	7
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.001	Minimum Non-Detect	0.001
Maximum Detect	0.18	Maximum Non-Detect	0.001
Variance Detects	0.00573	Percent Non-Detects	53.85%
Mean Detects	0.0556	SD Detects	0.0757
Median Detects	0.0132	CV Detects	1.362
Skewness Detects	1.215	Kurtosis Detects	-0.32
Mean of Logged Detects	-4.083	SD of Logged Detects	1.928

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.757	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.713	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.373	Lilliefors GOF Test
1% Lilliefors Critical Value	0.373	Detected Data Not Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0262	KM Standard Error of Mean	0.0165
90KM SD	0.0543	95% KM (BCA) UCL	0.0564
95% KM (t) UCL	0.0556	95% KM (Percentile Bootstrap) UCL	0.0544
95% KM (z) UCL	0.0533	95% KM Bootstrap t UCL	0.264
90% KM Chebyshev UCL	0.0757	95% KM Chebyshev UCL	0.0981
97.5% KM Chebyshev UCL	0.129	99% KM Chebyshev UCL	0.19

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.399	Anderson-Darling GOF Test
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.289	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.348	Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Traditional Plant Samples
Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	0.528	k star (bias corrected MLE)	0.375
Theta hat (MLE)	0.105	Theta star (bias corrected MLE)	0.148
nu hat (MLE)	6.334	nu star (bias corrected)	4.5
Mean (detects)	0.0556		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.001	Mean	0.031
Maximum	0.18	Median	0.01
SD	0.0543	CV	1.749
k hat (MLE)	0.68	k star (bias corrected MLE)	0.575
Theta hat (MLE)	0.0456	Theta star (bias corrected MLE)	0.054
nu hat (MLE)	17.69	nu star (bias corrected)	14.94
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (14.94, α)	7.221	Adjusted Chi Square Value (14.94, β)	6.47
95% Gamma Approximate UCL	0.0642	95% Gamma Adjusted UCL	0.0717

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0262	SD (KM)	0.0543
Variance (KM)	0.00294	SE of Mean (KM)	0.0165
k hat (KM)	0.233	k star (KM)	0.231
nu hat (KM)	6.058	nu star (KM)	5.993
theta hat (KM)	0.112	theta star (KM)	0.114
80% gamma percentile (KM)	0.0369	90% gamma percentile (KM)	0.079
95% gamma percentile (KM)	0.13	99% gamma percentile (KM)	0.267

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (5.99, α)	1.636	Adjusted Chi Square Value (5.99, β)	1.335
95% KM Approximate Gamma UCL	0.0959	95% KM Adjusted Gamma UCL	0.118

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.826	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.298	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0257	Mean in Log Scale	-7.31
SD in Original Scale	0.0567	SD in Log Scale	3.64
95% t UCL (assumes normality of ROS data)	0.0538	95% Percentile Bootstrap UCL	0.0533
95% BCA Bootstrap UCL	0.0624	95% Bootstrap t UCL	0.281
95% H-UCL (Log ROS)	3257		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.604	KM Geo Mean	0.00368
KM SD (logged)	1.847	95% Critical H Value (KM-Log)	4.437
KM Standard Error of Mean (logged)	0.561	95% H-UCL (KM -Log)	0.216
KM SD (logged)	1.847	95% Critical H Value (KM-Log)	4.437
KM Standard Error of Mean (logged)	0.561		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0259	Mean in Log Scale	-5.977
SD in Original Scale	0.0566	SD in Log Scale	2.209
95% t UCL (Assumes normality)	0.0539	95% H-Stat UCL	0.835

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0556

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.

UCL Statistics for Baseline Traditional Plant Samples
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Sodium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	9
Number of Detects	10	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	4	Minimum Non-Detect	4
Maximum Detect	14	Maximum Non-Detect	4
Variance Detects	10.5	Percent Non-Detects	23.08%
Mean Detects	7.54	SD Detects	3.241
Median Detects	7.1	CV Detects	0.43
Skewness Detects	0.819	Kurtosis Detects	0.0859
Mean of Logged Detects	1.94	SD of Logged Detects	0.422

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.781	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.165	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.304	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	6.723	KM Standard Error of Mean	0.901
90KM SD	3.082	95% KM (BCA) UCL	8.285
95% KM (t) UCL	8.329	95% KM (Percentile Bootstrap) UCL	8.246
95% KM (z) UCL	8.205	95% KM Bootstrap t UCL	8.859
90% KM Chebyshev UCL	9.426	95% KM Chebyshev UCL	10.65
97.5% KM Chebyshev UCL	12.35	99% KM Chebyshev UCL	15.69

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.303	Anderson-Darling GOF Test	
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.172	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.362	k star (bias corrected MLE)	4.52
Theta hat (MLE)	1.185	Theta star (bias corrected MLE)	1.668
nu hat (MLE)	127.2	nu star (bias corrected)	90.41
Mean (detects)	7.54		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0677	Mean	6.047
Maximum	14	Median	5.2
SD	4.01	CV	0.663
k hat (MLE)	1.25	k star (bias corrected MLE)	1.013
Theta hat (MLE)	4.838	Theta star (bias corrected MLE)	5.971
nu hat (MLE)	32.5	nu star (bias corrected)	26.33
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (26.33, α)	15.63	Adjusted Chi Square Value (26.33, β)	14.47
95% Gamma Approximate UCL	10.18	95% Gamma Adjusted UCL	11

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.723	SD (KM)	3.082
Variance (KM)	9.497	SE of Mean (KM)	0.901
k hat (KM)	4.759	k star (KM)	3.712
nu hat (KM)	123.7	nu star (KM)	96.52
theta hat (KM)	1.413	theta star (KM)	1.811
80% gamma percentile (KM)	9.35	90% gamma percentile (KM)	11.4
95% gamma percentile (KM)	13.3	99% gamma percentile (KM)	17.36

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (96.52, α)	74.86	Adjusted Chi Square Value (96.52, β)	72.14
95% KM Approximate Gamma UCL	8.668	95% KM Adjusted Gamma UCL	8.995

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.869	Detected Data appear Lognormal at 10% Significance Level	

UCL Statistics for Baseline Traditional Plant Samples

Lilliefors Test Statistic	0.155	Lilliefors GOF Test
10% Lilliefors Critical Value	0.241	Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.375	Mean in Log Scale	1.699
SD in Original Scale	3.581	SD in Log Scale	0.591
95% t UCL (assumes normality of ROS data)	8.145	95% Percentile Bootstrap UCL	8
95% BCA Bootstrap UCL	8.132	95% Bootstrap t UCL	8.414
95% H-UCL (Log ROS)	9.515		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.812	KM Geo Mean	6.122
KM SD (logged)	0.421	95% Critical H Value (KM-Log)	2.025
KM Standard Error of Mean (logged)	0.123	95% H-UCL (KM -Log)	8.559
KM SD (logged)	0.421	95% Critical H Value (KM-Log)	2.025
KM Standard Error of Mean (logged)	0.123		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.262	Mean in Log Scale	1.652
SD in Original Scale	3.712	SD in Log Scale	0.657
95% t UCL (Assumes normality)	8.097	95% H-Stat UCL	10.04

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 8.329

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Strontium

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
Minimum	0.111	Number of Missing Observations	0
Maximum	32.6	Mean	9.372
SD	9.722	Median	6.2
Coefficient of Variation	1.037	Std. Error of Mean	2.696
		Skewness	1.606

Normal GOF Test

Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.814	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.241	Lilliefors GOF Test
1% Lilliefors Critical Value	0.271	Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.18	95% Adjusted-CLT UCL (Chen-1995)	15.09
		95% Modified-t UCL (Johnson-1978)	14.38

Gamma GOF Test

A-D Test Statistic	0.23	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.76	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.119	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.244	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.94	k star (bias corrected MLE)	0.775
Theta hat (MLE)	9.967	Theta star (bias corrected MLE)	12.1
nu hat (MLE)	24.45	nu star (bias corrected)	20.14
MLE Mean (bias corrected)	9.372	MLE Sd (bias corrected)	10.65
		Approximate Chi Square Value (0.05)	10.95
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	10

Assuming Gamma Distribution

95% Approximate Gamma UCL	17.23	95% Adjusted Gamma UCL	18.87
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UCL Statistics for Baseline Traditional Plant Samples

		Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.885		Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889		Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.19		Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215		Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level				

		Lognormal Statistics		
Minimum of Logged Data	-2.198		Mean of logged Data	1.619
Maximum of Logged Data	3.484		SD of logged Data	1.441

		Assuming Lognormal Distribution		
95% H-UCL	65.51	90% Chebyshev (MVUE) UCL	28.98	
95% Chebyshev (MVUE) UCL	36.48	97.5% Chebyshev (MVUE) UCL	46.88	
99% Chebyshev (MVUE) UCL	67.31			

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

		Nonparametric Distribution Free UCLs		
95% CLT UCL	13.81	95% BCA Bootstrap UCL	14.87	
95% Standard Bootstrap UCL	13.65	95% Bootstrap-t UCL	18.76	
95% Hall's Bootstrap UCL	35.59	95% Percentile Bootstrap UCL	13.8	
90% Chebyshev(Mean, Sd) UCL	17.46	95% Chebyshev(Mean, Sd) UCL	21.13	
97.5% Chebyshev(Mean, Sd) UCL	26.21	99% Chebyshev(Mean, Sd) UCL	36.2	

Suggested UCL to Use
95% Student's-t UCL 14.18

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tellurium

		General Statistics	
Total Number of Observations	13	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	13
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Tellurium was not processed!

Thallium

		General Statistics	
Total Number of Observations	13	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	4
Number of Distinct Detects	9	Number of Distinct Non-Detects	1
Minimum Detect	5.8000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.0191	Maximum Non-Detect	4.0000E-4
Variance Detects	3.4853E-5	Percent Non-Detects	30.77%
Mean Detects	0.00354	SD Detects	0.0059
Median Detects	0.0015	CV Detects	1.666
Skewness Detects	2.866	Kurtosis Detects	8.396
Mean of Logged Detects	-6.317	SD of Logged Detects	1.068

		Normal GOF Test on Detects Only	
Shapiro Wilk Test Statistic	0.529		Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.764		Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.422		Lilliefors GOF Test
1% Lilliefors Critical Value	0.316		Detected Data Not Normal at 1% Significance Level

UCL Statistics for Baseline Traditional Plant Samples
Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00258	KM Standard Error of Mean	0.00143
90KM SD	0.00485	95% KM (BCA) UCL	0.00542
95% KM (t) UCL	0.00512	95% KM (Percentile Bootstrap) UCL	0.00524
95% KM (z) UCL	0.00493	95% KM Bootstrap t UCL	0.0131
90% KM Chebyshev UCL	0.00686	95% KM Chebyshev UCL	0.0088
97.5% KM Chebyshev UCL	0.0115	99% KM Chebyshev UCL	0.0168

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.952	Anderson-Darling GOF Test
5% A-D Critical Value	0.748	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.298	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.288	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.871	k star (bias corrected MLE)	0.654
Theta hat (MLE)	0.00407	Theta star (bias corrected MLE)	0.00542
nu hat (MLE)	15.67	nu star (bias corrected)	11.78
Mean (detects)	0.00354		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	5.8000E-4	Mean	0.00553
Maximum	0.0191	Median	0.00261
SD	0.00573	CV	1.036
k hat (MLE)	0.977	k star (bias corrected MLE)	0.803
Theta hat (MLE)	0.00566	Theta star (bias corrected MLE)	0.00689
nu hat (MLE)	25.39	nu star (bias corrected)	20.87
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (20.87, α)	11.49	Adjusted Chi Square Value (20.87, β)	10.51
95% Gamma Approximate UCL	0.01	95% Gamma Adjusted UCL	0.011

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00258	SD (KM)	0.00485
Variance (KM)	2.3554E-5	SE of Mean (KM)	0.00143
k hat (KM)	0.282	k star (KM)	0.268
nu hat (KM)	7.33	nu star (KM)	6.972
theta hat (KM)	0.00914	theta star (KM)	0.00961
80% gamma percentile (KM)	0.00383	90% gamma percentile (KM)	0.00769
95% gamma percentile (KM)	0.0122	99% gamma percentile (KM)	0.0241

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.97, α)	2.155	Adjusted Chi Square Value (6.97, β)	1.795
95% KM Approximate Gamma UCL	0.00834	95% KM Adjusted Gamma UCL	0.01

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.877	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.859	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.201	Lilliefors GOF Test
10% Lilliefors Critical Value	0.252	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0025	Mean in Log Scale	-7.134
SD in Original Scale	0.00509	SD in Log Scale	1.579
95% t UCL (assumes normality of ROS data)	0.00501	95% Percentile Bootstrap UCL	0.00512
95% BCA Bootstrap UCL	0.00674	95% Bootstrap t UCL	0.0122
95% H-UCL (Log ROS)	0.0166		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.78	KM Geo Mean	0.00114
KM SD (logged)	1.089	95% Critical H Value (KM-Log)	3.004
KM Standard Error of Mean (logged)	0.32	95% H-UCL (KM -Log)	0.00529
KM SD (logged)	1.089	95% Critical H Value (KM-Log)	3.004
KM Standard Error of Mean (logged)	0.32		

DL/2 Statistics

UCL Statistics for Baseline Traditional Plant Samples

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00252	Mean in Log Scale	-6.994
SD in Original Scale	0.00508	SD in Log Scale	1.37
95% t UCL (Assumes normality)	0.00503	95% H-Stat UCL	0.00948

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL 0.00529

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Tin

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	9
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.085	Minimum Non-Detect	0.02
Maximum Detect	0.776	Maximum Non-Detect	0.02
Variance Detects	0.111	Percent Non-Detects	69.23%
Mean Detects	0.378	SD Detects	0.334
Median Detects	0.325	CV Detects	0.883
Skewness Detects	0.439	Kurtosis Detects	-3.424
Mean of Logged Detects	-1.368	SD of Logged Detects	1.088

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.885	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.687	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.28	Lilliefors GOF Test
1% Lilliefors Critical Value	0.413	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.13	KM Standard Error of Mean	0.0737
90KM SD	0.23	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.261	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.251	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.351	95% KM Chebyshev UCL	0.451
97.5% KM Chebyshev UCL	0.59	99% KM Chebyshev UCL	0.863

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.408	Anderson-Darling GOF Test
5% A-D Critical Value	0.663	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.3	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.4	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level
Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	1.409	k star (bias corrected MLE)	0.519
Theta hat (MLE)	0.268	Theta star (bias corrected MLE)	0.728
nu hat (MLE)	11.28	nu star (bias corrected)	4.152
Mean (detects)	0.378		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.123
Maximum	0.776	Median	0.01
SD	0.243	CV	1.973
k hat (MLE)	0.429	k star (bias corrected MLE)	0.382
Theta hat (MLE)	0.287	Theta star (bias corrected MLE)	0.323
nu hat (MLE)	11.17	nu star (bias corrected)	9.922
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (9.92, α)	3.893	Adjusted Chi Square Value (9.92, β)	3.372
95% Gamma Approximate UCL	0.314	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.13	SD (KM)	0.23
Variance (KM)	0.0529	SE of Mean (KM)	0.0737
k hat (KM)	0.32	k star (KM)	0.297
nu hat (KM)	8.308	nu star (KM)	7.724
theta hat (KM)	0.407	theta star (KM)	0.438
80% gamma percentile (KM)	0.199	90% gamma percentile (KM)	0.384
95% gamma percentile (KM)	0.597	99% gamma percentile (KM)	1.151

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.72, α)	2.576	Adjusted Chi Square Value (7.72, β)	2.173
95% KM Approximate Gamma UCL	0.39	95% KM Adjusted Gamma UCL	0.462

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Traditional Plant Samples

Shapiro Wilk Test Statistic	0.882	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.792	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.255	Lilliefors GOF Test
10% Lilliefors Critical Value	0.346	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level
Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.122	Mean in Log Scale	-4.348
SD in Original Scale	0.244	SD in Log Scale	2.527
95% t UCL (assumes normality of ROS data)	0.243	95% Percentile Bootstrap UCL	0.242
95% BCA Bootstrap UCL	0.276	95% Bootstrap t UCL	0.77
95% H-UCL (Log ROS)	23.73		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.129	KM Geo Mean	0.0437
KM SD (logged)	1.285	95% Critical H Value (KM-Log)	3.366
KM Standard Error of Mean (logged)	0.412	95% H-UCL (KM -Log)	0.348
KM SD (logged)	1.285	95% Critical H Value (KM-Log)	3.366
KM Standard Error of Mean (logged)	0.412		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.123	Mean in Log Scale	-3.609
SD in Original Scale	0.243	SD in Log Scale	1.647
95% t UCL (Assumes normality)	0.243	95% H-Stat UCL	0.721

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.261

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Titanium

General Statistics

Total Number of Observations	13	Number of Distinct Observations	12
Number of Detects	11	Number of Non-Detects	2
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.156	Minimum Non-Detect	0.05
Maximum Detect	13.5	Maximum Non-Detect	0.05
Variance Detects	14.98	Percent Non-Detects	15.38%
Mean Detects	2.173	SD Detects	3.871
Median Detects	0.95	CV Detects	1.781
Skewness Detects	2.998	Kurtosis Detects	9.331
Mean of Logged Detects	-0.0858	SD of Logged Detects	1.289

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.537	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.792	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors GOF Test
1% Lilliefors Critical Value	0.291	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.846	KM Standard Error of Mean	1.012
90KM SD	3.48	95% KM (BCA) UCL	3.707
95% KM (t) UCL	3.65	95% KM (Percentile Bootstrap) UCL	3.704
95% KM (z) UCL	3.511	95% KM Bootstrap t UCL	10.19
90% KM Chebyshev UCL	4.883	95% KM Chebyshev UCL	6.259
97.5% KM Chebyshev UCL	8.168	99% KM Chebyshev UCL	11.92

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.738	Anderson-Darling GOF Test
5% A-D Critical Value	0.766	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.267	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.266	Detected Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

UCL Statistics for Baseline Traditional Plant Samples

k hat (MLE)	0.701	k star (bias corrected MLE)	0.571
Theta hat (MLE)	3.099	Theta star (bias corrected MLE)	3.808
nu hat (MLE)	15.42	nu star (bias corrected)	12.55
Mean (detects)	2.173		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.84
Maximum	13.5	Median	0.91
SD	3.626	CV	1.97
k hat (MLE)	0.462	k star (bias corrected MLE)	0.407
Theta hat (MLE)	3.98	Theta star (bias corrected MLE)	4.522
nu hat (MLE)	12.02	nu star (bias corrected)	10.58
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (10.58, α)	4.307	Adjusted Chi Square Value (10.58, β)	3.754
95% Gamma Approximate UCL	4.519	95% Gamma Adjusted UCL	5.186

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.846	SD (KM)	3.48
Variance (KM)	12.11	SE of Mean (KM)	1.012
k hat (KM)	0.281	k star (KM)	0.268
nu hat (KM)	7.317	nu star (KM)	6.962
theta hat (KM)	6.56	theta star (KM)	6.895
80% gamma percentile (KM)	2.743	90% gamma percentile (KM)	5.511
95% gamma percentile (KM)	8.752	99% gamma percentile (KM)	17.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.96, α)	2.15	Adjusted Chi Square Value (6.96, β)	1.79
95% KM Approximate Gamma UCL	5.979	95% KM Adjusted Gamma UCL	7.182

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.95	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.876	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.166	Lilliefors GOF Test
10% Lilliefors Critical Value	0.231	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.845	Mean in Log Scale	-0.559
SD in Original Scale	3.623	SD in Log Scale	1.654
95% t UCL (assumes normality of ROS data)	3.636	95% Percentile Bootstrap UCL	3.626
95% BCA Bootstrap UCL	4.8	95% Bootstrap t UCL	10.46
95% H-UCL (Log ROS)	15.63		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.533	KM Geo Mean	0.587
KM SD (logged)	1.543	95% Critical H Value (KM-Log)	3.863
KM Standard Error of Mean (logged)	0.449	95% H-UCL (KM -Log)	10.78
KM SD (logged)	1.543	95% Critical H Value (KM-Log)	3.863
KM Standard Error of Mean (logged)	0.449		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.842	Mean in Log Scale	-0.64
SD in Original Scale	3.624	SD in Log Scale	1.793
95% t UCL (Assumes normality)	3.634	95% H-Stat UCL	24.61

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Bootstrap t UCL	10.19	95% Hall's Bootstrap	10.78
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Traditional Plant Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Uranium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	5
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	7.4000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.0106	Maximum Non-Detect	4.0000E-4
Variance Detects	1.0476E-5	Percent Non-Detects	38.46%
Mean Detects	0.00278	SD Detects	0.00324
Median Detects	0.00205	CV Detects	1.163
Skewness Detects	2.561	Kurtosis Detects	6.895
Mean of Logged Detects	-6.26	SD of Logged Detects	0.845

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.62	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.749	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.413	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.333	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00187	KM Standard Error of Mean	7.8361E-4
90KM SD	0.00264	95% KM (BCA) UCL	0.00331
95% KM (t) UCL	0.00326	95% KM (Percentile Bootstrap) UCL	0.00329
95% KM (z) UCL	0.00316	95% KM Bootstrap t UCL	0.00526
90% KM Chebyshev UCL	0.00422	95% KM Chebyshev UCL	0.00528
97.5% KM Chebyshev UCL	0.00676	99% KM Chebyshev UCL	0.00966

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.712	Anderson-Darling GOF Test	
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.32	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.299	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	1.474	k star (bias corrected MLE)	1.005
Theta hat (MLE)	0.00189	Theta star (bias corrected MLE)	0.00277
nu hat (MLE)	23.59	nu star (bias corrected)	16.07
Mean (detects)	0.00278		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	7.4000E-4	Mean	0.00556
Maximum	0.0106	Median	0.00247
SD	0.00441	CV	0.794
k hat (MLE)	1.3	k star (bias corrected MLE)	1.052
Theta hat (MLE)	0.00427	Theta star (bias corrected MLE)	0.00529
nu hat (MLE)	33.81	nu star (bias corrected)	27.34
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (27.34, α)	16.42	Adjusted Chi Square Value (27.34, β)	15.22
95% Gamma Approximate UCL	0.00926	95% Gamma Adjusted UCL	0.00999

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00187	SD (KM)	0.00264
Variance (KM)	6.9847E-6	SE of Mean (KM)	7.8361E-4
k hat (KM)	0.499	k star (KM)	0.435
nu hat (KM)	12.96	nu star (KM)	11.31
theta hat (KM)	0.00374	theta star (KM)	0.00429
80% gamma percentile (KM)	0.00304	90% gamma percentile (KM)	0.00519
95% gamma percentile (KM)	0.00753	99% gamma percentile (KM)	0.0134

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (11.31, α)	4.773	Adjusted Chi Square Value (11.31, β)	4.184
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UCL Statistics for Baseline Traditional Plant Samples

95% KM Approximate Gamma UCL 0.00442 95% KM Adjusted Gamma UCL 0.00504

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.887	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.851	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.256	Lilliefors GOF Test
10% Lilliefors Critical Value	0.265	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0018	Mean in Log Scale	-7.113
SD in Original Scale	0.00279	SD in Log Scale	1.342
95% t UCL (assumes normality of ROS data)	0.00318	95% Percentile Bootstrap UCL	0.00315
95% BCA Bootstrap UCL	0.00399	95% Bootstrap t UCL	0.00518
95% H-UCL (Log ROS)	0.0077		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.862	KM Geo Mean	0.00105
KM SD (logged)	0.981	95% Critical H Value (KM-Log)	2.816
KM Standard Error of Mean (logged)	0.291	95% H-UCL (KM -Log)	0.00376
KM SD (logged)	0.981	95% Critical H Value (KM-Log)	2.816
KM Standard Error of Mean (logged)	0.291		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00179	Mean in Log Scale	-7.128
SD in Original Scale	0.0028	SD in Log Scale	1.312
95% t UCL (Assumes normality)	0.00317	95% H-Stat UCL	0.00692

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL 0.00504 95% GROS Adjusted Gamma UCL 0.00999

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Traditional Plant Samples

Vanadium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	6
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.027	Minimum Non-Detect	0.02
Maximum Detect	0.394	Maximum Non-Detect	0.02
Variance Detects	0.0164	Percent Non-Detects	46.15%
Mean Detects	0.107	SD Detects	0.128
Median Detects	0.07	CV Detects	1.195
Skewness Detects	2.488	Kurtosis Detects	6.394
Mean of Logged Detects	-2.624	SD of Logged Detects	0.865

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.608	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.73	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.438	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.35	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.067	KM Standard Error of Mean	0.0292
90KM SD	0.0974	95% KM (BCA) UCL	0.122
95% KM (t) UCL	0.119	95% KM (Percentile Bootstrap) UCL	0.12
95% KM (z) UCL	0.115	95% KM Bootstrap t UCL	0.213
90% KM Chebyshev UCL	0.155	95% KM Chebyshev UCL	0.194
97.5% KM Chebyshev UCL	0.249	99% KM Chebyshev UCL	0.357

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.812	Anderson-Darling GOF Test	
5% A-D Critical Value	0.722	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.37	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.317	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.42	k star (bias corrected MLE)	0.907
Theta hat (MLE)	0.0756	Theta star (bias corrected MLE)	0.118
nu hat (MLE)	19.88	nu star (bias corrected)	12.69
Mean (detects)	0.107		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0624
Maximum	0.394	Median	0.027
SD	0.104	CV	1.664
k hat (MLE)	0.78	k star (bias corrected MLE)	0.651
Theta hat (MLE)	0.08	Theta star (bias corrected MLE)	0.0958
nu hat (MLE)	20.27	nu star (bias corrected)	16.92
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (16.92, α)	8.618	Adjusted Chi Square Value (16.92, β)	7.786
95% Gamma Approximate UCL	0.123	95% Gamma Adjusted UCL	0.136

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.067	SD (KM)	0.0974
Variance (KM)	0.00948	SE of Mean (KM)	0.0292
k hat (KM)	0.473	k star (KM)	0.415
nu hat (KM)	12.31	nu star (KM)	10.8
theta hat (KM)	0.142	theta star (KM)	0.161
80% gamma percentile (KM)	0.109	90% gamma percentile (KM)	0.188
95% gamma percentile (KM)	0.275	99% gamma percentile (KM)	0.492

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.80, α)	4.448	Adjusted Chi Square Value (10.80, β)	3.884
95% KM Approximate Gamma UCL	0.163	95% KM Adjusted Gamma UCL	0.186

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.861	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.838	Detected Data appear Lognormal at 10% Significance Level	

UCL Statistics for Baseline Traditional Plant Samples

Lilliefors Test Statistic	0.306	Lilliefors GOF Test
10% Lilliefors Critical Value	0.28	Detected Data Not Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0615	Mean in Log Scale	-3.724
SD in Original Scale	0.104	SD in Log Scale	1.459
95% t UCL (assumes normality of ROS data)	0.113	95% Percentile Bootstrap UCL	0.113
95% BCA Bootstrap UCL	0.145	95% Bootstrap t UCL	0.201
95% H-UCL (Log ROS)	0.333		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.219	KM Geo Mean	0.04
KM SD (logged)	0.87	95% Critical H Value (KM-Log)	2.631
KM Standard Error of Mean (logged)	0.261	95% H-UCL (KM -Log)	0.113
KM SD (logged)	0.87	95% Critical H Value (KM-Log)	2.631
KM Standard Error of Mean (logged)	0.261		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0624	Mean in Log Scale	-3.538
SD in Original Scale	0.104	SD in Log Scale	1.196
95% t UCL (Assumes normality)	0.114	95% H-Stat UCL	0.179

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL 0.113

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zinc

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	1.71	Mean	23.64
Maximum	91.4	Median	9.86
SD	30.85	Std. Error of Mean	8.555
Coefficient of Variation	1.305	Skewness	1.895

Normal GOF Test

Shapiro Wilk Test Statistic	0.655	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.814	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.313	Lilliefors GOF Test
1% Lilliefors Critical Value	0.271	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	38.89	95% Adjusted-CLT UCL (Chen-1995)	42.52
		95% Modified-t UCL (Johnson-1978)	39.64

Gamma GOF Test

A-D Test Statistic	0.794	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.227	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.244	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.918	k star (bias corrected MLE)	0.758
Theta hat (MLE)	25.74	Theta star (bias corrected MLE)	31.2
nu hat (MLE)	23.88	nu star (bias corrected)	19.7

UCL Statistics for Baseline Traditional Plant Samples			
MLE Mean (bias corrected)	23.64	MLE Sd (bias corrected)	27.16
		Approximate Chi Square Value (0.05)	10.63
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	9.694

Assuming Gamma Distribution			
95% Approximate Gamma UCL	43.81	95% Adjusted Gamma UCL	48.05

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.889	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.149	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.215	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	0.536	Mean of logged Data	2.528
Maximum of Logged Data	4.515	SD of logged Data	1.149

Assuming Lognormal Distribution			
95% H-UCL	68.07	90% Chebyshev (MVUE) UCL	45.97
95% Chebyshev (MVUE) UCL	56.6	97.5% Chebyshev (MVUE) UCL	71.36
99% Chebyshev (MVUE) UCL	100.4		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	37.71	95% BCA Bootstrap UCL	42.63
95% Standard Bootstrap UCL	37	95% Bootstrap-t UCL	70.12
95% Hall's Bootstrap UCL	104.8	95% Percentile Bootstrap UCL	38.28
90% Chebyshev(Mean, Sd) UCL	49.31	95% Chebyshev(Mean, Sd) UCL	60.93
97.5% Chebyshev(Mean, Sd) UCL	77.07	99% Chebyshev(Mean, Sd) UCL	108.8

Suggested UCL to Use
95% Adjusted Gamma UCL 48.05

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

General Statistics			
Total Number of Observations	13	Number of Distinct Observations	5
Number of Detects	0	Number of Non-Detects	13
Number of Distinct Detects	0	Number of Distinct Non-Detects	5

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Zirconium was not processed!

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

User Selected Options

Date/Time of Computation ProUCL 5.2 2025-11-20 8:58:48 AM
 From File Northern Pike (40-70 cm) ProUCL Input.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	52	Number of Distinct Observations	41
Number of Detects	41	Number of Non-Detects	11
Number of Distinct Detects	40	Number of Distinct Non-Detects	1
Minimum Detect	0.41	Minimum Non-Detect	0.4
Maximum Detect	8.1	Maximum Non-Detect	0.4
Variance Detects	2.528	Percent Non-Detects	21.15%
Mean Detects	1.719	SD Detects	1.59
Median Detects	1.26	CV Detects	0.925
Skewness Detects	2.301	Kurtosis Detects	6.056
Mean of Logged Detects	0.242	SD of Logged Detects	0.75

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.74	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.92	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.215	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.16	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.44	KM Standard Error of Mean	0.21
90KM SD	1.495	95% KM (BCA) UCL	1.814
95% KM (t) UCL	1.791	95% KM (Percentile Bootstrap) UCL	1.811
95% KM (z) UCL	1.785	95% KM Bootstrap t UCL	1.912
90% KM Chebyshev UCL	2.069	95% KM Chebyshev UCL	2.355
97.5% KM Chebyshev UCL	2.75	99% KM Chebyshev UCL	3.528

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.031	Anderson-Darling GOF Test	
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.13	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.816	k star (bias corrected MLE)	1.699
Theta hat (MLE)	0.947	Theta star (bias corrected MLE)	1.012
nu hat (MLE)	148.9	nu star (bias corrected)	139.3
Mean (detects)	1.719		

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.357
Maximum	8.1	Median	0.975
SD	1.574	CV	1.16
k hat (MLE)	0.571	k star (bias corrected MLE)	0.551
Theta hat (MLE)	2.375	Theta star (bias corrected MLE)	2.462
nu hat (MLE)	59.43	nu star (bias corrected)	57.33
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (57.33, α)	40.93	Adjusted Chi Square Value (57.33, β)	40.53
95% Gamma Approximate UCL	1.901	95% Gamma Adjusted UCL	1.92

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.44	SD (KM)	1.495
Variance (KM)	2.234	SE of Mean (KM)	0.21
k hat (KM)	0.928	k star (KM)	0.887
nu hat (KM)	96.49	nu star (KM)	92.26
theta hat (KM)	1.552	theta star (KM)	1.623
80% gamma percentile (KM)	2.338	90% gamma percentile (KM)	3.414
95% gamma percentile (KM)	4.501	99% gamma percentile (KM)	7.047

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (92.26, α)	71.11	Adjusted Chi Square Value (92.26, β)	70.58
95% KM Approximate Gamma UCL	1.868	95% KM Adjusted Gamma UCL	1.882

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.95	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0748	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.126	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.405	Mean in Log Scale	-0.13
SD in Original Scale	1.536	SD in Log Scale	0.999
95% t UCL (assumes normality of ROS data)	1.762	95% Percentile Bootstrap UCL	1.771
95% BCA Bootstrap UCL	1.831	95% Bootstrap t UCL	1.893
95% H-UCL (Log ROS)	1.999		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.00331	KM Geo Mean	0.997
KM SD (logged)	0.81	95% Critical H Value (KM-Log)	2.124
KM Standard Error of Mean (logged)	0.114	95% H-UCL (KM -Log)	1.761
KM SD (logged)	0.81	95% Critical H Value (KM-Log)	2.124

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

KM Standard Error of Mean (logged) 0.114

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 1.398
SD in Original Scale 1.541
95% t UCL (Assumes normality) 1.756

DL/2 Log-Transformed

Mean in Log Scale -0.15
SD in Log Scale 1.012
95% H-Stat UCL 1.996

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL 1.868

95% GROS Approximate Gamma UCL 1.901

**When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Antimony

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Antimony was not processed!

Arsenic

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	51
		Number of Missing Observations	0
Minimum	0.0194	Mean	0.164
Maximum	0.697	Median	0.113
SD	0.129	Std. Error of Mean	0.0179
Coefficient of Variation	0.783	Skewness	1.858

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.834	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	1.4052E-7	Lilliefors GOF Test	
Lilliefors Test Statistic	0.172	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.141		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.194	95% Adjusted-CLT UCL (Chen-1995)	0.199
		95% Modified-t UCL (Johnson-1978)	0.195

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.497	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.763	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.118	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.125		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	2.033	k star (bias corrected MLE)	1.929
Theta hat (MLE)	0.0809	Theta star (bias corrected MLE)	0.0853
nu hat (MLE)	211.5	nu star (bias corrected)	200.6

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

MLE Mean (bias corrected)	0.164	MLE Sd (bias corrected)	0.118
		Approximate Chi Square Value (0.05)	168.8
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	168

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.195	95% Adjusted Gamma UCL	0.196
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.949	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0728	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.942	Mean of logged Data	-2.071
Maximum of Logged Data	-0.361	SD of logged Data	0.749

Assuming Lognormal Distribution

95% H-UCL	0.207	90% Chebyshev (MVUE) UCL	0.223
95% Chebyshev (MVUE) UCL	0.249	97.5% Chebyshev (MVUE) UCL	0.285
99% Chebyshev (MVUE) UCL	0.355		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.194	95% BCA Bootstrap UCL	0.2
95% Standard Bootstrap UCL	0.194	95% Bootstrap-t UCL	0.202
95% Hall's Bootstrap UCL	0.205	95% Percentile Bootstrap UCL	0.195
90% Chebyshev(Mean, Sd) UCL	0.218	95% Chebyshev(Mean, Sd) UCL	0.242
97.5% Chebyshev(Mean, Sd) UCL	0.276	99% Chebyshev(Mean, Sd) UCL	0.342

Suggested UCL to Use

95% Approximate Gamma UCL	0.195
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barlum

General Statistics

Total Number of Observations	52	Number of Distinct Observations	39
Number of Detects	51	Number of Non-Detects	1
Number of Distinct Detects	38	Number of Distinct Non-Detects	1
Minimum Detect	0.011	Minimum Non-Detect	0.01
Maximum Detect	0.166	Maximum Non-Detect	0.01
Variance Detects	0.00121	Percent Non-Detects	1.923%

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Mean Detects	0.0551	SD Detects	0.0348
Median Detects	0.05	CV Detects	0.632
Skewness Detects	1.281	Kurtosis Detects	1.934
Mean of Logged Detects	-3.096	SD of Logged Detects	0.659

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.893
1% Shapiro Wilk P Value	1.0058E-4
Lilliefors Test Statistic	0.117
1% Lilliefors Critical Value	0.143

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0542	KM Standard Error of Mean	0.00486
90KM SD	0.0347	95% KM (BCA) UCL	0.0625
95% KM (t) UCL	0.0624	95% KM (Percentile Bootstrap) UCL	0.0624
95% KM (z) UCL	0.0622	95% KM Bootstrap t UCL	0.0637
90% KM Chebyshev UCL	0.0688	95% KM Chebyshev UCL	0.0754
97.5% KM Chebyshev UCL	0.0846	99% KM Chebyshev UCL	0.103

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.229
5% A-D Critical Value	0.759
K-S Test Statistic	0.0634
5% K-S Critical Value	0.125

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.685	k star (bias corrected MLE)	2.54
Theta hat (MLE)	0.0205	Theta star (bias corrected MLE)	0.0217
nu hat (MLE)	273.9	nu star (bias corrected)	259.1
Mean (detects)	0.0551		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0542
Maximum	0.166	Median	0.05
SD	0.0351	CV	0.647
k hat (MLE)	2.526	k star (bias corrected MLE)	2.393
Theta hat (MLE)	0.0215	Theta star (bias corrected MLE)	0.0227
nu hat (MLE)	262.7	nu star (bias corrected)	248.9
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (248.92, α)	213.4	Adjusted Chi Square Value (248.92, β)	212.5
95% Gamma Approximate UCL	0.0633	95% Gamma Adjusted UCL	0.0635

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0542	SD (KM)	0.0347
Variance (KM)	0.00121	SE of Mean (KM)	0.00486
k hat (KM)	2.439	k star (KM)	2.311
nu hat (KM)	253.6	nu star (KM)	240.3
theta hat (KM)	0.0222	theta star (KM)	0.0235
80% gamma percentile (KM)	0.0798	90% gamma percentile (KM)	0.102
95% gamma percentile (KM)	0.123	99% gamma percentile (KM)	0.169

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (240.31, α)	205.4	Adjusted Chi Square Value (240.31, β)	204.5
95% KM Approximate Gamma UCL	0.0634	95% KM Adjusted Gamma UCL	0.0637

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.968	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0.308	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0929	Lilliefors GOF Test
10% Lilliefors Critical Value	0.113	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0542	Mean in Log Scale	-3.129
SD in Original Scale	0.0351	SD in Log Scale	0.695
95% t UCL (assumes normality of ROS data)	0.0624	95% Percentile Bootstrap UCL	0.0624
95% BCA Bootstrap UCL	0.0627	95% Bootstrap t UCL	0.0636
95% H-UCL (Log ROS)	0.0678		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.125	KM Geo Mean	0.0439
KM SD (logged)	0.679	95% Critical H Value (KM-Log)	2.009
KM Standard Error of Mean (logged)	0.0951	95% H-UCL (KM -Log)	0.0669
KM SD (logged)	0.679	95% Critical H Value (KM-Log)	2.009
KM Standard Error of Mean (logged)	0.0951		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0541	Mean in Log Scale	-3.139
SD in Original Scale	0.0352	SD in Log Scale	0.721
95% t UCL (Assumes normality)	0.0623	95% H-Stat UCL	0.0691

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0624

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Beryllium

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Beryllium was not processed!

Biismuth

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	6
Number of Detects	7	Number of Non-Detects	45
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.002	Minimum Non-Detect	0.002
Maximum Detect	0.0036	Maximum Non-Detect	0.002
Variance Detects	3.9000E-7	Percent Non-Detects	86.54%
Mean Detects	0.0028	SD Detects	6.2450E-4
Median Detects	0.0028	CV Detects	0.223
Skewness Detects	0.31	Kurtosis Detects	-1.359
Mean of Logged Detects	-5.9	SD of Logged Detects	0.224

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.73	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.186	Lilliefors GOF Test
1% Lilliefors Critical Value	0.35	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00211	KM Standard Error of Mean	5.1791E-5
90KM SD	3.4577E-4	95% KM (BCA) UCL	0.0022
95% KM (t) UCL	0.00219	95% KM (Percentile Bootstrap) UCL	0.00219
95% KM (z) UCL	0.00219	95% KM Bootstrap t UCL	0.00221
90% KM Chebyshev UCL	0.00226	95% KM Chebyshev UCL	0.00233
97.5% KM Chebyshev UCL	0.00243	99% KM Chebyshev UCL	0.00262

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.312	Anderson-Darling GOF Test
5% A-D Critical Value	0.707	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	23.56	k star (bias corrected MLE)	13.56
Theta hat (MLE)	1.1885E-4	Theta star (bias corrected MLE)	2.0653E-4
nu hat (MLE)	329.8	nu star (bias corrected)	189.8
Mean (detects)	0.0028		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.002	Mean	0.00903
Maximum	0.01	Median	0.01
SD	0.00249	CV	0.276
k hat (MLE)	7.079	k star (bias corrected MLE)	6.683
Theta hat (MLE)	0.00128	Theta star (bias corrected MLE)	0.00135
nu hat (MLE)	736.2	nu star (bias corrected)	695.1
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (695.08, α)	634.9	Adjusted Chi Square Value (695.08, β)	633.3
95% Gamma Approximate UCL	0.00989	95% Gamma Adjusted UCL	0.00991

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00211	SD (KM)	3.4577E-4
Variance (KM)	1.1956E-7	SE of Mean (KM)	5.1791E-5
k hat (KM)	37.16	k star (KM)	35.03
nu hat (KM)	3864	nu star (KM)	3643
theta hat (KM)	5.6724E-5	theta star (KM)	6.0175E-5
80% gamma percentile (KM)	0.0024	90% gamma percentile (KM)	0.00258
95% gamma percentile (KM)	0.00273	99% gamma percentile (KM)	0.00302

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	3503	Adjusted Chi Square Value (N/A, β)	3500
95% KM Approximate Gamma UCL	0.00219	95% KM Adjusted Gamma UCL	0.00219

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.932	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.838	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.174	Lilliefors GOF Test
10% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00121	Mean in Log Scale	-6.903
SD in Original Scale	7.8409E-4	SD in Log Scale	0.617

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

95% t UCL (assumes normality of ROS data)	0.00139	95% Percentile Bootstrap UCL	0.00139
95% BCA Bootstrap UCL	0.0014	95% Bootstrap t UCL	0.00143
95% H-UCL (Log ROS)	0.00144		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.172	KM Geo Mean	0.00209
KM SD (logged)	0.132	95% Critical H Value (KM-Log)	1.7
KM Standard Error of Mean (logged)	0.0197	95% H-UCL (KM -Log)	0.00217
KM SD (logged)	0.132	95% Critical H Value (KM-Log)	1.7
KM Standard Error of Mean (logged)	0.0197		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00124
SD in Original Scale	6.5630E-4
95% t UCL (Assumes normality)	0.00139

DL/2 Log-Transformed

Mean in Log Scale	-6.772
SD in Log Scale	0.356
95% H-Stat UCL	0.00133

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00219

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Boron

General Statistics

Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Boron was not processed!

Cadmium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	49
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.0011	Minimum Non-Detect	0.001

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Maximum Detect	0.0026	Maximum Non-Detect	0.001
Variance Detects	5.6333E-7	Percent Non-Detects	94.23%
Mean Detects	0.00183	SD Detects	7.5056E-4
Median Detects	0.0018	CV Detects	0.409
Skewness Detects	0.199	Kurtosis Detects	N/A
Mean of Logged Detects	-6.362	SD of Logged Detects	0.432

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00105	KM Standard Error of Mean	4.1401E-5
90KM SD	2.4376E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00112	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00112	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00117	95% KM Chebyshev UCL	0.00123
97.5% KM Chebyshev UCL	0.00131	99% KM Chebyshev UCL	0.00146

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.248	Anderson-Darling GOF Test
5% A-D Critical Value	0.636	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.228	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.433	Detected data appear Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	8.506	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.1554E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	51.04	nu star (bias corrected)	N/A
Mean (detects)	0.00183		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0011	Mean	0.00953
Maximum	0.01	Median	0.01
SD	0.00193	CV	0.202

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

k hat (MLE)	9.585	k star (bias corrected MLE)	9.045
Theta hat (MLE)	9.9409E-4	Theta star (bias corrected MLE)	0.00105
nu hat (MLE)	996.9	nu star (bias corrected)	940.7
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (940.71, α)	870.5	Adjusted Chi Square Value (940.71, β)	868.6
95% Gamma Approximate UCL	0.0103	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00105	SD (KM)	2.4376E-4
Variance (KM)	5.9419E-8	SE of Mean (KM)	4.1401E-5
k hat (KM)	18.49	k star (KM)	17.43
nu hat (KM)	1923	nu star (KM)	1813
theta hat (KM)	5.6694E-5	theta star (KM)	6.0121E-5
80% gamma percentile (KM)	0.00125	90% gamma percentile (KM)	0.00138
95% gamma percentile (KM)	0.00149	99% gamma percentile (KM)	0.00172

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1715	Adjusted Chi Square Value (N/A, β)	1712
95% KM Approximate Gamma UCL	0.00111	95% KM Adjusted Gamma UCL	0.00111

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.993
10% Shapiro Wilk Critical Value	0.789
Lilliefors Test Statistic	0.205
10% Lilliefors Critical Value	0.389

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.1320E-4	Mean in Log Scale	-9.785
SD in Original Scale	4.5686E-4	SD in Log Scale	1.699
95% t UCL (assumes normality of ROS data)	3.1934E-4	95% Percentile Bootstrap UCL	3.2648E-4
95% BCA Bootstrap UCL	3.5870E-4	95% Bootstrap t UCL	4.3211E-4
95% H-UCL (Log ROS)	5.0740E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.876	KM Geo Mean	0.00103
KM SD (logged)	0.153	95% Critical H Value (KM-Log)	1.708
KM Standard Error of Mean (logged)	0.026	95% H-UCL (KM -Log)	0.00108
KM SD (logged)	0.153	95% Critical H Value (KM-Log)	1.708
KM Standard Error of Mean (logged)	0.026		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	5.7692E-4
SD in Original Scale	3.4732E-4
95% t UCL (Assumes normality)	6.5761E-4

DL/2 Log-Transformed

Mean in Log Scale	-7.529
SD in Log Scale	0.304
95% H-Stat UCL	6.0506E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00112

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Calcium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	52
		Number of Missing Observations	0
Minimum	136	Mean	605.7
Maximum	1460	Median	546.5
SD	341.6	Std. Error of Mean	47.37
Coefficient of Variation	0.564	Skewness	0.723

Normal GOF Test

Shapiro Wilk Test Statistic	0.927
1% Shapiro Wilk P Value	0.00381
Lilliefors Test Statistic	0.118
1% Lilliefors Critical Value	0.141

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 685

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 688.7

95% Modified-t UCL (Johnson-1978) 685.8

Gamma GOF Test

A-D Test Statistic	0.267
5% A-D Critical Value	0.757
K-S Test Statistic	0.0645
5% K-S Critical Value	0.124

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.124	k star (bias corrected MLE)	2.957
Theta hat (MLE)	193.9	Theta star (bias corrected MLE)	204.8
nu hat (MLE)	324.9	nu star (bias corrected)	307.5
MLE Mean (bias corrected)	605.7	MLE Sd (bias corrected)	352.2
		Approximate Chi Square Value (0.05)	267.9
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	266.8

Assuming Gamma Distribution

95% Approximate Gamma UCL 695.2

95% Adjusted Gamma UCL 698

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963
10% Shapiro Wilk P Value	0.195
Lilliefors Test Statistic	0.0751
10% Lilliefors Critical Value	0.112

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Lognormal Statistics

Minimum of Logged Data	4.913	Mean of logged Data	6.238
Maximum of Logged Data	7.286	SD of logged Data	0.61

Assuming Lognormal Distribution

95% H-UCL	728.1	90% Chebyshev (MVUE) UCL	780.7
95% Chebyshev (MVUE) UCL	856.4	97.5% Chebyshev (MVUE) UCL	961.4
99% Chebyshev (MVUE) UCL	1168		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	683.6	95% BCA Bootstrap UCL	686.7
95% Standard Bootstrap UCL	682.2	95% Bootstrap-t UCL	690
95% Hall's Bootstrap UCL	688.1	95% Percentile Bootstrap UCL	683
90% Chebyshev(Mean, Sd) UCL	747.8	95% Chebyshev(Mean, Sd) UCL	812.1
97.5% Chebyshev(Mean, Sd) UCL	901.5	99% Chebyshev(Mean, Sd) UCL	1077

Suggested UCL to Use

95% Student's-t UCL 685

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cesium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	0.0076	Mean	0.0268
Maximum	0.0899	Median	0.0224
SD	0.0172	Std. Error of Mean	0.00239
Coefficient of Variation	0.642	Skewness	1.503

Normal GOF Test

Shapiro Wilk Test Statistic	0.853	Shapiro Wilk GOF Test
1% Shapiro Wilk P Value	1.0521E-6	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors GOF Test
1% Lilliefors Critical Value	0.141	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% UCLs (Adjusted for Skewness)

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

95% Student's-t UCL	0.0308	95% Adjusted-CLT UCL (Chen-1995)	0.0313
		95% Modified-t UCL (Johnson-1978)	0.0309

Gamma GOF Test

A-D Test Statistic	1.142	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.162	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.928	k star (bias corrected MLE)	2.772
Theta hat (MLE)	0.00916	Theta star (bias corrected MLE)	0.00967
nu hat (MLE)	304.5	nu star (bias corrected)	288.3
MLE Mean (bias corrected)	0.0268	MLE Sd (bias corrected)	0.0161
		Approximate Chi Square Value (0.05)	249.9
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	248.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.0309	95% Adjusted Gamma UCL	0.031
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.04	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.151	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.88	Mean of logged Data	-3.8
Maximum of Logged Data	-2.409	SD of logged Data	0.602

Assuming Lognormal Distribution

95% H-UCL	0.0316	90% Chebyshev (MVUE) UCL	0.0339
95% Chebyshev (MVUE) UCL	0.0371	97.5% Chebyshev (MVUE) UCL	0.0416
99% Chebyshev (MVUE) UCL	0.0505		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0307	95% BCA Bootstrap UCL	0.0312
95% Standard Bootstrap UCL	0.0307	95% Bootstrap-t UCL	0.0315
95% Hall's Bootstrap UCL	0.0317	95% Percentile Bootstrap UCL	0.0308
90% Chebyshev(Mean, Sd) UCL	0.034	95% Chebyshev(Mean, Sd) UCL	0.0372
97.5% Chebyshev(Mean, Sd) UCL	0.0417	99% Chebyshev(Mean, Sd) UCL	0.0506

Suggested UCL to Use

95% Student's-t UCL	0.0308
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UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	13
Number of Detects	18	Number of Non-Detects	34
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.011	Minimum Non-Detect	0.01
Maximum Detect	0.104	Maximum Non-Detect	0.01
Variance Detects	4.9624E-4	Percent Non-Detects	65.38%
Mean Detects	0.0237	SD Detects	0.0223
Median Detects	0.016	CV Detects	0.941
Skewness Detects	3.133	Kurtosis Detects	10.78
Mean of Logged Detects	-3.964	SD of Logged Detects	0.594

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.575	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.858	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.294	Lilliefors GOF Test
1% Lilliefors Critical Value	0.235	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0147	KM Standard Error of Mean	0.00204
90KM SD	0.0143	95% KM (BCA) UCL	0.0186
95% KM (t) UCL	0.0181	95% KM (Percentile Bootstrap) UCL	0.0184
95% KM (z) UCL	0.0181	95% KM Bootstrap t UCL	0.0236
90% KM Chebyshev UCL	0.0209	95% KM Chebyshev UCL	0.0236
97.5% KM Chebyshev UCL	0.0275	99% KM Chebyshev UCL	0.035

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.599	Anderson-Darling GOF Test
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.206	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.419	k star (bias corrected MLE)	2.053
Theta hat (MLE)	0.00978	Theta star (bias corrected MLE)	0.0115
nu hat (MLE)	87.1	nu star (bias corrected)	73.92
Mean (detects)	0.0237		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0147
Maximum	0.104	Median	0.01
SD	0.0144	CV	0.98
k hat (MLE)	3.177	k star (bias corrected MLE)	3.007
Theta hat (MLE)	0.00464	Theta star (bias corrected MLE)	0.0049
nu hat (MLE)	330.5	nu star (bias corrected)	312.7
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (312.72, α)	272.8	Adjusted Chi Square Value (312.72, β)	271.7
95% Gamma Approximate UCL	0.0169	95% Gamma Adjusted UCL	0.017

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0147	SD (KM)	0.0143
Variance (KM)	2.0450E-4	SE of Mean (KM)	0.00204
k hat (KM)	1.061	k star (KM)	1.013
nu hat (KM)	110.4	nu star (KM)	105.3
theta hat (KM)	0.0139	theta star (KM)	0.0145
80% gamma percentile (KM)	0.0237	90% gamma percentile (KM)	0.0338
95% gamma percentile (KM)	0.0439	99% gamma percentile (KM)	0.0674

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (105.32, α)	82.64	Adjusted Chi Square Value (105.32, β)	82.06
95% KM Approximate Gamma UCL	0.0188	95% KM Adjusted Gamma UCL	0.0189

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.813
10% Shapiro Wilk Critical Value	0.914
Lilliefors Test Statistic	0.179
10% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0105	Mean in Log Scale	-5.227
SD in Original Scale	0.0162	SD in Log Scale	1.168
95% t UCL (assumes normality of ROS data)	0.0142	95% Percentile Bootstrap UCL	0.0145
95% BCA Bootstrap UCL	0.0158	95% Bootstrap t UCL	0.0176
95% H-UCL (Log ROS)	0.016		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.383	KM Geo Mean	0.0125
KM SD (logged)	0.457	95% Critical H Value (KM-Log)	1.855
KM Standard Error of Mean (logged)	0.0651	95% H-UCL (KM -Log)	0.0156
KM SD (logged)	0.457	95% Critical H Value (KM-Log)	1.855
KM Standard Error of Mean (logged)	0.0651		

DL/2 Statistics

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0115	Mean in Log Scale	-4.837
SD in Original Scale	0.0157	SD in Log Scale	0.727
95% t UCL (Assumes normality)	0.0151	95% H-Stat UCL	0.0127

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL 0.0156

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Cobalt

General Statistics

Total Number of Observations	52	Number of Distinct Observations	5
Number of Detects	5	Number of Non-Detects	47
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.004	Minimum Non-Detect	0.004
Maximum Detect	0.0064	Maximum Non-Detect	0.004
Variance Detects	9.6300E-7	Percent Non-Detects	90.38%
Mean Detects	0.00476	SD Detects	9.8133E-4
Median Detects	0.0044	CV Detects	0.206
Skewness Detects	1.605	Kurtosis Detects	2.479
Mean of Logged Detects	-5.363	SD of Logged Detects	0.191

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.83	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.686	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.243	Lilliefors GOF Test
1% Lilliefors Critical Value	0.396	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00407	KM Standard Error of Mean	5.4657E-5
90KM SD	3.5253E-4	95% KM (BCA) UCL	0.00416
95% KM (t) UCL	0.00416	95% KM (Percentile Bootstrap) UCL	0.00416
95% KM (z) UCL	0.00416	95% KM Bootstrap t UCL	0.00431
90% KM Chebyshev UCL	0.00424	95% KM Chebyshev UCL	0.00431
97.5% KM Chebyshev UCL	0.00441	99% KM Chebyshev UCL	0.00462

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.457	Anderson-Darling GOF Test
5% A-D Critical Value	0.679	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.25	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	32.71	k star (bias corrected MLE)	13.22
Theta hat (MLE)	1.4552E-4	Theta star (bias corrected MLE)	3.6014E-4
nu hat (MLE)	327.1	nu star (bias corrected)	132.2
Mean (detects)	0.00476		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.004	Mean	0.0095
Maximum	0.01	Median	0.01
SD	0.00158	CV	0.167
k hat (MLE)	23.8	k star (bias corrected MLE)	22.44
Theta hat (MLE)	3.9904E-4	Theta star (bias corrected MLE)	4.2323E-4
nu hat (MLE)	2475	nu star (bias corrected)	2333
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (N/A, α)	2222	Adjusted Chi Square Value (N/A, β)	2219
95% Gamma Approximate UCL	0.00997	95% Gamma Adjusted UCL	0.00999

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00407	SD (KM)	3.5253E-4
Variance (KM)	1.2428E-7	SE of Mean (KM)	5.4657E-5
k hat (KM)	133.5	k star (KM)	125.8
nu hat (KM)	13883	nu star (KM)	13084
theta hat (KM)	3.0511E-5	theta star (KM)	3.2376E-5
80% gamma percentile (KM)	0.00438	90% gamma percentile (KM)	0.00454
95% gamma percentile (KM)	0.00469	99% gamma percentile (KM)	0.00497

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	12819	Adjusted Chi Square Value (N/A, β)	12811
95% KM Approximate Gamma UCL	0.00416	95% KM Adjusted Gamma UCL	0.00416

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.806	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.319	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00188	Mean in Log Scale	-6.463
SD in Original Scale	0.00122	SD in Log Scale	0.615
95% t UCL (assumes normality of ROS data)	0.00216	95% Percentile Bootstrap UCL	0.00216
95% BCA Bootstrap UCL	0.00219	95% Bootstrap t UCL	0.00222
95% H-UCL (Log ROS)	0.00223		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.506	KM Geo Mean	0.00406
KM SD (logged)	0.0707	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.011	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0707	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.011		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00227
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DL/2 Log-Transformed

Mean in Log Scale	-6.133
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UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

SD in Original Scale	8.6634E-4	SD in Log Scale	0.259
95% t UCL (Assumes normality)	0.00247	95% H-Stat UCL	0.00239

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00416

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observations	52	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	0.064	Mean	0.144
Maximum	0.222	Median	0.143
SD	0.0336	Std. Error of Mean	0.00466
Coefficient of Variation	0.234	Skewness	0.282

Normal GOF Test

Shapiro Wilk Test Statistic 0.975
 1% Shapiro Wilk P Value 0.517
 Lilliefors Test Statistic 0.0929
 1% Lilliefors Critical Value 0.141

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.152

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.152
 95% Modified-t UCL (Johnson-1978) 0.152

Gamma GOF Test

A-D Test Statistic 0.306
 5% A-D Critical Value 0.749
 K-S Test Statistic 0.0804
 5% K-S Critical Value 0.123

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	18.13	k star (bias corrected MLE)	17.09
Theta hat (MLE)	0.00793	Theta star (bias corrected MLE)	0.00841
nu hat (MLE)	1885	nu star (bias corrected)	1778
MLE Mean (bias corrected)	0.144	MLE Sd (bias corrected)	0.0348

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

		Approximate Chi Square Value (0.05)	1681
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	1678

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.152	95% Adjusted Gamma UCL	0.152
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.972	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.426	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0875	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.749	Mean of logged Data	-1.967
Maximum of Logged Data	-1.505	SD of logged Data	0.242

Assuming Lognormal Distribution

95% H-UCL	0.153	90% Chebyshev (MVUE) UCL	0.159
95% Chebyshev (MVUE) UCL	0.165	97.5% Chebyshev (MVUE) UCL	0.174
99% Chebyshev (MVUE) UCL	0.193		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.151	95% BCA Bootstrap UCL	0.152
95% Standard Bootstrap UCL	0.151	95% Bootstrap-t UCL	0.152
95% Hall's Bootstrap UCL	0.152	95% Percentile Bootstrap UCL	0.151
90% Chebyshev(Mean, Sd) UCL	0.158	95% Chebyshev(Mean, Sd) UCL	0.164
97.5% Chebyshev(Mean, Sd) UCL	0.173	99% Chebyshev(Mean, Sd) UCL	0.19

Suggested UCL to Use

95% Student's-t UCL 0.152

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Iron

General Statistics

Total Number of Observations	52	Number of Distinct Observations	50
		Number of Missing Observations	0
Minimum	0.85	Mean	3.171
Maximum	10.6	Median	2.59
SD	1.869	Std. Error of Mean	0.259
Coefficient of Variation	0.589	Skewness	1.872

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Normal GOF Test

Shapiro Wilk Test Statistic 0.831
 1% Shapiro Wilk P Value 1.0233E-7
 Lilliefors Test Statistic 0.175
 1% Lilliefors Critical Value 0.141

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 3.605

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 3.669
 95% Modified-t UCL (Johnson-1978) 3.616

Gamma GOF Test

A-D Test Statistic 0.873
 5% A-D Critical Value 0.754
 K-S Test Statistic 0.106
 5% K-S Critical Value 0.124

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE) 3.836
 Theta hat (MLE) 0.827
 nu hat (MLE) 399
 MLE Mean (bias corrected) 3.171
 Adjusted Level of Significance 0.0454

k star (bias corrected MLE) 3.628
 Theta star (bias corrected MLE) 0.874
 nu star (bias corrected) 377.3
 MLE Sd (bias corrected) 1.665
 Approximate Chi Square Value (0.05) 333.3
 Adjusted Chi Square Value 332.1

Assuming Gamma Distribution

95% Approximate Gamma UCL 3.59

95% Adjusted Gamma UCL 3.602

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.983
 10% Shapiro Wilk P Value 0.81
 Lilliefors Test Statistic 0.0717
 10% Lilliefors Critical Value 0.112

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data -0.163
 Maximum of Logged Data 2.361

Mean of logged Data 1.018
 SD of logged Data 0.511

Assuming Lognormal Distribution

95% H-UCL 3.609
 95% Chebyshev (MVUE) UCL 4.168
 99% Chebyshev (MVUE) UCL 5.479

90% Chebyshev (MVUE) UCL 3.849
 97.5% Chebyshev (MVUE) UCL 4.61

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Nonparametric Distribution Free UCLs

95% CLT UCL	3.597	95% BCA Bootstrap UCL	3.687
95% Standard Bootstrap UCL	3.596	95% Bootstrap-t UCL	3.697
95% Hall's Bootstrap UCL	3.704	95% Percentile Bootstrap UCL	3.62
90% Chebyshev(Mean, Sd) UCL	3.948	95% Chebyshev(Mean, Sd) UCL	4.301
97.5% Chebyshev(Mean, Sd) UCL	4.789	99% Chebyshev(Mean, Sd) UCL	5.75

Suggested UCL to Use

95% Approximate Gamma UCL 3.59

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Lead

General Statistics

Total Number of Observations	52	Number of Distinct Observations	11
Number of Detects	11	Number of Non-Detects	41
Number of Distinct Detects	11	Number of Distinct Non-Detects	1
Minimum Detect	0.004	Minimum Non-Detect	0.004
Maximum Detect	0.0138	Maximum Non-Detect	0.004
Variance Detects	1.0208E-5	Percent Non-Detects	78.85%
Mean Detects	0.00762	SD Detects	0.00319
Median Detects	0.0067	CV Detects	0.419
Skewness Detects	1.006	Kurtosis Detects	0.0767
Mean of Logged Detects	-4.951	SD of Logged Detects	0.398

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.792	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.292	Lilliefors GOF Test
1% Lilliefors Critical Value	0.291	Detected Data Not Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00477	KM Standard Error of Mean	2.9617E-4
90KM SD	0.00204	95% KM (BCA) UCL	0.00528
95% KM (t) UCL	0.00526	95% KM (Percentile Bootstrap) UCL	0.00527
95% KM (z) UCL	0.00525	95% KM Bootstrap t UCL	0.0055
90% KM Chebyshev UCL	0.00565	95% KM Chebyshev UCL	0.00606
97.5% KM Chebyshev UCL	0.00661	99% KM Chebyshev UCL	0.00771

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.552	Anderson-Darling GOF Test
5% A-D Critical Value	0.731	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.249	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.256	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.918	k star (bias corrected MLE)	5.092
Theta hat (MLE)	0.0011	Theta star (bias corrected MLE)	0.0015
nu hat (MLE)	152.2	nu star (bias corrected)	112
Mean (detects)	0.00762		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.004	Mean	0.0095
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UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Maximum	0.0138	Median	0.01
SD	0.00172	CV	0.181
k hat (MLE)	23.41	k star (bias corrected MLE)	22.08
Theta hat (MLE)	4.0557E-4	Theta star (bias corrected MLE)	4.3015E-4
nu hat (MLE)	2435	nu star (bias corrected)	2296
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (N/A, α)	2186	Adjusted Chi Square Value (N/A, β)	2183
95% Gamma Approximate UCL	0.00998	95% Gamma Adjusted UCL	0.00999

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00477	SD (KM)	0.00204
Variance (KM)	4.1465E-6	SE of Mean (KM)	2.9617E-4
k hat (KM)	5.477	k star (KM)	5.174
nu hat (KM)	569.6	nu star (KM)	538
theta hat (KM)	8.7013E-4	theta star (KM)	9.2111E-4
80% gamma percentile (KM)	0.00638	90% gamma percentile (KM)	0.00757
95% gamma percentile (KM)	0.00865	99% gamma percentile (KM)	0.0109

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (538.04, α)	485.2	Adjusted Chi Square Value (538.04, β)	483.8
95% KM Approximate Gamma UCL	0.00528	95% KM Adjusted Gamma UCL	0.0053

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.918
10% Shapiro Wilk Critical Value	0.876
Lilliefors Test Statistic	0.224
10% Lilliefors Critical Value	0.231

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00294	Mean in Log Scale	-6.25
SD in Original Scale	0.00297	SD in Log Scale	0.937
95% t UCL (assumes normality of ROS data)	0.00363	95% Percentile Bootstrap UCL	0.00363
95% BCA Bootstrap UCL	0.00372	95% Bootstrap t UCL	0.00383
95% H-UCL (Log ROS)	0.00402		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.401	KM Geo Mean	0.00451
KM SD (logged)	0.291	95% Critical H Value (KM-Log)	1.715
KM Standard Error of Mean (logged)	0.0423	95% H-UCL (KM -Log)	0.00505
KM SD (logged)	0.291	95% Critical H Value (KM-Log)	1.715
KM Standard Error of Mean (logged)	0.0423		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00319
SD in Original Scale	0.00271
95% t UCL (Assumes normality)	0.00382

DL/2 Log-Transformed

Mean in Log Scale	-5.947
SD in Log Scale	0.55
95% H-Stat UCL	0.00352

DL/2 is not a recommended method, provided for comparisons and historical reasons

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00526

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lithium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Lithium was not processed!

Magnesium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	141	Mean	324.9
Maximum	486	Median	332
SD	46.56	Std. Error of Mean	6.456
Coefficient of Variation	0.143	Skewness	-0.482

Normal GOF Test

Shapiro Wilk Test Statistic	0.897	Shapiro Wilk GOF Test
1% Shapiro Wilk P Value	1.3564E-4	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.142	Lilliefors GOF Test
1% Lilliefors Critical Value	0.141	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 335.7

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 335

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

95% Modified-t UCL (Johnson-1978) 335.6

Gamma GOF Test

A-D Test Statistic 2.115
 5% A-D Critical Value 0.748
 K-S Test Statistic 0.149
 5% K-S Critical Value 0.123

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	42.75	k star (bias corrected MLE)	40.3
Theta hat (MLE)	7.599	Theta star (bias corrected MLE)	8.062
nu hat (MLE)	4446	nu star (bias corrected)	4191
MLE Mean (bias corrected)	324.9	MLE Sd (bias corrected)	51.18
		Approximate Chi Square Value (0.05)	4042
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	4038

Assuming Gamma Distribution

95% Approximate Gamma UCL 336.9 95% Adjusted Gamma UCL 337.2

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.802
 10% Shapiro Wilk P Value 5.1708E-9
 Lilliefors Test Statistic 0.16
 10% Lilliefors Critical Value 0.112

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.949	Mean of logged Data	5.772
Maximum of Logged Data	6.186	SD of logged Data	0.163

Assuming Lognormal Distribution

95% H-UCL	338.4	90% Chebyshev (MVUE) UCL	347.6
95% Chebyshev (MVUE) UCL	357.6	97.5% Chebyshev (MVUE) UCL	371.6
99% Chebyshev (MVUE) UCL	399.1		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	335.5	95% BCA Bootstrap UCL	334.8
95% Standard Bootstrap UCL	335.3	95% Bootstrap-t UCL	335.2
95% Hall's Bootstrap UCL	336.1	95% Percentile Bootstrap UCL	335.2
90% Chebyshev(Mean, Sd) UCL	344.3	95% Chebyshev(Mean, Sd) UCL	353
97.5% Chebyshev(Mean, Sd) UCL	365.2	99% Chebyshev(Mean, Sd) UCL	389.1

Suggested UCL to Use

95% Student's-t UCL 335.7

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Manganese

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	51
		Number of Missing Observations	0
Minimum	0.122	Mean	0.515
Maximum	1.45	Median	0.438
SD	0.295	Std. Error of Mean	0.041
Coefficient of Variation	0.573	Skewness	1.035

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.911	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	6.3654E-4	Lilliefors GOF Test	
Lilliefors Test Statistic	0.16	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.141		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.584	95% Adjusted-CLT UCL (Chen-1995)	0.589
		95% Modified-t UCL (Johnson-1978)	0.585

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.37	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.756	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0925	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.124		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.259	k star (bias corrected MLE)	3.084
Theta hat (MLE)	0.158	Theta star (bias corrected MLE)	0.167
nu hat (MLE)	338.9	nu star (bias corrected)	320.7
MLE Mean (bias corrected)	0.515	MLE Sd (bias corrected)	0.293
		Approximate Chi Square Value (0.05)	280.2
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	279.1

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.589	95% Adjusted Gamma UCL	0.592

Lognormal GOF Test

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.476	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0768	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.104	Mean of logged Data	-0.825
Maximum of Logged Data	0.372	SD of logged Data	0.587

Assuming Lognormal Distribution

95% H-UCL	0.611	90% Chebyshev (MVUE) UCL	0.654
95% Chebyshev (MVUE) UCL	0.715	97.5% Chebyshev (MVUE) UCL	0.8
99% Chebyshev (MVUE) UCL	0.967		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.582	95% BCA Bootstrap UCL	0.59
95% Standard Bootstrap UCL	0.581	95% Bootstrap-t UCL	0.592
95% Hall's Bootstrap UCL	0.591	95% Percentile Bootstrap UCL	0.583
90% Chebyshev(Mean, Sd) UCL	0.638	95% Chebyshev(Mean, Sd) UCL	0.694
97.5% Chebyshev(Mean, Sd) UCL	0.771	99% Chebyshev(Mean, Sd) UCL	0.923

Suggested UCL to Use

95% Approximate Gamma UCL 0.589

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Mercury

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	51
		Number of Missing Observations	0
Minimum	0.0652	Mean	0.343
Maximum	0.873	Median	0.314
SD	0.161	Std. Error of Mean	0.0223
Coefficient of Variation	0.469	Skewness	1.375

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.895	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	9.9770E-5	Lilliefors GOF Test	
Lilliefors Test Statistic	0.142	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.141		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.38	95% Adjusted-CLT UCL (Chen-1995)	0.384
		95% Modified-t UCL (Johnson-1978)	0.381

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.499	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.753	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0854	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.123		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	5.163	k star (bias corrected MLE)	4.878
Theta hat (MLE)	0.0664	Theta star (bias corrected MLE)	0.0703
nu hat (MLE)	536.9	nu star (bias corrected)	507.3
MLE Mean (bias corrected)	0.343	MLE Sd (bias corrected)	0.155
		Approximate Chi Square Value (0.05)	456
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	454.7

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.381	95% Adjusted Gamma UCL	0.382

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.974	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	0.506	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0734	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.112		

Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Lognormal Statistics

Minimum of Logged Data	-2.73	Mean of logged Data	-1.171
Maximum of Logged Data	-0.136	SD of logged Data	0.458

Assuming Lognormal Distribution

95% H-UCL	0.388	90% Chebyshev (MVUE) UCL	0.412
95% Chebyshev (MVUE) UCL	0.443	97.5% Chebyshev (MVUE) UCL	0.486
99% Chebyshev (MVUE) UCL	0.571		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.379	95% BCA Bootstrap UCL	0.384
95% Standard Bootstrap UCL	0.379	95% Bootstrap-t UCL	0.387
95% Hall's Bootstrap UCL	0.387	95% Percentile Bootstrap UCL	0.379
90% Chebyshev(Mean, Sd) UCL	0.41	95% Chebyshev(Mean, Sd) UCL	0.44
97.5% Chebyshev(Mean, Sd) UCL	0.482	99% Chebyshev(Mean, Sd) UCL	0.565

Suggested UCL to Use

95% Approximate Gamma UCL 0.381

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methylmercury

General Statistics

Total Number of Observations	52	Number of Distinct Observations	49
		Number of Missing Observations	0
Minimum	63.6	Mean	236.7
Maximum	576	Median	217
SD	117.7	Std. Error of Mean	16.33
Coefficient of Variation	0.497	Skewness	0.625

Normal GOF Test

Shapiro Wilk Test Statistic	0.931
1% Shapiro Wilk P Value	0.0061
Lilliefors Test Statistic	0.107
1% Lilliefors Critical Value	0.141

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 264

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	265.1
95% Modified-t UCL (Johnson-1978)	264.3

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Gamma GOF Test

A-D Test Statistic	0.678	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.098	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.124	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.055	k star (bias corrected MLE)	3.834
Theta hat (MLE)	58.37	Theta star (bias corrected MLE)	61.74
nu hat (MLE)	421.7	nu star (bias corrected)	398.7
MLE Mean (bias corrected)	236.7	MLE Sd (bias corrected)	120.9
		Approximate Chi Square Value (0.05)	353.4
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	352.2

Assuming Gamma Distribution

95% Approximate Gamma UCL	267	95% Adjusted Gamma UCL	267.9
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.0758	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0959	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.153	Mean of logged Data	5.338
Maximum of Logged Data	6.356	SD of logged Data	0.525

Assuming Lognormal Distribution

95% H-UCL	274.5	90% Chebyshev (MVUE) UCL	293
95% Chebyshev (MVUE) UCL	317.9	97.5% Chebyshev (MVUE) UCL	352.4
99% Chebyshev (MVUE) UCL	420.1		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	263.6	95% BCA Bootstrap UCL	264.6
95% Standard Bootstrap UCL	263.2	95% Bootstrap-t UCL	266.1
95% Hall's Bootstrap UCL	265.7	95% Percentile Bootstrap UCL	263.4
90% Chebyshev(Mean, Sd) UCL	285.7	95% Chebyshev(Mean, Sd) UCL	307.9
97.5% Chebyshev(Mean, Sd) UCL	338.7	99% Chebyshev(Mean, Sd) UCL	399.2

Suggested UCL to Use

95% Student's-t UCL 264

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Molybdenum was not processed!

Nickel

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Nickel was not processed!

Phosphorus

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	1140	Mean	2554
Maximum	3420	Median	2550
SD	322.3	Std. Error of Mean	44.7
Coefficient of Variation	0.126	Skewness	-1.305

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.899	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	1.6173E-4	Lilliefors GOF Test	
Lilliefors Test Statistic	0.143	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.141		

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 2629

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 2619
95% Modified-t UCL (Johnson-1978) 2628

Gamma GOF Test

A-D Test Statistic 2.042
5% A-D Critical Value 0.748
K-S Test Statistic 0.172
5% K-S Critical Value 0.123

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 52.41
Theta hat (MLE) 48.73
nu hat (MLE) 5451
MLE Mean (bias corrected) 2554
Adjusted Level of Significance 0.0454

k star (bias corrected MLE) 49.4
Theta star (bias corrected MLE) 51.7
nu star (bias corrected) 5138
MLE Sd (bias corrected) 363.4
Approximate Chi Square Value (0.05) 4972
Adjusted Chi Square Value 4968

Assuming Gamma Distribution

95% Approximate Gamma UCL 2639

95% Adjusted Gamma UCL 2642

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.771
10% Shapiro Wilk P Value 2.487E-10
Lilliefors Test Statistic 0.189
10% Lilliefors Critical Value 0.112

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 7.039
Maximum of Logged Data 8.137

Mean of logged Data 7.836
SD of logged Data 0.149

Assuming Lognormal Distribution

95% H-UCL 2651
95% Chebyshev (MVUE) UCL 2789
99% Chebyshev (MVUE) UCL 3085

90% Chebyshev (MVUE) UCL 2716
97.5% Chebyshev (MVUE) UCL 2889

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 2628
95% Standard Bootstrap UCL 2626
95% Hall's Bootstrap UCL 2625
90% Chebyshev(Mean, Sd) UCL 2688

95% BCA Bootstrap UCL 2618
95% Bootstrap-t UCL 2623
95% Percentile Bootstrap UCL 2624
95% Chebyshev(Mean, Sd) UCL 2749

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

97.5% Chebyshev(Mean, Sd) UCL 2833

99% Chebyshev(Mean, Sd) UCL 2999

Suggested UCL to Use

95% Student's-t UCL 2629

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Potassium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	2030	Mean	4201
Maximum	4950	Median	4290
SD	435.9	Std. Error of Mean	60.45
Coefficient of Variation	0.104	Skewness	-2.682

Normal GOF Test

Shapiro Wilk Test Statistic	0.794
1% Shapiro Wilk P Value	2.5193E-9
Lilliefors Test Statistic	0.177
1% Lilliefors Critical Value	0.141

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 4303

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 4277

95% Modified-t UCL (Johnson-1978) 4299

Gamma GOF Test

A-D Test Statistic	3.704
5% A-D Critical Value	0.748
K-S Test Statistic	0.202
5% K-S Critical Value	0.123

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	73.08	k star (bias corrected MLE)	68.88
Theta hat (MLE)	57.49	Theta star (bias corrected MLE)	61
nu hat (MLE)	7600	nu star (bias corrected)	7163
MLE Mean (bias corrected)	4201	MLE Sd (bias corrected)	506.2
		Approximate Chi Square Value (0.05)	6967
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	6962

Assuming Gamma Distribution

95% Approximate Gamma UCL 4319

95% Adjusted Gamma UCL 4323

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.667
10% Shapiro Wilk P Value	2.265E-14
Lilliefors Test Statistic	0.214
10% Lilliefors Critical Value	0.112

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.616	Mean of logged Data	8.336
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UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Maximum of Logged Data 8.507 SD of logged Data 0.127

Assuming Lognormal Distribution

95% H-UCL	4336	90% Chebyshev (MVUE) UCL	4429
95% Chebyshev (MVUE) UCL	4530	97.5% Chebyshev (MVUE) UCL	4671
99% Chebyshev (MVUE) UCL	4947		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	4301	95% BCA Bootstrap UCL	4280
95% Standard Bootstrap UCL	4300	95% Bootstrap-t UCL	4284
95% Hall's Bootstrap UCL	4283	95% Percentile Bootstrap UCL	4293
90% Chebyshev(Mean, Sd) UCL	4383	95% Chebyshev(Mean, Sd) UCL	4465
97.5% Chebyshev(Mean, Sd) UCL	4579	99% Chebyshev(Mean, Sd) UCL	4803

Suggested UCL to Use

95% Student's-t UCL 4303

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Rubidium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	3.42	Mean	6.851
Maximum	12.7	Median	5.82
SD	2.491	Std. Error of Mean	0.345
Coefficient of Variation	0.364	Skewness	1.087

Normal GOF Test

Shapiro Wilk Test Statistic 0.809
 1% Shapiro Wilk P Value 1.1144E-8
 Lilliefors Test Statistic 0.261
 1% Lilliefors Critical Value 0.141

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 7.43

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 7.475
 95% Modified-t UCL (Johnson-1978) 7.439

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Gamma GOF Test

A-D Test Statistic	3.377
5% A-D Critical Value	0.751
K-S Test Statistic	0.225
5% K-S Critical Value	0.123

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.992	k star (bias corrected MLE)	8.486
Theta hat (MLE)	0.762	Theta star (bias corrected MLE)	0.807
nu hat (MLE)	935.2	nu star (bias corrected)	882.6
MLE Mean (bias corrected)	6.851	MLE Sd (bias corrected)	2.352
		Approximate Chi Square Value (0.05)	814.6
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	812.8

Assuming Gamma Distribution

95% Approximate Gamma UCL	7.423	95% Adjusted Gamma UCL	7.44
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.88
10% Shapiro Wilk P Value	2.0165E-5
Lilliefors Test Statistic	0.204
10% Lilliefors Critical Value	0.112

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.23	Mean of logged Data	1.868
Maximum of Logged Data	2.542	SD of logged Data	0.329

Assuming Lognormal Distribution

95% H-UCL	7.403	90% Chebyshev (MVUE) UCL	7.784
95% Chebyshev (MVUE) UCL	8.218	97.5% Chebyshev (MVUE) UCL	8.819
99% Chebyshev (MVUE) UCL	10		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	7.419	95% BCA Bootstrap UCL	7.489
95% Standard Bootstrap UCL	7.417	95% Bootstrap-t UCL	7.509
95% Hall's Bootstrap UCL	7.471	95% Percentile Bootstrap UCL	7.428
90% Chebyshev(Mean, Sd) UCL	7.888	95% Chebyshev(Mean, Sd) UCL	8.357
97.5% Chebyshev(Mean, Sd) UCL	9.008	99% Chebyshev(Mean, Sd) UCL	10.29

Suggested UCL to Use

95% Student's-t UCL 7.43

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	0.072	Mean	0.16
Maximum	0.206	Median	0.162
SD	0.0267	Std. Error of Mean	0.0037
Coefficient of Variation	0.167	Skewness	-0.959

Normal GOF Test			
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0.0273	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.121	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.141	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.166	95% Adjusted-CLT UCL (Chen-1995)	0.165
		95% Modified-t UCL (Johnson-1978)	0.166

Gamma GOF Test			
A-D Test Statistic	1.378	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.151	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.123	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	30.67	k star (bias corrected MLE)	28.92
Theta hat (MLE)	0.00521	Theta star (bias corrected MLE)	0.00553
nu hat (MLE)	3190	nu star (bias corrected)	3007
MLE Mean (bias corrected)	0.16	MLE Sd (bias corrected)	0.0297
		Approximate Chi Square Value (0.05)	2881
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	2877

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.167	95% Adjusted Gamma UCL	0.167

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.863	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	2.8874E-6	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.167	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.112	Data Not Lognormal at 10% Significance Level	

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.631	Mean of logged Data	-1.85
Maximum of Logged Data	-1.58	SD of logged Data	0.193

Assuming Lognormal Distribution

95% H-UCL	0.168	90% Chebyshev (MVUE) UCL	0.173
95% Chebyshev (MVUE) UCL	0.179	97.5% Chebyshev (MVUE) UCL	0.187
99% Chebyshev (MVUE) UCL	0.203		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.166	95% BCA Bootstrap UCL	0.165
95% Standard Bootstrap UCL	0.166	95% Bootstrap-t UCL	0.165
95% Hall's Bootstrap UCL	0.165	95% Percentile Bootstrap UCL	0.166
90% Chebyshev(Mean, Sd) UCL	0.171	95% Chebyshev(Mean, Sd) UCL	0.176
97.5% Chebyshev(Mean, Sd) UCL	0.183	99% Chebyshev(Mean, Sd) UCL	0.197

Suggested UCL to Use

95% Student's-t UCL 0.166

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Sodium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	124	Mean	300.8
Maximum	446	Median	301
SD	55.05	Std. Error of Mean	7.634
Coefficient of Variation	0.183	Skewness	0.111

Normal GOF Test

Shapiro Wilk Test Statistic	0.954
1% Shapiro Wilk P Value	0.0795
Lilliefors Test Statistic	0.119
1% Lilliefors Critical Value	0.141

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 313.6

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 313.5

95% Modified-t UCL (Johnson-1978) 313.6

Gamma GOF Test

A-D Test Statistic 0.847

5% A-D Critical Value 0.748

K-S Test Statistic 0.103

5% K-S Critical Value 0.123

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE) 28.25

Theta hat (MLE) 10.65

nu hat (MLE) 2938

MLE Mean (bias corrected) 300.8

Adjusted Level of Significance 0.0454

k star (bias corrected MLE) 26.63

Theta star (bias corrected MLE) 11.29

nu star (bias corrected) 2770

MLE Sd (bias corrected) 58.29

Approximate Chi Square Value (0.05) 2648

Adjusted Chi Square Value 2645

Assuming Gamma Distribution

95% Approximate Gamma UCL 314.6

95% Adjusted Gamma UCL 315

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.901

10% Shapiro Wilk P Value 1.9316E-4

Lilliefors Test Statistic 0.117

10% Lilliefors Critical Value 0.112

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 4.82

Maximum of Logged Data 6.1

Mean of logged Data 5.689

SD of logged Data 0.197

Assuming Lognormal Distribution

95% H-UCL 315.9

95% Chebyshev (MVUE) UCL 337.4

99% Chebyshev (MVUE) UCL 383.8

90% Chebyshev (MVUE) UCL 326.1

97.5% Chebyshev (MVUE) UCL 353.1

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 313.4

95% Standard Bootstrap UCL 313.3

95% Hall's Bootstrap UCL 314

90% Chebyshev(Mean, Sd) UCL 323.7

97.5% Chebyshev(Mean, Sd) UCL 348.5

95% BCA Bootstrap UCL 313.6

95% Bootstrap-t UCL 313.8

95% Percentile Bootstrap UCL 313.6

95% Chebyshev(Mean, Sd) UCL 334.1

99% Chebyshev(Mean, Sd) UCL 376.8

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Suggested UCL to Use

95% Student's-t UCL 313.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Strontium

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	49
		Number of Missing Observations	0
Minimum	0.036	Mean	0.288
Maximum	0.806	Median	0.229
SD	0.186	Std. Error of Mean	0.0258
Coefficient of Variation	0.646	Skewness	0.846

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.918	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0.00146	Lilliefors GOF Test	
Lilliefors Test Statistic	0.147	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.141		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.331	95% Adjusted-CLT UCL (Chen-1995)	0.333
		95% Modified-t UCL (Johnson-1978)	0.331

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.303	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.761	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0744	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.125		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	2.332	k star (bias corrected MLE)	2.21
Theta hat (MLE)	0.123	Theta star (bias corrected MLE)	0.13
nu hat (MLE)	242.5	nu star (bias corrected)	229.8
MLE Mean (bias corrected)	0.288	MLE Sd (bias corrected)	0.194
		Approximate Chi Square Value (0.05)	195.8
Adjusted Level of Significance	0.0454	Adjusted Chi Square Value	194.9

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.338	95% Adjusted Gamma UCL	0.339

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.964	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	0.214	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0895	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.112		

Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Lognormal Statistics

Minimum of Logged Data	-3.324	Mean of logged Data	-1.475
Maximum of Logged Data	-0.216	SD of logged Data	0.728

Assuming Lognormal Distribution

95% H-UCL	0.367	90% Chebyshev (MVUE) UCL	0.395
95% Chebyshev (MVUE) UCL	0.44	97.5% Chebyshev (MVUE) UCL	0.502
99% Chebyshev (MVUE) UCL	0.624		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.33	95% BCA Bootstrap UCL	0.331
95% Standard Bootstrap UCL	0.329	95% Bootstrap-t UCL	0.335
95% Hall's Bootstrap UCL	0.333	95% Percentile Bootstrap UCL	0.33
90% Chebyshev(Mean, Sd) UCL	0.365	95% Chebyshev(Mean, Sd) UCL	0.4
97.5% Chebyshev(Mean, Sd) UCL	0.449	99% Chebyshev(Mean, Sd) UCL	0.544

Suggested UCL to Use

95% Approximate Gamma UCL 0.338

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tellurium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	52
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tellurium was not processed!

Thallium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	8.2000E-4	Mean	0.0037
Maximum	0.0148	Median	0.00308
SD	0.00281	Std. Error of Mean	3.9002E-4

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Coefficient of Variation 0.759 Skewness 2.892

Normal GOF Test

Shapiro Wilk Test Statistic	0.656	Shapiro Wilk GOF Test
1% Shapiro Wilk P Value	9.104E-15	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.25	Lilliefors GOF Test
1% Lilliefors Critical Value	0.141	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.00436

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.00451
 95% Modified-t UCL (Johnson-1978) 0.00438

Gamma GOF Test

A-D Test Statistic	1.658	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.157	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.124	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.948	k star (bias corrected MLE)	2.79
Theta hat (MLE)	0.00126	Theta star (bias corrected MLE)	0.00133
nu hat (MLE)	306.6	nu star (bias corrected)	290.2
MLE Mean (bias corrected)	0.0037	MLE Sd (bias corrected)	0.00222
Adjusted Level of Significance	0.0454	Approximate Chi Square Value (0.05)	251.7
		Adjusted Chi Square Value	250.7

Assuming Gamma Distribution

95% Approximate Gamma UCL 0.00427 95% Adjusted Gamma UCL 0.00429

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.0278	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.123	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-7.106	Mean of logged Data	-5.777
Maximum of Logged Data	-4.213	SD of logged Data	0.571

Assuming Lognormal Distribution

95% H-UCL	0.00425	90% Chebyshev (MVUE) UCL	0.00455
95% Chebyshev (MVUE) UCL	0.00497	97.5% Chebyshev (MVUE) UCL	0.00554
99% Chebyshev (MVUE) UCL	0.00668		

Nonparametric Distribution Free UCL Statistics

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.00435	95% BCA Bootstrap UCL	0.00453
95% Standard Bootstrap UCL	0.00434	95% Bootstrap-t UCL	0.0047
95% Hall's Bootstrap UCL	0.00466	95% Percentile Bootstrap UCL	0.00438
90% Chebyshev(Mean, Sd) UCL	0.00487	95% Chebyshev(Mean, Sd) UCL	0.0054
97.5% Chebyshev(Mean, Sd) UCL	0.00614	99% Chebyshev(Mean, Sd) UCL	0.00759

Suggested UCL to Use

95% Student's-t UCL 0.00436

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tin

General Statistics

Total Number of Observations	52	Number of Distinct Observations	22
Number of Detects	32	Number of Non-Detects	20
Number of Distinct Detects	21	Number of Distinct Non-Detects	1
Minimum Detect	0.021	Minimum Non-Detect	0.02
Maximum Detect	0.078	Maximum Non-Detect	0.02
Variance Detects	1.9551E-4	Percent Non-Detects	38.46%
Mean Detects	0.0338	SD Detects	0.014
Median Detects	0.029	CV Detects	0.414
Skewness Detects	1.895	Kurtosis Detects	3.411
Mean of Logged Detects	-3.45	SD of Logged Detects	0.341

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.775	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.904	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.208	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.18	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0285	KM Standard Error of Mean	0.00179
90KM SD	0.0127	95% KM (BCA) UCL	0.0316
95% KM (t) UCL	0.0315	95% KM (Percentile Bootstrap) UCL	0.0315
95% KM (z) UCL	0.0314	95% KM Bootstrap t UCL	0.0325
90% KM Chebyshev UCL	0.0339	95% KM Chebyshev UCL	0.0363
97.5% KM Chebyshev UCL	0.0397	99% KM Chebyshev UCL	0.0463

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.453	Anderson-Darling GOF Test	
5% A-D Critical Value	0.747	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.171	Kolmogorov-Smirnov GOF	

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

5% K-S Critical Value 0.156 Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	8.04	k star (bias corrected MLE)	7.307
Theta hat (MLE)	0.00421	Theta star (bias corrected MLE)	0.00463
nu hat (MLE)	514.5	nu star (bias corrected)	467.6
Mean (detects)	0.0338		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.025
Maximum	0.078	Median	0.024
SD	0.0157	CV	0.627
k hat (MLE)	3.005	k star (bias corrected MLE)	2.844
Theta hat (MLE)	0.00832	Theta star (bias corrected MLE)	0.00879
nu hat (MLE)	312.5	nu star (bias corrected)	295.8
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (295.81, α)	257	Adjusted Chi Square Value (295.81, β)	255.9
95% Gamma Approximate UCL	0.0288	95% Gamma Adjusted UCL	0.0289

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0285	SD (KM)	0.0127
Variance (KM)	1.6171E-4	SE of Mean (KM)	0.00179
k hat (KM)	5.023	k star (KM)	4.746
nu hat (KM)	522.4	nu star (KM)	493.6
theta hat (KM)	0.00567	theta star (KM)	0.00601
80% gamma percentile (KM)	0.0385	90% gamma percentile (KM)	0.046
95% gamma percentile (KM)	0.0529	99% gamma percentile (KM)	0.0673

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (493.57, α)	443.1	Adjusted Chi Square Value (493.57, β)	441.7
95% KM Approximate Gamma UCL	0.0317	95% KM Adjusted Gamma UCL	0.0318

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.888	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.941	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.146	Lilliefors GOF Test
10% Lilliefors Critical Value	0.142	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0261	Mean in Log Scale	-3.782
SD in Original Scale	0.0148	SD in Log Scale	0.527
95% t UCL (assumes normality of ROS data)	0.0296	95% Percentile Bootstrap UCL	0.0296

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

95% BCA Bootstrap UCL	0.0299	95% Bootstrap t UCL	0.0303
95% H-UCL (Log ROS)	0.0301		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.628	KM Geo Mean	0.0266
KM SD (logged)	0.346	95% Critical H Value (KM-Log)	1.746
KM Standard Error of Mean (logged)	0.0488	95% H-UCL (KM -Log)	0.0307
KM SD (logged)	0.346	95% Critical H Value (KM-Log)	1.746
KM Standard Error of Mean (logged)	0.0488		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0247
SD in Original Scale	0.016
95% t UCL (Assumes normality)	0.0284

DL/2 Log-Transformed

Mean in Log Scale	-3.895
SD in Log Scale	0.627
95% H-Stat UCL	0.0294

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0315

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Uranium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	4
Number of Detects	4	Number of Non-Detects	48
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	4.2000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	4.7000E-4	Maximum Non-Detect	4.0000E-4
Variance Detects	6.000E-10	Percent Non-Detects	92.31%
Mean Detects	4.4000E-4	SD Detects	2.4495E-5
Median Detects	4.3500E-4	CV Detects	0.0557
Skewness Detects	0.544	Kurtosis Detects	-2.944
Mean of Logged Detects	-7.73	SD of Logged Detects	0.0553

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.862	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.687	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.293	Lilliefors GOF Test
1% Lilliefors Critical Value	0.413	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.0308E-4	KM Standard Error of Mean	1.9495E-6
90KM SD	1.2175E-5	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.0634E-4	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.0628E-4	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.0893E-4	95% KM Chebyshev UCL	4.1157E-4
97.5% KM Chebyshev UCL	4.1525E-4	99% KM Chebyshev UCL	4.2247E-4

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.444	Anderson-Darling GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.328	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	434.1	k star (bias corrected MLE)	108.7
Theta hat (MLE)	1.0136E-6	Theta star (bias corrected MLE)	4.0483E-6
nu hat (MLE)	3473	nu star (bias corrected)	869.5
Mean (detects)	4.4000E-4		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.2000E-4	Mean	0.00926
Maximum	0.01	Median	0.01
SD	0.00257	CV	0.278
k hat (MLE)	3.206	k star (bias corrected MLE)	3.034
Theta hat (MLE)	0.00289	Theta star (bias corrected MLE)	0.00305
nu hat (MLE)	333.4	nu star (bias corrected)	315.5
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (315.54, α)	275.4	Adjusted Chi Square Value (315.54, β)	274.3
95% Gamma Approximate UCL	0.0106	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.0308E-4	SD (KM)	1.2175E-5
Variance (KM)	1.482E-10	SE of Mean (KM)	1.9495E-6
k hat (KM)	1096	k star (KM)	1033
nu hat (KM)	113996	nu star (KM)	107420
theta hat (KM)	3.6773E-7	theta star (KM)	3.9024E-7
80% gamma percentile (KM)	4.1359E-4	90% gamma percentile (KM)	4.1923E-4
95% gamma percentile (KM)	4.2393E-4	99% gamma percentile (KM)	4.3283E-4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	106659	Adjusted Chi Square Value (N/A, β)	106638
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UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

95% KM Approximate Gamma UCL 4.0595E-4

95% KM Adjusted Gamma UCL 4.0604E-4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.86	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.792	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.294	Lilliefors GOF Test
10% Lilliefors Critical Value	0.346	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.1159E-4	Mean in Log Scale	-8.092
SD in Original Scale	6.0280E-5	SD in Log Scale	0.191
95% t UCL (assumes normality of ROS data)	3.2560E-4	95% Percentile Bootstrap UCL	3.2549E-4
95% BCA Bootstrap UCL	3.2561E-4	95% Bootstrap t UCL	3.2679E-4
95% H-UCL (Log ROS)	3.2638E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.817	KM Geo Mean	4.0291E-4
KM SD (logged)	0.0284	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00455	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0284	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00455		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.1846E-4	Mean in Log Scale	-8.457
SD in Original Scale	6.4849E-5	SD in Log Scale	0.212
95% t UCL (Assumes normality)	2.3353E-4	95% H-Stat UCL	2.2873E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 4.0634E-4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Vanadium

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	1
Number of Detects	1	Number of Non-Detects	51
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Vanadium was not processed!

Zinc

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	48
		Number of Missing Observations	0
Minimum	2.03	Mean	4.707
Maximum	8.81	Median	4.56
SD	1.145	Std. Error of Mean	0.159
Coefficient of Variation	0.243	Skewness	1.151

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.93	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0.0057	Lilliefors GOF Test	
Lilliefors Test Statistic	0.106	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.141		

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.973	95% Adjusted-CLT UCL (Chen-1995)	4.995
		95% Modified-t UCL (Johnson-1978)	4.977

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.63	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.749	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0837	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.123		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	18.36	k star (bias corrected MLE)	17.32
Theta hat (MLE)	0.256	Theta star (bias corrected MLE)	0.272
nu hat (MLE)	1910	nu star (bias corrected)	1801
MLE Mean (bias corrected)	4.707	MLE Sd (bias corrected)	1.131

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Adjusted Level of Significance	0.0454	Approximate Chi Square Value (0.05)	1704
		Adjusted Chi Square Value	1701

Assuming Gamma Distribution

95% Approximate Gamma UCL	4.976	95% Adjusted Gamma UCL	4.984
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.967	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.281	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0806	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.112	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.708	Mean of logged Data	1.521
Maximum of Logged Data	2.176	SD of logged Data	0.237

Assuming Lognormal Distribution

95% H-UCL	4.986	90% Chebyshev (MVUE) UCL	5.175
95% Chebyshev (MVUE) UCL	5.388	97.5% Chebyshev (MVUE) UCL	5.683
99% Chebyshev (MVUE) UCL	6.262		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	4.968	95% BCA Bootstrap UCL	4.986
95% Standard Bootstrap UCL	4.965	95% Bootstrap-t UCL	5.014
95% Hall's Bootstrap UCL	5.031	95% Percentile Bootstrap UCL	4.972
90% Chebyshev(Mean, Sd) UCL	5.183	95% Chebyshev(Mean, Sd) UCL	5.399
97.5% Chebyshev(Mean, Sd) UCL	5.698	99% Chebyshev(Mean, Sd) UCL	6.287

Suggested UCL to Use

95% Student's-t UCL 4.973

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

General Statistics

Total Number of Observations	52	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	50
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.05	Minimum Non-Detect	0.04

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Maximum Detect	0.065	Maximum Non-Detect	0.04
Variance Detects	1.1250E-4	Percent Non-Detects	96.15%
Mean Detects	0.0575	SD Detects	0.0106
Median Detects	0.0575	CV Detects	0.184
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-2.865	SD of Logged Detects	0.186

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0407	KM Standard Error of Mean	7.2029E-4
90KM SD	0.00367	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0419	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0419	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0428	95% KM Chebyshev UCL	0.0438
97.5% KM Chebyshev UCL	0.0452	99% KM Chebyshev UCL	0.0478

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	58.44	k star (bias corrected MLE)	N/A
Theta hat (MLE)	9.8387E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	233.8	nu star (bias corrected)	N/A
Mean (detects)	0.0575		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0407	SD (KM)	0.00367
Variance (KM)	1.3489E-5	SE of Mean (KM)	7.2029E-4
k hat (KM)	122.6	k star (KM)	115.6
nu hat (KM)	12754	nu star (KM)	12020
theta hat (KM)	3.3165E-4	theta star (KM)	3.5192E-4
80% gamma percentile (KM)	0.0438	90% gamma percentile (KM)	0.0456
95% gamma percentile (KM)	0.0471	99% gamma percentile (KM)	0.05

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	11766	Adjusted Level of Significance (β)	0.0454
95% KM Approximate Gamma UCL	0.0416	Adjusted Chi Square Value (N/A, β)	11759
		95% KM Adjusted Gamma UCL	0.0416

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples

Mean in Original Scale	0.0121	Mean in Log Scale	-4.801
SD in Original Scale	0.0122	SD in Log Scale	0.888
95% t UCL (assumes normality of ROS data)	0.0149	95% Percentile Bootstrap UCL	0.015
95% BCA Bootstrap UCL	0.0154	95% Bootstrap t UCL	0.016
95% H-UCL (Log ROS)	0.016		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.205	KM Geo Mean	0.0405
KM SD (logged)	0.0728	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0143	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0728	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0143		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0214
SD in Original Scale	0.00743
95% t UCL (Assumes normality)	0.0232

DL/2 Log-Transformed

Mean in Log Scale	-3.872
SD in Log Scale	0.205
95% H-Stat UCL	0.0223

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0419

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

User Selected Options

Date/Time of Computation ProUCL 5.2 2025-11-20 9:31:06 AM
 From File Walleye (28-52 cm) UCL Input.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	30	Number of Distinct Observations	25
Number of Detects	27	Number of Non-Detects	3
Number of Distinct Detects	25	Number of Distinct Non-Detects	1
Minimum Detect	0.4	Minimum Non-Detect	0.4
Maximum Detect	2.6	Maximum Non-Detect	0.4
Variance Detects	0.35	Percent Non-Detects	10%
Mean Detects	1.078	SD Detects	0.592
Median Detects	0.92	CV Detects	0.549
Skewness Detects	0.81	Kurtosis Detects	-0.065
Mean of Logged Detects	-0.0705	SD of Logged Detects	0.554

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.909	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.894	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.161	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.194	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.01	KM Standard Error of Mean	0.109
90KM SD	0.587	95% KM (BCA) UCL	1.192
95% KM (t) UCL	1.196	95% KM (Percentile Bootstrap) UCL	1.192
95% KM (z) UCL	1.19	95% KM Bootstrap t UCL	1.218
90% KM Chebyshev UCL	1.338	95% KM Chebyshev UCL	1.486
97.5% KM Chebyshev UCL	1.692	99% KM Chebyshev UCL	2.097

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.509	Anderson-Darling GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.111	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.169	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.597	k star (bias corrected MLE)	3.222
Theta hat (MLE)	0.3	Theta star (bias corrected MLE)	0.334
nu hat (MLE)	194.3	nu star (bias corrected)	174
Mean (detects)	1.078		

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.979
Maximum	2.6	Median	0.815
SD	0.637	CV	0.65
k hat (MLE)	1.644	k star (bias corrected MLE)	1.502
Theta hat (MLE)	0.595	Theta star (bias corrected MLE)	0.652
nu hat (MLE)	98.65	nu star (bias corrected)	90.12
Adjusted Level of Significance (β)	0.041		
Approximate Chi Square Value (90.12, α)	69.23	Adjusted Chi Square Value (90.12, β)	68.17
95% Gamma Approximate UCL	1.274	95% Gamma Adjusted UCL	1.294

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.01	SD (KM)	0.587
Variance (KM)	0.345	SE of Mean (KM)	0.109
k hat (KM)	2.958	k star (KM)	2.685
nu hat (KM)	177.5	nu star (KM)	161.1
theta hat (KM)	0.341	theta star (KM)	0.376
80% gamma percentile (KM)	1.46	90% gamma percentile (KM)	1.836
95% gamma percentile (KM)	2.189	99% gamma percentile (KM)	2.959

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (161.09, α)	132.7	Adjusted Chi Square Value (161.09, β)	131.3
95% KM Approximate Gamma UCL	1.226	95% KM Adjusted Gamma UCL	1.239

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.946	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.935	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0981	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.153	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.996	Mean in Log Scale	-0.2
SD in Original Scale	0.614	SD in Log Scale	0.659
95% t UCL (assumes normality of ROS data)	1.186	95% Percentile Bootstrap UCL	1.182
95% BCA Bootstrap UCL	1.192	95% Bootstrap t UCL	1.211
95% H-UCL (Log ROS)	1.314		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.155	KM Geo Mean	0.856
KM SD (logged)	0.575	95% Critical H Value (KM-Log)	2.015
KM Standard Error of Mean (logged)	0.107	95% H-UCL (KM -Log)	1.253
KM SD (logged)	0.575	95% Critical H Value (KM-Log)	2.015

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

KM Standard Error of Mean (logged) 0.107

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 0.99
SD in Original Scale 0.621
95% t UCL (Assumes normality) 1.183

DL/2 Log-Transformed

Mean in Log Scale -0.224
SD in Log Scale 0.704
95% H-Stat UCL 1.354

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 1.196

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Antimony

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	28
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0075	Minimum Non-Detect	0.002
Maximum Detect	0.0117	Maximum Non-Detect	0.002
Variance Detects	8.8200E-6	Percent Non-Detects	93.33%
Mean Detects	0.0096	SD Detects	0.00297
Median Detects	0.0096	CV Detects	0.309
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-4.671	SD of Logged Detects	0.314

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00251	KM Standard Error of Mean	5.0911E-4
90KM SD	0.00197	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00337	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00334	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00403	95% KM Chebyshev UCL	0.00473
97.5% KM Chebyshev UCL	0.00569	99% KM Chebyshev UCL	0.00757

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	20.56	k star (bias corrected MLE)	N/A
Theta hat (MLE)	4.6695E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	82.24	nu star (bias corrected)	N/A
Mean (detects)	0.0096		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00251	SD (KM)	0.00197
Variance (KM)	3.8880E-6	SE of Mean (KM)	5.0911E-4
k hat (KM)	1.616	k star (KM)	1.477
nu hat (KM)	96.97	nu star (KM)	88.6
theta hat (KM)	0.00155	theta star (KM)	0.0017
80% gamma percentile (KM)	0.00388	90% gamma percentile (KM)	0.00524
95% gamma percentile (KM)	0.00656	99% gamma percentile (KM)	0.00955

Gamma Kaplan-Meier (KM) Statistics

Adjusted Level of Significance (β) 0.041

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Approximate Chi Square Value (88.60, α)	67.9	Adjusted Chi Square Value (88.60, β)	66.86
95% KM Approximate Gamma UCL	0.00327	95% KM Adjusted Gamma UCL	0.00332

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00154	Mean in Log Scale	-7.333
SD in Original Scale	0.00247	SD in Log Scale	1.352
95% t UCL (assumes normality of ROS data)	0.00231	95% Percentile Bootstrap UCL	0.00233
95% BCA Bootstrap UCL	0.00258	95% Bootstrap t UCL	0.0032
95% H-UCL (Log ROS)	0.00342		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.112	KM Geo Mean	0.00222
KM SD (logged)	0.389	95% Critical H Value (KM-Log)	1.867
KM Standard Error of Mean (logged)	0.101	95% H-UCL (KM -Log)	0.00274
KM SD (logged)	0.389	95% Critical H Value (KM-Log)	1.867
KM Standard Error of Mean (logged)	0.101		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00157
SD in Original Scale	0.00225
95% t UCL (Assumes normality)	0.00227

DL/2 Log-Transformed

Mean in Log Scale	-6.759
SD in Log Scale	0.571
95% H-Stat UCL	0.00169

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	0.00337
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	30	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	0.0306	Mean	0.0841
Maximum	0.25	Median	0.0665
SD	0.0528	Std. Error of Mean	0.00964
Coefficient of Variation	0.628	Skewness	1.574

Normal GOF Test

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Shapiro Wilk Test Statistic	0.845	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.9	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.156	Lilliefors GOF Test
1% Lilliefors Critical Value	0.185	Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.1	95% Adjusted-CLT UCL (Chen-1995)	0.103
		95% Modified-t UCL (Johnson-1978)	0.101

Gamma GOF Test

A-D Test Statistic	0.485	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.103	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.161	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.19	k star (bias corrected MLE)	2.893
Theta hat (MLE)	0.0264	Theta star (bias corrected MLE)	0.0291
nu hat (MLE)	191.4	nu star (bias corrected)	173.6
MLE Mean (bias corrected)	0.0841	MLE Sd (bias corrected)	0.0494
		Approximate Chi Square Value (0.05)	144.1
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	142.6

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.101	95% Adjusted Gamma UCL	0.102
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.102	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.487	Mean of logged Data	-2.641
Maximum of Logged Data	-1.386	SD of logged Data	0.576

Assuming Lognormal Distribution

95% H-UCL	0.104	90% Chebyshev (MVUE) UCL	0.112
95% Chebyshev (MVUE) UCL	0.124	97.5% Chebyshev (MVUE) UCL	0.142
99% Chebyshev (MVUE) UCL	0.176		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

95% CLT UCL	0.1	95% BCA Bootstrap UCL	0.103
95% Standard Bootstrap UCL	0.0995	95% Bootstrap-t UCL	0.104
95% Hall's Bootstrap UCL	0.107	95% Percentile Bootstrap UCL	0.1
90% Chebyshev(Mean, Sd) UCL	0.113	95% Chebyshev(Mean, Sd) UCL	0.126
97.5% Chebyshev(Mean, Sd) UCL	0.144	99% Chebyshev(Mean, Sd) UCL	0.18

Suggested UCL to Use

95% Student's-t UCL 0.1

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Barium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	19
Number of Detects	26	Number of Non-Detects	4
Number of Distinct Detects	19	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.072	Maximum Non-Detect	0.01
Variance Detects	2.0009E-4	Percent Non-Detects	13.33%
Mean Detects	0.0236	SD Detects	0.0141
Median Detects	0.019	CV Detects	0.6
Skewness Detects	1.938	Kurtosis Detects	4.459
Mean of Logged Detects	-3.881	SD of Logged Detects	0.501

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.802	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.891	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.191	Lilliefors GOF Test
1% Lilliefors Critical Value	0.199	Detected Data appear Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0218	KM Standard Error of Mean	0.00255
90KM SD	0.0137	95% KM (BCA) UCL	0.0262
95% KM (t) UCL	0.0261	95% KM (Percentile Bootstrap) UCL	0.0261
95% KM (z) UCL	0.026	95% KM Bootstrap t UCL	0.0277
90% KM Chebyshev UCL	0.0294	95% KM Chebyshev UCL	0.0329
97.5% KM Chebyshev UCL	0.0377	99% KM Chebyshev UCL	0.0472

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.719	Anderson-Darling GOF Test
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.137	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.172	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.916	k star (bias corrected MLE)	3.49
Theta hat (MLE)	0.00602	Theta star (bias corrected MLE)	0.00676
nu hat (MLE)	203.6	nu star (bias corrected)	181.5
Mean (detects)	0.0236		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Minimum	0.01	Mean	0.0218
Maximum	0.072	Median	0.018
SD	0.0139	CV	0.641
k hat (MLE)	3.495	k star (bias corrected MLE)	3.168
Theta hat (MLE)	0.00623	Theta star (bias corrected MLE)	0.00687
nu hat (MLE)	209.7	nu star (bias corrected)	190.1
Adjusted Level of Significance (β)	0.041		
Approximate Chi Square Value (190.08, α)	159.2	Adjusted Chi Square Value (190.08, β)	157.6
95% Gamma Approximate UCL	0.026	95% Gamma Adjusted UCL	0.0263

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0218	SD (KM)	0.0137
Variance (KM)	1.8805E-4	SE of Mean (KM)	0.00255
k hat (KM)	2.52	k star (KM)	2.29
nu hat (KM)	151.2	nu star (KM)	137.4
theta hat (KM)	0.00864	theta star (KM)	0.00951
80% gamma percentile (KM)	0.0321	90% gamma percentile (KM)	0.041
95% gamma percentile (KM)	0.0495	99% gamma percentile (KM)	0.0681

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (137.39, α)	111.3	Adjusted Chi Square Value (137.39, β)	110
95% KM Approximate Gamma UCL	0.0269	95% KM Adjusted Gamma UCL	0.0272

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.933	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.104	Lilliefors GOF Test
10% Lilliefors Critical Value	0.156	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0213	Mean in Log Scale	-4.036
SD in Original Scale	0.0144	SD in Log Scale	0.62
95% t UCL (assumes normality of ROS data)	0.0258	95% Percentile Bootstrap UCL	0.0258
95% BCA Bootstrap UCL	0.0265	95% Bootstrap t UCL	0.0273
95% H-UCL (Log ROS)	0.0271		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.977	KM Geo Mean	0.0187
KM SD (logged)	0.52	95% Critical H Value (KM-Log)	1.968
KM Standard Error of Mean (logged)	0.0968	95% H-UCL (KM -Log)	0.0259
KM SD (logged)	0.52	95% Critical H Value (KM-Log)	1.968
KM Standard Error of Mean (logged)	0.0968		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0211	Mean in Log Scale	-4.07
SD in Original Scale	0.0146	SD in Log Scale	0.676
95% t UCL (Assumes normality)	0.0256	95% H-Stat UCL	0.028

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples
DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use
95% KM (t) UCL 0.0261

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Beryllium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Beryllium was not processed!

Bismuth

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	29
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Bismuth was not processed!

Boron

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Boron was not processed!

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Cadmium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	2
Number of Detects	3	Number of Non-Detects	27
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.001	Minimum Non-Detect	0.001
Maximum Detect	0.0014	Maximum Non-Detect	0.001
Variance Detects	5.3333E-8	Percent Non-Detects	90%
Mean Detects	0.00113	SD Detects	2.3094E-4
Median Detects	0.001	CV Detects	0.204
Skewness Detects	1.732	Kurtosis Detects	N/A
Mean of Logged Detects	-6.796	SD of Logged Detects	0.194

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.753	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors GOF Test
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00101	KM Standard Error of Mean	1.6055E-5
90KM SD	7.1802E-5	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00104	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00104	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00106	95% KM Chebyshev UCL	0.00108
97.5% KM Chebyshev UCL	0.00111	99% KM Chebyshev UCL	0.00117

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.619	Anderson-Darling GOF Test
5% A-D Critical Value	0.634	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.427	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.431	Detected data appear Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	38.61	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.9353E-5	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	231.7	nu star (bias corrected)	N/A
Mean (detects)	0.00113		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.001	Mean	0.00911
Maximum	0.01	Median	0.01
SD	0.00271	CV	0.297
k hat (MLE)	4.121	k star (bias corrected MLE)	3.731
Theta hat (MLE)	0.00221	Theta star (bias corrected MLE)	0.00244
nu hat (MLE)	247.3	nu star (bias corrected)	223.9
Adjusted Level of Significance (β)	0.041		
Approximate Chi Square Value (223.89, α)	190.3	Adjusted Chi Square Value (223.89, β)	188.5
95% Gamma Approximate UCL	0.0107	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00101	SD (KM)	7.1802E-5
Variance (KM)	5.1556E-9	SE of Mean (KM)	1.6055E-5
k hat (KM)	199.2	k star (KM)	179.3
nu hat (KM)	11950	nu star (KM)	10757
theta hat (KM)	5.0877E-6	theta star (KM)	5.6523E-6
80% gamma percentile (KM)	0.00108	90% gamma percentile (KM)	0.00111
95% gamma percentile (KM)	0.00114	99% gamma percentile (KM)	0.0012

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	10517	Adjusted Chi Square Value (N/A, β)	10503
95% KM Approximate Gamma UCL	0.00104	95% KM Adjusted Gamma UCL	0.00104

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.789	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors GOF Test
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.3587E-4	Mean in Log Scale	-7.937
SD in Original Scale	2.9741E-4	SD in Log Scale	0.64
95% t UCL (assumes normality of ROS data)	5.2814E-4	95% Percentile Bootstrap UCL	5.2702E-4
95% BCA Bootstrap UCL	5.3977E-4	95% Bootstrap t UCL	5.5536E-4
95% H-UCL (Log ROS)	5.6144E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.897	KM Geo Mean	0.00101
KM SD (logged)	0.0604	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0135	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0604	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0135		

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 5.6333E-4
 SD in Original Scale 2.0254E-4
 95% t UCL (Assumes normality) 6.2617E-4

DL/2 Log-Transformed

Mean in Log Scale -7.52
 SD in Log Scale 0.251
 95% H-Stat UCL 6.0764E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00104

When a data set follows an approximate distribution passing only one of the GOF tests,
 it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	91.6	Mean	191.3
Maximum	409	Median	168.5
SD	88.51	Std. Error of Mean	16.16
Coefficient of Variation	0.463	Skewness	0.727

Normal GOF Test

Shapiro Wilk Test Statistic 0.895
 1% Shapiro Wilk Critical Value 0.9
 Lilliefors Test Statistic 0.17
 1% Lilliefors Critical Value 0.185

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 218.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 220.2
 95% Modified-t UCL (Johnson-1978) 219.1

Gamma GOF Test

A-D Test Statistic 0.956
 5% A-D Critical Value 0.746
 K-S Test Statistic 0.18
 5% K-S Critical Value 0.16

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Gamma Statistics

k hat (MLE)	5.116	k star (bias corrected MLE)	4.627
Theta hat (MLE)	37.4	Theta star (bias corrected MLE)	41.35
nu hat (MLE)	307	nu star (bias corrected)	277.6
MLE Mean (bias corrected)	191.3	MLE Sd (bias corrected)	88.95
		Approximate Chi Square Value (0.05)	240
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	238

Assuming Gamma Distribution

95% Approximate Gamma UCL	221.3	95% Adjusted Gamma UCL	223.2
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.916	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.176	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.517	Mean of logged Data	5.153
Maximum of Logged Data	6.014	SD of logged Data	0.456

Assuming Lognormal Distribution

95% H-UCL	225.6	90% Chebyshev (MVUE) UCL	240.6
95% Chebyshev (MVUE) UCL	263	97.5% Chebyshev (MVUE) UCL	294.1
99% Chebyshev (MVUE) UCL	355.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	217.9	95% BCA Bootstrap UCL	219.8
95% Standard Bootstrap UCL	217.5	95% Bootstrap-t UCL	221.7
95% Hall's Bootstrap UCL	220.2	95% Percentile Bootstrap UCL	218.2
90% Chebyshev(Mean, Sd) UCL	239.8	95% Chebyshev(Mean, Sd) UCL	261.8
97.5% Chebyshev(Mean, Sd) UCL	292.2	99% Chebyshev(Mean, Sd) UCL	352.1

Suggested UCL to Use

95% Student's-t UCL	218.8
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Cesium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	0.0072	Mean	0.0285
Maximum	0.106	Median	0.0263
SD	0.0169	Std. Error of Mean	0.00309
Coefficient of Variation	0.593	Skewness	3.435

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.669	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.9		
Lilliefors Test Statistic	0.222	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.185	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0338	95% Adjusted-CLT UCL (Chen-1995)	0.0357
		95% Modified-t UCL (Johnson-1978)	0.0341

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.08	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.748		
K-S Test Statistic	0.144	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics			
k hat (MLE)	4.541	k star (bias corrected MLE)	4.109
Theta hat (MLE)	0.00628	Theta star (bias corrected MLE)	0.00694
nu hat (MLE)	272.4	nu star (bias corrected)	246.5
MLE Mean (bias corrected)	0.0285	MLE Sd (bias corrected)	0.0141
		Approximate Chi Square Value (0.05)	211.2
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	209.3

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0333	95% Adjusted Gamma UCL	0.0336

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.917	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.939		
Lilliefors Test Statistic	0.149	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.146	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Lognormal Statistics

Minimum of Logged Data	-4.934	Mean of logged Data	-3.671
Maximum of Logged Data	-2.244	SD of logged Data	0.472

Assuming Lognormal Distribution

95% H-UCL	0.0337	90% Chebyshev (MVUE) UCL	0.0359
95% Chebyshev (MVUE) UCL	0.0394	97.5% Chebyshev (MVUE) UCL	0.0442
99% Chebyshev (MVUE) UCL	0.0536		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0336	95% BCA Bootstrap UCL	0.0364
95% Standard Bootstrap UCL	0.0335	95% Bootstrap-t UCL	0.0378
95% Hall's Bootstrap UCL	0.0575	95% Percentile Bootstrap UCL	0.034
90% Chebyshev(Mean, Sd) UCL	0.0378	95% Chebyshev(Mean, Sd) UCL	0.042
97.5% Chebyshev(Mean, Sd) UCL	0.0478	99% Chebyshev(Mean, Sd) UCL	0.0593

Suggested UCL to Use

95% Adjusted Gamma UCL 0.0336

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	7
Number of Detects	14	Number of Non-Detects	16
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.03	Maximum Non-Detect	0.01
Variance Detects	5.0709E-5	Percent Non-Detects	53.33%
Mean Detects	0.0154	SD Detects	0.00712
Median Detects	0.012	CV Detects	0.464
Skewness Detects	1.497	Kurtosis Detects	0.855
Mean of Logged Detects	-4.255	SD of Logged Detects	0.389

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.708	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.825	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.344	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.263	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0125	KM Standard Error of Mean	0.00102
90KM SD	0.0054	95% KM (BCA) UCL	0.0142
95% KM (t) UCL	0.0142	95% KM (Percentile Bootstrap) UCL	0.0142
95% KM (z) UCL	0.0142	95% KM Bootstrap t UCL	0.0158
90% KM Chebyshev UCL	0.0156	95% KM Chebyshev UCL	0.017
97.5% KM Chebyshev UCL	0.0189	99% KM Chebyshev UCL	0.0227

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.625	Anderson-Darling GOF Test
5% A-D Critical Value	0.737	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.324	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.229	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	6.466	k star (bias corrected MLE)	5.128
Theta hat (MLE)	0.00238	Theta star (bias corrected MLE)	0.00299
nu hat (MLE)	181	nu star (bias corrected)	143.6
Mean (detects)	0.0154		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0125
Maximum	0.03	Median	0.01
SD	0.00549	CV	0.439
k hat (MLE)	8.502	k star (bias corrected MLE)	7.674
Theta hat (MLE)	0.00147	Theta star (bias corrected MLE)	0.00163
nu hat (MLE)	510.1	nu star (bias corrected)	460.4
Adjusted Level of Significance (β)	0.041		
Approximate Chi Square Value (460.45, α)	411.7	Adjusted Chi Square Value (460.45, β)	409
95% Gamma Approximate UCL	0.014	95% Gamma Adjusted UCL	0.0141

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0125	SD (KM)	0.0054
Variance (KM)	2.9117E-5	SE of Mean (KM)	0.00102
k hat (KM)	5.366	k star (KM)	4.852
nu hat (KM)	322	nu star (KM)	291.1
theta hat (KM)	0.00233	theta star (KM)	0.00258
80% gamma percentile (KM)	0.0169	90% gamma percentile (KM)	0.0201
95% gamma percentile (KM)	0.0231	99% gamma percentile (KM)	0.0293

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (291.12, α)	252.6	Adjusted Chi Square Value (291.12, β)	250.5
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UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

95% KM Approximate Gamma UCL 0.0144 95% KM Adjusted Gamma UCL 0.0145

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.771	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.895	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.309	Lilliefors GOF Test
10% Lilliefors Critical Value	0.208	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00986	Mean in Log Scale	-4.843
SD in Original Scale	0.00719	SD in Log Scale	0.678
95% t UCL (assumes normality of ROS data)	0.0121	95% Percentile Bootstrap UCL	0.0121
95% BCA Bootstrap UCL	0.0125	95% Bootstrap t UCL	0.0129
95% H-UCL (Log ROS)	0.0129		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.442	KM Geo Mean	0.0118
KM SD (logged)	0.31	95% Critical H Value (KM-Log)	1.814
KM Standard Error of Mean (logged)	0.0587	95% H-UCL (KM -Log)	0.0137
KM SD (logged)	0.31	95% Critical H Value (KM-Log)	1.814
KM Standard Error of Mean (logged)	0.0587		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00983	Mean in Log Scale	-4.812
SD in Original Scale	0.0071	SD in Log Scale	0.59
95% t UCL (Assumes normality)	0.012	95% H-Stat UCL	0.0121

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0142

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cobalt

General Statistics

Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cobalt was not processed!

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Copper

General Statistics

Total Number of Observations	30	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	0.11	Mean	0.168
Maximum	0.238	Median	0.17
SD	0.0349	Std. Error of Mean	0.00636
Coefficient of Variation	0.208	Skewness	0.177

Normal GOF Test

Shapiro Wilk Test Statistic	0.966
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.134
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.179

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	0.178
95% Modified-t UCL (Johnson-1978)	0.179

Gamma GOF Test

A-D Test Statistic	0.321
5% A-D Critical Value	0.744
K-S Test Statistic	0.123
5% K-S Critical Value	0.16

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	23.64	k star (bias corrected MLE)	21.3
Theta hat (MLE)	0.0071	Theta star (bias corrected MLE)	0.00788
nu hat (MLE)	1418	nu star (bias corrected)	1278
MLE Mean (bias corrected)	0.168	MLE Sd (bias corrected)	0.0364
		Approximate Chi Square Value (0.05)	1196
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	1191

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.179	95% Adjusted Gamma UCL	0.18
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.111
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.207	Mean of logged Data	-1.806
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UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Maximum of Logged Data -1.435 SD of logged Data 0.211

Assuming Lognormal Distribution

95% H-UCL	0.18	90% Chebyshev (MVUE) UCL	0.187
95% Chebyshev (MVUE) UCL	0.196	97.5% Chebyshev (MVUE) UCL	0.209
99% Chebyshev (MVUE) UCL	0.233		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.178	95% BCA Bootstrap UCL	0.178
95% Standard Bootstrap UCL	0.178	95% Bootstrap-t UCL	0.179
95% Hall's Bootstrap UCL	0.179	95% Percentile Bootstrap UCL	0.178
90% Chebyshev(Mean, Sd) UCL	0.187	95% Chebyshev(Mean, Sd) UCL	0.196
97.5% Chebyshev(Mean, Sd) UCL	0.208	99% Chebyshev(Mean, Sd) UCL	0.231

Suggested UCL to Use

95% Student's-t UCL 0.179

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Iron

General Statistics

Total Number of Observations	30	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	1.63	Mean	2.81
Maximum	5.12	Median	2.585
SD	0.781	Std. Error of Mean	0.143
Coefficient of Variation	0.278	Skewness	0.785

Normal GOF Test

Shapiro Wilk Test Statistic 0.944
 1% Shapiro Wilk Critical Value 0.9
 Lilliefors Test Statistic 0.139
 1% Lilliefors Critical Value 0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 3.052

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 3.066
 95% Modified-t UCL (Johnson-1978) 3.056

Gamma GOF Test

A-D Test Statistic 0.326

Anderson-Darling Gamma GOF Test

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.111	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	13.95	k star (bias corrected MLE)	12.58
Theta hat (MLE)	0.201	Theta star (bias corrected MLE)	0.223
nu hat (MLE)	837	nu star (bias corrected)	754.7
MLE Mean (bias corrected)	2.81	MLE Sd (bias corrected)	0.792
		Approximate Chi Square Value (0.05)	691.9
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	688.5

Assuming Gamma Distribution

95% Approximate Gamma UCL	3.065	95% Adjusted Gamma UCL	3.08
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0934	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.489	Mean of logged Data	0.997
Maximum of Logged Data	1.633	SD of logged Data	0.274

Assuming Lognormal Distribution

95% H-UCL	3.082	90% Chebyshev (MVUE) UCL	3.237
95% Chebyshev (MVUE) UCL	3.431	97.5% Chebyshev (MVUE) UCL	3.7
99% Chebyshev (MVUE) UCL	4.227		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	3.045	95% BCA Bootstrap UCL	3.065
95% Standard Bootstrap UCL	3.038	95% Bootstrap-t UCL	3.075
95% Hall's Bootstrap UCL	3.088	95% Percentile Bootstrap UCL	3.044
90% Chebyshev(Mean, Sd) UCL	3.238	95% Chebyshev(Mean, Sd) UCL	3.432
97.5% Chebyshev(Mean, Sd) UCL	3.701	99% Chebyshev(Mean, Sd) UCL	4.229

Suggested UCL to Use

95% Student's-t UCL 3.052

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Lead

General Statistics

Total Number of Observations	30	Number of Distinct Observations	9
Number of Detects	8	Number of Non-Detects	22
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.0043	Minimum Non-Detect	0.004
Maximum Detect	0.0483	Maximum Non-Detect	0.004
Variance Detects	3.0504E-4	Percent Non-Detects	73.33%
Mean Detects	0.0205	SD Detects	0.0175
Median Detects	0.0155	CV Detects	0.852
Skewness Detects	0.799	Kurtosis Detects	-0.953
Mean of Logged Detects	-4.267	SD of Logged Detects	0.979

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.854	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.749	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.22	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.333	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0084	KM Standard Error of Mean	0.00218
90KM SD	0.0112	95% KM (BCA) UCL	0.0121
95% KM (t) UCL	0.0121	95% KM (Percentile Bootstrap) UCL	0.012
95% KM (z) UCL	0.012	95% KM Bootstrap t UCL	0.0148
90% KM Chebyshev UCL	0.0149	95% KM Chebyshev UCL	0.0179
97.5% KM Chebyshev UCL	0.022	99% KM Chebyshev UCL	0.0301

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.407	Anderson-Darling GOF Test	
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.299	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	1.461	k star (bias corrected MLE)	0.996
Theta hat (MLE)	0.014	Theta star (bias corrected MLE)	0.0206
nu hat (MLE)	23.37	nu star (bias corrected)	15.94
Mean (detects)	0.0205		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0043	Mean	0.0128
Maximum	0.0483	Median	0.01
SD	0.00979	CV	0.765
k hat (MLE)	3.348	k star (bias corrected MLE)	3.035
Theta hat (MLE)	0.00382	Theta star (bias corrected MLE)	0.00422
nu hat (MLE)	200.9	nu star (bias corrected)	182.1
Adjusted Level of Significance (β)	0.041		
Approximate Chi Square Value (182.11, α)	151.9	Adjusted Chi Square Value (182.11, β)	150.3
95% Gamma Approximate UCL	0.0153	95% Gamma Adjusted UCL	0.0155

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0084	SD (KM)	0.0112
Variance (KM)	1.2442E-4	SE of Mean (KM)	0.00218
k hat (KM)	0.567	k star (KM)	0.533
nu hat (KM)	34.03	nu star (KM)	31.96
theta hat (KM)	0.0148	theta star (KM)	0.0158
80% gamma percentile (KM)	0.0138	90% gamma percentile (KM)	0.0224
95% gamma percentile (KM)	0.0315	99% gamma percentile (KM)	0.0538

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (31.96, α)	20.04	Adjusted Chi Square Value (31.96, β)	19.49
95% KM Approximate Gamma UCL	0.0134	95% KM Adjusted Gamma UCL	0.0138

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.851	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.21	Lilliefors GOF Test
10% Lilliefors Critical Value	0.265	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00601	Mean in Log Scale	-7.035
SD in Original Scale	0.0124	SD in Log Scale	2.202
95% t UCL (assumes normality of ROS data)	0.00985	95% Percentile Bootstrap UCL	0.01
95% BCA Bootstrap UCL	0.0111	95% Bootstrap t UCL	0.0135
95% H-UCL (Log ROS)	0.0567		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.187	KM Geo Mean	0.00559
KM SD (logged)	0.729	95% Critical H Value (KM-Log)	2.165
KM Standard Error of Mean (logged)	0.142	95% H-UCL (KM -Log)	0.00977
KM SD (logged)	0.729	95% Critical H Value (KM-Log)	2.165
KM Standard Error of Mean (logged)	0.142		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00693
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DL/2 Log-Transformed

Mean in Log Scale	-5.695
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UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

SD in Original Scale	0.012	SD in Log Scale	0.999
95% t UCL (Assumes normality)	0.0106	95% H-Stat UCL	0.00877

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0121

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Lithium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Lithium was not processed!

Magnesium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	257	Mean	305.4
Maximum	342	Median	308.5
SD	24.52	Std. Error of Mean	4.477
Coefficient of Variation	0.0803	Skewness	-0.261

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.948	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.9	Lilliefors GOF Test	
Lilliefors Test Statistic	0.119	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.185		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	313	95% Adjusted-CLT UCL (Chen-1995)	312.6
		95% Modified-t UCL (Johnson-1978)	313

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.498	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.745	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.118	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.16		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	157.6	k star (bias corrected MLE)	141.8
Theta hat (MLE)	1.938	Theta star (bias corrected MLE)	2.154
nu hat (MLE)	9454	nu star (bias corrected)	8510
MLE Mean (bias corrected)	305.4	MLE Sd (bias corrected)	25.65

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Adjusted Level of Significance	0.041	Approximate Chi Square Value (0.05)	8296
		Adjusted Chi Square Value	8284

Assuming Gamma Distribution

95% Approximate Gamma UCL	313.3	95% Adjusted Gamma UCL	313.7
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.112	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.549	Mean of logged Data	5.719
Maximum of Logged Data	5.835	SD of logged Data	0.0815

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	319.1
95% Chebyshev (MVUE) UCL	325.3	97.5% Chebyshev (MVUE) UCL	333.9
99% Chebyshev (MVUE) UCL	350.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	312.8	95% BCA Bootstrap UCL	312.4
95% Standard Bootstrap UCL	312.7	95% Bootstrap-t UCL	312.7
95% Hall's Bootstrap UCL	312.4	95% Percentile Bootstrap UCL	312.7
90% Chebyshev(Mean, Sd) UCL	318.9	95% Chebyshev(Mean, Sd) UCL	324.9
97.5% Chebyshev(Mean, Sd) UCL	333.4	99% Chebyshev(Mean, Sd) UCL	350

Suggested UCL to Use

95% Student's-t UCL 313

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Manganese

General Statistics

Total Number of Observations	30	Number of Distinct Observations	27
		Number of Missing Observations	0
Minimum	0.069	Mean	0.115

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Maximum	0.189	Median	0.113
SD	0.0312	Std. Error of Mean	0.0057
Coefficient of Variation	0.271	Skewness	0.613

Normal GOF Test

Shapiro Wilk Test Statistic	0.955
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.0947
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.125

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.125

95% Modified-t UCL (Johnson-1978) 0.125

Gamma GOF Test

A-D Test Statistic	0.181
5% A-D Critical Value	0.745
K-S Test Statistic	0.0699
5% K-S Critical Value	0.16

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	14.52
Theta hat (MLE)	0.00793
nu hat (MLE)	871.3
MLE Mean (bias corrected)	0.115
Adjusted Level of Significance	0.041

k star (bias corrected MLE)	13.09
Theta star (bias corrected MLE)	0.0088
nu star (bias corrected)	785.5
MLE Sd (bias corrected)	0.0318
Approximate Chi Square Value (0.05)	721.5
Adjusted Chi Square Value	717.9

Assuming Gamma Distribution

95% Approximate Gamma UCL 0.125

95% Adjusted Gamma UCL 0.126

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.0677
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.674
Maximum of Logged Data	-1.666

Mean of logged Data	-2.196
SD of logged Data	0.268

Assuming Lognormal Distribution

95% H-UCL	0.126
95% Chebyshev (MVUE) UCL	0.14
99% Chebyshev (MVUE) UCL	0.172

90% Chebyshev (MVUE) UCL	0.132
97.5% Chebyshev (MVUE) UCL	0.151

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.125	95% BCA Bootstrap UCL	0.125
95% Standard Bootstrap UCL	0.124	95% Bootstrap-t UCL	0.126
95% Hall's Bootstrap UCL	0.126	95% Percentile Bootstrap UCL	0.125
90% Chebyshev(Mean, Sd) UCL	0.132	95% Chebyshev(Mean, Sd) UCL	0.14
97.5% Chebyshev(Mean, Sd) UCL	0.151	99% Chebyshev(Mean, Sd) UCL	0.172

Suggested UCL to Use

95% Student's-t UCL 0.125

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	0.207	Mean	0.403
Maximum	0.857	Median	0.354
SD	0.164	Std. Error of Mean	0.0299
Coefficient of Variation	0.406	Skewness	1.529

Normal GOF Test

Shapiro Wilk Test Statistic	0.834
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.188
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.454

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.461

95% Modified-t UCL (Johnson-1978) 0.455

Gamma GOF Test

A-D Test Statistic	0.899
5% A-D Critical Value	0.746
K-S Test Statistic	0.141
5% K-S Critical Value	0.16

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

k hat (MLE)	7.769	k star (bias corrected MLE)	7.015
Theta hat (MLE)	0.0519	Theta star (bias corrected MLE)	0.0575
nu hat (MLE)	466.2	nu star (bias corrected)	420.9
MLE Mean (bias corrected)	0.403	MLE Sd (bias corrected)	0.152
		Approximate Chi Square Value (0.05)	374.3
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	371.8

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.454	95% Adjusted Gamma UCL	0.457
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.117
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.575	Mean of logged Data	-0.974
Maximum of Logged Data	-0.154	SD of logged Data	0.355

Assuming Lognormal Distribution

95% H-UCL	0.454	90% Chebyshev (MVUE) UCL	0.481
95% Chebyshev (MVUE) UCL	0.517	97.5% Chebyshev (MVUE) UCL	0.567
99% Chebyshev (MVUE) UCL	0.666		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.452	95% BCA Bootstrap UCL	0.46
95% Standard Bootstrap UCL	0.452	95% Bootstrap-t UCL	0.468
95% Hall's Bootstrap UCL	0.463	95% Percentile Bootstrap UCL	0.453
90% Chebyshev(Mean, Sd) UCL	0.493	95% Chebyshev(Mean, Sd) UCL	0.534
97.5% Chebyshev(Mean, Sd) UCL	0.59	99% Chebyshev(Mean, Sd) UCL	0.701

Suggested UCL to Use

95% Adjusted Gamma UCL	0.457
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Methylmercury

General Statistics

Total Number of Observations	30	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	86.5	Mean	256
Maximum	498	Median	244
SD	107.3	Std. Error of Mean	19.59
Coefficient of Variation	0.419	Skewness	0.483

Normal GOF Test

Shapiro Wilk Test Statistic	0.96
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.0961
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 289.3

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	290
95% Modified-t UCL (Johnson-1978)	289.5

Gamma GOF Test

A-D Test Statistic	0.209
5% A-D Critical Value	0.746
K-S Test Statistic	0.0831
5% K-S Critical Value	0.16

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.701	k star (bias corrected MLE)	5.153
Theta hat (MLE)	44.9	Theta star (bias corrected MLE)	49.68
nu hat (MLE)	342	nu star (bias corrected)	309.2
MLE Mean (bias corrected)	256	MLE Sd (bias corrected)	112.8
		Approximate Chi Square Value (0.05)	269.4
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	267.3

Assuming Gamma Distribution

95% Approximate Gamma UCL	293.7	95% Adjusted Gamma UCL	296.1
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.0849
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.46	Mean of logged Data	5.455
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UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Maximum of Logged Data 6.211 SD of logged Data 0.444

Assuming Lognormal Distribution

95% H-UCL	302	90% Chebyshev (MVUE) UCL	321.8
95% Chebyshev (MVUE) UCL	351.1	97.5% Chebyshev (MVUE) UCL	391.8
99% Chebyshev (MVUE) UCL	471.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	288.2	95% BCA Bootstrap UCL	290
95% Standard Bootstrap UCL	287.6	95% Bootstrap-t UCL	290.8
95% Hall's Bootstrap UCL	289.9	95% Percentile Bootstrap UCL	288.5
90% Chebyshev(Mean, Sd) UCL	314.7	95% Chebyshev(Mean, Sd) UCL	341.4
97.5% Chebyshev(Mean, Sd) UCL	378.3	99% Chebyshev(Mean, Sd) UCL	450.9

Suggested UCL to Use

95% Student's-t UCL 289.3

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics

Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Molybdenum was not processed!

Nickel

General Statistics

Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

The data set for variable Nickel was not processed!

Phosphorus

General Statistics

Total Number of Observations	30	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	2060	Mean	2486
Maximum	2940	Median	2455
SD	199.5	Std. Error of Mean	36.43
Coefficient of Variation	0.0803	Skewness	0.159

Normal GOF Test

Shapiro Wilk Test Statistic	0.981
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.125
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 2548

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 2547

95% Modified-t UCL (Johnson-1978) 2548

Gamma GOF Test

A-D Test Statistic	0.311
5% A-D Critical Value	0.745
K-S Test Statistic	0.114
5% K-S Critical Value	0.16

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	160.5	k star (bias corrected MLE)	144.5
Theta hat (MLE)	15.48	Theta star (bias corrected MLE)	17.2
nu hat (MLE)	9632	nu star (bias corrected)	8670
MLE Mean (bias corrected)	2486	MLE Sd (bias corrected)	206.8
		Approximate Chi Square Value (0.05)	8454
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	8442

Assuming Gamma Distribution

95% Approximate Gamma UCL 2549

95% Adjusted Gamma UCL 2553

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.981
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.109
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.63	Mean of logged Data	7.815
Maximum of Logged Data	7.986	SD of logged Data	0.0804

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	2595
95% Chebyshev (MVUE) UCL	2645	97.5% Chebyshev (MVUE) UCL	2714
99% Chebyshev (MVUE) UCL	2849		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	2546	95% BCA Bootstrap UCL	2546
95% Standard Bootstrap UCL	2545	95% Bootstrap-t UCL	2549
95% Hall's Bootstrap UCL	2549	95% Percentile Bootstrap UCL	2545
90% Chebyshev(Mean, Sd) UCL	2595	95% Chebyshev(Mean, Sd) UCL	2644
97.5% Chebyshev(Mean, Sd) UCL	2713	99% Chebyshev(Mean, Sd) UCL	2848

Suggested UCL to Use

95% Student's-t UCL 2548

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Potassium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	24
		Number of Missing Observations	0
Minimum	3920	Mean	4558
Maximum	4990	Median	4630
SD	266.9	Std. Error of Mean	48.72
Coefficient of Variation	0.0585	Skewness	-0.808

Normal GOF Test

Shapiro Wilk Test Statistic	0.923
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.149
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 4641

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 4630

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

95% Modified-t UCL (Johnson-1978) 4640

Gamma GOF Test

A-D Test Statistic 0.942
5% A-D Critical Value 0.745
K-S Test Statistic 0.155
5% K-S Critical Value 0.16

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	291.9	k star (bias corrected MLE)	262.7
Theta hat (MLE)	15.62	Theta star (bias corrected MLE)	17.35
nu hat (MLE)	17514	nu star (bias corrected)	15764
MLE Mean (bias corrected)	4558	MLE Sd (bias corrected)	281.2
		Approximate Chi Square Value (0.05)	15473
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	15456

Assuming Gamma Distribution

95% Approximate Gamma UCL 4644 95% Adjusted Gamma UCL 4649

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.911
10% Shapiro Wilk Critical Value 0.939
Lilliefors Test Statistic 0.154
10% Lilliefors Critical Value 0.146

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.274	Mean of logged Data	8.423
Maximum of Logged Data	8.515	SD of logged Data	0.0601

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4708
95% Chebyshev (MVUE) UCL	4776	97.5% Chebyshev (MVUE) UCL	4871
99% Chebyshev (MVUE) UCL	5056		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	4638	95% BCA Bootstrap UCL	4629
95% Standard Bootstrap UCL	4637	95% Bootstrap-t UCL	4634
95% Hall's Bootstrap UCL	4632	95% Percentile Bootstrap UCL	4635
90% Chebyshev(Mean, Sd) UCL	4704	95% Chebyshev(Mean, Sd) UCL	4770
97.5% Chebyshev(Mean, Sd) UCL	4862	99% Chebyshev(Mean, Sd) UCL	5043

Suggested UCL to Use

95% Student's-t UCL 4641

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Rubidium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	5.78	Mean	13.68
Maximum	25.2	Median	12.85
SD	4.663	Std. Error of Mean	0.851
Coefficient of Variation	0.341	Skewness	0.621

Normal GOF Test

Shapiro Wilk Test Statistic	0.961
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.108
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 15.13

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	15.19
95% Modified-t UCL (Johnson-1978)	15.15

Gamma GOF Test

A-D Test Statistic	0.198
5% A-D Critical Value	0.746
K-S Test Statistic	0.0779
5% K-S Critical Value	0.16

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.008	k star (bias corrected MLE)	8.129
Theta hat (MLE)	1.519	Theta star (bias corrected MLE)	1.683
nu hat (MLE)	540.5	nu star (bias corrected)	487.8
MLE Mean (bias corrected)	13.68	MLE Sd (bias corrected)	4.799
		Approximate Chi Square Value (0.05)	437.5
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	434.8

Assuming Gamma Distribution

95% Approximate Gamma UCL	15.25	95% Adjusted Gamma UCL	15.35
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.984
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.0885
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.754	Mean of logged Data	2.56
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UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Maximum of Logged Data 3.227 SD of logged Data 0.346

Assuming Lognormal Distribution

95% H-UCL	15.45	90% Chebyshev (MVUE) UCL	16.36
95% Chebyshev (MVUE) UCL	17.56	97.5% Chebyshev (MVUE) UCL	19.23
99% Chebyshev (MVUE) UCL	22.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	15.08	95% BCA Bootstrap UCL	15.18
95% Standard Bootstrap UCL	15.06	95% Bootstrap-t UCL	15.23
95% Hall's Bootstrap UCL	15.19	95% Percentile Bootstrap UCL	15.08
90% Chebyshev(Mean, Sd) UCL	16.24	95% Chebyshev(Mean, Sd) UCL	17.39
97.5% Chebyshev(Mean, Sd) UCL	19	99% Chebyshev(Mean, Sd) UCL	22.15

Suggested UCL to Use

95% Student's-t UCL 15.13

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	0.164	Mean	0.2
Maximum	0.246	Median	0.197
SD	0.0211	Std. Error of Mean	0.00384
Coefficient of Variation	0.105	Skewness	0.78

Normal GOF Test

Shapiro Wilk Test Statistic 0.929
 1% Shapiro Wilk Critical Value 0.9
 Lilliefors Test Statistic 0.146
 1% Lilliefors Critical Value 0.185

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.207

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.207

95% Modified-t UCL (Johnson-1978) 0.207

Gamma GOF Test

A-D Test Statistic 0.61

Anderson-Darling Gamma GOF Test

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.131	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	97.47	k star (bias corrected MLE)	87.75
Theta hat (MLE)	0.00206	Theta star (bias corrected MLE)	0.00228
nu hat (MLE)	5848	nu star (bias corrected)	5265
MLE Mean (bias corrected)	0.2	MLE Sd (bias corrected)	0.0214
Adjusted Level of Significance	0.041	Approximate Chi Square Value (0.05)	5097
		Adjusted Chi Square Value	5088

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.207	95% Adjusted Gamma UCL	0.207
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.951	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.808	Mean of logged Data	-1.613
Maximum of Logged Data	-1.402	SD of logged Data	0.102

Assuming Lognormal Distribution

95% H-UCL	0.207	90% Chebyshev (MVUE) UCL	0.212
95% Chebyshev (MVUE) UCL	0.217	97.5% Chebyshev (MVUE) UCL	0.224
99% Chebyshev (MVUE) UCL	0.238		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.207	95% BCA Bootstrap UCL	0.207
95% Standard Bootstrap UCL	0.207	95% Bootstrap-t UCL	0.208
95% Hall's Bootstrap UCL	0.207	95% Percentile Bootstrap UCL	0.207
90% Chebyshev(Mean, Sd) UCL	0.212	95% Chebyshev(Mean, Sd) UCL	0.217
97.5% Chebyshev(Mean, Sd) UCL	0.224	99% Chebyshev(Mean, Sd) UCL	0.239

Suggested UCL to Use

95% Student's-t UCL 0.207

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Sodium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	24
		Number of Missing Observations	0
Minimum	199	Mean	248.3
Maximum	303	Median	247
SD	24.47	Std. Error of Mean	4.468
Coefficient of Variation	0.0985	Skewness	0.166

Normal GOF Test

Shapiro Wilk Test Statistic	0.97	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.9	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.122	Lilliefors GOF Test
1% Lilliefors Critical Value	0.185	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	255.9	95% Adjusted-CLT UCL (Chen-1995)	255.8
		95% Modified-t UCL (Johnson-1978)	255.9

Gamma GOF Test

A-D Test Statistic	0.313	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	106.2	k star (bias corrected MLE)	95.63
Theta hat (MLE)	2.337	Theta star (bias corrected MLE)	2.596
nu hat (MLE)	6374	nu star (bias corrected)	5738
MLE Mean (bias corrected)	248.3	MLE Sd (bias corrected)	25.39
		Approximate Chi Square Value (0.05)	5563
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	5553

Assuming Gamma Distribution

95% Approximate Gamma UCL	256.1	95% Adjusted Gamma UCL	256.6
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.117	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Minimum of Logged Data	5.293	Mean of logged Data	5.51
Maximum of Logged Data	5.714	SD of logged Data	0.099

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	261.8
95% Chebyshev (MVUE) UCL	267.9	97.5% Chebyshev (MVUE) UCL	276.4
99% Chebyshev (MVUE) UCL	293		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	255.6	95% BCA Bootstrap UCL	255.6
95% Standard Bootstrap UCL	255.7	95% Bootstrap-t UCL	256.2
95% Hall's Bootstrap UCL	256.3	95% Percentile Bootstrap UCL	255.5
90% Chebyshev(Mean, Sd) UCL	261.7	95% Chebyshev(Mean, Sd) UCL	267.8
97.5% Chebyshev(Mean, Sd) UCL	276.2	99% Chebyshev(Mean, Sd) UCL	292.8

Suggested UCL to Use

95% Student's-t UCL 255.9

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Strontium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	0.014	Mean	0.0573
Maximum	0.133	Median	0.042
SD	0.0377	Std. Error of Mean	0.00689
Coefficient of Variation	0.658	Skewness	0.622

Normal GOF Test

Shapiro Wilk Test Statistic	0.887
1% Shapiro Wilk Critical Value	0.9
Lilliefors Test Statistic	0.177
1% Lilliefors Critical Value	0.185

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.069

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	0.0695
95% Modified-t UCL (Johnson-1978)	0.0692

Gamma GOF Test

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

A-D Test Statistic	0.729	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.139	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.162	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	2.324	k star (bias corrected MLE)	2.114
Theta hat (MLE)	0.0247	Theta star (bias corrected MLE)	0.0271
nu hat (MLE)	139.4	nu star (bias corrected)	126.8
MLE Mean (bias corrected)	0.0573	MLE Sd (bias corrected)	0.0394
		Approximate Chi Square Value (0.05)	101.8
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	100.5

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.0714	95% Adjusted Gamma UCL	0.0723
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.939	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.134	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.146	Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.269	Mean of logged Data	-3.089
Maximum of Logged Data	-2.017	SD of logged Data	0.711

Assuming Lognormal Distribution

95% H-UCL	0.0779	90% Chebyshev (MVUE) UCL	0.0825
95% Chebyshev (MVUE) UCL	0.0936	97.5% Chebyshev (MVUE) UCL	0.109
99% Chebyshev (MVUE) UCL	0.139		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0687	95% BCA Bootstrap UCL	0.0694
95% Standard Bootstrap UCL	0.0685	95% Bootstrap-t UCL	0.07
95% Hall's Bootstrap UCL	0.0691	95% Percentile Bootstrap UCL	0.0686
90% Chebyshev(Mean, Sd) UCL	0.078	95% Chebyshev(Mean, Sd) UCL	0.0874
97.5% Chebyshev(Mean, Sd) UCL	0.1	99% Chebyshev(Mean, Sd) UCL	0.126

Suggested UCL to Use

95% Student's-t UCL 0.069

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Tellurium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tellurium was not processed!

Thallium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	0.00111	Mean	0.00351
Maximum	0.00635	Median	0.00362
SD	0.00129	Std. Error of Mean	2.3617E-4
Coefficient of Variation	0.368	Skewness	0.06

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.98	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.9		
Lilliefors Test Statistic	0.0821	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.185	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.00392	95% Adjusted-CLT UCL (Chen-1995)	0.00391
		95% Modified-t UCL (Johnson-1978)	0.00392

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.4	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.746		
K-S Test Statistic	0.109	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	6.672	k star (bias corrected MLE)	6.027
Theta hat (MLE)	5.2670E-4	Theta star (bias corrected MLE)	5.8306E-4
nu hat (MLE)	400.3	nu star (bias corrected)	361.6

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

MLE Mean (bias corrected)	0.00351	MLE Sd (bias corrected)	0.00143
		Approximate Chi Square Value (0.05)	318.5
Adjusted Level of Significance	0.041	Adjusted Chi Square Value	316.2

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.00399	95% Adjusted Gamma UCL	0.00402
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.947
10% Shapiro Wilk Critical Value	0.939
Lilliefors Test Statistic	0.118
10% Lilliefors Critical Value	0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-6.803	Mean of logged Data	-5.728
Maximum of Logged Data	-5.059	SD of logged Data	0.42

Assuming Lognormal Distribution

95% H-UCL	0.00412	90% Chebyshev (MVUE) UCL	0.00438
95% Chebyshev (MVUE) UCL	0.00476	97.5% Chebyshev (MVUE) UCL	0.00529
99% Chebyshev (MVUE) UCL	0.00633		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0039	95% BCA Bootstrap UCL	0.0039
95% Standard Bootstrap UCL	0.0039	95% Bootstrap-t UCL	0.00392
95% Hall's Bootstrap UCL	0.00392	95% Percentile Bootstrap UCL	0.00391
90% Chebyshev(Mean, Sd) UCL	0.00422	95% Chebyshev(Mean, Sd) UCL	0.00454
97.5% Chebyshev(Mean, Sd) UCL	0.00499	99% Chebyshev(Mean, Sd) UCL	0.00586

Suggested UCL to Use

95% Student's-t UCL 0.00392

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

TIn

General Statistics

Total Number of Observations	30	Number of Distinct Observations	7
Number of Detects	10	Number of Non-Detects	20
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.02	Minimum Non-Detect	0.02
Maximum Detect	0.035	Maximum Non-Detect	0.02
Variance Detects	3.4011E-5	Percent Non-Detects	66.67%

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Mean Detects	0.0273	SD Detects	0.00583
Median Detects	0.028	CV Detects	0.214
Skewness Detects	0.0947	Kurtosis Detects	-1.617
Mean of Logged Detects	-3.622	SD of Logged Detects	0.217

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.781	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.17	Lilliefors GOF Test
1% Lilliefors Critical Value	0.304	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0224	KM Standard Error of Mean	9.0361E-4
90KM SD	0.0047	95% KM (BCA) UCL	0.0239
95% KM (t) UCL	0.024	95% KM (Percentile Bootstrap) UCL	0.0239
95% KM (z) UCL	0.0239	95% KM Bootstrap t UCL	0.0244
90% KM Chebyshev UCL	0.0251	95% KM Chebyshev UCL	0.0264
97.5% KM Chebyshev UCL	0.0281	99% KM Chebyshev UCL	0.0314

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.49	Anderson-Darling GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.177	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	24.01	k star (bias corrected MLE)	16.87
Theta hat (MLE)	0.00114	Theta star (bias corrected MLE)	0.00162
nu hat (MLE)	480.2	nu star (bias corrected)	337.5
Mean (detects)	0.0273		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0173
Maximum	0.035	Median	0.0147
SD	0.00824	CV	0.475
k hat (MLE)	5.227	k star (bias corrected MLE)	4.727
Theta hat (MLE)	0.00332	Theta star (bias corrected MLE)	0.00367
nu hat (MLE)	313.6	nu star (bias corrected)	283.6
Adjusted Level of Significance (β)	0.041		
Approximate Chi Square Value (283.61, α)	245.6	Adjusted Chi Square Value (283.61, β)	243.6
95% Gamma Approximate UCL	0.02	95% Gamma Adjusted UCL	0.0202

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0224	SD (KM)	0.0047
Variance (KM)	2.2046E-5	SE of Mean (KM)	9.0361E-4
k hat (KM)	22.83	k star (KM)	20.57
nu hat (KM)	1370	nu star (KM)	1234
theta hat (KM)	9.8271E-4	theta star (KM)	0.00109
80% gamma percentile (KM)	0.0265	90% gamma percentile (KM)	0.029
95% gamma percentile (KM)	0.0311	99% gamma percentile (KM)	0.0355

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1153	Adjusted Chi Square Value (N/A, β)	1149
95% KM Approximate Gamma UCL	0.024	95% KM Adjusted Gamma UCL	0.0241

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.891	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.869	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.184	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.241	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.018	Mean in Log Scale	-4.111
SD in Original Scale	0.00799	SD in Log Scale	0.44
95% t UCL (assumes normality of ROS data)	0.0205	95% Percentile Bootstrap UCL	0.0204
95% BCA Bootstrap UCL	0.0206	95% Bootstrap t UCL	0.0208
95% H-UCL (Log ROS)	0.0211		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.815	KM Geo Mean	0.022
KM SD (logged)	0.181	95% Critical H Value (KM-Log)	1.745
KM Standard Error of Mean (logged)	0.0349	95% H-UCL (KM -Log)	0.0238
KM SD (logged)	0.181	95% Critical H Value (KM-Log)	1.745
KM Standard Error of Mean (logged)	0.0349		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0158	Mean in Log Scale	-4.277
SD in Original Scale	0.00891	SD in Log Scale	0.487
95% t UCL (Assumes normality)	0.0185	95% H-Stat UCL	0.0186

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.024

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Uranium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Uranium was not processed!

Vanadium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	30
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Vanadium was not processed!

Zinc

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	24
		Number of Missing Observations	0
Minimum	3.06	Mean	3.568
Maximum	4.39	Median	3.545
SD	0.338	Std. Error of Mean	0.0616
Coefficient of Variation	0.0946	Skewness	0.456

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.9	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0952	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.185	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

95% Normal UCL

95% Student's-t UCL 3.673

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 3.675
 95% Modified-t UCL (Johnson-1978) 3.674

Gamma GOF Test

A-D Test Statistic 0.318
 5% A-D Critical Value 0.745
 K-S Test Statistic 0.0991
 5% K-S Critical Value 0.16

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 117.7
 Theta hat (MLE) 0.0303
 nu hat (MLE) 7061
 MLE Mean (bias corrected) 3.568
 Adjusted Level of Significance 0.041

k star (bias corrected MLE) 105.9
 Theta star (bias corrected MLE) 0.0337
 nu star (bias corrected) 6356
 MLE Sd (bias corrected) 0.347
 Approximate Chi Square Value (0.05) 6172
 Adjusted Chi Square Value 6162

Assuming Gamma Distribution

95% Approximate Gamma UCL 3.675

95% Adjusted Gamma UCL 3.681

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.965
 10% Shapiro Wilk Critical Value 0.939
 Lilliefors Test Statistic 0.0948
 10% Lilliefors Critical Value 0.146

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 1.118
 Maximum of Logged Data 1.479

Mean of logged Data 1.268
 SD of logged Data 0.0935

Assuming Lognormal Distribution

95% H-UCL N/A
 95% Chebyshev (MVUE) UCL 3.834
 99% Chebyshev (MVUE) UCL 4.175

90% Chebyshev (MVUE) UCL 3.751
 97.5% Chebyshev (MVUE) UCL 3.949

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 3.67
 95% Standard Bootstrap UCL 3.668
 95% Hall's Bootstrap UCL 3.677
 90% Chebyshev(Mean, Sd) UCL 3.753
 97.5% Chebyshev(Mean, Sd) UCL 3.953

95% BCA Bootstrap UCL 3.674
 95% Bootstrap-t UCL 3.679
 95% Percentile Bootstrap UCL 3.671
 95% Chebyshev(Mean, Sd) UCL 3.837
 99% Chebyshev(Mean, Sd) UCL 4.181

Suggested UCL to Use

UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples

95% Student's-t UCL 3.673

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

General Statistics			
Total Number of Observations	30	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	29
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!

It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Zirconium was not processed!

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

User Selected Options

Date/Time of Computation ProUCL 5.2 2025-11-20 9:56:03 AM
 From File Forage Fish (large) UCL Input.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 10000

Aluminum

General Statistics

Total Number of Observations	46	Number of Distinct Observations	32
Number of Detects	33	Number of Non-Detects	13
Number of Distinct Detects	31	Number of Distinct Non-Detects	1
Minimum Detect	0.45	Minimum Non-Detect	0.4
Maximum Detect	22	Maximum Non-Detect	0.4
Variance Detects	13.97	Percent Non-Detects	28.26%
Mean Detects	2.015	SD Detects	3.738
Median Detects	1.09	CV Detects	1.854
Skewness Detects	5.099	Kurtosis Detects	27.56
Mean of Logged Detects	0.23	SD of Logged Detects	0.773

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.368	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.906	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.367	Lilliefors GOF Test
1% Lilliefors Critical Value	0.177	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.559	KM Standard Error of Mean	0.479
90KM SD	3.201	95% KM (BCA) UCL	2.549
95% KM (t) UCL	2.364	95% KM (Percentile Bootstrap) UCL	2.449
95% KM (z) UCL	2.347	95% KM Bootstrap t UCL	4.394
90% KM Chebyshev UCL	2.997	95% KM Chebyshev UCL	3.648
97.5% KM Chebyshev UCL	4.552	99% KM Chebyshev UCL	6.328

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.127	Anderson-Darling GOF Test
5% A-D Critical Value	0.771	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.157	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.202	k star (bias corrected MLE)	1.113
Theta hat (MLE)	1.677	Theta star (bias corrected MLE)	1.811
nu hat (MLE)	79.33	nu star (bias corrected)	73.45
Mean (detects)	2.015		

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.449
Maximum	22	Median	0.93
SD	3.281	CV	2.265
k hat (MLE)	0.431	k star (bias corrected MLE)	0.418
Theta hat (MLE)	3.358	Theta star (bias corrected MLE)	3.468
nu hat (MLE)	39.69	nu star (bias corrected)	38.44
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (38.44, α)	25.24	Adjusted Chi Square Value (38.44, β)	24.89
95% Gamma Approximate UCL	2.206	95% Gamma Adjusted UCL	2.237

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.559	SD (KM)	3.201
Variance (KM)	10.25	SE of Mean (KM)	0.479
k hat (KM)	0.237	k star (KM)	0.236
nu hat (KM)	21.82	nu star (KM)	21.73
theta hat (KM)	6.573	theta star (KM)	6.6
80% gamma percentile (KM)	2.216	90% gamma percentile (KM)	4.696
95% gamma percentile (KM)	7.673	99% gamma percentile (KM)	15.66

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (21.73, α)	12.14	Adjusted Chi Square Value (21.73, β)	11.9
95% KM Approximate Gamma UCL	2.791	95% KM Adjusted Gamma UCL	2.846

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.866	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.942	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.16	Lilliefors GOF Test
10% Lilliefors Critical Value	0.139	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.512	Mean in Log Scale	-0.271
SD in Original Scale	3.255	SD in Log Scale	1.066
95% t UCL (assumes normality of ROS data)	2.318	95% Percentile Bootstrap UCL	2.416
95% BCA Bootstrap UCL	2.975	95% Bootstrap t UCL	4.239
95% H-UCL (Log ROS)	1.97		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.0937	KM Geo Mean	0.911
KM SD (logged)	0.826	95% Critical H Value (KM-Log)	2.152
KM Standard Error of Mean (logged)	0.124	95% H-UCL (KM -Log)	1.67
KM SD (logged)	0.826	95% Critical H Value (KM-Log)	2.152

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

KM Standard Error of Mean (logged) 0.124

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.502	Mean in Log Scale	-0.29
SD in Original Scale	3.258	SD in Log Scale	1.061
95% t UCL (Assumes normality)	2.309	95% H-Stat UCL	1.92

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 2.364

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Antimony

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	43
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.0023	Minimum Non-Detect	0.002
Maximum Detect	0.007	Maximum Non-Detect	0.002
Variance Detects	5.7633E-6	Percent Non-Detects	93.48%
Mean Detects	0.00493	SD Detects	0.0024
Median Detects	0.0055	CV Detects	0.487
Skewness Detects	-1.003	Kurtosis Detects	N/A
Mean of Logged Detects	-5.413	SD of Logged Detects	0.586

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.26	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00219	KM Standard Error of Mean	1.5899E-4
90KM SD	8.8042E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00246	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00245	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00267	95% KM Chebyshev UCL	0.00288
97.5% KM Chebyshev UCL	0.00318	99% KM Chebyshev UCL	0.00377

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.357	Anderson-Darling GOF Test	
5% A-D Critical Value	0.637	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.321	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.433	Detected data appear Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.087	k star (bias corrected MLE)	N/A
Theta hat (MLE)	9.6974E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	30.52	nu star (bias corrected)	N/A
Mean (detects)	0.00493		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0023	Mean	0.00967
Maximum	0.01	Median	0.01
SD	0.00136	CV	0.141
k hat (MLE)	26.35	k star (bias corrected MLE)	24.64
Theta hat (MLE)	3.6702E-4	Theta star (bias corrected MLE)	3.9239E-4
nu hat (MLE)	2424	nu star (bias corrected)	2267
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (N/A, α)	2158	Adjusted Chi Square Value (N/A, β)	2154
95% Gamma Approximate UCL	0.0102	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00219	SD (KM)	8.8042E-4
Variance (KM)	7.7514E-7	SE of Mean (KM)	1.5899E-4
k hat (KM)	6.195	k star (KM)	5.805
nu hat (KM)	569.9	nu star (KM)	534.1
theta hat (KM)	3.5374E-4	theta star (KM)	3.7747E-4
80% gamma percentile (KM)	0.0029	90% gamma percentile (KM)	0.00341
95% gamma percentile (KM)	0.00387	99% gamma percentile (KM)	0.00484

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (534.08, α)	481.5	Adjusted Chi Square Value (534.08, β)	479.9
95% KM Approximate Gamma UCL	0.00243	95% KM Adjusted Gamma UCL	0.00244

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.789	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.307	Lilliefors GOF Test
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.0686E-4	Mean in Log Scale	-9.501
SD in Original Scale	0.00132	SD in Log Scale	2.081
95% t UCL (assumes normality of ROS data)	8.3410E-4	95% Percentile Bootstrap UCL	8.5734E-4
95% BCA Bootstrap UCL	9.8124E-4	95% Bootstrap t UCL	0.00144
95% H-UCL (Log ROS)	0.00205		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.162	KM Geo Mean	0.00211
KM SD (logged)	0.233	95% Critical H Value (KM-Log)	1.78
KM Standard Error of Mean (logged)	0.042	95% H-UCL (KM -Log)	0.0023
KM SD (logged)	0.233	95% Critical H Value (KM-Log)	1.78
KM Standard Error of Mean (logged)	0.042		

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 0.00126
SD in Original Scale 0.0011
95% t UCL (Assumes normality) 0.00153

DL/2 Log-Transformed

Mean in Log Scale -6.81
SD in Log Scale 0.393
95% H-Stat UCL 0.00132

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00246

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Arsenic

General Statistics

Total Number of Observations	46	Number of Distinct Observations	46
		Number of Missing Observations	0
Minimum	0.028	Mean	0.112
Maximum	0.288	Median	0.103
SD	0.0586	Std. Error of Mean	0.00863
Coefficient of Variation	0.523	Skewness	0.933

Normal GOF Test

Shapiro Wilk Test Statistic	0.937
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.104
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.126

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.127

95% Modified-t UCL (Johnson-1978) 0.127

Gamma GOF Test

A-D Test Statistic	0.132
5% A-D Critical Value	0.754
K-S Test Statistic	0.0696
5% K-S Critical Value	0.131

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.777	k star (bias corrected MLE)	3.545
Theta hat (MLE)	0.0296	Theta star (bias corrected MLE)	0.0316
nu hat (MLE)	347.4	nu star (bias corrected)	326.1
MLE Mean (bias corrected)	0.112	MLE Sd (bias corrected)	0.0595
		Approximate Chi Square Value (0.05)	285.3
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	284

Assuming Gamma Distribution

95% Approximate Gamma UCL 0.128

95% Adjusted Gamma UCL 0.129

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.0782
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.576	Mean of logged Data	-2.328
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum of Logged Data -1.245 SD of logged Data 0.548

Assuming Lognormal Distribution

95% H-UCL	0.133	90% Chebyshev (MVUE) UCL	0.142
95% Chebyshev (MVUE) UCL	0.155	97.5% Chebyshev (MVUE) UCL	0.173
99% Chebyshev (MVUE) UCL	0.209		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.126	95% BCA Bootstrap UCL	0.127
95% Standard Bootstrap UCL	0.126	95% Bootstrap-t UCL	0.128
95% Hall's Bootstrap UCL	0.128	95% Percentile Bootstrap UCL	0.126
90% Chebyshev(Mean, Sd) UCL	0.138	95% Chebyshev(Mean, Sd) UCL	0.15
97.5% Chebyshev(Mean, Sd) UCL	0.166	99% Chebyshev(Mean, Sd) UCL	0.198

Suggested UCL to Use

95% Student's-t UCL 0.126

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	31
Number of Detects	45	Number of Non-Detects	1
Number of Distinct Detects	30	Number of Distinct Non-Detects	1
Minimum Detect	0.012	Minimum Non-Detect	0.01
Maximum Detect	0.123	Maximum Non-Detect	0.01
Variance Detects	3.5239E-4	Percent Non-Detects	2.174%
Mean Detects	0.034	SD Detects	0.0188
Median Detects	0.03	CV Detects	0.552
Skewness Detects	2.57	Kurtosis Detects	10.66
Mean of Logged Detects	-3.499	SD of Logged Detects	0.48

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.805	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.157	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meler (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0335	KM Standard Error of Mean	0.00279
90KM SD	0.0187	95% KM (BCA) UCL	0.0384
95% KM (t) UCL	0.0381	95% KM (Percentile Bootstrap) UCL	0.0383

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% KM (z) UCL	0.038	95% KM Bootstrap t UCL	0.0397
90% KM Chebyshev UCL	0.0418	95% KM Chebyshev UCL	0.0456
97.5% KM Chebyshev UCL	0.0509	99% KM Chebyshev UCL	0.0612

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.353	Anderson-Darling GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.09	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.45	k star (bias corrected MLE)	4.168
Theta hat (MLE)	0.00764	Theta star (bias corrected MLE)	0.00815
nu hat (MLE)	400.5	nu star (bias corrected)	375.1
Mean (detects)	0.034		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0335
Maximum	0.123	Median	0.03
SD	0.0189	CV	0.565
k hat (MLE)	4.155	k star (bias corrected MLE)	3.898
Theta hat (MLE)	0.00805	Theta star (bias corrected MLE)	0.00858
nu hat (MLE)	382.2	nu star (bias corrected)	358.6
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (358.63, α)	315.7	Adjusted Chi Square Value (358.63, β)	314.4
95% Gamma Approximate UCL	0.038	95% Gamma Adjusted UCL	0.0382

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0335	SD (KM)	0.0187
Variance (KM)	3.4929E-4	SE of Mean (KM)	0.00279
k hat (KM)	3.205	k star (KM)	3.01
nu hat (KM)	294.8	nu star (KM)	276.9
theta hat (KM)	0.0104	theta star (KM)	0.0111
80% gamma percentile (KM)	0.0477	90% gamma percentile (KM)	0.0593
95% gamma percentile (KM)	0.0701	99% gamma percentile (KM)	0.0936

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (276.93, α)	239.4	Adjusted Chi Square Value (276.93, β)	238.3
95% KM Approximate Gamma UCL	0.0387	95% KM Adjusted Gamma UCL	0.0389

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.953	Detected Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Lilliefors Test Statistic	0.0733	Lilliefors GOF Test
10% Lilliefors Critical Value	0.12	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0334	Mean in Log Scale	-3.525
SD in Original Scale	0.0189	SD in Log Scale	0.508
95% t UCL (assumes normality of ROS data)	0.0381	95% Percentile Bootstrap UCL	0.0383
95% BCA Bootstrap UCL	0.0391	95% Bootstrap t UCL	0.0397
95% H-UCL (Log ROS)	0.0386		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.523	KM Geo Mean	0.0295
KM SD (logged)	0.496	95% Critical H Value (KM-Log)	1.881
KM Standard Error of Mean (logged)	0.074	95% H-UCL (KM -Log)	0.0384
KM SD (logged)	0.496	95% Critical H Value (KM-Log)	1.881
KM Standard Error of Mean (logged)	0.074		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0333
SD in Original Scale	0.019
95% t UCL (Assumes normality)	0.0381

DL/2 Log-Transformed

Mean in Log Scale	-3.538
SD in Log Scale	0.543
95% H-Stat UCL	0.0394

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	0.0389	95% GROS Adjusted Gamma UCL	0.0382
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Beryllium

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	46
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Beryllium was not processed!

Bismuth

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	45
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Bismuth was not processed!

Boron

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	46
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Boron was not processed!

Cadmium

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	2
Number of Detects	2	Number of Non-Detects	44
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.001	Minimum Non-Detect	0.001
Maximum Detect	0.0011	Maximum Non-Detect	0.001

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Variance Detects	5.0000E-9	Percent Non-Detects	95.65%
Mean Detects	0.00105	SD Detects	7.0711E-5
Median Detects	0.00105	CV Detects	0.0673
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-6.86	SD of Logged Detects	0.0674

**Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.001	KM Standard Error of Mean	3.0408E-6
90KM SD	1.4583E-5	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00101	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00101	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00101	95% KM Chebyshev UCL	0.00102
97.5% KM Chebyshev UCL	0.00102	99% KM Chebyshev UCL	0.00103

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	440.7	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.3828E-6	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1763	nu star (bias corrected)	N/A
Mean (detects)	0.00105		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.001	SD (KM)	1.4583E-5
Variance (KM)	2.127E-10	SE of Mean (KM)	3.0408E-6
k hat (KM)	4723	k star (KM)	4415
nu hat (KM)	434487	nu star (KM)	406153
theta hat (KM)	2.1220E-7	theta star (KM)	2.2701E-7
80% gamma percentile (KM)	0.00101	90% gamma percentile (KM)	0.00102
95% gamma percentile (KM)	0.00103	99% gamma percentile (KM)	0.00104

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	404671	Adjusted Level of Significance (β)	0.0448
95% KM Approximate Gamma UCL	0.00101	Adjusted Chi Square Value (N/A, β)	404624
		95% KM Adjusted Gamma UCL	0.00101

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.6150E-4	Mean in Log Scale	-7.534
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

SD in Original Scale	1.8167E-4	SD in Log Scale	0.316
95% t UCL (assumes normality of ROS data)	6.0648E-4	95% Percentile Bootstrap UCL	6.0584E-4
95% BCA Bootstrap UCL	6.0839E-4	95% Bootstrap t UCL	6.1071E-4
95% H-UCL (Log ROS)	6.1080E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.906	KM Geo Mean	0.001
KM SD (logged)	0.0139	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0029	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0139	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0029		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	5.2391E-4
SD in Original Scale	1.1389E-4
95% t UCL (Assumes normality)	5.5211E-4

DL/2 Log-Transformed

Mean in Log Scale	-7.569
SD in Log Scale	0.153
95% H-Stat UCL	5.4366E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.00101

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	103	Mean	342.5
Maximum	1200	Median	292
SD	246.6	Std. Error of Mean	36.36
Coefficient of Variation	0.72	Skewness	1.811

Normal GOF Test

Shapiro Wilk Test Statistic	0.81
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.166
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% UCLs (Adjusted for Skewness)

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% Student's-t UCL	403.6	95% Adjusted-CLT UCL (Chen-1995)	412.7
		95% Modified-t UCL (Johnson-1978)	405.2

Gamma GOF Test

A-D Test Statistic	0.745	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.086	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.57	k star (bias corrected MLE)	2.417
Theta hat (MLE)	133.3	Theta star (bias corrected MLE)	141.7
nu hat (MLE)	236.4	nu star (bias corrected)	222.3
MLE Mean (bias corrected)	342.5	MLE Sd (bias corrected)	220.4
		Approximate Chi Square Value (0.05)	188.8
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	187.8

Assuming Gamma Distribution

95% Approximate Gamma UCL	403.3	95% Adjusted Gamma UCL	405.5
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data appear Lognormal at 10% Significance Level

Lilliefors Test Statistic	0.0864	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.119	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.635	Mean of logged Data	5.629
Maximum of Logged Data	7.09	SD of logged Data	0.637

Assuming Lognormal Distribution

95% H-UCL	411.8	90% Chebyshev (MVUE) UCL	442.3
95% Chebyshev (MVUE) UCL	489	97.5% Chebyshev (MVUE) UCL	553.8
99% Chebyshev (MVUE) UCL	681		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	402.4	95% BCA Bootstrap UCL	414.7
95% Standard Bootstrap UCL	402.6	95% Bootstrap-t UCL	419.5
95% Hall's Bootstrap UCL	419.2	95% Percentile Bootstrap UCL	405
90% Chebyshev(Mean, Sd) UCL	451.6	95% Chebyshev(Mean, Sd) UCL	501
97.5% Chebyshev(Mean, Sd) UCL	569.6	99% Chebyshev(Mean, Sd) UCL	704.3

Suggested UCL to Use

95% Adjusted Gamma UCL 405.5

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Ceslum

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	0.0036	Mean	0.00814
Maximum	0.0166	Median	0.00665
SD	0.00357	Std. Error of Mean	5.2652E-4
Coefficient of Variation	0.439	Skewness	1.065

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.841	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.927	Lilliefors GOF Test	
Lilliefors Test Statistic	0.201	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.151		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.00902	95% Adjusted-CLT UCL (Chen-1995)	0.00909
		95% Modified-t UCL (Johnson-1978)	0.00903

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.864	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.752	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.169	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.131		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	6.203	k star (bias corrected MLE)	5.813
Theta hat (MLE)	0.00131	Theta star (bias corrected MLE)	0.0014
nu hat (MLE)	570.7	nu star (bias corrected)	534.8
MLE Mean (bias corrected)	0.00814	MLE Sd (bias corrected)	0.00337
		Approximate Chi Square Value (0.05)	482.2
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	480.6

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.00903	95% Adjusted Gamma UCL	0.00906

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.917	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.953	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.153	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.119		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Minimum of Logged Data	-5.627	Mean of logged Data	-4.894
Maximum of Logged Data	-4.098	SD of logged Data	0.4

Assuming Lognormal Distribution

95% H-UCL	0.00904	90% Chebyshev (MVUE) UCL	0.00958
95% Chebyshev (MVUE) UCL	0.0102	97.5% Chebyshev (MVUE) UCL	0.0112
99% Chebyshev (MVUE) UCL	0.013		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.009	95% BCA Bootstrap UCL	0.00909
95% Standard Bootstrap UCL	0.009	95% Bootstrap-t UCL	0.00912
95% Hall's Bootstrap UCL	0.00907	95% Percentile Bootstrap UCL	0.00902
90% Chebyshev(Mean, Sd) UCL	0.00972	95% Chebyshev(Mean, Sd) UCL	0.0104
97.5% Chebyshev(Mean, Sd) UCL	0.0114	99% Chebyshev(Mean, Sd) UCL	0.0134

Suggested UCL to Use

95% Student's-t UCL 0.00902

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	8
Number of Detects	13	Number of Non-Detects	33
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.08	Maximum Non-Detect	0.01
Variance Detects	3.4674E-4	Percent Non-Detects	71.74%
Mean Detects	0.0219	SD Detects	0.0186
Median Detects	0.016	CV Detects	0.849
Skewness Detects	2.941	Kurtosis Detects	9.21
Mean of Logged Detects	-4.003	SD of Logged Detects	0.547

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.58	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.814	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.353	Lilliefors GOF Test
1% Lilliefors Critical Value	0.271	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0134	KM Standard Error of Mean	0.00168
90KM SD	0.0109	95% KM (BCA) UCL	0.0166

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% KM (t) UCL	0.0162	95% KM (Percentile Bootstrap) UCL	0.0163
95% KM (z) UCL	0.0161	95% KM Bootstrap t UCL	0.0215
90% KM Chebyshev UCL	0.0184	95% KM Chebyshev UCL	0.0207
97.5% KM Chebyshev UCL	0.0238	99% KM Chebyshev UCL	0.03

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.462	Anderson-Darling GOF Test
5% A-D Critical Value	0.74	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.319	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.238	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.887	k star (bias corrected MLE)	2.272
Theta hat (MLE)	0.00759	Theta star (bias corrected MLE)	0.00965
nu hat (MLE)	75.05	nu star (bias corrected)	59.07
Mean (detects)	0.0219		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0134
Maximum	0.08	Median	0.01
SD	0.011	CV	0.826
k hat (MLE)	4.316	k star (bias corrected MLE)	4.049
Theta hat (MLE)	0.0031	Theta star (bias corrected MLE)	0.0033
nu hat (MLE)	397	nu star (bias corrected)	372.5
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (372.48, α)	328.8	Adjusted Chi Square Value (372.48, β)	327.4
95% Gamma Approximate UCL	0.0151	95% Gamma Adjusted UCL	0.0152

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0134	SD (KM)	0.0109
Variance (KM)	1.1928E-4	SE of Mean (KM)	0.00168
k hat (KM)	1.499	k star (KM)	1.415
nu hat (KM)	137.9	nu star (KM)	130.2
theta hat (KM)	0.00892	theta star (KM)	0.00945
80% gamma percentile (KM)	0.0208	90% gamma percentile (KM)	0.0283
95% gamma percentile (KM)	0.0355	99% gamma percentile (KM)	0.052

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (130.21, α)	104.9	Adjusted Chi Square Value (130.21, β)	104.1
95% KM Approximate Gamma UCL	0.0166	95% KM Adjusted Gamma UCL	0.0167

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.797	Shapiro Wilk GOF Test
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

10% Shapiro Wilk Critical Value	0.889	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.279	Lilliefors GOF Test
10% Lilliefors Critical Value	0.215	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00864	Mean in Log Scale	-5.395
SD in Original Scale	0.0129	SD in Log Scale	1.147
95% t UCL (assumes normality of ROS data)	0.0118	95% Percentile Bootstrap UCL	0.0121
95% BCA Bootstrap UCL	0.0133	95% Bootstrap t UCL	0.0146
95% H-UCL (Log ROS)	0.0134		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.435	KM Geo Mean	0.0119
KM SD (logged)	0.389	95% Critical H Value (KM-Log)	1.812
KM Standard Error of Mean (logged)	0.0597	95% H-UCL (KM -Log)	0.0142
KM SD (logged)	0.389	95% Critical H Value (KM-Log)	1.812
KM Standard Error of Mean (logged)	0.0597		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00978
SD in Original Scale	0.0123
95% t UCL (Assumes normality)	0.0128

DL/2 Log-Transformed

Mean in Log Scale	-4.932
SD in Log Scale	0.654
95% H-Stat UCL	0.0108

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0162

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Cobalt

General Statistics

Total Number of Observations	46	Number of Distinct Observations	8
Number of Detects	10	Number of Non-Detects	36
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.0041	Minimum Non-Detect	0.004
Maximum Detect	0.0203	Maximum Non-Detect	0.004
Variance Detects	2.5523E-5	Percent Non-Detects	78.26%
Mean Detects	0.00715	SD Detects	0.00505
Median Detects	0.0045	CV Detects	0.707
Skewness Detects	2.306	Kurtosis Detects	5.829
Mean of Logged Detects	-5.094	SD of Logged Detects	0.535

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.665	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.781	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.3	Lilliefors GOF Test
1% Lilliefors Critical Value	0.304	Detected Data appear Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00468	KM Standard Error of Mean	4.0174E-4
90KM SD	0.00258	95% KM (BCA) UCL	0.00548
95% KM (t) UCL	0.00536	95% KM (Percentile Bootstrap) UCL	0.00539
95% KM (z) UCL	0.00535	95% KM Bootstrap t UCL	0.00646
90% KM Chebyshev UCL	0.00589	95% KM Chebyshev UCL	0.00644
97.5% KM Chebyshev UCL	0.00719	99% KM Chebyshev UCL	0.00868

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.1	Anderson-Darling GOF Test
5% A-D Critical Value	0.731	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.328	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.268	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.415	k star (bias corrected MLE)	2.457
Theta hat (MLE)	0.00209	Theta star (bias corrected MLE)	0.00291
nu hat (MLE)	68.29	nu star (bias corrected)	49.14
Mean (detects)	0.00715		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0041	Mean	0.00938
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum	0.0203	Median	0.01
SD	0.00255	CV	0.272
k hat (MLE)	11.97	k star (bias corrected MLE)	11.21
Theta hat (MLE)	7.8347E-4	Theta star (bias corrected MLE)	8.3705E-4
nu hat (MLE)	1102	nu star (bias corrected)	1031
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (N/A, α)	957.5	Adjusted Chi Square Value (N/A, β)	955.2
95% Gamma Approximate UCL	0.0101	95% Gamma Adjusted UCL	0.0101

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00468	SD (KM)	0.00258
Variance (KM)	6.6817E-6	SE of Mean (KM)	4.0174E-4
k hat (KM)	3.285	k star (KM)	3.085
nu hat (KM)	302.2	nu star (KM)	283.8
theta hat (KM)	0.00143	theta star (KM)	0.00152
80% gamma percentile (KM)	0.00666	90% gamma percentile (KM)	0.00826
95% gamma percentile (KM)	0.00975	99% gamma percentile (KM)	0.013

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (283.81, α)	245.8	Adjusted Chi Square Value (283.81, β)	244.7
95% KM Approximate Gamma UCL	0.00541	95% KM Adjusted Gamma UCL	0.00543

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.777	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.869	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.319	Lilliefors GOF Test
10% Lilliefors Critical Value	0.241	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00232	Mean in Log Scale	-6.807
SD in Original Scale	0.00349	SD in Log Scale	1.248
95% t UCL (assumes normality of ROS data)	0.00318	95% Percentile Bootstrap UCL	0.00322
95% BCA Bootstrap UCL	0.0035	95% Bootstrap t UCL	0.00378
95% H-UCL (Log ROS)	0.00391		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.429	KM Geo Mean	0.00439
KM SD (logged)	0.295	95% Critical H Value (KM-Log)	1.769
KM Standard Error of Mean (logged)	0.0458	95% H-UCL (KM -Log)	0.00496
KM SD (logged)	0.295	95% Critical H Value (KM-Log)	1.769
KM Standard Error of Mean (logged)	0.0458		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00312	Mean in Log Scale	-5.971
SD in Original Scale	0.00312	SD in Log Scale	0.525
95% t UCL (Assumes normality)	0.00389	95% H-Stat UCL	0.0034

DL/2 is not a recommended method, provided for comparisons and historical reasons

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00536

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observations	46	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	0.136	Mean	0.208
Maximum	0.45	Median	0.188
SD	0.0667	Std. Error of Mean	0.00984
Coefficient of Variation	0.322	Skewness	1.823

Normal GOF Test

Shapiro Wilk Test Statistic	0.825
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.193
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.224

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.227

95% Modified-t UCL (Johnson-1978) 0.224

Gamma GOF Test

A-D Test Statistic	1.362
5% A-D Critical Value	0.749
K-S Test Statistic	0.154
5% K-S Critical Value	0.13

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.36	k star (bias corrected MLE)	11.57
Theta hat (MLE)	0.0168	Theta star (bias corrected MLE)	0.0179
nu hat (MLE)	1137	nu star (bias corrected)	1064
MLE Mean (bias corrected)	0.208	MLE Sd (bias corrected)	0.061

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

		Approximate Chi Square Value (0.05)	989.7
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	987.4

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.223	95% Adjusted Gamma UCL	0.224
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.133	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.119	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.995	Mean of logged Data	-1.614
Maximum of Logged Data	-0.799	SD of logged Data	0.277

Assuming Lognormal Distribution

95% H-UCL	0.223	90% Chebyshev (MVUE) UCL	0.232
95% Chebyshev (MVUE) UCL	0.244	97.5% Chebyshev (MVUE) UCL	0.26
99% Chebyshev (MVUE) UCL	0.292		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.224	95% BCA Bootstrap UCL	0.227
95% Standard Bootstrap UCL	0.224	95% Bootstrap-t UCL	0.228
95% Hall's Bootstrap UCL	0.229	95% Percentile Bootstrap UCL	0.224
90% Chebyshev(Mean, Sd) UCL	0.237	95% Chebyshev(Mean, Sd) UCL	0.25
97.5% Chebyshev(Mean, Sd) UCL	0.269	99% Chebyshev(Mean, Sd) UCL	0.305

Suggested UCL to Use

95% Student's-t UCL	0.224
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Iron

General Statistics

Total Number of Observations	46	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	1.41	Mean	4.677
Maximum	45.7	Median	3.45
SD	6.35	Std. Error of Mean	0.936
Coefficient of Variation	1.358	Skewness	6.251

Normal GOF Test

Shapiro Wilk Test Statistic	0.328
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.346
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 6.249

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	7.139
95% Modified-t UCL (Johnson-1978)	6.393

Gamma GOF Test

A-D Test Statistic	4.097
5% A-D Critical Value	0.759
K-S Test Statistic	0.211
5% K-S Critical Value	0.132

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.344	k star (bias corrected MLE)	2.205
Theta hat (MLE)	1.995	Theta star (bias corrected MLE)	2.121
nu hat (MLE)	215.6	nu star (bias corrected)	202.9
MLE Mean (bias corrected)	4.677	MLE Sd (bias corrected)	3.149
		Approximate Chi Square Value (0.05)	170.9
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	170

Assuming Gamma Distribution

95% Approximate Gamma UCL	5.551	95% Adjusted Gamma UCL	5.582
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.827
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.143
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.344	Mean of logged Data	1.314
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum of Logged Data	3.822	SD of logged Data	0.524
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Assuming Lognormal Distribution

95% H-UCL	4.952	90% Chebyshev (MVUE) UCL	5.294
95% Chebyshev (MVUE) UCL	5.765	97.5% Chebyshev (MVUE) UCL	6.418
99% Chebyshev (MVUE) UCL	7.702		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	6.217	95% BCA Bootstrap UCL	7.519
95% Standard Bootstrap UCL	6.186	95% Bootstrap-t UCL	10.39
95% Hall's Bootstrap UCL	12.3	95% Percentile Bootstrap UCL	6.48
90% Chebyshev(Mean, Sd) UCL	7.485	95% Chebyshev(Mean, Sd) UCL	8.758
97.5% Chebyshev(Mean, Sd) UCL	10.52	99% Chebyshev(Mean, Sd) UCL	13.99

Suggested UCL to Use

95% Student's-t UCL 6.249

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods,

then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	46	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	41
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0042	Minimum Non-Detect	0.004
Maximum Detect	0.0134	Maximum Non-Detect	0.004
Variance Detects	1.3203E-5	Percent Non-Detects	89.13%
Mean Detects	0.00746	SD Detects	0.00363
Median Detects	0.0065	CV Detects	0.487
Skewness Detects	1.4	Kurtosis Detects	1.967
Mean of Logged Detects	-4.983	SD of Logged Detects	0.449

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.885	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.686	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.23	Lilliefors GOF Test
1% Lilliefors Critical Value	0.396	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meler (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00438	KM Standard Error of Mean	2.5043E-4
90KM SD	0.00152	95% KM (BCA) UCL	0.0048
95% KM (t) UCL	0.0048	95% KM (Percentile Bootstrap) UCL	0.00478
95% KM (z) UCL	0.00479	95% KM Bootstrap t UCL	0.00498
90% KM Chebyshev UCL	0.00513	95% KM Chebyshev UCL	0.00547
97.5% KM Chebyshev UCL	0.00594	99% KM Chebyshev UCL	0.00687

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.267	Anderson-Darling GOF Test
5% A-D Critical Value	0.68	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.177	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.358	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	6.051	k star (bias corrected MLE)	2.554
Theta hat (MLE)	0.00123	Theta star (bias corrected MLE)	0.00292
nu hat (MLE)	60.51	nu star (bias corrected)	25.54
Mean (detects)	0.00746		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0042	Mean	0.00972
Maximum	0.0134	Median	0.01
SD	0.00135	CV	0.138
k hat (MLE)	38.38	k star (bias corrected MLE)	35.89
Theta hat (MLE)	2.5334E-4	Theta star (bias corrected MLE)	2.7090E-4
nu hat (MLE)	3531	nu star (bias corrected)	3302
Adjusted Level of Significance (β)	0.0448	Adjusted Chi Square Value (N/A, β)	3166
Approximate Chi Square Value (N/A, α)	3170	95% Gamma Adjusted UCL	0.0101
95% Gamma Approximate UCL	0.0101		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00438	SD (KM)	0.00152
Variance (KM)	2.3079E-6	SE of Mean (KM)	2.5043E-4
k hat (KM)	8.298	k star (KM)	7.771
nu hat (KM)	763.4	nu star (KM)	714.9
theta hat (KM)	5.2739E-4	theta star (KM)	5.6313E-4
80% gamma percentile (KM)	0.00561	90% gamma percentile (KM)	0.00647
95% gamma percentile (KM)	0.00724	99% gamma percentile (KM)	0.00883

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (714.93, α)	653.9	Adjusted Chi Square Value (714.93, β)	652
95% KM Approximate Gamma UCL	0.00478	95% KM Adjusted Gamma UCL	0.0048

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.806	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.155	Lilliefors GOF Test
10% Lilliefors Critical Value	0.319	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00148	Mean in Log Scale	-7.47
SD in Original Scale	0.00248	SD in Log Scale	1.434
95% t UCL (assumes normality of ROS data)	0.00209	95% Percentile Bootstrap UCL	0.00212
95% BCA Bootstrap UCL	0.0023	95% Bootstrap t UCL	0.0025
95% H-UCL (Log ROS)	0.00292		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.463	KM Geo Mean	0.00424
KM SD (logged)	0.214	95% Critical H Value (KM-Log)	1.777
KM Standard Error of Mean (logged)	0.0352	95% H-UCL (KM -Log)	0.00459
KM SD (logged)	0.214	95% Critical H Value (KM-Log)	1.777
KM Standard Error of Mean (logged)	0.0352		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00259	Mean in Log Scale	-6.081
SD in Original Scale	0.00203	SD in Log Scale	0.41
95% t UCL (Assumes normality)	0.0031	95% H-Stat UCL	0.00278

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0048

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lithium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	46
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Lithium was not processed!

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Magnesium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	281	Mean	324.1
Maximum	378	Median	318
SD	28.88	Std. Error of Mean	4.258
Coefficient of Variation	0.0891	Skewness	0.248

Normal GOF Test

Shapiro Wilk Test Statistic	0.916
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.137
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 331.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	331.3
95% Modified-t UCL (Johnson-1978)	331.3

Gamma GOF Test

A-D Test Statistic	1.161
5% A-D Critical Value	0.747
K-S Test Statistic	0.133
5% K-S Critical Value	0.13

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	129.9	k star (bias corrected MLE)	121.4
Theta hat (MLE)	2.495	Theta star (bias corrected MLE)	2.669
nu hat (MLE)	11950	nu star (bias corrected)	11172
MLE Mean (bias corrected)	324.1	MLE Sd (bias corrected)	29.41
		Approximate Chi Square Value (0.05)	10928
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	10920

Assuming Gamma Distribution

95% Approximate Gamma UCL	331.3	95% Adjusted Gamma UCL	331.6
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.919
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.128
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.638	Mean of logged Data	5.777
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum of Logged Data 5.935 SD of logged Data 0.0886

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	336.8
95% Chebyshev (MVUE) UCL	342.6	97.5% Chebyshev (MVUE) UCL	350.6
99% Chebyshev (MVUE) UCL	366.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	331.1	95% BCA Bootstrap UCL	331.3
95% Standard Bootstrap UCL	331.1	95% Bootstrap-t UCL	331.4
95% Hall's Bootstrap UCL	331.1	95% Percentile Bootstrap UCL	331.1
90% Chebyshev(Mean, Sd) UCL	336.9	95% Chebyshev(Mean, Sd) UCL	342.6
97.5% Chebyshev(Mean, Sd) UCL	350.7	99% Chebyshev(Mean, Sd) UCL	366.5

Suggested UCL to Use

95% Student's-t UCL 331.2

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Manganese

General Statistics

Total Number of Observations	46	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	0.11	Mean	0.281
Maximum	0.758	Median	0.256
SD	0.138	Std. Error of Mean	0.0204
Coefficient of Variation	0.492	Skewness	1.684

Normal GOF Test

Shapiro Wilk Test Statistic	0.849
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.176
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.315

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	0.32
95% Modified-t UCL (Johnson-1978)	0.316

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Gamma GOF Test

A-D Test Statistic	0.636	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.113	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.131	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.257	k star (bias corrected MLE)	4.929
Theta hat (MLE)	0.0535	Theta star (bias corrected MLE)	0.0571
nu hat (MLE)	483.7	nu star (bias corrected)	453.5
MLE Mean (bias corrected)	0.281	MLE Sd (bias corrected)	0.127
		Approximate Chi Square Value (0.05)	405.1
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	403.6

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.315	95% Adjusted Gamma UCL	0.316
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0853	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.119	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.207	Mean of logged Data	-1.367
Maximum of Logged Data	-0.277	SD of logged Data	0.437

Assuming Lognormal Distribution

95% H-UCL	0.316	90% Chebyshev (MVUE) UCL	0.336
95% Chebyshev (MVUE) UCL	0.361	97.5% Chebyshev (MVUE) UCL	0.397
99% Chebyshev (MVUE) UCL	0.466		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.315	95% BCA Bootstrap UCL	0.322
95% Standard Bootstrap UCL	0.315	95% Bootstrap-t UCL	0.323
95% Hall's Bootstrap UCL	0.323	95% Percentile Bootstrap UCL	0.316
90% Chebyshev(Mean, Sd) UCL	0.342	95% Chebyshev(Mean, Sd) UCL	0.37
97.5% Chebyshev(Mean, Sd) UCL	0.408	99% Chebyshev(Mean, Sd) UCL	0.484

Suggested UCL to Use

95% Adjusted Gamma UCL	0.316
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	0.0509	Mean	0.143
Maximum	0.323	Median	0.131
SD	0.069	Std. Error of Mean	0.0102
Coefficient of Variation	0.481	Skewness	0.833

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.905	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.927	Lilliefors GOF Test	
Lilliefors Test Statistic	0.148	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.151		

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.16	95% Adjusted-CLT UCL (Chen-1995)	0.161
		95% Modified-t UCL (Johnson-1978)	0.161

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.621	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.753	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0978	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.131		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	4.701	k star (bias corrected MLE)	4.409
Theta hat (MLE)	0.0305	Theta star (bias corrected MLE)	0.0325
nu hat (MLE)	432.5	nu star (bias corrected)	405.6
MLE Mean (bias corrected)	0.143	MLE Sd (bias corrected)	0.0683
		Approximate Chi Square Value (0.05)	359.9
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	358.5

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.162	95% Adjusted Gamma UCL	0.162

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.96	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.953	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0926	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.119		

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.978	Mean of logged Data	-2.053
Maximum of Logged Data	-1.13	SD of logged Data	0.476

Assuming Lognormal Distribution

95% H-UCL	0.164	90% Chebyshev (MVUE) UCL	0.175
95% Chebyshev (MVUE) UCL	0.189	97.5% Chebyshev (MVUE) UCL	0.209
99% Chebyshev (MVUE) UCL	0.248		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.16	95% BCA Bootstrap UCL	0.161
95% Standard Bootstrap UCL	0.16	95% Bootstrap-t UCL	0.162
95% Hall's Bootstrap UCL	0.161	95% Percentile Bootstrap UCL	0.16
90% Chebyshev(Mean, Sd) UCL	0.174	95% Chebyshev(Mean, Sd) UCL	0.188
97.5% Chebyshev(Mean, Sd) UCL	0.207	99% Chebyshev(Mean, Sd) UCL	0.245

Suggested UCL to Use

95% Student's-t UCL 0.16

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Methylmercury

General Statistics

Total Number of Observations	46	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	24.8	Mean	104.3
Maximum	333	Median	82.7
SD	67	Std. Error of Mean	9.878
Coefficient of Variation	0.642	Skewness	1.396

Normal GOF Test

Shapiro Wilk Test Statistic	0.881
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.144
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 120.9

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 122.7

95% Modified-t UCL (Johnson-1978) 121.2

Gamma GOF Test

A-D Test Statistic	0.341
5% A-D Critical Value	0.757
K-S Test Statistic	0.0823
5% K-S Critical Value	0.132

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.778	k star (bias corrected MLE)	2.611
Theta hat (MLE)	37.54	Theta star (bias corrected MLE)	39.94
nu hat (MLE)	255.6	nu star (bias corrected)	240.2
MLE Mean (bias corrected)	104.3	MLE Sd (bias corrected)	64.54
		Approximate Chi Square Value (0.05)	205.3
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	204.3

Assuming Gamma Distribution

95% Approximate Gamma UCL 122

95% Adjusted Gamma UCL 122.6

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.117
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Minimum of Logged Data	3.211	Mean of logged Data	4.457
Maximum of Logged Data	5.808	SD of logged Data	0.635

Assuming Lognormal Distribution

95% H-UCL	127.2	90% Chebyshev (MVUE) UCL	136.7
95% Chebyshev (MVUE) UCL	151.1	97.5% Chebyshev (MVUE) UCL	171
99% Chebyshev (MVUE) UCL	210.2		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	120.5	95% BCA Bootstrap UCL	122.1
95% Standard Bootstrap UCL	120.4	95% Bootstrap-t UCL	123.5
95% Hall's Bootstrap UCL	123.7	95% Percentile Bootstrap UCL	120.9
90% Chebyshev(Mean, Sd) UCL	133.9	95% Chebyshev(Mean, Sd) UCL	147.3
97.5% Chebyshev(Mean, Sd) UCL	166	99% Chebyshev(Mean, Sd) UCL	202.6

Suggested UCL to Use

95% Student's-t UCL 120.9

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics

Total Number of Observations	46	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	44
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0043	Minimum Non-Detect	0.004
Maximum Detect	0.0045	Maximum Non-Detect	0.004
Variance Detects	2.0000E-8	Percent Non-Detects	95.65%
Mean Detects	0.0044	SD Detects	1.4142E-4
Median Detects	0.0044	CV Detects	0.0321
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-5.426	SD of Logged Detects	0.0321

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00402	KM Standard Error of Mean	1.7556E-5
90KM SD	8.4195E-5	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00405	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00405	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00407	95% KM Chebyshev UCL	0.00409
97.5% KM Chebyshev UCL	0.00413	99% KM Chebyshev UCL	0.00419

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1936	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.2731E-6	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	7743	nu star (bias corrected)	N/A
Mean (detects)	0.0044		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00402	SD (KM)	8.4195E-5
Variance (KM)	7.0888E-9	SE of Mean (KM)	1.7556E-5
k hat (KM)	2277	k star (KM)	2128
nu hat (KM)	209460	nu star (KM)	195801
theta hat (KM)	1.7645E-6	theta star (KM)	1.8876E-6
80% gamma percentile (KM)	0.00409	90% gamma percentile (KM)	0.00413
95% gamma percentile (KM)	0.00416	99% gamma percentile (KM)	0.00422

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	194772	Adjusted Level of Significance (β)	0.0448
95% KM Approximate Gamma UCL	0.00404	Adjusted Chi Square Value (N/A, β)	194740
		95% KM Adjusted Gamma UCL	0.00404

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00323	Mean in Log Scale	-5.748
SD in Original Scale	4.8980E-4	SD in Log Scale	0.151
95% t UCL (assumes normality of ROS data)	0.00335	95% Percentile Bootstrap UCL	0.00334
95% BCA Bootstrap UCL	0.00335	95% Bootstrap t UCL	0.00335
95% H-UCL (Log ROS)	0.00335		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.517	KM Geo Mean	0.00402
KM SD (logged)	0.02	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00416	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.02	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00416		

DL/2 Statistics

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0021	Mean in Log Scale	-6.18
SD in Original Scale	4.9529E-4	SD in Log Scale	0.163
95% t UCL (Assumes normality)	0.00223	95% H-Stat UCL	0.00219

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.00405

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nickel

General Statistics

Total Number of Observations	46	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	45
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Nickel was not processed!

Phosphorus

General Statistics

Total Number of Observations	46	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	2130	Mean	2554
Maximum	3380	Median	2475
SD	296.4	Std. Error of Mean	43.7
Coefficient of Variation	0.116	Skewness	1.293

Normal GOF Test

Shapiro Wilk Test Statistic	0.867
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.154
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% UCLs (Adjusted for Skewness)

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% Student's-t UCL 2627

95% Adjusted-CLT UCL (Chen-1995) 2634

95% Modified-t UCL (Johnson-1978) 2628

Gamma GOF Test

A-D Test Statistic 1.688
 5% A-D Critical Value 0.747
 K-S Test Statistic 0.142
 5% K-S Critical Value 0.13

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 82.11
 Theta hat (MLE) 31.1
 nu hat (MLE) 7554
 MLE Mean (bias corrected) 2554
 Adjusted Level of Significance 0.0448

k star (bias corrected MLE) 76.77
 Theta star (bias corrected MLE) 33.27
 nu star (bias corrected) 7063
 MLE Sd (bias corrected) 291.5
 Approximate Chi Square Value (0.05) 6868
 Adjusted Chi Square Value 6862

Assuming Gamma Distribution

95% Approximate Gamma UCL 2626

95% Adjusted Gamma UCL 2628

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.899
 10% Shapiro Wilk Critical Value 0.953
 Lilliefors Test Statistic 0.135
 10% Lilliefors Critical Value 0.119

Shapiro Wilk Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 7.664
 Maximum of Logged Data 8.126

Mean of logged Data 7.839
 SD of logged Data 0.11

Assuming Lognormal Distribution

95% H-UCL 2625
 95% Chebyshev (MVUE) UCL 2734
 99% Chebyshev (MVUE) UCL 2965

90% Chebyshev (MVUE) UCL 2677
 97.5% Chebyshev (MVUE) UCL 2812

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 2626
 95% Standard Bootstrap UCL 2625
 95% Hall's Bootstrap UCL 2638
 90% Chebyshev(Mean, Sd) UCL 2685
 97.5% Chebyshev(Mean, Sd) UCL 2827

95% BCA Bootstrap UCL 2633
 95% Bootstrap-t UCL 2640
 95% Percentile Bootstrap UCL 2627
 95% Chebyshev(Mean, Sd) UCL 2744
 99% Chebyshev(Mean, Sd) UCL 2988

Suggested UCL to Use

95% Student's-t UCL 2627

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Potassium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	3610	Mean	4370
Maximum	5060	Median	4390
SD	308.5	Std. Error of Mean	45.49
Coefficient of Variation	0.0706	Skewness	-0.0766

Normal GOF Test

Shapiro Wilk Test Statistic	0.99
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.0528
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 4447

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 4445

95% Modified-t UCL (Johnson-1978) 4447

Gamma GOF Test

A-D Test Statistic	0.157
5% A-D Critical Value	0.747
K-S Test Statistic	0.0604
5% K-S Critical Value	0.13

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	203.1	k star (bias corrected MLE)	189.8
Theta hat (MLE)	21.52	Theta star (bias corrected MLE)	23.02
nu hat (MLE)	18681	nu star (bias corrected)	17464
MLE Mean (bias corrected)	4370	MLE Sd (bias corrected)	317.2
		Approximate Chi Square Value (0.05)	17158
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	17148

Assuming Gamma Distribution

95% Approximate Gamma UCL 4448

95% Adjusted Gamma UCL 4451

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.986
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.064
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Lognormal Statistics

Minimum of Logged Data	8.191	Mean of logged Data	8.38
Maximum of Logged Data	8.529	SD of logged Data	0.0712

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	4508
95% Chebyshev (MVUE) UCL	4571	97.5% Chebyshev (MVUE) UCL	4657
99% Chebyshev (MVUE) UCL	4828		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	4445	95% BCA Bootstrap UCL	4442
95% Standard Bootstrap UCL	4444	95% Bootstrap-t UCL	4447
95% Hall's Bootstrap UCL	4447	95% Percentile Bootstrap UCL	4443
90% Chebyshev(Mean, Sd) UCL	4507	95% Chebyshev(Mean, Sd) UCL	4569
97.5% Chebyshev(Mean, Sd) UCL	4655	99% Chebyshev(Mean, Sd) UCL	4823

Suggested UCL to Use

95% Student's-t UCL 4447

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Rubidium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	2.72	Mean	5.543
Maximum	9.22	Median	5.085
SD	1.666	Std. Error of Mean	0.246
Coefficient of Variation	0.301	Skewness	0.644

Normal GOF Test

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.927	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.159	Lilliefors GOF Test
1% Lilliefors Critical Value	0.151	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% Student's-t UCL	5.955	95% Adjusted-CLT UCL (Chen-1995)	5.972
		95% Modified-t UCL (Johnson-1978)	5.959

Gamma GOF Test

A-D Test Statistic	0.878
5% A-D Critical Value	0.749
K-S Test Statistic	0.125
5% K-S Critical Value	0.13

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.9	k star (bias corrected MLE)	11.14
Theta hat (MLE)	0.466	Theta star (bias corrected MLE)	0.497
nu hat (MLE)	1095	nu star (bias corrected)	1025
MLE Mean (bias corrected)	5.543	MLE Sd (bias corrected)	1.661
		Approximate Chi Square Value (0.05)	951.7
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	949.4

Assuming Gamma Distribution

95% Approximate Gamma UCL	5.97	95% Adjusted Gamma UCL	5.984
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.105
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.001	Mean of logged Data	1.67
Maximum of Logged Data	2.221	SD of logged Data	0.294

Assuming Lognormal Distribution

95% H-UCL	5.992	90% Chebyshev (MVUE) UCL	6.272
95% Chebyshev (MVUE) UCL	6.603	97.5% Chebyshev (MVUE) UCL	7.064
99% Chebyshev (MVUE) UCL	7.968		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	5.947	95% BCA Bootstrap UCL	5.971
95% Standard Bootstrap UCL	5.941	95% Bootstrap-t UCL	5.976
95% Hall's Bootstrap UCL	5.962	95% Percentile Bootstrap UCL	5.95
90% Chebyshev(Mean, Sd) UCL	6.279	95% Chebyshev(Mean, Sd) UCL	6.613
97.5% Chebyshev(Mean, Sd) UCL	7.076	99% Chebyshev(Mean, Sd) UCL	7.986

Suggested UCL to Use

95% Adjusted Gamma UCL 5.984

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	0.136	Mean	0.255
Maximum	0.425	Median	0.25
SD	0.0679	Std. Error of Mean	0.01
Coefficient of Variation	0.267	Skewness	0.536
Normal GOF Test			
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.927	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.092	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.151	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.272	95% Adjusted-CLT UCL (Chen-1995)	0.272
		95% Modified-t UCL (Johnson-1978)	0.272
Gamma GOF Test			
A-D Test Statistic	0.251	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0814	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.13	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.7	k star (bias corrected MLE)	13.75
Theta hat (MLE)	0.0173	Theta star (bias corrected MLE)	0.0185
nu hat (MLE)	1352	nu star (bias corrected)	1265
MLE Mean (bias corrected)	0.255	MLE Sd (bias corrected)	0.0687
		Approximate Chi Square Value (0.05)	1184
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	1181
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.272	95% Adjusted Gamma UCL	0.273

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.982
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.0832
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.995	Mean of logged Data	-1.402
Maximum of Logged Data	-0.856	SD of logged Data	0.266

Assuming Lognormal Distribution

95% H-UCL	0.274	90% Chebyshev (MVUE) UCL	0.285
95% Chebyshev (MVUE) UCL	0.299	97.5% Chebyshev (MVUE) UCL	0.318
99% Chebyshev (MVUE) UCL	0.356		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.271	95% BCA Bootstrap UCL	0.272
95% Standard Bootstrap UCL	0.271	95% Bootstrap-t UCL	0.273
95% Hall's Bootstrap UCL	0.273	95% Percentile Bootstrap UCL	0.271
90% Chebyshev(Mean, Sd) UCL	0.285	95% Chebyshev(Mean, Sd) UCL	0.298
97.5% Chebyshev(Mean, Sd) UCL	0.317	99% Chebyshev(Mean, Sd) UCL	0.354

Suggested UCL to Use

95% Student's-t UCL 0.272

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Sodium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	224	Mean	282.6
Maximum	399	Median	281.5
SD	35.92	Std. Error of Mean	5.297
Coefficient of Variation	0.127	Skewness	0.748

Normal GOF Test

Shapiro Wilk Test Statistic	0.947
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.0894
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 291.5

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	291.9
95% Modified-t UCL (Johnson-1978)	291.6

Gamma GOF Test

A-D Test Statistic	0.46
5% A-D Critical Value	0.747
K-S Test Statistic	0.085
5% K-S Critical Value	0.13

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	65.54	k star (bias corrected MLE)	61.28
Theta hat (MLE)	4.312	Theta star (bias corrected MLE)	4.612
nu hat (MLE)	6030	nu star (bias corrected)	5638
MLE Mean (bias corrected)	282.6	MLE Sd (bias corrected)	36.1
		Approximate Chi Square Value (0.05)	5464
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	5459

Assuming Gamma Distribution

95% Approximate Gamma UCL	291.6	95% Adjusted Gamma UCL	291.9
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.965
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.0932
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.412	Mean of logged Data	5.636
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum of Logged Data 5.989 SD of logged Data 0.124

Assuming Lognormal Distribution

95% H-UCL	291.8	90% Chebyshev (MVUE) UCL	298.2
95% Chebyshev (MVUE) UCL	305.2	97.5% Chebyshev (MVUE) UCL	315
99% Chebyshev (MVUE) UCL	334.3		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	291.3	95% BCA Bootstrap UCL	292.1
95% Standard Bootstrap UCL	291.4	95% Bootstrap-t UCL	292.1
95% Hall's Bootstrap UCL	292.6	95% Percentile Bootstrap UCL	291.7
90% Chebyshev(Mean, Sd) UCL	298.5	95% Chebyshev(Mean, Sd) UCL	305.7
97.5% Chebyshev(Mean, Sd) UCL	315.7	99% Chebyshev(Mean, Sd) UCL	335.3

Suggested UCL to Use

95% Student's-t UCL 291.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Strontium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	0.023	Mean	0.154
Maximum	0.59	Median	0.132
SD	0.121	Std. Error of Mean	0.0178
Coefficient of Variation	0.785	Skewness	1.739

Normal GOF Test

Shapiro Wilk Test Statistic 0.831
 1% Shapiro Wilk Critical Value 0.927
 Lilliefors Test Statistic 0.161
 1% Lilliefors Critical Value 0.151

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.184

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.188

95% Modified-t UCL (Johnson-1978) 0.185

Gamma GOF Test

A-D Test Statistic 0.397

Anderson-Darling Gamma GOF Test

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0674	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.971	k star (bias corrected MLE)	1.857
Theta hat (MLE)	0.0781	Theta star (bias corrected MLE)	0.0829
nu hat (MLE)	181.4	nu star (bias corrected)	170.9
MLE Mean (bias corrected)	0.154	MLE Sd (bias corrected)	0.113
		Approximate Chi Square Value (0.05)	141.6
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	140.8

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.186	95% Adjusted Gamma UCL	0.187
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0903	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.119	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.772	Mean of logged Data	-2.145
Maximum of Logged Data	-0.528	SD of logged Data	0.766

Assuming Lognormal Distribution

95% H-UCL	0.199	90% Chebyshev (MVUE) UCL	0.214
95% Chebyshev (MVUE) UCL	0.241	97.5% Chebyshev (MVUE) UCL	0.278
99% Chebyshev (MVUE) UCL	0.35		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.183	95% BCA Bootstrap UCL	0.189
95% Standard Bootstrap UCL	0.183	95% Bootstrap-t UCL	0.192
95% Hall's Bootstrap UCL	0.192	95% Percentile Bootstrap UCL	0.185
90% Chebyshev(Mean, Sd) UCL	0.208	95% Chebyshev(Mean, Sd) UCL	0.232
97.5% Chebyshev(Mean, Sd) UCL	0.265	99% Chebyshev(Mean, Sd) UCL	0.331

Suggested UCL to Use

95% Adjusted Gamma UCL	0.187
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Tellurium

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	46
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tellurium was not processed!

Thallium

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	43
Number of Detects	44	Number of Non-Detects	2
Number of Distinct Detects	42	Number of Distinct Non-Detects	1
Minimum Detect	4.2000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.00359	Maximum Non-Detect	4.0000E-4
Variance Detects	8.1966E-7	Percent Non-Detects	4.348%
Mean Detects	0.00173	SD Detects	9.0535E-4
Median Detects	0.0017	CV Detects	0.522
Skewness Detects	0.522	Kurtosis Detects	-0.667
Mean of Logged Detects	-6.506	SD of Logged Detects	0.576

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.924	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.109	Lilliefors GOF Test
1% Lilliefors Critical Value	0.154	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00168	KM Standard Error of Mean	1.3671E-4
90KM SD	9.1662E-4	95% KM (BCA) UCL	0.0019
95% KM (t) UCL	0.00191	95% KM (Percentile Bootstrap) UCL	0.0019
95% KM (z) UCL	0.0019	95% KM Bootstrap t UCL	0.00192
90% KM Chebyshev UCL	0.00209	95% KM Chebyshev UCL	0.00227
97.5% KM Chebyshev UCL	0.00253	99% KM Chebyshev UCL	0.00304

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.372	Anderson-Darling GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0844	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.134	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Gamma Statistics on Detected Data Only

k hat (MLE)	3.517	k star (bias corrected MLE)	3.292
Theta hat (MLE)	4.9298E-4	Theta star (bias corrected MLE)	5.2662E-4
nu hat (MLE)	309.5	nu star (bias corrected)	289.7
Mean (detects)	0.00173		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.2000E-4	Mean	0.00209
Maximum	0.01	Median	0.00177
SD	0.00192	CV	0.917
k hat (MLE)	2.116	k star (bias corrected MLE)	1.992
Theta hat (MLE)	9.8938E-4	Theta star (bias corrected MLE)	0.00105
nu hat (MLE)	194.6	nu star (bias corrected)	183.3
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (183.29, α)	153	Adjusted Chi Square Value (183.29, β)	152.1
95% Gamma Approximate UCL	0.00251	95% Gamma Adjusted UCL	0.00252

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00168	SD (KM)	9.1662E-4
Variance (KM)	8.4020E-7	SE of Mean (KM)	1.3671E-4
k hat (KM)	3.343	k star (KM)	3.139
nu hat (KM)	307.5	nu star (KM)	288.8
theta hat (KM)	5.0135E-4	theta star (KM)	5.3385E-4
80% gamma percentile (KM)	0.00238	90% gamma percentile (KM)	0.00294
95% gamma percentile (KM)	0.00347	99% gamma percentile (KM)	0.00461

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (288.81, α)	250.4	Adjusted Chi Square Value (288.81, β)	249.3
95% KM Approximate Gamma UCL	0.00193	95% KM Adjusted Gamma UCL	0.00194

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.952	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.11	Lilliefors GOF Test
10% Lilliefors Critical Value	0.122	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00167	Mean in Log Scale	-6.567
SD in Original Scale	9.2840E-4	SD in Log Scale	0.632
95% t UCL (assumes normality of ROS data)	0.0019	95% Percentile Bootstrap UCL	0.0019
95% BCA Bootstrap UCL	0.00191	95% Bootstrap t UCL	0.00192
95% H-UCL (Log ROS)	0.00207		

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.564	KM Geo Mean	0.00141
KM SD (logged)	0.618	95% Critical H Value (KM-Log)	1.971
KM Standard Error of Mean (logged)	0.0922	95% H-UCL (KM -Log)	0.00205
KM SD (logged)	0.618	95% Critical H Value (KM-Log)	1.971
KM Standard Error of Mean (logged)	0.0922		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.00167
SD in Original Scale	9.3981E-4
95% t UCL (Assumes normality)	0.0019

DL/2 Log-Transformed

Mean in Log Scale	-6.594
SD in Log Scale	0.699
95% H-Stat UCL	0.00216

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00191

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Tin

General Statistics

Total Number of Observations	46	Number of Distinct Observations	17
Number of Detects	26	Number of Non-Detects	20
Number of Distinct Detects	16	Number of Distinct Non-Detects	1
Minimum Detect	0.022	Minimum Non-Detect	0.02
Maximum Detect	0.049	Maximum Non-Detect	0.02
Variance Detects	5.6118E-5	Percent Non-Detects	43.48%
Mean Detects	0.032	SD Detects	0.00749
Median Detects	0.031	CV Detects	0.234
Skewness Detects	0.831	Kurtosis Detects	-0.0536
Mean of Logged Detects	-3.466	SD of Logged Detects	0.224

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.911	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.891	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors GOF Test
1% Lilliefors Critical Value	0.199	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0268	KM Standard Error of Mean	0.00122
90KM SD	0.00813	95% KM (BCA) UCL	0.0287
95% KM (t) UCL	0.0289	95% KM (Percentile Bootstrap) UCL	0.0288
95% KM (z) UCL	0.0288	95% KM Bootstrap t UCL	0.0291
90% KM Chebyshev UCL	0.0305	95% KM Chebyshev UCL	0.0321
97.5% KM Chebyshev UCL	0.0344	99% KM Chebyshev UCL	0.039

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.595	Anderson-Darling GOF Test
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.148	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.171	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	20.42	k star (bias corrected MLE)	18.09
Theta hat (MLE)	0.00157	Theta star (bias corrected MLE)	0.00177
nu hat (MLE)	1062	nu star (bias corrected)	940.8
Mean (detects)	0.032		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0247
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum	0.049	Median	0.0245
SD	0.0104	CV	0.421
k hat (MLE)	5.548	k star (bias corrected MLE)	5.201
Theta hat (MLE)	0.00446	Theta star (bias corrected MLE)	0.00476
nu hat (MLE)	510.4	nu star (bias corrected)	478.5
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (478.46, α)	428.7	Adjusted Chi Square Value (478.46, β)	427.2
95% Gamma Approximate UCL	0.0276	95% Gamma Adjusted UCL	0.0277

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0268	SD (KM)	0.00813
Variance (KM)	6.6114E-5	SE of Mean (KM)	0.00122
k hat (KM)	10.87	k star (KM)	10.17
nu hat (KM)	999.8	nu star (KM)	935.9
theta hat (KM)	0.00247	theta star (KM)	0.00263
80% gamma percentile (KM)	0.0335	90% gamma percentile (KM)	0.038
95% gamma percentile (KM)	0.042	99% gamma percentile (KM)	0.0501

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (935.91, α)	865.9	Adjusted Chi Square Value (935.91, β)	863.7
95% KM Approximate Gamma UCL	0.029	95% KM Adjusted Gamma UCL	0.029

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.946
10% Shapiro Wilk Critical Value	0.933
Lilliefors Test Statistic	0.141
10% Lilliefors Critical Value	0.156

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0258	Mean in Log Scale	-3.722
SD in Original Scale	0.00937	SD in Log Scale	0.362
95% t UCL (assumes normality of ROS data)	0.0281	95% Percentile Bootstrap UCL	0.0281
95% BCA Bootstrap UCL	0.0282	95% Bootstrap t UCL	0.0283
95% H-UCL (Log ROS)	0.0284		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.66	KM Geo Mean	0.0257
KM SD (logged)	0.276	95% Critical H Value (KM-Log)	1.776
KM Standard Error of Mean (logged)	0.0415	95% H-UCL (KM -Log)	0.0288
KM SD (logged)	0.276	95% Critical H Value (KM-Log)	1.776
KM Standard Error of Mean (logged)	0.0415		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0225
SD in Original Scale	0.0124
95% t UCL (Assumes normality)	0.0255

DL/2 Log-Transformed

Mean in Log Scale	-3.961
SD in Log Scale	0.595
95% H-Stat UCL	0.027

DL/2 is not a recommended method, provided for comparisons and historical reasons

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0289

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Uranium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	43
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	4.1000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.0012	Maximum Non-Detect	4.0000E-4
Variance Detects	1.5623E-7	Percent Non-Detects	93.48%
Mean Detects	8.1333E-4	SD Detects	3.9526E-4
Median Detects	8.3000E-4	CV Detects	0.486
Skewness Detects	-0.189	Kurtosis Detects	N/A
Mean of Logged Detects	-7.206	SD of Logged Detects	0.546

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.999	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.183	Lilliefors GOF Test
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.2696E-4	KM Standard Error of Mean	2.3688E-5
90KM SD	1.3118E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.6674E-4	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.6592E-4	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	4.9802E-4	95% KM Chebyshev UCL	5.3021E-4
97.5% KM Chebyshev UCL	5.7489E-4	99% KM Chebyshev UCL	6.6265E-4

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.271	Anderson-Darling GOF Test
5% A-D Critical Value	0.637	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.242	Kolmogorov-Smirnov GOF

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

5% K-S Critical Value 0.433 Detected data appear Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	5.601	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.4522E-4	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	33.6	nu star (bias corrected)	N/A
Mean (detects)	8.1333E-4		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.1000E-4	Mean	0.0094
Maximum	0.01	Median	0.01
SD	0.00229	CV	0.244
k hat (MLE)	4.796	k star (bias corrected MLE)	4.498
Theta hat (MLE)	0.00196	Theta star (bias corrected MLE)	0.00209
nu hat (MLE)	441.3	nu star (bias corrected)	413.8
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (413.81, α)	367.7	Adjusted Chi Square Value (413.81, β)	366.3
95% Gamma Approximate UCL	0.0106	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.2696E-4	SD (KM)	1.3118E-4
Variance (KM)	1.7208E-8	SE of Mean (KM)	2.3688E-5
k hat (KM)	10.59	k star (KM)	9.917
nu hat (KM)	974.6	nu star (KM)	912.4
theta hat (KM)	4.0304E-5	theta star (KM)	4.3053E-5
80% gamma percentile (KM)	5.3491E-4	90% gamma percentile (KM)	6.0730E-4
95% gamma percentile (KM)	6.7164E-4	99% gamma percentile (KM)	8.0377E-4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (912.36, α)	843.3	Adjusted Chi Square Value (912.36, β)	841.1
95% KM Approximate Gamma UCL	4.6195E-4	95% KM Adjusted Gamma UCL	4.6312E-4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.968	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.789	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.248	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	8.5032E-5	Mean in Log Scale	-11.23
SD in Original Scale	2.1787E-4	SD in Log Scale	2.046

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% t UCL (assumes normality of ROS data)	1.3898E-4	95% Percentile Bootstrap UCL	1.4322E-4
95% BCA Bootstrap UCL	1.6230E-4	95% Bootstrap t UCL	2.2977E-4
95% H-UCL (Log ROS)	3.2836E-4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.784	KM Geo Mean	4.1644E-4
KM SD (logged)	0.19	95% Critical H Value (KM-Log)	1.768
KM Standard Error of Mean (logged)	0.0344	95% H-UCL (KM -Log)	4.4586E-4
KM SD (logged)	0.19	95% Critical H Value (KM-Log)	1.768
KM Standard Error of Mean (logged)	0.0344		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	2.4000E-4
SD in Original Scale	1.7432E-4
95% t UCL (Assumes normality)	2.8316E-4

DL/2 Log-Transformed

Mean in Log Scale	-8.432
SD in Log Scale	0.347
95% H-Stat UCL	2.5372E-4

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 4.6674E-4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	45
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Vanadium was not processed!

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Zinc

General Statistics

Total Number of Observations	46	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	2.64	Mean	3.753
Maximum	5.73	Median	3.505
SD	0.761	Std. Error of Mean	0.112
Coefficient of Variation	0.203	Skewness	0.683

Normal GOF Test

Shapiro Wilk Test Statistic	0.932
1% Shapiro Wilk Critical Value	0.927
Lilliefors Test Statistic	0.147
1% Lilliefors Critical Value	0.151

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 3.941

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	3.949
95% Modified-t UCL (Johnson-1978)	3.943

Gamma GOF Test

A-D Test Statistic	0.756
5% A-D Critical Value	0.748
K-S Test Statistic	0.129
5% K-S Critical Value	0.13

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	26.23	k star (bias corrected MLE)	24.54
Theta hat (MLE)	0.143	Theta star (bias corrected MLE)	0.153
nu hat (MLE)	2413	nu star (bias corrected)	2257
MLE Mean (bias corrected)	3.753	MLE Sd (bias corrected)	0.758
		Approximate Chi Square Value (0.05)	2148
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	2144

Assuming Gamma Distribution

95% Approximate Gamma UCL	3.944	95% Adjusted Gamma UCL	3.95
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953
10% Shapiro Wilk Critical Value	0.953
Lilliefors Test Statistic	0.118
10% Lilliefors Critical Value	0.119

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.971	Mean of logged Data	1.303
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UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Maximum of Logged Data	1.746	SD of logged Data	0.196
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Assuming Lognormal Distribution

95% H-UCL	3.952	90% Chebyshev (MVUE) UCL	4.079
95% Chebyshev (MVUE) UCL	4.228	97.5% Chebyshev (MVUE) UCL	4.434
99% Chebyshev (MVUE) UCL	4.839		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	3.937	95% BCA Bootstrap UCL	3.952
95% Standard Bootstrap UCL	3.936	95% Bootstrap-t UCL	3.962
95% Hall's Bootstrap UCL	3.955	95% Percentile Bootstrap UCL	3.937
90% Chebyshev(Mean, Sd) UCL	4.089	95% Chebyshev(Mean, Sd) UCL	4.241
97.5% Chebyshev(Mean, Sd) UCL	4.453	99% Chebyshev(Mean, Sd) UCL	4.868

Suggested UCL to Use

95% Student's-t UCL 3.941

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

General Statistics

Total Number of Observations	46	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	40
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.047	Minimum Non-Detect	0.04
Maximum Detect	0.123	Maximum Non-Detect	0.04
Variance Detects	7.3950E-4	Percent Non-Detects	86.96%
Mean Detects	0.0715	SD Detects	0.0272
Median Detects	0.0655	CV Detects	0.38
Skewness Detects	1.716	Kurtosis Detects	3.358
Mean of Logged Detects	-2.689	SD of Logged Detects	0.336

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.832	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.713	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.297	Lilliefors GOF Test
1% Lilliefors Critical Value	0.373	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0441	KM Standard Error of Mean	0.00224
90KM SD	0.0139	95% KM (BCA) UCL	0.0479

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

95% KM (t) UCL	0.0479	95% KM (Percentile Bootstrap) UCL	0.0478
95% KM (z) UCL	0.0478	95% KM Bootstrap t UCL	0.0492
90% KM Chebyshev UCL	0.0508	95% KM Chebyshev UCL	0.0539
97.5% KM Chebyshev UCL	0.0581	99% KM Chebyshev UCL	0.0664

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.391	Anderson-Darling GOF Test
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.248	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	9.975	k star (bias corrected MLE)	5.098
Theta hat (MLE)	0.00717	Theta star (bias corrected MLE)	0.014
nu hat (MLE)	119.7	nu star (bias corrected)	61.18
Mean (detects)	0.0715		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0189
Maximum	0.123	Median	0.01
SD	0.0228	CV	1.202
k hat (MLE)	1.66	k star (bias corrected MLE)	1.566
Theta hat (MLE)	0.0114	Theta star (bias corrected MLE)	0.0121
nu hat (MLE)	152.7	nu star (bias corrected)	144.1
Adjusted Level of Significance (β)	0.0448		
Approximate Chi Square Value (144.07, α)	117.3	Adjusted Chi Square Value (144.07, β)	116.5
95% Gamma Approximate UCL	0.0233	95% Gamma Adjusted UCL	0.0234

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0441	SD (KM)	0.0139
Variance (KM)	1.9292E-4	SE of Mean (KM)	0.00224
k hat (KM)	10.08	k star (KM)	9.442
nu hat (KM)	927.8	nu star (KM)	868.6
theta hat (KM)	0.00437	theta star (KM)	0.00467
80% gamma percentile (KM)	0.0555	90% gamma percentile (KM)	0.0632
95% gamma percentile (KM)	0.0701	99% gamma percentile (KM)	0.0842

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (868.62, α)	801.2	Adjusted Chi Square Value (868.62, β)	799.1
95% KM Approximate Gamma UCL	0.0478	95% KM Adjusted Gamma UCL	0.0479

Lognormal GOF Test on Detected Observations Only

UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.826	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.233	Lilliefors GOF Test
10% Lilliefors Critical Value	0.298	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0215	Mean in Log Scale	-4.303
SD in Original Scale	0.0234	SD in Log Scale	0.981
95% t UCL (assumes normality of ROS data)	0.0273	95% Percentile Bootstrap UCL	0.0274
95% BCA Bootstrap UCL	0.0285	95% Bootstrap t UCL	0.0295
95% H-UCL (Log ROS)	0.0307		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.15	KM Geo Mean	0.0429
KM SD (logged)	0.21	95% Critical H Value (KM-Log)	1.776
KM Standard Error of Mean (logged)	0.0339	95% H-UCL (KM -Log)	0.0463
KM SD (logged)	0.21	95% Critical H Value (KM-Log)	1.776
KM Standard Error of Mean (logged)	0.0339		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0267
SD in Original Scale	0.0197
95% t UCL (Assumes normality)	0.0316

DL/2 Log-Transformed

Mean in Log Scale	-3.753
SD in Log Scale	0.431
95% H-Stat UCL	0.029

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0479

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

User Selected Options		
Date/Time of Computation	ProUCL 5.2 2025-11-18 1:38:11 PM	
From File	GBP_Baselines_2025-10-27_x.xls	
Full Precision	OFF	
Confidence Coefficient		95%
Number of Bootstrap Operations		10000

Aluminum

General Statistics

Total Number of Observations	45	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	0.96	Mean	12.85
Maximum	84.7	Median	5.96
SD	17.9	Std. Error of Mean	2.668
Coefficient of Variation	1.393	Skewness	2.671

Normal GOF Test

Shapiro Wilk Test Statistic	0.657	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.253	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	17.33	95% Adjusted-CLT UCL (Chen-1995)	18.37
		95% Modified-t UCL (Johnson-1978)	17.51

Gamma GOF Test

A-D Test Statistic	1.039	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.785	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.111	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.137	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.836	k star (bias corrected MLE)	0.795
Theta hat (MLE)	15.37	Theta star (bias corrected MLE)	16.16
nu hat (MLE)	75.22	nu star (bias corrected)	71.54
MLE Mean (bias corrected)	12.85	MLE Sd (bias corrected)	14.41
		Approximate Chi Square Value (0.05)	53.07
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	52.54

Assuming Gamma Distribution

95% Approximate Gamma UCL	17.32	95% Adjusted Gamma UCL	17.49
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.074	Lilliefors Lognormal GOF Test

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

10% Lilliefors Critical Value 0.12 Data appear Lognormal at 10% Significance Level

[Data appear Lognormal at 10% Significance Level](#)

Lognormal Statistics

Minimum of Logged Data	-0.0408	Mean of logged Data	1.847
Maximum of Logged Data	4.439	SD of logged Data	1.201

Assuming Lognormal Distribution

95% H-UCL	20.9	90% Chebyshev (MVUE) UCL	21.08
95% Chebyshev (MVUE) UCL	24.88	97.5% Chebyshev (MVUE) UCL	30.15
99% Chebyshev (MVUE) UCL	40.5		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	17.23	95% BCA Bootstrap UCL	18.5
95% Standard Bootstrap UCL	17.18	95% Bootstrap-t UCL	19.53
95% Hall's Bootstrap UCL	20.21	95% Percentile Bootstrap UCL	17.5
90% Chebyshev(Mean, Sd) UCL	20.85	95% Chebyshev(Mean, Sd) UCL	24.48
97.5% Chebyshev(Mean, Sd) UCL	29.51	99% Chebyshev(Mean, Sd) UCL	39.39

Suggested UCL to Use

[95% Adjusted Gamma UCL](#) 17.49

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods,

then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Antimony

General Statistics

Total Number of Observations	45	Number of Distinct Observations	9
Number of Detects	9	Number of Non-Detects	36
Number of Distinct Detects	8	Number of Distinct Non-Detects	1
Minimum Detect	0.0021	Minimum Non-Detect	0.002
Maximum Detect	0.0228	Maximum Non-Detect	0.002
Variance Detects	4.46E-05	Percent Non-Detects	80%
Mean Detects	0.00773	SD Detects	0.00668
Median Detects	0.0069	CV Detects	0.864
Skewness Detects	1.653	Kurtosis Detects	2.845
Mean of Logged Detects	-5.163	SD of Logged Detects	0.821

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.816	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.764	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.256	Lilliefors GOF Test
1% Lilliefors Critical Value	0.316	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00315	KM Standard Error of Mean	5.74E-04
90KM SD	0.00363	95% KM (BCA) UCL	0.0041
95% KM (t) UCL	0.00411	95% KM (Percentile Bootstrap) UCL	0.00409
95% KM (z) UCL	0.00409	95% KM Bootstrap t UCL	0.00515
90% KM Chebyshev UCL	0.00487	95% KM Chebyshev UCL	0.00565
97.5% KM Chebyshev UCL	0.00673	99% KM Chebyshev UCL	0.00886

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.355	Anderson-Darling GOF Test
5% A-D Critical Value	0.732	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.187	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.283	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	1.81	k star (bias corrected MLE)	1.281
Theta hat (MLE)	0.00427	Theta star (bias corrected MLE)	0.00604
nu hat (MLE)	32.59	nu star (bias corrected)	23.06
Mean (detects)	0.00773		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0021	Mean	0.00955
Maximum	0.0228	Median	0.01
SD	0.00299	CV	0.313

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

k hat (MLE)	7.831 k star (bias corrected MLE)	7.324
Theta hat (MLE)	0.00122 Theta star (bias corrected MLE)	0.0013
nu hat (MLE)	704.8 nu star (bias corrected)	659.2
Adjusted Level of Significance (β)	0.0447	
Approximate Chi Square Value (659.15, α)	600.6 Adjusted Chi Square Value (659.15, β)	598.7
95% Gamma Approximate UCL	0.0105 95% Gamma Adjusted UCL	0.0105

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00315 SD (KM)	0.00363
Variance (KM)	1.32E-05 SE of Mean (KM)	5.74E-04
k hat (KM)	0.75 k star (KM)	0.715
nu hat (KM)	67.54 nu star (KM)	64.37
theta hat (KM)	0.00419 theta star (KM)	0.0044
80% gamma percentile (KM)	0.00517 90% gamma percentile (KM)	0.00786
95% gamma percentile (KM)	0.0106 99% gamma percentile (KM)	0.0172

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (64.37, α)	46.91 Adjusted Chi Square Value (64.37, β)	46.42
95% KM Approximate Gamma UCL	0.00432 95% KM Adjusted Gamma UCL	0.00436

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.932 Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.859 Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.188 Lilliefors GOF Test
10% Lilliefors Critical Value	0.252 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00184 Mean in Log Scale	-8.051
SD in Original Scale	0.00414 SD in Log Scale	2.032
95% t UCL (assumes normality of ROS data)	0.00287 95% Percentile Bootstrap UCL	0.00291
95% BCA Bootstrap UCL	0.00327 95% Bootstrap t UCL	0.00385
95% H-UCL (Log ROS)	0.00789	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.004 KM Geo Mean	0.00247
KM SD (logged)	0.545 95% Critical H Value (KM-Log)	1.939
KM Standard Error of Mean (logged)	0.0861 95% H-UCL (KM -Log)	0.00336
KM SD (logged)	0.545 95% Critical H Value (KM-Log)	1.939
KM Standard Error of Mean (logged)	0.0861	

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.00235 Mean in Log Scale	-6.559
SD in Original Scale	0.00394 SD in Log Scale	0.788
95% t UCL (Assumes normality)	0.00333 95% H-Stat UCL	0.0025

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% KM (t) UCL

0.00411

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Arsenic

General Statistics

Total Number of Observations	45	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	0.0312	Mean	0.0708
Maximum	0.246	Median	0.052
SD	0.049	Std. Error of Mean	0.00731
Coefficient of Variation	0.692	Skewness	2.148

Normal GOF Test

Shapiro Wilk Test Statistic	0.701	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.272	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0831	95% Adjusted-CLT UCL (Chen-1995)	0.0853
		95% Modified-t UCL (Johnson-1978)	0.0835

Gamma GOF Test

A-D Test Statistic	3.01	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.231	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.133	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.353	k star (bias corrected MLE)	3.145
Theta hat (MLE)	0.0211	Theta star (bias corrected MLE)	0.0225
nu hat (MLE)	301.8	nu star (bias corrected)	283
MLE Mean (bias corrected)	0.0708	MLE Sd (bias corrected)	0.0399
		Approximate Chi Square Value (0.05)	245.1
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	243.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.0818	95% Adjusted Gamma UCL	0.0822
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.871	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.209	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.467	Mean of logged Data	-2.804
Maximum of Logged Data	-1.402	SD of logged Data	0.517

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Assuming Lognormal Distribution

95% H-UCL	0.0803	90% Chebyshev (MVUE) UCL	0.0857
95% Chebyshev (MVUE) UCL	0.0933	97.5% Chebyshev (MVUE) UCL	0.104
99% Chebyshev (MVUE) UCL	0.125		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0828	95% BCA Bootstrap UCL	0.0858
95% Standard Bootstrap UCL	0.0827	95% Bootstrap-t UCL	0.0867
95% Hall's Bootstrap UCL	0.085	95% Percentile Bootstrap UCL	0.0835
90% Chebyshev(Mean, Sd) UCL	0.0927	95% Chebyshev(Mean, Sd) UCL	0.103
97.5% Chebyshev(Mean, Sd) UCL	0.116	99% Chebyshev(Mean, Sd) UCL	0.143

Suggested UCL to Use

95% Student's-t UCL	0.0831
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	0.467	Mean	1.119
Maximum	2.92	Median	1.04
SD	0.497	Std. Error of Mean	0.0741
Coefficient of Variation	0.444	Skewness	1.532

Normal GOF Test

Shapiro Wilk Test Statistic	0.884	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.129	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.244	95% Adjusted-CLT UCL (Chen-1995)	1.259
		95% Modified-t UCL (Johnson-1978)	1.247

Gamma GOF Test

A-D Test Statistic	0.405	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.075	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

k hat (MLE)	6.134 k star (bias corrected MLE)	5.739
Theta hat (MLE)	0.182 Theta star (bias corrected MLE)	0.195
nu hat (MLE)	552 nu star (bias corrected)	516.5
MLE Mean (bias corrected)	1.119 MLE Sd (bias corrected)	0.467
	Approximate Chi Square Value (0.05)	464.8
Adjusted Level of Significance	0.0447 Adjusted Chi Square Value	463.2

Assuming Gamma Distribution

95% Approximate Gamma UCL	1.244 95% Adjusted Gamma UCL	1.248
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98 Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953 Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0684 Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12 Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.761 Mean of logged Data	0.0289
Maximum of Logged Data	1.072 SD of logged Data	0.407

Assuming Lognormal Distribution

95% H-UCL	1.252 90% Chebyshev (MVUE) UCL	1.325
95% Chebyshev (MVUE) UCL	1.42 97.5% Chebyshev (MVUE) UCL	1.552
99% Chebyshev (MVUE) UCL	1.811	

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	1.241 95% BCA Bootstrap UCL	1.258
95% Standard Bootstrap UCL	1.241 95% Bootstrap-t UCL	1.272
95% Hall's Bootstrap UCL	1.281 95% Percentile Bootstrap UCL	1.245
90% Chebyshev(Mean, Sd) UCL	1.342 95% Chebyshev(Mean, Sd) UCL	1.442
97.5% Chebyshev(Mean, Sd) UCL	1.582 99% Chebyshev(Mean, Sd) UCL	1.857

Suggested UCL to Use

95% Student's-t UCL	1.244
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Beryllium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	45
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Beryllium was not processed!

Bismuth

General Statistics

Total Number of Observations	45	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	43
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.0025	Minimum Non-Detect	0.002
Maximum Detect	0.0033	Maximum Non-Detect	0.002
Variance Detects	3.20E-07	Percent Non-Detects	95.56%
Mean Detects	0.0029	SD Detects	5.66E-04
Median Detects	0.0029	CV Detects	0.195
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-5.853	SD of Logged Detects	0.196

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00204	KM Standard Error of Mean	4.30E-05
90KM SD	2.04E-04	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00211	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00211	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00217	95% KM Chebyshev UCL	0.00223
97.5% KM Chebyshev UCL	0.00231	99% KM Chebyshev UCL	0.00247

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	52.23	k star (bias corrected MLE)	N/A
Theta hat (MLE)	5.55E-05	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	208.9	nu star (bias corrected)	N/A
Mean (detects)	0.0029		

Estimates of Gamma Parameters using KM Estimates

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Mean (KM)	0.00204 SD (KM)	2.04E-04
Variance (KM)	4.15E-08 SE of Mean (KM)	4.30E-05
k hat (KM)	100.3 k star (KM)	93.58
nu hat (KM)	9023 nu star (KM)	8423
theta hat (KM)	2.03E-05 theta star (KM)	2.18E-05
80% gamma percentile (KM)	0.00222 90% gamma percentile (KM)	0.00231
95% gamma percentile (KM)	0.0024 99% gamma percentile (KM)	0.00256

Gamma Kaplan-Meier (KM) Statistics

	Adjusted Level of Significance (β)	0.0447
Approximate Chi Square Value (N/A, α)	8210 Adjusted Chi Square Value (N/A, β)	8203
95% KM Approximate Gamma UCL	0.00209 95% KM Adjusted Gamma UCL	0.00209

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	6.16E-04 Mean in Log Scale	-7.8
SD in Original Scale	6.41E-04 SD in Log Scale	0.916
95% t UCL (assumes normality of ROS data)	7.77E-04 95% Percentile Bootstrap UCL	7.80E-04
95% BCA Bootstrap UCL	8.08E-04 95% Bootstrap t UCL	8.46E-04
95% H-UCL (Log ROS)	8.54E-04	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.199 KM Geo Mean	0.00203
KM SD (logged)	0.0801 95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0169 95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0801 95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0169	

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.00108 Mean in Log Scale	-6.861
SD in Original Scale	4.05E-04 SD in Log Scale	0.222
95% t UCL (Assumes normality)	0.00119 95% H-Stat UCL	0.00114

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	0.00211
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Boron

General Statistics

Total Number of Observations	45 Number of Distinct Observations	1
Number of Detects	0 Number of Non-Detects	45
Number of Distinct Detects	0 Number of Distinct Non-Detects	1

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!

Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Boron was not processed!

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Cadmium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	30
Number of Detects	44	Number of Non-Detects	1
Number of Distinct Detects	29	Number of Distinct Non-Detects	1
Minimum Detect	0.0015	Minimum Non-Detect	0.001
Maximum Detect	0.0173	Maximum Non-Detect	0.001
Variance Detects	1.08E-05	Percent Non-Detects	2.22%
Mean Detects	0.00411	SD Detects	0.00328
Median Detects	0.00295	CV Detects	0.799
Skewness Detects	2.308	Kurtosis Detects	6.066
Mean of Logged Detects	-5.708	SD of Logged Detects	0.614

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.732	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.213	Lilliefors GOF Test
1% Lilliefors Critical Value	0.154	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00404	KM Standard Error of Mean	4.88E-04
90KM SD	0.00324	95% KM (BCA) UCL	0.00493
95% KM (t) UCL	0.00486	95% KM (Percentile Bootstrap) UCL	0.0049
95% KM (z) UCL	0.00484	95% KM Bootstrap t UCL	0.00512
90% KM Chebyshev UCL	0.0055	95% KM Chebyshev UCL	0.00617
97.5% KM Chebyshev UCL	0.00709	99% KM Chebyshev UCL	0.0089

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.771	Anderson-Darling GOF Test
5% A-D Critical Value	0.758	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.135	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.5	k star (bias corrected MLE)	2.345
Theta hat (MLE)	0.00164	Theta star (bias corrected MLE)	0.00175
nu hat (MLE)	220	nu star (bias corrected)	206.3
Mean (detects)	0.00411		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0015	Mean	0.00424
Maximum	0.0173	Median	0.003
SD	0.00336	CV	0.793
k hat (MLE)	2.426	k star (bias corrected MLE)	2.279
Theta hat (MLE)	0.00175	Theta star (bias corrected MLE)	0.00186

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

nu hat (MLE)	218.3 nu star (bias corrected)	205.1
Adjusted Level of Significance (β)	0.0447	
Approximate Chi Square Value (205.12, α)	173 Adjusted Chi Square Value (205.12, β)	172
95% Gamma Approximate UCL	0.00503 95% Gamma Adjusted UCL	0.00505

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00404 SD (KM)	0.00324
Variance (KM)	1.05E-05 SE of Mean (KM)	4.88E-04
k hat (KM)	1.554 k star (KM)	1.465
nu hat (KM)	139.9 nu star (KM)	131.9
theta hat (KM)	0.0026 theta star (KM)	0.00276
80% gamma percentile (KM)	0.00626 90% gamma percentile (KM)	0.00846
95% gamma percentile (KM)	0.0106 99% gamma percentile (KM)	0.0154

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (131.88, α)	106.4 Adjusted Chi Square Value (131.88, β)	105.6
95% KM Approximate Gamma UCL	0.00501 95% KM Adjusted Gamma UCL	0.00504

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.914 Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.952 Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.113 Lilliefors GOF Test	
10% Lilliefors Critical Value	0.122 Detected Data appear Lognormal at 10% Significance Level	

[Detected Data appear Approximate Lognormal at 10% Significance Level](#)

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00403 Mean in Log Scale	-5.743
SD in Original Scale	0.00328 SD in Log Scale	0.65
95% t UCL (assumes normality of ROS data)	0.00485 95% Percentile Bootstrap UCL	0.00487
95% BCA Bootstrap UCL	0.005 95% Bootstrap t UCL	0.00517
95% H-UCL (Log ROS)	0.00483	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.735 KM Geo Mean	0.00323
KM SD (logged)	0.626 95% Critical H Value (KM-Log)	2.004
KM Standard Error of Mean (logged)	0.0944 95% H-UCL (KM -Log)	0.00475
KM SD (logged)	0.626 95% Critical H Value (KM-Log)	2.004
KM Standard Error of Mean (logged)	0.0944	

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.00403 Mean in Log Scale	-5.75
SD in Original Scale	0.00329 SD in Log Scale	0.669
95% t UCL (Assumes normality)	0.00485 95% H-Stat UCL	0.00489

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

[Detected Data appear Approximate Lognormal Distributed at 10% Significance Level](#)

Suggested UCL to Use

[KM H-UCL](#) 0.00475

[Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.](#)

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	4510	Mean	14319
Maximum	24200	Median	14700
SD	5054	Std. Error of Mean	753.4
Coefficient of Variation	0.353	Skewness	0.0366

Normal GOF Test

Shapiro Wilk Test Statistic	0.965	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.0837	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15585	95% Adjusted-CLT UCL (Chen-1995)	15562
		95% Modified-t UCL (Johnson-1978)	15585

Gamma GOF Test

A-D Test Statistic	0.614	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.106	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.11	k star (bias corrected MLE)	6.651
Theta hat (MLE)	2014	Theta star (bias corrected MLE)	2153
nu hat (MLE)	639.9	nu star (bias corrected)	598.6
MLE Mean (bias corrected)	14319	MLE Sd (bias corrected)	5552
		Approximate Chi Square Value (0.05)	542.8
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	541.1

Assuming Gamma Distribution

95% Approximate Gamma UCL	15790	95% Adjusted Gamma UCL	15841
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.12	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.414	Mean of logged Data	9.497
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Maximum of Logged Data	10.09 SD of logged Data	0.405
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Assuming Lognormal Distribution

95% H-UCL	16188	90% Chebyshev (MVUE) UCL	17141
95% Chebyshev (MVUE) UCL	18366	97.5% Chebyshev (MVUE) UCL	20066
99% Chebyshev (MVUE) UCL	23405		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	15558	95% BCA Bootstrap UCL	15558
95% Standard Bootstrap UCL	15539	95% Bootstrap-t UCL	15595
95% Hall's Bootstrap UCL	15578	95% Percentile Bootstrap UCL	15542
90% Chebyshev(Mean, Sd) UCL	16579	95% Chebyshev(Mean, Sd) UCL	17603
97.5% Chebyshev(Mean, Sd) UCL	19024	99% Chebyshev(Mean, Sd) UCL	21815

Suggested UCL to Use

95% Student's-t UCL 15585

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Cesium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	0.0022	Mean	0.0143
Maximum	0.0432	Median	0.0138
SD	0.00912	Std. Error of Mean	0.00136
Coefficient of Variation	0.639	Skewness	1.121

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.147	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0166	95% Adjusted-CLT UCL (Chen-1995)	0.0168
		95% Modified-t UCL (Johnson-1978)	0.0166

Gamma GOF Test

A-D Test Statistic	0.889	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.134	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.133	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.325	k star (bias corrected MLE)	2.185
Theta hat (MLE)	0.00614	Theta star (bias corrected MLE)	0.00654
nu hat (MLE)	209.3	nu star (bias corrected)	196.6
MLE Mean (bias corrected)	0.0143	MLE Sd (bias corrected)	0.00967
		Approximate Chi Square Value (0.05)	165.2
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	164.2

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.017	95% Adjusted Gamma UCL	0.0171
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.178	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-6.119	Mean of logged Data	-4.479
Maximum of Logged Data	-3.142	SD of logged Data	0.744

Assuming Lognormal Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% H-UCL	0.019	90% Chebyshev (MVUE) UCL	0.0203
95% Chebyshev (MVUE) UCL	0.0228	97.5% Chebyshev (MVUE) UCL	0.0262
99% Chebyshev (MVUE) UCL	0.0329		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0165	95% BCA Bootstrap UCL	0.0167
95% Standard Bootstrap UCL	0.0165	95% Bootstrap-t UCL	0.0168
95% Hall's Bootstrap UCL	0.0169	95% Percentile Bootstrap UCL	0.0165
90% Chebyshev(Mean, Sd) UCL	0.0184	95% Chebyshev(Mean, Sd) UCL	0.0202
97.5% Chebyshev(Mean, Sd) UCL	0.0228	99% Chebyshev(Mean, Sd) UCL	0.0278

Suggested UCL to Use

95% Student's-t UCL 0.0166

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	27
Number of Detects	40	Number of Non-Detects	5
Number of Distinct Detects	27	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.176	Maximum Non-Detect	0.01
Variance Detects	0.00146	Percent Non-Detects	11.11%
Mean Detects	0.0389	SD Detects	0.0381
Median Detects	0.026	CV Detects	0.981
Skewness Detects	2.59	Kurtosis Detects	6.921
Mean of Logged Detects	-3.533	SD of Logged Detects	0.695

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.652	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.919	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.286	Lilliefors GOF Test
1% Lilliefors Critical Value	0.162	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0357	KM Standard Error of Mean	0.00553
90KM SD	0.0367	95% KM (BCA) UCL	0.0458
95% KM (t) UCL	0.045	95% KM (Percentile Bootstrap) UCL	0.0453
95% KM (z) UCL	0.0448	95% KM Bootstrap t UCL	0.0496
90% KM Chebyshev UCL	0.0523	95% KM Chebyshev UCL	0.0598
97.5% KM Chebyshev UCL	0.0702	99% KM Chebyshev UCL	0.0907

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.18	Anderson-Darling GOF Test
5% A-D Critical Value	0.76	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.214	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.141	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.901	k star (bias corrected MLE)	1.775
Theta hat (MLE)	0.0204	Theta star (bias corrected MLE)	0.0219
nu hat (MLE)	152.1	nu star (bias corrected)	142
Mean (detects)	0.0389		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0357
Maximum	0.176	Median	0.023
SD	0.0371	CV	1.039
k hat (MLE)	1.718	k star (bias corrected MLE)	1.618
Theta hat (MLE)	0.0208	Theta star (bias corrected MLE)	0.022
nu hat (MLE)	154.6	nu star (bias corrected)	145.6
Adjusted Level of Significance (β)	0.0447		
Approximate Chi Square Value (145.62, α)	118.7	Adjusted Chi Square Value (145.62, β)	117.9
95% Gamma Approximate UCL	0.0437	95% Gamma Adjusted UCL	0.044

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0357	SD (KM)	0.0367
Variance (KM)	0.00134	SE of Mean (KM)	0.00553
k hat (KM)	0.947	k star (KM)	0.898
nu hat (KM)	85.21	nu star (KM)	80.86
theta hat (KM)	0.0377	theta star (KM)	0.0397
80% gamma percentile (KM)	0.0579	90% gamma percentile (KM)	0.0843
95% gamma percentile (KM)	0.111	99% gamma percentile (KM)	0.173

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (80.86, α)	61.14	Adjusted Chi Square Value (80.86, β)	60.57
95% KM Approximate Gamma UCL	0.0472	95% KM Adjusted Gamma UCL	0.0476

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.915	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.949	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.16	Lilliefors GOF Test
10% Lilliefors Critical Value	0.128	Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0352	Mean in Log Scale	-3.709
SD in Original Scale	0.0374	SD in Log Scale	0.829
95% t UCL (assumes normality of ROS data)	0.0446	95% Percentile Bootstrap UCL	0.0448

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% BCA Bootstrap UCL	0.0467	95% Bootstrap t UCL	0.0495
95% H-UCL (Log ROS)	0.0454		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.652	KM Geo Mean	0.0259
KM SD (logged)	0.729	95% Critical H Value (KM-Log)	2.099
KM Standard Error of Mean (logged)	0.11	95% H-UCL (KM -Log)	0.0426
KM SD (logged)	0.729	95% Critical H Value (KM-Log)	2.099
KM Standard Error of Mean (logged)	0.11		

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.0351	Mean in Log Scale	-3.729
SD in Original Scale	0.0375	SD in Log Scale	0.862
95% t UCL (Assumes normality)	0.0445	95% H-Stat UCL	0.0465

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL	0.045
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Cobalt

General Statistics

Total Number of Observations	45	Number of Distinct Observations	41
Number of Detects	43	Number of Non-Detects	2
Number of Distinct Detects	41	Number of Distinct Non-Detects	1
Minimum Detect	0.004	Minimum Non-Detect	0.004
Maximum Detect	0.0587	Maximum Non-Detect	0.004
Variance Detects	1.56E-04	Percent Non-Detects	4.44%
Mean Detects	0.0147	SD Detects	0.0125
Median Detects	0.0101	CV Detects	0.85
Skewness Detects	1.958	Kurtosis Detects	3.824
Mean of Logged Detects	-4.487	SD of Logged Detects	0.71

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.766	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.217	Lilliefors GOF Test
1% Lilliefors Critical Value	0.156	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0142	KM Standard Error of Mean	0.00185
90KM SD	0.0123	95% KM (BCA) UCL	0.0175
95% KM (t) UCL	0.0174	95% KM (Percentile Bootstrap) UCL	0.0174
95% KM (z) UCL	0.0173	95% KM Bootstrap t UCL	0.0183
90% KM Chebyshev UCL	0.0198	95% KM Chebyshev UCL	0.0223
97.5% KM Chebyshev UCL	0.0258	99% KM Chebyshev UCL	0.0327

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.196	Anderson-Darling GOF Test
5% A-D Critical Value	0.76	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.136	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.137	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.016	k star (bias corrected MLE)	1.891
Theta hat (MLE)	0.0073	Theta star (bias corrected MLE)	0.00778
nu hat (MLE)	173.4	nu star (bias corrected)	162.6
Mean (detects)	0.0147		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.004	Mean	0.0145
Maximum	0.0587	Median	0.01
SD	0.0123	CV	0.845
k hat (MLE)	2.082	k star (bias corrected MLE)	1.958

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Theta hat (MLE)	0.00697	Theta star (bias corrected MLE)	0.00741
nu hat (MLE)	187.4	nu star (bias corrected)	176.2
Adjusted Level of Significance (β)	0.0447		
Approximate Chi Square Value (176.25, α)	146.5	Adjusted Chi Square Value (176.25, β)	145.7
95% Gamma Approximate UCL	0.0174	95% Gamma Adjusted UCL	0.0176

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0142	SD (KM)	0.0123
Variance (KM)	1.51E-04	SE of Mean (KM)	0.00185
k hat (KM)	1.345	k star (KM)	1.27
nu hat (KM)	121.1	nu star (KM)	114.3
theta hat (KM)	0.0106	theta star (KM)	0.0112
80% gamma percentile (KM)	0.0224	90% gamma percentile (KM)	0.0309
95% gamma percentile (KM)	0.0392	99% gamma percentile (KM)	0.0583

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (114.32, α)	90.63	Adjusted Chi Square Value (114.32, β)	89.94
95% KM Approximate Gamma UCL	0.018	95% KM Adjusted Gamma UCL	0.0181

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.944	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.951	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.107	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.123	Detected Data appear Lognormal at 10% Significance Level	

[Detected Data appear Approximate Lognormal at 10% Significance Level](#)

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0142	Mean in Log Scale	-4.563
SD in Original Scale	0.0125	SD in Log Scale	0.782
95% t UCL (assumes normality of ROS data)	0.0173	95% Percentile Bootstrap UCL	0.0173
95% BCA Bootstrap UCL	0.0177	95% Bootstrap t UCL	0.0182
95% H-UCL (Log ROS)	0.0182		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.533	KM Geo Mean	0.0108
KM SD (logged)	0.718	95% Critical H Value (KM-Log)	2.09
KM Standard Error of Mean (logged)	0.108	95% H-UCL (KM -Log)	0.0174
KM SD (logged)	0.718	95% Critical H Value (KM-Log)	2.09
KM Standard Error of Mean (logged)	0.108		

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.0142	Mean in Log Scale	-4.564
SD in Original Scale	0.0125	SD in Log Scale	0.781
95% t UCL (Assumes normality)	0.0173	95% H-Stat UCL	0.0182

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

[Detected Data appear Approximate Gamma Distributed at 5% Significance Level](#)

Suggested UCL to Use

95% KM Adjusted Gamma UCL	0.0181	95% GROS Adjusted Gamma UCL	0.0176
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observations	45	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	0.174	Mean	0.498
Maximum	0.97	Median	0.426
SD	0.208	Std. Error of Mean	0.031
Coefficient of Variation	0.418	Skewness	0.546

Normal GOF Test

Shapiro Wilk Test Statistic	0.9	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.178	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.55	95% Adjusted-CLT UCL (Chen-1995)	0.552
		95% Modified-t UCL (Johnson-1978)	0.551

Gamma GOF Test

A-D Test Statistic	1.347	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.165	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.019	k star (bias corrected MLE)	5.633
Theta hat (MLE)	0.0828	Theta star (bias corrected MLE)	0.0884
nu hat (MLE)	541.7	nu star (bias corrected)	507
MLE Mean (bias corrected)	0.498	MLE Sd (bias corrected)	0.21
		Approximate Chi Square Value (0.05)	455.7
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	454.1

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.554	95% Adjusted Gamma UCL	0.556
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.933	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.152	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.749	Mean of logged Data	-0.782
Maximum of Logged Data	-0.0305	SD of logged Data	0.42

Assuming Lognormal Distribution

95% H-UCL	0.562	90% Chebyshev (MVUE) UCL	0.595
95% Chebyshev (MVUE) UCL	0.639	97.5% Chebyshev (MVUE) UCL	0.7
99% Chebyshev (MVUE) UCL	0.82		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.549	95% BCA Bootstrap UCL	0.551
95% Standard Bootstrap UCL	0.549	95% Bootstrap-t UCL	0.553
95% Hall's Bootstrap UCL	0.551	95% Percentile Bootstrap UCL	0.55
90% Chebyshev(Mean, Sd) UCL	0.591	95% Chebyshev(Mean, Sd) UCL	0.633
97.5% Chebyshev(Mean, Sd) UCL	0.692	99% Chebyshev(Mean, Sd) UCL	0.807

Suggested UCL to Use

95% Student's-t UCL 0.55

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Iron

General Statistics

Total Number of Observations	45	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	9.07	Mean	24.05
Maximum	108	Median	18.9
SD	19.41	Std. Error of Mean	2.894
Coefficient of Variation	0.807	Skewness	2.881

Normal GOF Test

Shapiro Wilk Test Statistic	0.658	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.256	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	28.91	95% Adjusted-CLT UCL (Chen-1995)	30.14
		95% Modified-t UCL (Johnson-1978)	29.12

Gamma GOF Test

A-D Test Statistic	2.087	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.169	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.133	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.824	k star (bias corrected MLE)	2.651
Theta hat (MLE)	8.515	Theta star (bias corrected MLE)	9.073
nu hat (MLE)	254.2	nu star (bias corrected)	238.6
MLE Mean (bias corrected)	24.05	MLE Sd (bias corrected)	14.77
		Approximate Chi Square Value (0.05)	203.8
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	202.8

Assuming Gamma Distribution

95% Approximate Gamma UCL	28.15	95% Adjusted Gamma UCL	28.3
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.914	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.123	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.205	Mean of logged Data	2.993
Maximum of Logged Data	4.682	SD of logged Data	0.559

Assuming Lognormal Distribution

95% H-UCL	27.47	90% Chebyshev (MVUE) UCL	29.37
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% Chebyshev (MVUE) UCL	32.16	97.5% Chebyshev (MVUE) UCL	36.03
99% Chebyshev (MVUE) UCL	43.63		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	28.81	95% BCA Bootstrap UCL	30.41
95% Standard Bootstrap UCL	28.76	95% Bootstrap-t UCL	31.63
95% Hall's Bootstrap UCL	33.3	95% Percentile Bootstrap UCL	29.1
90% Chebyshev(Mean, Sd) UCL	32.73	95% Chebyshev(Mean, Sd) UCL	36.66
97.5% Chebyshev(Mean, Sd) UCL	42.12	99% Chebyshev(Mean, Sd) UCL	52.84

Suggested UCL to Use

95% Student's-t UCL	28.91
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	45	Number of Distinct Observations	43
Number of Detects	44	Number of Non-Detects	1
Number of Distinct Detects	42	Number of Distinct Non-Detects	1
Minimum Detect	0.0051	Minimum Non-Detect	0.004
Maximum Detect	0.499	Maximum Non-Detect	0.004
Variance Detects	0.00634	Percent Non-Detects	2.22%
Mean Detects	0.039	SD Detects	0.0796
Median Detects	0.0174	CV Detects	2.043
Skewness Detects	4.921	Kurtosis Detects	27.04
Mean of Logged Detects	-3.868	SD of Logged Detects	0.892

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.394	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.371	Lilliefors GOF Test
1% Lilliefors Critical Value	0.154	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0382	KM Standard Error of Mean	0.0118
90KM SD	0.078	95% KM (BCA) UCL	0.0605
95% KM (t) UCL	0.0579	95% KM (Percentile Bootstrap) UCL	0.0592
95% KM (z) UCL	0.0575	95% KM Bootstrap t UCL	0.0912
90% KM Chebyshev UCL	0.0735	95% KM Chebyshev UCL	0.0895
97.5% KM Chebyshev UCL	0.112	99% KM Chebyshev UCL	0.155

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.863	Anderson-Darling GOF Test
5% A-D Critical Value	0.78	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.282	Kolmogorov-Smirnov GOF

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

5% K-S Critical Value 0.138 Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.934 k star (bias corrected MLE)	0.885
Theta hat (MLE)	0.0417 Theta star (bias corrected MLE)	0.044
nu hat (MLE)	82.19 nu star (bias corrected)	77.92
Mean (detects)	0.039	

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0051 Mean	0.0383
Maximum	0.499 Median	0.0171
SD	0.0788 CV	2.057
k hat (MLE)	0.934 k star (bias corrected MLE)	0.887
Theta hat (MLE)	0.041 Theta star (bias corrected MLE)	0.0432
nu hat (MLE)	84.09 nu star (bias corrected)	79.82
Adjusted Level of Significance (β)	0.0447	
Approximate Chi Square Value (79.82, α)	60.23 Adjusted Chi Square Value (79.82, β)	59.67
95% Gamma Approximate UCL	0.0508 95% Gamma Adjusted UCL	0.0513

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0382 SD (KM)	0.078
Variance (KM)	0.00608 SE of Mean (KM)	0.0118
k hat (KM)	0.24 k star (KM)	0.239
nu hat (KM)	21.58 nu star (KM)	21.47
theta hat (KM)	0.159 theta star (KM)	0.16
80% gamma percentile (KM)	0.0545 90% gamma percentile (KM)	0.115
95% gamma percentile (KM)	0.187 99% gamma percentile (KM)	0.382

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (21.47, α)	11.95 Adjusted Chi Square Value (21.47, β)	11.71
95% KM Approximate Gamma UCL	0.0687 95% KM Adjusted Gamma UCL	0.07

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.864 Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.952 Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.172 Lilliefors GOF Test	
10% Lilliefors Critical Value	0.122 Detected Data Not Lognormal at 10% Significance Level	

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0382 Mean in Log Scale	-3.916
SD in Original Scale	0.0789 SD in Log Scale	0.939
95% t UCL (assumes normality of ROS data)	0.0579 95% Percentile Bootstrap UCL	0.0593
95% BCA Bootstrap UCL	0.0695 95% Bootstrap t UCL	0.0918
95% H-UCL (Log ROS)	0.0429	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

KM Mean (logged)	-3.905	KM Geo Mean	0.0201
KM SD (logged)	0.906	95% Critical H Value (KM-Log)	2.27
KM Standard Error of Mean (logged)	0.137	95% H-UCL (KM -Log)	0.0414
KM SD (logged)	0.906	95% Critical H Value (KM-Log)	2.27
KM Standard Error of Mean (logged)	0.137		

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.0381	Mean in Log Scale	-3.92
SD in Original Scale	0.0789	SD in Log Scale	0.949
95% t UCL (Assumes normality)	0.0579	95% H-Stat UCL	0.0433

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0579

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Lithium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	7
Number of Detects	14	Number of Non-Detects	31
Number of Distinct Detects	7	Number of Distinct Non-Detects	1
Minimum Detect	0.1	Minimum Non-Detect	0.1
Maximum Detect	0.17	Maximum Non-Detect	0.1
Variance Detects	5.04E-04	Percent Non-Detects	68.89%
Mean Detects	0.125	SD Detects	0.0224
Median Detects	0.125	CV Detects	0.18
Skewness Detects	0.595	Kurtosis Detects	-0.313
Mean of Logged Detects	-2.094	SD of Logged Detects	0.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.909	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.825	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.153	Lilliefors GOF Test
1% Lilliefors Critical Value	0.263	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.108	KM Standard Error of Mean	0.00259
90KM SD	0.0167	95% KM (BCA) UCL	0.112
95% KM (t) UCL	0.112	95% KM (Percentile Bootstrap) UCL	0.112
95% KM (z) UCL	0.112	95% KM Bootstrap t UCL	0.114
90% KM Chebyshev UCL	0.116	95% KM Chebyshev UCL	0.119
97.5% KM Chebyshev UCL	0.124	99% KM Chebyshev UCL	0.134

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.458	Anderson-Darling GOF Test
5% A-D Critical Value	0.733	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.172	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.228	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	34.58	k star (bias corrected MLE)	27.22
Theta hat (MLE)	0.00361	Theta star (bias corrected MLE)	0.00459
nu hat (MLE)	968.3	nu star (bias corrected)	762.2
Mean (detects)	0.125		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0765
Maximum	0.17	Median	0.0733
SD	0.0407	CV	0.531
k hat (MLE)	2.837	k star (bias corrected MLE)	2.663
Theta hat (MLE)	0.027	Theta star (bias corrected MLE)	0.0287

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

nu hat (MLE)	255.3 nu star (bias corrected)	239.7
Adjusted Level of Significance (β)	0.0447	
Approximate Chi Square Value (239.65, α)	204.8 Adjusted Chi Square Value (239.65, β)	203.8
95% Gamma Approximate UCL	0.0895 95% Gamma Adjusted UCL	0.09

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.108 SD (KM)	0.0167
Variance (KM)	2.80E-04 SE of Mean (KM)	0.00259
k hat (KM)	41.56 k star (KM)	38.8
nu hat (KM)	3740 nu star (KM)	3492
theta hat (KM)	0.00259 theta star (KM)	0.00278
80% gamma percentile (KM)	0.122 90% gamma percentile (KM)	0.13
95% gamma percentile (KM)	0.138 99% gamma percentile (KM)	0.152

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	3356 Adjusted Chi Square Value (N/A, β)	3352
95% KM Approximate Gamma UCL	0.112 95% KM Adjusted Gamma UCL	0.112

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.916 Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.895 Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.168 Lilliefors GOF Test
10% Lilliefors Critical Value	0.208 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0861 Mean in Log Scale	-2.517
SD in Original Scale	0.032 SD in Log Scale	0.366
95% t UCL (assumes normality of ROS data)	0.0941 95% Percentile Bootstrap UCL	0.094
95% BCA Bootstrap UCL	0.0942 95% Bootstrap t UCL	0.095
95% H-UCL (Log ROS)	0.0954	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.238 KM Geo Mean	0.107
KM SD (logged)	0.135 95% Critical H Value (KM-Log)	1.682
KM Standard Error of Mean (logged)	0.0209 95% H-UCL (KM -Log)	0.111
KM SD (logged)	0.135 95% Critical H Value (KM-Log)	1.682
KM Standard Error of Mean (logged)	0.0209	

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.0733 Mean in Log Scale	-2.715
SD in Original Scale	0.0372 SD in Log Scale	0.433
95% t UCL (Assumes normality)	0.0826 95% H-Stat UCL	0.0821

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.112
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Magnesium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	178	Mean	431.5
Maximum	598	Median	435
SD	75.7	Std. Error of Mean	11.28
Coefficient of Variation	0.175	Skewness	-0.688

Normal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.0599	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	450.5	95% Adjusted-CLT UCL (Chen-1995)	448.8
		95% Modified-t UCL (Johnson-1978)	450.3

Gamma GOF Test

A-D Test Statistic	0.652	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.09	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	28.18	k star (bias corrected MLE)	26.32
Theta hat (MLE)	15.31	Theta star (bias corrected MLE)	16.4
nu hat (MLE)	2536	nu star (bias corrected)	2369
MLE Mean (bias corrected)	431.5	MLE Sd (bias corrected)	84.11
		Approximate Chi Square Value (0.05)	2257
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	2253

Assuming Gamma Distribution

95% Approximate Gamma UCL	452.9	95% Adjusted Gamma UCL	453.7
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.882	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.106	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.182	Mean of logged Data	6.049
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Maximum of Logged Data	6.394 SD of logged Data	0.202
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Assuming Lognormal Distribution

95% H-UCL	455.4	90% Chebyshev (MVUE) UCL	471.7
95% Chebyshev (MVUE) UCL	489.6	97.5% Chebyshev (MVUE) UCL	514.3
99% Chebyshev (MVUE) UCL	562.9		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	450.1	95% BCA Bootstrap UCL	448.7
95% Standard Bootstrap UCL	449.8	95% Bootstrap-t UCL	449.5
95% Hall's Bootstrap UCL	449.5	95% Percentile Bootstrap UCL	449.4
90% Chebyshev(Mean, Sd) UCL	465.4	95% Chebyshev(Mean, Sd) UCL	480.7
97.5% Chebyshev(Mean, Sd) UCL	502	99% Chebyshev(Mean, Sd) UCL	543.8

Suggested UCL to Use

95% Student's-t UCL 450.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Manganese

General Statistics

Total Number of Observations	45	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	2.28	Mean	11.45
Maximum	62.5	Median	6.19
SD	12.81	Std. Error of Mean	1.91
Coefficient of Variation	1.119	Skewness	2.497

Normal GOF Test

Shapiro Wilk Test Statistic	0.648	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.29	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level	

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL

95% UCLs (Adjusted for Skewness)

14.66	95% Adjusted-CLT UCL (Chen-1995)	15.35
	95% Modified-t UCL (Johnson-1978)	14.78

Gamma GOF Test

A-D Test Statistic	2.786	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.134	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.491	k star (bias corrected MLE)	1.407
Theta hat (MLE)	7.679	Theta star (bias corrected MLE)	8.141
nu hat (MLE)	134.2	nu star (bias corrected)	126.6
MLE Mean (bias corrected)	11.45	MLE Sd (bias corrected)	9.656
		Approximate Chi Square Value (0.05)	101.6
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	100.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	14.27	95% Adjusted Gamma UCL	14.37
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.908	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.138	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.824	Mean of logged Data	2.067
Maximum of Logged Data	4.135	SD of logged Data	0.787

Assuming Lognormal Distribution

95% H-UCL	13.9	90% Chebyshev (MVUE) UCL	14.86
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% Chebyshev (MVUE) UCL	16.76	97.5% Chebyshev (MVUE) UCL	19.39
99% Chebyshev (MVUE) UCL	24.55		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	14.59	95% BCA Bootstrap UCL	15.4
95% Standard Bootstrap UCL	14.56	95% Bootstrap-t UCL	16.13
95% Hall's Bootstrap UCL	15.53	95% Percentile Bootstrap UCL	14.73
90% Chebyshev(Mean, Sd) UCL	17.18	95% Chebyshev(Mean, Sd) UCL	19.78
97.5% Chebyshev(Mean, Sd) UCL	23.38	99% Chebyshev(Mean, Sd) UCL	30.45

Suggested UCL to Use

95% Student's-t UCL	14.66
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury

General Statistics

Total Number of Observations	45	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	0.0161	Mean	0.0649
Maximum	0.194	Median	0.0605
SD	0.0317	Std. Error of Mean	0.00472
Coefficient of Variation	0.488	Skewness	1.75

Normal GOF Test

Shapiro Wilk Test Statistic	0.886	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.154	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0728	95% Adjusted-CLT UCL (Chen-1995)	0.0739
		95% Modified-t UCL (Johnson-1978)	0.073

Gamma GOF Test

A-D Test Statistic	0.268	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.095	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.972 k star (bias corrected MLE)	4.655
Theta hat (MLE)	0.013 Theta star (bias corrected MLE)	0.0139
nu hat (MLE)	447.5 nu star (bias corrected)	419
MLE Mean (bias corrected)	0.0649 MLE Sd (bias corrected)	0.0301
	Approximate Chi Square Value (0.05)	372.5
Adjusted Level of Significance	0.0447 Adjusted Chi Square Value	371.1

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.0729	95% Adjusted Gamma UCL	0.0732
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.992	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0731	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.129 Mean of logged Data	-2.839
Maximum of Logged Data	-1.64 SD of logged Data	0.464

Assuming Lognormal Distribution

95% H-UCL	0.0742	90% Chebyshev (MVUE) UCL	0.079
95% Chebyshev (MVUE) UCL	0.0853	97.5% Chebyshev (MVUE) UCL	0.0942
99% Chebyshev (MVUE) UCL	0.112		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0726	95% BCA Bootstrap UCL	0.0738
95% Standard Bootstrap UCL	0.0726	95% Bootstrap-t UCL	0.0747
95% Hall's Bootstrap UCL	0.0764	95% Percentile Bootstrap UCL	0.0728
90% Chebyshev(Mean, Sd) UCL	0.079	95% Chebyshev(Mean, Sd) UCL	0.0854
97.5% Chebyshev(Mean, Sd) UCL	0.0943	99% Chebyshev(Mean, Sd) UCL	0.112

Suggested UCL to Use

95% Adjusted Gamma UCL	0.0732
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Methylmercury

General Statistics

Total Number of Observations	45	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	14.4	Mean	45.82
Maximum	106	Median	43.7
SD	20.07	Std. Error of Mean	2.992
Coefficient of Variation	0.438	Skewness	0.809

Normal GOF Test

Shapiro Wilk Test Statistic	0.941	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.0958	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	50.85	95% Adjusted-CLT UCL (Chen-1995)	51.13
		95% Modified-t UCL (Johnson-1978)	50.91

Gamma GOF Test

A-D Test Statistic	0.35	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0931	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.483	k star (bias corrected MLE)	5.132
Theta hat (MLE)	8.358	Theta star (bias corrected MLE)	8.929
nu hat (MLE)	493.4	nu star (bias corrected)	461.9
MLE Mean (bias corrected)	45.82	MLE Sd (bias corrected)	20.23
		Approximate Chi Square Value (0.05)	413
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	411.5

Assuming Gamma Distribution

95% Approximate Gamma UCL	51.24	95% Adjusted Gamma UCL	51.43
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.977	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0818	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.667	Mean of logged Data	3.731
Maximum of Logged Data	4.663	SD of logged Data	0.445

Assuming Lognormal Distribution

95% H-UCL	52.19	90% Chebyshev (MVUE) UCL	55.43
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% Chebyshev (MVUE) UCL	59.73	97.5% Chebyshev (MVUE) UCL	65.7
99% Chebyshev (MVUE) UCL	77.43		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	50.74	95% BCA Bootstrap UCL	51.18
95% Standard Bootstrap UCL	50.72	95% Bootstrap-t UCL	51.35
95% Hall's Bootstrap UCL	51.31	95% Percentile Bootstrap UCL	50.74
90% Chebyshev(Mean, Sd) UCL	54.8	95% Chebyshev(Mean, Sd) UCL	58.87
97.5% Chebyshev(Mean, Sd) UCL	64.51	99% Chebyshev(Mean, Sd) UCL	75.6

Suggested UCL to Use

95% Student's-t UCL	50.85
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics

Total Number of Observations	45	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	0.0064	Mean	0.0141
Maximum	0.0318	Median	0.0121
SD	0.00658	Std. Error of Mean	9.82E-04
Coefficient of Variation	0.466	Skewness	1.328

Normal GOF Test

Shapiro Wilk Test Statistic	0.833	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.193	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0158	95% Adjusted-CLT UCL (Chen-1995)	0.016
		95% Modified-t UCL (Johnson-1978)	0.0158

Gamma GOF Test

A-D Test Statistic	1.331	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.765	k star (bias corrected MLE)	5.395
Theta hat (MLE)	0.00245	Theta star (bias corrected MLE)	0.00262

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

nu hat (MLE)	518.8 nu star (bias corrected)	485.6
MLE Mean (bias corrected)	0.0141 MLE Sd (bias corrected)	0.00609
	Approximate Chi Square Value (0.05)	435.5
Adjusted Level of Significance	0.0447 Adjusted Chi Square Value	433.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.0158 95% Adjusted Gamma UCL	0.0158
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.935 Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953 Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.111 Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12 Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.051 Mean of logged Data	-4.348
Maximum of Logged Data	-3.448 SD of logged Data	0.412

Assuming Lognormal Distribution

95% H-UCL	0.0158 90% Chebyshev (MVUE) UCL	0.0167
95% Chebyshev (MVUE) UCL	0.0179 97.5% Chebyshev (MVUE) UCL	0.0196
99% Chebyshev (MVUE) UCL	0.0229	

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0158 95% BCA Bootstrap UCL	0.016
95% Standard Bootstrap UCL	0.0157 95% Bootstrap-t UCL	0.0161
95% Hall's Bootstrap UCL	0.016 95% Percentile Bootstrap UCL	0.0158
90% Chebyshev(Mean, Sd) UCL	0.0171 95% Chebyshev(Mean, Sd) UCL	0.0184
97.5% Chebyshev(Mean, Sd) UCL	0.0203 99% Chebyshev(Mean, Sd) UCL	0.0239

Suggested UCL to Use

95% H-UCL	0.0158
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nickel

General Statistics

Total Number of Observations	45 Number of Distinct Observations	8
Number of Detects	8 Number of Non-Detects	37
Number of Distinct Detects	7 Number of Distinct Non-Detects	1
Minimum Detect	0.05 Minimum Non-Detect	0.04
Maximum Detect	0.105 Maximum Non-Detect	0.04
Variance Detects	4.05E-04 Percent Non-Detects	82.22%
Mean Detects	0.0666 SD Detects	0.0201
Median Detects	0.0595 CV Detects	0.302
Skewness Detects	1.409 Kurtosis Detects	0.686

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Mean of Logged Detects -2.743 SD of Logged Detects 0.271

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.778 **Shapiro Wilk GOF Test**
 1% Shapiro Wilk Critical Value 0.749 Detected Data appear Normal at 1% Significance Level
 Lilliefors Test Statistic 0.36 **Lilliefors GOF Test**
 1% Lilliefors Critical Value 0.333 Detected Data Not Normal at 1% Significance Level

Detected Data appear Approximate Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean 0.0447 KM Standard Error of Mean 0.00206
 90KM SD 0.0129 95% KM (BCA) UCL 0.0483
95% KM (t) UCL 0.0482 95% KM (Percentile Bootstrap) UCL 0.0482
 95% KM (z) UCL 0.0481 95% KM Bootstrap t UCL 0.0504
 90% KM Chebyshev UCL 0.0509 95% KM Chebyshev UCL 0.0537
 97.5% KM Chebyshev UCL 0.0576 99% KM Chebyshev UCL 0.0652

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 0.808 **Anderson-Darling GOF Test**
 5% A-D Critical Value 0.716 Detected Data Not Gamma Distributed at 5% Significance Level
 K-S Test Statistic 0.347 **Kolmogorov-Smirnov GOF**
 5% K-S Critical Value 0.294 Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE) 14.64 k star (bias corrected MLE) 9.23
 Theta hat (MLE) 0.00455 Theta star (bias corrected MLE) 0.00722
 nu hat (MLE) 234.2 nu star (bias corrected) 147.7
 Mean (detects) 0.0666

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum 0.01 Mean 0.023
 Maximum 0.105 Median 0.01
 SD 0.023 CV 1
 k hat (MLE) 1.66 k star (bias corrected MLE) 1.564
 Theta hat (MLE) 0.0139 Theta star (bias corrected MLE) 0.0147
 nu hat (MLE) 149.4 nu star (bias corrected) 140.8
 Adjusted Level of Significance (β) 0.0447
 Approximate Chi Square Value (140.75, α) 114.3 Adjusted Chi Square Value (140.75, β) 113.5
 95% Gamma Approximate UCL 0.0283 95% Gamma Adjusted UCL 0.0285

Estimates of Gamma Parameters using KM Estimates

Mean (KM) 0.0447 SD (KM) 0.0129
 Variance (KM) 1.67E-04 SE of Mean (KM) 0.00206
 k hat (KM) 12.01 k star (KM) 11.22
 nu hat (KM) 1080 nu star (KM) 1010
 theta hat (KM) 0.00373 theta star (KM) 0.00399

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

80% gamma percentile (KM)	0.0554	90% gamma percentile (KM)	0.0625
95% gamma percentile (KM)	0.0687	99% gamma percentile (KM)	0.0815

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	937	Adjusted Chi Square Value (N/A, β)	934.7
95% KM Approximate Gamma UCL	0.0482	95% KM Adjusted Gamma UCL	0.0483

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.823	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.851	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.329	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.265	Detected Data Not Lognormal at 10% Significance Level	

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0291	Mean in Log Scale	-3.768
SD in Original Scale	0.0214	SD in Log Scale	0.69
95% t UCL (assumes normality of ROS data)	0.0345	95% Percentile Bootstrap UCL	0.0345
95% BCA Bootstrap UCL	0.0351	95% Bootstrap t UCL	0.0359
95% H-UCL (Log ROS)	0.0363		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.134	KM Geo Mean	0.0435
KM SD (logged)	0.211	95% Critical H Value (KM-Log)	1.696
KM Standard Error of Mean (logged)	0.0336	95% H-UCL (KM -Log)	0.047
KM SD (logged)	0.211	95% Critical H Value (KM-Log)	1.696
KM Standard Error of Mean (logged)	0.0336		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0283	Mean in Log Scale	-3.704
SD in Original Scale	0.0197	SD in Log Scale	0.465
95% t UCL (Assumes normality)	0.0332	95% H-Stat UCL	0.0313

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0482
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Phosphorus

General Statistics

Total Number of Observations	45	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	3540	Mean	9488
Maximum	15500	Median	9570
SD	2595	Std. Error of Mean	386.9
Coefficient of Variation	0.274	Skewness	-0.0328

Normal GOF Test

Shapiro Wilk Test Statistic	0.989	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.0751	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	10138	95% Adjusted-CLT UCL (Chen-1995) 10122
		95% Modified-t UCL (Johnson-1978) 10138

Gamma GOF Test

A-D Test Statistic	0.435	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0905	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	12.15	k star (bias corrected MLE)	11.36
Theta hat (MLE)	780.9	Theta star (bias corrected MLE)	835.6
nu hat (MLE)	1094	nu star (bias corrected)	1022
MLE Mean (bias corrected)	9488	MLE Sd (bias corrected)	2816
		Approximate Chi Square Value (0.05)	948.8
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	946.4

Assuming Gamma Distribution

95% Approximate Gamma UCL	10220	95% Adjusted Gamma UCL	10245
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.1	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data appear Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.172	Mean of logged Data	9.116
Maximum of Logged Data	9.649	SD of logged Data	0.306

Assuming Lognormal Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% H-UCL	10351	90% Chebyshev (MVUE) UCL	10851
95% Chebyshev (MVUE) UCL	11452	97.5% Chebyshev (MVUE) UCL	12285
99% Chebyshev (MVUE) UCL	13923		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	10124	95% BCA Bootstrap UCL	10116
95% Standard Bootstrap UCL	10114	95% Bootstrap-t UCL	10147
95% Hall's Bootstrap UCL	10144	95% Percentile Bootstrap UCL	10103
90% Chebyshev(Mean, Sd) UCL	10649	95% Chebyshev(Mean, Sd) UCL	11174
97.5% Chebyshev(Mean, Sd) UCL	11904	99% Chebyshev(Mean, Sd) UCL	13337

Suggested UCL to Use

95% Student's-t UCL 10138

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Potassium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	32
		Number of Missing Observations	0
Minimum	1200	Mean	3110
Maximum	3690	Median	3120
SD	379.2	Std. Error of Mean	56.53
Coefficient of Variation	0.122	Skewness	-2.84

Normal GOF Test

Shapiro Wilk Test Statistic	0.781	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.164	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3205	95% Adjusted-CLT UCL (Chen-1995)	3177
		95% Modified-t UCL (Johnson-1978)	3201

Gamma GOF Test

A-D Test Statistic	3.1	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.199	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.131	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Gamma Statistics

k hat (MLE)	47.76 k star (bias corrected MLE)	44.59
Theta hat (MLE)	65.1 Theta star (bias corrected MLE)	69.73
nu hat (MLE)	4299 nu star (bias corrected)	4013
MLE Mean (bias corrected)	3110 MLE Sd (bias corrected)	465.7
	Approximate Chi Square Value (0.05)	3867
Adjusted Level of Significance	0.0447 Adjusted Chi Square Value	3862

Assuming Gamma Distribution

95% Approximate Gamma UCL	3227 95% Adjusted Gamma UCL	3231
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.598 Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953 Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.216 Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12 Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.09 Mean of logged Data	8.032
Maximum of Logged Data	8.213 SD of logged Data	0.163

Assuming Lognormal Distribution

95% H-UCL	3250 90% Chebyshev (MVUE) UCL	3346
95% Chebyshev (MVUE) UCL	3449 97.5% Chebyshev (MVUE) UCL	3593
99% Chebyshev (MVUE) UCL	3875	

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	3203 95% BCA Bootstrap UCL	3179
95% Standard Bootstrap UCL	3201 95% Bootstrap-t UCL	3189
95% Hall's Bootstrap UCL	3187 95% Percentile Bootstrap UCL	3194
90% Chebyshev(Mean, Sd) UCL	3279 95% Chebyshev(Mean, Sd) UCL	3356
97.5% Chebyshev(Mean, Sd) UCL	3463 99% Chebyshev(Mean, Sd) UCL	3672

Suggested UCL to Use

95% Student's-t UCL	3205
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Rubidium

General Statistics

Total Number of Observations	45 Number of Distinct Observations	44
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

	Number of Missing Observations	0
Minimum	1.83 Mean	6.526
Maximum	11.7 Median	6.06
SD	2.921 Std. Error of Mean	0.435
Coefficient of Variation	0.448 Skewness	0.174

Normal GOF Test

Shapiro Wilk Test Statistic	0.911	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.174	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.258 95% Adjusted-CLT UCL (Chen-1995)	7.254
	95% Modified-t UCL (Johnson-1978)	7.26

Gamma GOF Test

A-D Test Statistic	1.152	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.155	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.642 k star (bias corrected MLE)	4.348
Theta hat (MLE)	1.406 Theta star (bias corrected MLE)	1.501
nu hat (MLE)	417.8 nu star (bias corrected)	391.3
MLE Mean (bias corrected)	6.526 MLE Sd (bias corrected)	3.13
	Approximate Chi Square Value (0.05)	346.5
Adjusted Level of Significance	0.0447 Adjusted Chi Square Value	345.1

Assuming Gamma Distribution

95% Approximate Gamma UCL	7.371 95% Adjusted Gamma UCL	7.401
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.157	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.604 Mean of logged Data	1.764
Maximum of Logged Data	2.46 SD of logged Data	0.497

Assuming Lognormal Distribution

95% H-UCL	7.616 90% Chebyshev (MVUE) UCL	8.118
95% Chebyshev (MVUE) UCL	8.812 97.5% Chebyshev (MVUE) UCL	9.777
99% Chebyshev (MVUE) UCL	11.67	

Nonparametric Distribution Free UCL Statistics

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	7.242	95% BCA Bootstrap UCL	7.243
95% Standard Bootstrap UCL	7.24	95% Bootstrap-t UCL	7.284
95% Hall's Bootstrap UCL	7.253	95% Percentile Bootstrap UCL	7.228
90% Chebyshev(Mean, Sd) UCL	7.832	95% Chebyshev(Mean, Sd) UCL	8.424
97.5% Chebyshev(Mean, Sd) UCL	9.245	99% Chebyshev(Mean, Sd) UCL	10.86

Suggested UCL to Use

95% Student's-t UCL 7.258

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	0.096	Mean	0.26
Maximum	0.357	Median	0.28
SD	0.054	Std. Error of Mean	0.00804
Coefficient of Variation	0.207	Skewness	-1.09

Normal GOF Test

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.169	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.274	95% Adjusted-CLT UCL (Chen-1995)	0.272
		95% Modified-t UCL (Johnson-1978)	0.274

Gamma GOF Test

A-D Test Statistic	2.124	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.182	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	18.64	k star (bias corrected MLE)	17.41
Theta hat (MLE)	0.014	Theta star (bias corrected MLE)	0.0149
nu hat (MLE)	1677	nu star (bias corrected)	1567
MLE Mean (bias corrected)	0.26	MLE Sd (bias corrected)	0.0624
		Approximate Chi Square Value (0.05)	1476
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	1473

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.276	95% Adjusted Gamma UCL	0.277
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.825	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.182	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.343	Mean of logged Data	-1.373
Maximum of Logged Data	-1.03	SD of logged Data	0.253

Assuming Lognormal Distribution

95% H-UCL	0.279	90% Chebyshev (MVUE) UCL	0.291
95% Chebyshev (MVUE) UCL	0.305	97.5% Chebyshev (MVUE) UCL	0.324
99% Chebyshev (MVUE) UCL	0.361		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.273	95% BCA Bootstrap UCL	0.273
95% Standard Bootstrap UCL	0.273	95% Bootstrap-t UCL	0.272
95% Hall's Bootstrap UCL	0.272	95% Percentile Bootstrap UCL	0.273
90% Chebyshev(Mean, Sd) UCL	0.284	95% Chebyshev(Mean, Sd) UCL	0.295
97.5% Chebyshev(Mean, Sd) UCL	0.31	99% Chebyshev(Mean, Sd) UCL	0.34

Suggested UCL to Use

95% Student's-t UCL	0.274
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Sodium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	339	Mean	998.8
Maximum	1280	Median	1020
SD	156.9	Std. Error of Mean	23.39
Coefficient of Variation	0.157	Skewness	-1.585

Normal GOF Test

Shapiro Wilk Test Statistic	0.899	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.125	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1038	95% Adjusted-CLT UCL (Chen-1995) 1031
		95% Modified-t UCL (Johnson-1978) 1037

Gamma GOF Test

A-D Test Statistic	1.652	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.164	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.131	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	30.53	k star (bias corrected MLE)	28.51
Theta hat (MLE)	32.71	Theta star (bias corrected MLE)	35.03
nu hat (MLE)	2748	nu star (bias corrected)	2566
MLE Mean (bias corrected)	998.8	MLE Sd (bias corrected)	187.1
		Approximate Chi Square Value (0.05)	2449
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	2446

Assuming Gamma Distribution

95% Approximate Gamma UCL	1046	95% Adjusted Gamma UCL	1048
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.724	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.191	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.826	Mean of logged Data	6.89
Maximum of Logged Data	7.155	SD of logged Data	0.202

Assuming Lognormal Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% H-UCL	1056	90% Chebyshev (MVUE) UCL	1094
95% Chebyshev (MVUE) UCL	1135	97.5% Chebyshev (MVUE) UCL	1193
99% Chebyshev (MVUE) UCL	1305		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	1037	95% BCA Bootstrap UCL	1032
95% Standard Bootstrap UCL	1037	95% Bootstrap-t UCL	1033
95% Hall's Bootstrap UCL	1033	95% Percentile Bootstrap UCL	1035
90% Chebyshev(Mean, Sd) UCL	1069	95% Chebyshev(Mean, Sd) UCL	1101
97.5% Chebyshev(Mean, Sd) UCL	1145	99% Chebyshev(Mean, Sd) UCL	1232

Suggested UCL to Use

95% Student's-t UCL	1038
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Strontium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	45
		Number of Missing Observations	0
Minimum	2.74	Mean	7.087
Maximum	16.5	Median	6.76
SD	2.7	Std. Error of Mean	0.402
Coefficient of Variation	0.381	Skewness	1.172

Normal GOF Test

Shapiro Wilk Test Statistic	0.932	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.0939	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.763	95% Adjusted-CLT UCL (Chen-1995)	7.824
		95% Modified-t UCL (Johnson-1978)	7.775

Gamma GOF Test

A-D Test Statistic	0.2	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

K-S Test Statistic 0.0677 **Kolmogorov-Smirnov Gamma GOF Test**
 5% K-S Critical Value 0.132 Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.659 k star (bias corrected MLE)	7.163
Theta hat (MLE)	0.925 Theta star (bias corrected MLE)	0.989
nu hat (MLE)	689.3 nu star (bias corrected)	644.7
MLE Mean (bias corrected)	7.087 MLE Sd (bias corrected)	2.648
	Approximate Chi Square Value (0.05)	586.8
Adjusted Level of Significance	0.0447 Adjusted Chi Square Value	584.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	7.786 95% Adjusted Gamma UCL	7.811
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Lognormal GOF Test

Shapiro Wilk Test Statistic 0.992 **Shapiro Wilk Lognormal GOF Test**
 10% Shapiro Wilk Critical Value 0.953 Data appear Lognormal at 10% Significance Level
 Lilliefors Test Statistic 0.0682 **Lilliefors Lognormal GOF Test**
 10% Lilliefors Critical Value 0.12 Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.008 Mean of logged Data	1.892
Maximum of Logged Data	2.803 SD of logged Data	0.37

Assuming Lognormal Distribution

95% H-UCL	7.858 90% Chebyshev (MVUE) UCL	8.292
95% Chebyshev (MVUE) UCL	8.838 97.5% Chebyshev (MVUE) UCL	9.595
99% Chebyshev (MVUE) UCL	11.08	

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	7.749 95% BCA Bootstrap UCL	7.825
95% Standard Bootstrap UCL	7.746 95% Bootstrap-t UCL	7.849
95% Hall's Bootstrap UCL	7.89 95% Percentile Bootstrap UCL	7.775
90% Chebyshev(Mean, Sd) UCL	8.295 95% Chebyshev(Mean, Sd) UCL	8.841
97.5% Chebyshev(Mean, Sd) UCL	9.601 99% Chebyshev(Mean, Sd) UCL	11.09

Suggested UCL to Use

95% Student's-t UCL 7.763

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tellurium

General Statistics

Total Number of Observations	45 Number of Distinct Observations	1
Number of Detects	0 Number of Non-Detects	45

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Number of Distinct Detects

0 Number of Distinct Non-Detects

1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tellurium was not processed!

Thallium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	8.00E-04	Mean	0.00359
Maximum	0.0196	Median	0.00227
SD	0.00362	Std. Error of Mean	5.40E-04
Coefficient of Variation	1.008	Skewness	3.073

Normal GOF Test

Shapiro Wilk Test Statistic	0.605	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.316	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0045	95% Adjusted-CLT UCL (Chen-1995)	0.00474
		95% Modified-t UCL (Johnson-1978)	0.00454

Gamma GOF Test

A-D Test Statistic	2.436	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.203	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.133	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.007	k star (bias corrected MLE)	1.888
Theta hat (MLE)	0.00179	Theta star (bias corrected MLE)	0.0019
nu hat (MLE)	180.6	nu star (bias corrected)	169.9
MLE Mean (bias corrected)	0.00359	MLE Sd (bias corrected)	0.00261
		Approximate Chi Square Value (0.05)	140.7
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	139.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.00433	95% Adjusted Gamma UCL	0.00436
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Lilliefors Test Statistic 0.143 **Lilliefors Lognormal GOF Test**
 10% Lilliefors Critical Value 0.12 Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data -7.131 Mean of logged Data -5.899
 Maximum of Logged Data -3.932 SD of logged Data 0.666

Assuming Lognormal Distribution

95% H-UCL 0.0042 90% Chebyshev (MVUE) UCL 0.0045
 95% Chebyshev (MVUE) UCL 0.005 97.5% Chebyshev (MVUE) UCL 0.00569
 99% Chebyshev (MVUE) UCL 0.00704

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 0.00448 95% BCA Bootstrap UCL 0.00475
 95% Standard Bootstrap UCL 0.00447 95% Bootstrap-t UCL 0.00513
 95% Hall's Bootstrap UCL 0.00514 95% Percentile Bootstrap UCL 0.00453
 90% Chebyshev(Mean, Sd) UCL 0.00521 95% Chebyshev(Mean, Sd) UCL 0.00594
 97.5% Chebyshev(Mean, Sd) UCL 0.00696 99% Chebyshev(Mean, Sd) UCL 0.00896

Suggested UCL to Use

95% Student's-t UCL 0.0045

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods,

then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tin

General Statistics

Total Number of Observations 45 Number of Distinct Observations 32
 Number of Detects 33 Number of Non-Detects 12
 Number of Distinct Detects 32 Number of Distinct Non-Detects 1
 Minimum Detect 0.02 Minimum Non-Detect 0.02
 Maximum Detect 0.419 Maximum Non-Detect 0.02
 Variance Detects 0.00634 Percent Non-Detects 26.67%
 Mean Detects 0.0739 SD Detects 0.0797
 Median Detects 0.043 CV Detects 1.078
 Skewness Detects 3.019 Kurtosis Detects 10.83
 Mean of Logged Detects -2.932 SD of Logged Detects 0.744

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.642 **Shapiro Wilk GOF Test**
 1% Shapiro Wilk Critical Value 0.906 Detected Data Not Normal at 1% Significance Level
 Lilliefors Test Statistic 0.249 **Lilliefors GOF Test**

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

1% Lilliefors Critical Value 0.177 Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0595	KM Standard Error of Mean	0.0108
90KM SD	0.0713	95% KM (BCA) UCL	0.08
95% KM (t) UCL	0.0776	95% KM (Percentile Bootstrap) UCL	0.0782
95% KM (z) UCL	0.0773	95% KM Bootstrap t UCL	0.0896
90% KM Chebyshev UCL	0.0919	95% KM Chebyshev UCL	0.107
97.5% KM Chebyshev UCL	0.127	99% KM Chebyshev UCL	0.167

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.596	Anderson-Darling GOF Test	
5% A-D Critical Value	0.763	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.167	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.156	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.678	k star (bias corrected MLE)	1.546
Theta hat (MLE)	0.044	Theta star (bias corrected MLE)	0.0478
nu hat (MLE)	110.8	nu star (bias corrected)	102
Mean (detects)	0.0739		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0568
Maximum	0.419	Median	0.032
SD	0.0737	CV	1.296
k hat (MLE)	1.116	k star (bias corrected MLE)	1.057
Theta hat (MLE)	0.0509	Theta star (bias corrected MLE)	0.0538
nu hat (MLE)	100.5	nu star (bias corrected)	95.1
Adjusted Level of Significance (β)	0.0447		
Approximate Chi Square Value (95.10, α)	73.61	Adjusted Chi Square Value (95.10, β)	72.98
95% Gamma Approximate UCL	0.0734	95% Gamma Adjusted UCL	0.0741

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0595	SD (KM)	0.0713
Variance (KM)	0.00508	SE of Mean (KM)	0.0108
k hat (KM)	0.697	k star (KM)	0.666
nu hat (KM)	62.75	nu star (KM)	59.9
theta hat (KM)	0.0854	theta star (KM)	0.0894
80% gamma percentile (KM)	0.098	90% gamma percentile (KM)	0.151
95% gamma percentile (KM)	0.206	99% gamma percentile (KM)	0.338

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (59.90, α)	43.1	Adjusted Chi Square Value (59.90, β)	42.63
95% KM Approximate Gamma UCL	0.0827	95% KM Adjusted Gamma UCL	0.0836

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.942	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.13	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.139	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0568	Mean in Log Scale	-3.405
SD in Original Scale	0.0737	SD in Log Scale	1.041
95% t UCL (assumes normality of ROS data)	0.0753	95% Percentile Bootstrap UCL	0.076
95% BCA Bootstrap UCL	0.0806	95% Bootstrap t UCL	0.0876
95% H-UCL (Log ROS)	0.0835		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.193	KM Geo Mean	0.041
KM SD (logged)	0.762	95% Critical H Value (KM-Log)	2.129
KM Standard Error of Mean (logged)	0.115	95% H-UCL (KM -Log)	0.0701
KM SD (logged)	0.762	95% Critical H Value (KM-Log)	2.129
KM Standard Error of Mean (logged)	0.115		

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.0568	Mean in Log Scale	-3.378
SD in Original Scale	0.0737	SD in Log Scale	0.981
95% t UCL (Assumes normality)	0.0753	95% H-Stat UCL	0.0781

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL	0.0701
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Uranium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	42
Number of Detects	43	Number of Non-Detects	2
Number of Distinct Detects	41	Number of Distinct Non-Detects	1
Minimum Detect	4.20E-04	Minimum Non-Detect	4.00E-04
Maximum Detect	0.011	Maximum Non-Detect	4.00E-04
Variance Detects	7.84E-06	Percent Non-Detects	4.44%
Mean Detects	0.00371	SD Detects	0.0028
Median Detects	0.00298	CV Detects	0.755
Skewness Detects	1.486	Kurtosis Detects	1.485
Mean of Logged Detects	-5.85	SD of Logged Detects	0.734

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.814	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.923	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.21	Lilliefors GOF Test
1% Lilliefors Critical Value	0.156	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00356	KM Standard Error of Mean	4.21E-04
90KM SD	0.00279	95% KM (BCA) UCL	0.00428
95% KM (t) UCL	0.00427	95% KM (Percentile Bootstrap) UCL	0.00426
95% KM (z) UCL	0.00425	95% KM Bootstrap t UCL	0.00441
90% KM Chebyshev UCL	0.00482	95% KM Chebyshev UCL	0.0054
97.5% KM Chebyshev UCL	0.00619	99% KM Chebyshev UCL	0.00775

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.737	Anderson-Darling GOF Test
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.12	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.136	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.134	k star (bias corrected MLE)	2
Theta hat (MLE)	0.00174	Theta star (bias corrected MLE)	0.00185
nu hat (MLE)	183.5	nu star (bias corrected)	172
Mean (detects)	0.00371		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.20E-04	Mean	0.00399
Maximum	0.011	Median	0.00315
SD	0.00303	CV	0.761
k hat (MLE)	2.005	k star (bias corrected MLE)	1.886
Theta hat (MLE)	0.00199	Theta star (bias corrected MLE)	0.00211

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

nu hat (MLE)	180.4 nu star (bias corrected)	169.7
Adjusted Level of Significance (β)	0.0447	
Approximate Chi Square Value (169.72, α)	140.6 Adjusted Chi Square Value (169.72, β)	139.7
95% Gamma Approximate UCL	0.00481 95% Gamma Adjusted UCL	0.00484

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00356 SD (KM)	0.00279
Variance (KM)	7.79E-06 SE of Mean (KM)	4.21E-04
k hat (KM)	1.629 k star (KM)	1.535
nu hat (KM)	146.6 nu star (KM)	138.1
theta hat (KM)	0.00219 theta star (KM)	0.00232
80% gamma percentile (KM)	0.0055 90% gamma percentile (KM)	0.00738
95% gamma percentile (KM)	0.0092 99% gamma percentile (KM)	0.0133

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (138.14, α)	112 Adjusted Chi Square Value (138.14, β)	111.2
95% KM Approximate Gamma UCL	0.00439 95% KM Adjusted Gamma UCL	0.00442

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.968 Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.951 Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.1 Lilliefors GOF Test	
10% Lilliefors Critical Value	0.123 Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00357 Mean in Log Scale	-5.928
SD in Original Scale	0.00282 SD in Log Scale	0.806
95% t UCL (assumes normality of ROS data)	0.00427 95% Percentile Bootstrap UCL	0.00428
95% BCA Bootstrap UCL	0.00433 95% Bootstrap t UCL	0.00441
95% H-UCL (Log ROS)	0.0048	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.937 KM Geo Mean	0.00264
KM SD (logged)	0.818 95% Critical H Value (KM-Log)	2.178
KM Standard Error of Mean (logged)	0.123 95% H-UCL (KM -Log)	0.00482
KM SD (logged)	0.818 95% Critical H Value (KM-Log)	2.178
KM Standard Error of Mean (logged)	0.123	

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.00355 Mean in Log Scale	-5.968
SD in Original Scale	0.00283 SD in Log Scale	0.907
95% t UCL (Assumes normality)	0.00426 95% H-Stat UCL	0.00527

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamma UCL	0.00442 95% GROS Adjusted Gamma UCL	0.00484
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics

Total Number of Observations	45	Number of Distinct Observations	39
Number of Detects	44	Number of Non-Detects	1
Number of Distinct Detects	38	Number of Distinct Non-Detects	1
Minimum Detect	0.022	Minimum Non-Detect	0.02
Maximum Detect	0.378	Maximum Non-Detect	0.02
Variance Detects	0.00664	Percent Non-Detects	2.22%
Mean Detects	0.0994	SD Detects	0.0815
Median Detects	0.0785	CV Detects	0.819
Skewness Detects	2.197	Kurtosis Detects	5.057
Mean of Logged Detects	-2.549	SD of Logged Detects	0.674

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.741	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.924	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.204	Lilliefors GOF Test
1% Lilliefors Critical Value	0.154	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0976	KM Standard Error of Mean	0.0121
90KM SD	0.0805	95% KM (BCA) UCL	0.119
95% KM (t) UCL	0.118	95% KM (Percentile Bootstrap) UCL	0.119
95% KM (z) UCL	0.118	95% KM Bootstrap t UCL	0.125
90% KM Chebyshev UCL	0.134	95% KM Chebyshev UCL	0.151
97.5% KM Chebyshev UCL	0.173	99% KM Chebyshev UCL	0.218

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.043	Anderson-Darling GOF Test
5% A-D Critical Value	0.759	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.133	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.135	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.235	k star (bias corrected MLE)	2.098
Theta hat (MLE)	0.0445	Theta star (bias corrected MLE)	0.0474
nu hat (MLE)	196.7	nu star (bias corrected)	184.6
Mean (detects)	0.0994		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0974
Maximum	0.378	Median	0.078

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

SD	0.0816 CV	0.838
k hat (MLE)	2.033 k star (bias corrected MLE)	1.912
Theta hat (MLE)	0.0479 Theta star (bias corrected MLE)	0.0509
nu hat (MLE)	183 nu star (bias corrected)	172.1
Adjusted Level of Significance (β)	0.0447	
Approximate Chi Square Value (172.12, α)	142.8 Adjusted Chi Square Value (172.12, β)	141.9
95% Gamma Approximate UCL	0.117 95% Gamma Adjusted UCL	0.118

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0976 SD (KM)	0.0805
Variance (KM)	0.00648 SE of Mean (KM)	0.0121
k hat (KM)	1.472 k star (KM)	1.388
nu hat (KM)	132.4 nu star (KM)	125
theta hat (KM)	0.0664 theta star (KM)	0.0703
80% gamma percentile (KM)	0.152 90% gamma percentile (KM)	0.207
95% gamma percentile (KM)	0.261 99% gamma percentile (KM)	0.383

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (124.95, α)	100.1 Adjusted Chi Square Value (124.95, β)	99.4
95% KM Approximate Gamma UCL	0.122 95% KM Adjusted Gamma UCL	0.123

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963 Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.952 Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.112 Lilliefors GOF Test	
10% Lilliefors Critical Value	0.122 Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0975 Mean in Log Scale	-2.587
SD in Original Scale	0.0815 SD in Log Scale	0.715
95% t UCL (assumes normality of ROS data)	0.118 95% Percentile Bootstrap UCL	0.118
95% BCA Bootstrap UCL	0.121 95% Bootstrap t UCL	0.125
95% H-UCL (Log ROS)	0.122	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.579 KM Geo Mean	0.0759
KM SD (logged)	0.689 95% Critical H Value (KM-Log)	2.062
KM Standard Error of Mean (logged)	0.104 95% H-UCL (KM -Log)	0.119
KM SD (logged)	0.689 95% Critical H Value (KM-Log)	2.062
KM Standard Error of Mean (logged)	0.104	

DL/2 Statistics

DL/2 Normal

DL/2 Log-Transformed

Mean in Original Scale	0.0974 Mean in Log Scale	-2.594
SD in Original Scale	0.0816 SD in Log Scale	0.733
95% t UCL (Assumes normality)	0.118 95% H-Stat UCL	0.123

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

95% KM Adjusted Gamma UCL

0.123 95% GROS Adjusted Gamma UCL

0.118

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zinc

General Statistics

Total Number of Observations	45	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	9.15	Mean	20.17
Maximum	50.6	Median	18.2
SD	8.144	Std. Error of Mean	1.214
Coefficient of Variation	0.404	Skewness	2.504

Normal GOF Test

Shapiro Wilk Test Statistic	0.675	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.926	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.306	Lilliefors GOF Test
1% Lilliefors Critical Value	0.153	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.21	95% Adjusted-CLT UCL (Chen-1995)	22.65
		95% Modified-t UCL (Johnson-1978)	22.28

Gamma GOF Test

A-D Test Statistic	4.065	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.264	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.132	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.098	k star (bias corrected MLE)	8.506
Theta hat (MLE)	2.216	Theta star (bias corrected MLE)	2.371
nu hat (MLE)	818.8	nu star (bias corrected)	765.6
MLE Mean (bias corrected)	20.17	MLE Sd (bias corrected)	6.914
		Approximate Chi Square Value (0.05)	702.4
Adjusted Level of Significance	0.0447	Adjusted Chi Square Value	700.4

Assuming Gamma Distribution

95% Approximate Gamma UCL	21.98	95% Adjusted Gamma UCL	22.04
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.953	Data Not Lognormal at 10% Significance Level

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples

Lilliefors Test Statistic	0.24	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.12	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.214	Mean of logged Data	2.948
Maximum of Logged Data	3.924	SD of logged Data	0.314

Assuming Lognormal Distribution

95% H-UCL	21.8	90% Chebyshev (MVUE) UCL	22.87
95% Chebyshev (MVUE) UCL	24.17	97.5% Chebyshev (MVUE) UCL	25.97
99% Chebyshev (MVUE) UCL	29.51		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	22.16	95% BCA Bootstrap UCL	22.69
95% Standard Bootstrap UCL	22.14	95% Bootstrap-t UCL	23.11
95% Hall's Bootstrap UCL	23.06	95% Percentile Bootstrap UCL	22.28
90% Chebyshev(Mean, Sd) UCL	23.81	95% Chebyshev(Mean, Sd) UCL	25.46
97.5% Chebyshev(Mean, Sd) UCL	27.75	99% Chebyshev(Mean, Sd) UCL	32.25

Suggested UCL to Use

95% Student's-t UCL 22.21

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

User Selected Options
 Date/Time of Computation ProUCL 5.2 2025-11-18 10:38:06 AM
 From File Small fish UCL input_b.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Moisture

General Statistics

Total Number of Observations	40	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	74.9	Mean	77.83
Maximum	80.7	Median	77.85
SD	1.459	Std. Error of Mean	0.231
Coefficient of Variation	0.0187	Skewness	0.00948

Normal GOF Test

Shapiro Wilk Test Statistic 0.964
 1% Shapiro Wilk Critical Value 0.919
 Lilliefors Test Statistic 0.136
 1% Lilliefors Critical Value 0.162

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 78.22

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 78.21
 95% Modified-t UCL (Johnson-1978) 78.22

Gamma GOF Test

A-D Test Statistic 0.353
 5% A-D Critical Value 0.747
 K-S Test Statistic 0.119
 5% K-S Critical Value 0.139

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE) 2917
 Theta hat (MLE) 0.0267
 nu hat (MLE) 233347
 MLE Mean (bias corrected) 77.83
 Adjusted Level of Significance 0.044

k star (bias corrected MLE) 2698
 Theta star (bias corrected MLE) 0.0288
 nu star (bias corrected) 215847
 MLE Sd (bias corrected) 1.498
 Approximate Chi Square Value (0.05) 214768
 Adjusted Chi Square Value 214728

Assuming Gamma Distribution

95% Approximate Gamma UCL 78.22

95% Adjusted Gamma UCL 78.23

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.964
 10% Shapiro Wilk Critical Value 0.949
 Lilliefors Test Statistic 0.14
 10% Lilliefors Critical Value 0.128

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 10% Significance Level

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 4.316
 Maximum of Logged Data 4.391

Mean of logged Data 4.354
 SD of logged Data 0.0188

Assuming Lognormal Distribution

95% H-UCL N/A
 95% Chebyshev (MVUE) UCL 78.83
 99% Chebyshev (MVUE) UCL 80.12

90% Chebyshev (MVUE) UCL 78.52
 97.5% Chebyshev (MVUE) UCL 79.27

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 78.21
 95% Standard Bootstrap UCL 78.21
 95% Hall's Bootstrap UCL 78.23
 90% Chebyshev(Mean, Sd) UCL 78.52
 97.5% Chebyshev(Mean, Sd) UCL 79.27

95% BCA Bootstrap UCL 78.23
 95% Bootstrap-t UCL 78.23
 95% Percentile Bootstrap UCL 78.21
 95% Chebyshev(Mean, Sd) UCL 78.83
 99% Chebyshev(Mean, Sd) UCL 80.12

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples
Suggested UCL to Use

95% Student's-t UCL 78.22

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Aluminum

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	0.64	Mean	6.34
Maximum	15.8	Median	5.445
SD	3.825	Std. Error of Mean	0.605
Coefficient of Variation	0.603	Skewness	0.729
Normal GOF Test			
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.359	95% Adjusted-CLT UCL (Chen-1995)	7.41
		95% Modified-t UCL (Johnson-1978)	7.371
Gamma GOF Test			
A-D Test Statistic	0.322	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0742	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.141	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.399	k star (bias corrected MLE)	2.236
Theta hat (MLE)	2.643	Theta star (bias corrected MLE)	2.836
nu hat (MLE)	191.9	nu star (bias corrected)	178.9
MLE Mean (bias corrected)	6.34	MLE Sd (bias corrected)	4.24
		Approximate Chi Square Value (0.05)	148.9
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	147.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	7.615	95% Adjusted Gamma UCL	7.667
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.118	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.446	Mean of logged Data	1.624
Maximum of Logged Data	2.76	SD of logged Data	0.754
Assuming Lognormal Distribution			
95% H-UCL	8.737	90% Chebyshev (MVUE) UCL	9.32
95% Chebyshev (MVUE) UCL	10.51	97.5% Chebyshev (MVUE) UCL	12.17
99% Chebyshev (MVUE) UCL	15.43		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.335	95% BCA Bootstrap UCL	7.378
95% Standard Bootstrap UCL	7.321	95% Bootstrap-t UCL	7.442
95% Hall's Bootstrap UCL	7.418	95% Percentile Bootstrap UCL	7.302
90% Chebyshev(Mean, Sd) UCL	8.155	95% Chebyshev(Mean, Sd) UCL	8.977
97.5% Chebyshev(Mean, Sd) UCL	10.12	99% Chebyshev(Mean, Sd) UCL	12.36
Suggested UCL to Use			
95% Student's-t UCL	7.359		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Antimony

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	11
Number of Detects	13	Number of Non-Detects	27
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.0021	Minimum Non-Detect	0.002
Maximum Detect	0.0051	Maximum Non-Detect	0.002
Variance Detects	7.8436E-7	Percent Non-Detects	67.5%
Mean Detects	0.00305	SD Detects	8.8564E-4
Median Detects	0.0029	CV Detects	0.29
Skewness Detects	0.962	Kurtosis Detects	0.857
Mean of Logged Detects	-5.828	SD of Logged Detects	0.277

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.911	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.814	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.141	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.271	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.00234	KM Standard Error of Mean	1.1389E-4
90KM SD	6.9206E-4	95% KM (BCA) UCL	0.00254
95% KM (t) UCL	0.00253	95% KM (Percentile Bootstrap) UCL	0.00254
95% KM (z) UCL	0.00253	95% KM Bootstrap t UCL	0.0026
90% KM Chebyshev UCL	0.00268	95% KM Chebyshev UCL	0.00284
97.5% KM Chebyshev UCL	0.00305	99% KM Chebyshev UCL	0.00348

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.321	Anderson-Darling GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.165	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.236	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only			
k hat (MLE)	13.96	k star (bias corrected MLE)	10.79
Theta hat (MLE)	2.1872E-4	Theta star (bias corrected MLE)	2.8299E-4
nu hat (MLE)	363	nu star (bias corrected)	280.6
Mean (detects)	0.00305		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0021	Mean	0.00774
Maximum	0.01	Median	0.01
SD	0.00333	CV	0.43
k hat (MLE)	3.694	k star (bias corrected MLE)	3.433
Theta hat (MLE)	0.0021	Theta star (bias corrected MLE)	0.00226
nu hat (MLE)	295.5	nu star (bias corrected)	274.7
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (274.67, α)	237.3	Adjusted Chi Square Value (274.67, β)	236
95% Gamma Approximate UCL	0.00896	95% Gamma Adjusted UCL	0.00901

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.00234	SD (KM)	6.9206E-4
Variance (KM)	4.7894E-7	SE of Mean (KM)	1.1389E-4
k hat (KM)	11.46	k star (KM)	10.61
nu hat (KM)	916.6	nu star (KM)	849.2
theta hat (KM)	2.0446E-4	theta star (KM)	2.2069E-4
80% gamma percentile (KM)	0.00292	90% gamma percentile (KM)	0.0033
95% gamma percentile (KM)	0.00364	99% gamma percentile (KM)	0.00433

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (849.16, α)	782.5	Adjusted Chi Square Value (849.16, β)	780.1
95% KM Approximate Gamma UCL	0.00254	95% KM Adjusted Gamma UCL	0.00255

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.889	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.162	Lilliefors GOF Test	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

10% Lilliefors Critical Value 0.215 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0018	Mean in Log Scale	-6.479
SD in Original Scale	0.00106	SD in Log Scale	0.577
95% t UCL (assumes normality of ROS data)	0.00209	95% Percentile Bootstrap UCL	0.00208
95% BCA Bootstrap UCL	0.0021	95% Bootstrap t UCL	0.00213
95% H-UCL (Log ROS)	0.00218		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.089	KM Geo Mean	0.00227
KM SD (logged)	0.236	95% Critical H Value (KM-Log)	1.757
KM Standard Error of Mean (logged)	0.0389	95% H-UCL (KM -Log)	0.00249
KM SD (logged)	0.236	95% Critical H Value (KM-Log)	1.757
KM Standard Error of Mean (logged)	0.0389		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00167	Mean in Log Scale	-6.557
SD in Original Scale	0.00109	SD in Log Scale	0.535
95% t UCL (Assumes normality)	0.00196	95% H-Stat UCL	0.00194

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00253

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Arsenic

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.0555	Mean	0.209
Maximum	0.333	Median	0.226
SD	0.0738	Std. Error of Mean	0.0117
Coefficient of Variation	0.353	Skewness	-0.147
Normal GOF Test			
Shapiro Wilk Test Statistic	0.961	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.229	95% Adjusted-CLT UCL (Chen-1995)	0.228
		95% Modified-t UCL (Johnson-1978)	0.229
Gamma GOF Test			
A-D Test Statistic	0.667	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.159	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.896	k star (bias corrected MLE)	6.395
Theta hat (MLE)	0.0303	Theta star (bias corrected MLE)	0.0327
nu hat (MLE)	551.7	nu star (bias corrected)	511.6
MLE Mean (bias corrected)	0.209	MLE Sd (bias corrected)	0.0826
		Approximate Chi Square Value (0.05)	460.2
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	458.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.232	95% Adjusted Gamma UCL	0.233
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.173	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.891	Mean of logged Data	-1.64
Maximum of Logged Data	-1.1	SD of logged Data	0.416
Assuming Lognormal Distribution			
95% H-UCL	0.239	90% Chebyshev (MVUE) UCL	0.254
95% Chebyshev (MVUE) UCL	0.273	97.5% Chebyshev (MVUE) UCL	0.3
99% Chebyshev (MVUE) UCL	0.354		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.228	95% BCA Bootstrap UCL	0.226
95% Standard Bootstrap UCL	0.228	95% Bootstrap-t UCL	0.228
95% Hall's Bootstrap UCL	0.228	95% Percentile Bootstrap UCL	0.227
90% Chebyshev(Mean, Sd) UCL	0.244	95% Chebyshev(Mean, Sd) UCL	0.26
97.5% Chebyshev(Mean, Sd) UCL	0.282	99% Chebyshev(Mean, Sd) UCL	0.325
Suggested UCL to Use			
95% Student's-t UCL	0.229		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples
reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Barium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	1.01	Mean	1.75
Maximum	2.67	Median	1.645
SD	0.461	Std. Error of Mean	0.0728
Coefficient of Variation	0.263	Skewness	0.406
Normal GOF Test			
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.872	95% Adjusted-CLT UCL (Chen-1995)	1.875
		95% Modified-t UCL (Johnson-1978)	1.873
Gamma GOF Test			
A-D Test Statistic	0.393	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0919	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	14.96	k star (bias corrected MLE)	13.85
Theta hat (MLE)	0.117	Theta star (bias corrected MLE)	0.126
nu hat (MLE)	1197	nu star (bias corrected)	1108
MLE Mean (bias corrected)	1.75	MLE Sd (bias corrected)	0.47
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	1032
		Adjusted Chi Square Value	1029
Assuming Gamma Distribution			
95% Approximate Gamma UCL	1.879	95% Adjusted Gamma UCL	1.884
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0929	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.00995	Mean of logged Data	0.526
Maximum of Logged Data	0.982	SD of logged Data	0.264
Assuming Lognormal Distribution			
95% H-UCL	1.888	90% Chebyshev (MVUE) UCL	1.972
95% Chebyshev (MVUE) UCL	2.073	97.5% Chebyshev (MVUE) UCL	2.213
99% Chebyshev (MVUE) UCL	2.488		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.87	95% BCA Bootstrap UCL	1.872
95% Standard Bootstrap UCL	1.869	95% Bootstrap-t UCL	1.884
95% Hall's Bootstrap UCL	1.881	95% Percentile Bootstrap UCL	1.867
90% Chebyshev(Mean, Sd) UCL	1.968	95% Chebyshev(Mean, Sd) UCL	2.067
97.5% Chebyshev(Mean, Sd) UCL	2.204	99% Chebyshev(Mean, Sd) UCL	2.474
Suggested UCL to Use			
95% Student's-t UCL	1.872		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Beryllium

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	40
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Beryllium was not processed!

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Bismuth

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	37
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.0026	Minimum Non-Detect	0.002
Maximum Detect	0.0033	Maximum Non-Detect	0.002
Variance Detects	1.2333E-7	Percent Non-Detects	92.5%
Mean Detects	0.00297	SD Detects	3.5119E-4
Median Detects	0.003	CV Detects	0.118
Skewness Detects	-0.423	Kurtosis Detects	N/A
Mean of Logged Detects	-5.825	SD of Logged Detects	0.12

**Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.**

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.993	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.204	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level	

**Detected Data appear Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes**

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00207	KM Standard Error of Mean	5.1597E-5
90KM SD	2.6645E-4	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00216	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00216	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00223	95% KM Chebyshev UCL	0.0023
97.5% KM Chebyshev UCL	0.00239	99% KM Chebyshev UCL	0.00259

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.261	Anderson-Darling GOF Test	
5% A-D Critical Value	0.635	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.235	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.431	Detected data appear Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	105.3	k star (bias corrected MLE)	N/A
Theta hat (MLE)	2.8180E-5	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	631.7	nu star (bias corrected)	N/A
Mean (detects)	0.00297		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0026	Mean	0.00947
Maximum	0.01	Median	0.01
SD	0.00188	CV	0.198
k hat (MLE)	13.57	k star (bias corrected MLE)	12.57
Theta hat (MLE)	6.9809E-4	Theta star (bias corrected MLE)	7.5369E-4
nu hat (MLE)	1086	nu star (bias corrected)	1005
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (N/A, α)	932.8	Adjusted Chi Square Value (N/A, β)	930.2
95% Gamma Approximate UCL	0.0102	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00207	SD (KM)	2.6645E-4
Variance (KM)	7.0994E-8	SE of Mean (KM)	5.1597E-5
k hat (KM)	60.5	k star (KM)	55.98
nu hat (KM)	4840	nu star (KM)	4478
theta hat (KM)	3.4255E-5	theta star (KM)	3.7022E-5
80% gamma percentile (KM)	0.0023	90% gamma percentile (KM)	0.00243
95% gamma percentile (KM)	0.00255	99% gamma percentile (KM)	0.00277

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	4324	Adjusted Chi Square Value (N/A, β)	4318
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

95% KM Approximate Gamma UCL 0.00215 95% KM Adjusted Gamma UCL 0.00215

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.987	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.789	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.219	Lilliefors GOF Test
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00139	Mean in Log Scale	-6.674
SD in Original Scale	6.4328E-4	SD in Log Scale	0.445
95% t UCL (assumes normality of ROS data)	0.00156	95% Percentile Bootstrap UCL	0.00156
95% BCA Bootstrap UCL	0.00157	95% Bootstrap t UCL	0.00158
95% H-UCL (Log ROS)	0.00159		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.185	KM Geo Mean	0.00206
KM SD (logged)	0.106	95% Critical H Value (KM-Log)	1.701
KM Standard Error of Mean (logged)	0.0205	95% H-UCL (KM -Log)	0.00213
KM SD (logged)	0.106	95% Critical H Value (KM-Log)	1.701
KM Standard Error of Mean (logged)	0.0205		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 0.00115
SD in Original Scale 5.3060E-4
95% t UCL (Assumes normality) 0.00129

DL/2 Log-Transformed

Mean in Log Scale -6.827
SD in Log Scale 0.29
95% H-Stat UCL 0.00123

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00216

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Boron

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	40
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Boron was not processed!

Cadmium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.0036	Mean	0.0104
Maximum	0.0294	Median	0.00805
SD	0.0064	Std. Error of Mean	0.00101
Coefficient of Variation	0.617	Skewness	1.358

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.83	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.919	Lilliefors GOF Test	
Lilliefors Test Statistic	0.223	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.162		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0121	95% Adjusted-CLT UCL (Chen-1995)	0.0123
		95% Modified-t UCL (Johnson-1978)	0.0121

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.268	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.754	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.157	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.14		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.363	k star (bias corrected MLE)	3.128
Theta hat (MLE)	0.00308	Theta star (bias corrected MLE)	0.00332
nu hat (MLE)	269.1	nu star (bias corrected)	250.2
MLE Mean (bias corrected)	0.0104	MLE Sd (bias corrected)	0.00586
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	214.6
		Adjusted Chi Square Value	213.4

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0121	95% Adjusted Gamma UCL	0.0122

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.94	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.949	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.118	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.128		

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	-5.627	Mean of logged Data	-4.725
Maximum of Logged Data	-3.527	SD of logged Data	0.546

Assuming Lognormal Distribution			
95% H-UCL	0.0122	90% Chebyshev (MVUE) UCL	0.0131
95% Chebyshev (MVUE) UCL	0.0143	97.5% Chebyshev (MVUE) UCL	0.0161
99% Chebyshev (MVUE) UCL	0.0196		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Nonparametric Distribution Free UCLs

95% CLT UCL	0.012	95% BCA Bootstrap UCL	0.0122
95% Standard Bootstrap UCL	0.012	95% Bootstrap-t UCL	0.0123
95% Hall's Bootstrap UCL	0.0122	95% Percentile Bootstrap UCL	0.012
90% Chebyshev(Mean, Sd) UCL	0.0134	95% Chebyshev(Mean, Sd) UCL	0.0148
97.5% Chebyshev(Mean, Sd) UCL	0.0167	99% Chebyshev(Mean, Sd) UCL	0.0204

Suggested UCL to Use

95% H-UCL 0.0122

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	5880	Mean	8683
Maximum	14200	Median	8705
SD	1534	Std. Error of Mean	242.6
Coefficient of Variation	0.177	Skewness	1.129

Normal GOF Test

Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.106	Lilliefors GOF Test
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9091	95% Adjusted-CLT UCL (Chen-1995)	9128
		95% Modified-t UCL (Johnson-1978)	9099

Gamma GOF Test

A-D Test Statistic	0.283	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0883	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	35.2	k star (bias corrected MLE)	32.57
Theta hat (MLE)	246.7	Theta star (bias corrected MLE)	266.6
nu hat (MLE)	2816	nu star (bias corrected)	2606
MLE Mean (bias corrected)	8683	MLE Sd (bias corrected)	1521
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	2488
		Adjusted Chi Square Value	2484

Assuming Gamma Distribution

95% Approximate Gamma UCL	9093	95% Adjusted Gamma UCL	9109
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.982	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0853	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.679	Mean of logged Data	9.055
Maximum of Logged Data	9.561	SD of logged Data	0.169

Assuming Lognormal Distribution

95% H-UCL	9099	90% Chebyshev (MVUE) UCL	9381
95% Chebyshev (MVUE) UCL	9698	97.5% Chebyshev (MVUE) UCL	10139
99% Chebyshev (MVUE) UCL	11004		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

95% CLT UCL	9082	95% BCA Bootstrap UCL	9149
95% Standard Bootstrap UCL	9087	95% Bootstrap-t UCL	9144
95% Hall's Bootstrap UCL	9204	95% Percentile Bootstrap UCL	9104
90% Chebyshev(Mean, Sd) UCL	9410	95% Chebyshev(Mean, Sd) UCL	9740
97.5% Chebyshev(Mean, Sd) UCL	10198	99% Chebyshev(Mean, Sd) UCL	11097

Suggested UCL to Use

95% Student's-t UCL 9091

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Cesium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	0.0013	Mean	0.0108
Maximum	0.0554	Median	0.00555
SD	0.0145	Std. Error of Mean	0.00229
Coefficient of Variation	1.345	Skewness	2.257
Normal GOF Test			
Shapiro Wilk Test Statistic	0.632	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.273	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0146	95% Adjusted-CLT UCL (Chen-1995)	0.0154
		95% Modified-t UCL (Johnson-1978)	0.0148
Gamma GOF Test			
A-D Test Statistic	1.686	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.782	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.18	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.144	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.93	k star (bias corrected MLE)	0.876
Theta hat (MLE)	0.0116	Theta star (bias corrected MLE)	0.0123
nu hat (MLE)	74.36	nu star (bias corrected)	70.12
MLE Mean (bias corrected)	0.0108	MLE Sd (bias corrected)	0.0115
		Approximate Chi Square Value (0.05)	51.84
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	51.25
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0146	95% Adjusted Gamma UCL	0.0147
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.93	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0997	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-6.645	Mean of logged Data	-5.158
Maximum of Logged Data	-2.893	SD of logged Data	1.088
Assuming Lognormal Distribution			
95% H-UCL	0.0161	90% Chebyshev (MVUE) UCL	0.0164
95% Chebyshev (MVUE) UCL	0.0192	97.5% Chebyshev (MVUE) UCL	0.0232
99% Chebyshev (MVUE) UCL	0.0309		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0145	95% BCA Bootstrap UCL	0.0156
95% Standard Bootstrap UCL	0.0144	95% Bootstrap-t UCL	0.016
95% Hall's Bootstrap UCL	0.0148	95% Percentile Bootstrap UCL	0.0147
90% Chebyshev(Mean, Sd) UCL	0.0176	95% Chebyshev(Mean, Sd) UCL	0.0207
97.5% Chebyshev(Mean, Sd) UCL	0.0251	99% Chebyshev(Mean, Sd) UCL	0.0335
Suggested UCL to Use			
95% H-UCL	0.0161		

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	23
Number of Detects	30	Number of Non-Detects	10
Number of Distinct Detects	23	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.054	Maximum Non-Detect	0.01
Variance Detects	1.6423E-4	Percent Non-Detects	25%
Mean Detects	0.0259	SD Detects	0.0128
Median Detects	0.024	CV Detects	0.495
Skewness Detects	0.52	Kurtosis Detects	-0.988
Mean of Logged Detects	-3.777	SD of Logged Detects	0.512

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.91	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.9	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.156	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.185	Detected Data appear Normal at 1% Significance Level	

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0219	KM Standard Error of Mean	0.00207
90KM SD	0.0129	95% KM (BCA) UCL	0.0252
95% KM (t) UCL	0.0254	95% KM (Percentile Bootstrap) UCL	0.0253
95% KM (z) UCL	0.0253	95% KM Bootstrap t UCL	0.0256
90% KM Chebyshev UCL	0.0281	95% KM Chebyshev UCL	0.031
97.5% KM Chebyshev UCL	0.0349	99% KM Chebyshev UCL	0.0426

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.708	Anderson-Darling GOF Test	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.139	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.161	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.215	k star (bias corrected MLE)	3.815
Theta hat (MLE)	0.00615	Theta star (bias corrected MLE)	0.00679
nu hat (MLE)	252.9	nu star (bias corrected)	228.9
Mean (detects)	0.0259		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0219
Maximum	0.054	Median	0.0165
SD	0.0131	CV	0.596
k hat (MLE)	3.21	k star (bias corrected MLE)	2.986
Theta hat (MLE)	0.00683	Theta star (bias corrected MLE)	0.00734
nu hat (MLE)	256.8	nu star (bias corrected)	238.9
Adjusted Level of Significance (β)	0.044		
Approximate Chi Square Value (238.88, α)	204.1	Adjusted Chi Square Value (238.88, β)	202.9
95% Gamma Approximate UCL	0.0257	95% Gamma Adjusted UCL	0.0258

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0219	SD (KM)	0.0129
Variance (KM)	1.6647E-4	SE of Mean (KM)	0.00207
k hat (KM)	2.888	k star (KM)	2.688
nu hat (KM)	231	nu star (KM)	215
theta hat (KM)	0.00759	theta star (KM)	0.00816
80% gamma percentile (KM)	0.0317	90% gamma percentile (KM)	0.0398
95% gamma percentile (KM)	0.0475	99% gamma percentile (KM)	0.0642

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (215.02, α)	182.1	Adjusted Chi Square Value (215.02, β)	181
95% KM Approximate Gamma UCL	0.0259	95% KM Adjusted Gamma UCL	0.0261

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.935	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.939	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.13	Lilliefors GOF Test
10% Lilliefors Critical Value	0.146	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0212	Mean in Log Scale	-4.076
SD in Original Scale	0.0138	SD in Log Scale	0.7
95% t UCL (assumes normality of ROS data)	0.0249	95% Percentile Bootstrap UCL	0.0249
95% BCA Bootstrap UCL	0.0249	95% Bootstrap t UCL	0.0252
95% H-UCL (Log ROS)	0.0274		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.984	KM Geo Mean	0.0186
KM SD (logged)	0.565	95% Critical H Value (KM-Log)	1.972
KM Standard Error of Mean (logged)	0.0908	95% H-UCL (KM -Log)	0.0261
KM SD (logged)	0.565	95% Critical H Value (KM-Log)	1.972
KM Standard Error of Mean (logged)	0.0908		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0207
SD in Original Scale	0.0144
95% t UCL (Assumes normality)	0.0245

DL/2 Log-Transformed

Mean in Log Scale	-4.157
SD in Log Scale	0.8
95% H-Stat UCL	0.0285

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0254

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Cobalt

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	0.0111	Mean	0.106
Maximum	0.272	Median	0.0943
SD	0.0808	Std. Error of Mean	0.0128
Coefficient of Variation	0.764	Skewness	0.452
Normal GOF Test			
Shapiro Wilk Test Statistic	0.885	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.196	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.127	95% Adjusted-CLT UCL (Chen-1995)	0.128
		95% Modified-t UCL (Johnson-1978)	0.127
Gamma GOF Test			
A-D Test Statistic	1.343	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.142	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.401	k star (bias corrected MLE)	1.312
Theta hat (MLE)	0.0755	Theta star (bias corrected MLE)	0.0806
nu hat (MLE)	112.1	nu star (bias corrected)	105
MLE Mean (bias corrected)	0.106	MLE Sd (bias corrected)	0.0923
		Approximate Chi Square Value (0.05)	82.34
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	81.59
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.135	95% Adjusted Gamma UCL	0.136
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.17	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.501	Mean of logged Data	-2.644
Maximum of Logged Data	-1.302	SD of logged Data	0.993
Assuming Lognormal Distribution			
95% H-UCL	0.17	90% Chebyshev (MVUE) UCL	0.177
95% Chebyshev (MVUE) UCL	0.205	97.5% Chebyshev (MVUE) UCL	0.245
99% Chebyshev (MVUE) UCL	0.322		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.127	95% BCA Bootstrap UCL	0.127
95% Standard Bootstrap UCL	0.126	95% Bootstrap-t UCL	0.129
95% Hall's Bootstrap UCL	0.128	95% Percentile Bootstrap UCL	0.125
90% Chebyshev(Mean, Sd) UCL	0.144	95% Chebyshev(Mean, Sd) UCL	0.161
97.5% Chebyshev(Mean, Sd) UCL	0.186	99% Chebyshev(Mean, Sd) UCL	0.233
Suggested UCL to Use			
95% Student's-t UCL	0.127		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Copper

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	0.451	Mean	0.757
Maximum	1.94	Median	0.637
SD	0.323	Std. Error of Mean	0.051
Coefficient of Variation	0.426	Skewness	2.166
Normal GOF Test			
Shapiro Wilk Test Statistic	0.766	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.843	95% Adjusted-CLT UCL (Chen-1995)	0.859
		95% Modified-t UCL (Johnson-1978)	0.845
Gamma GOF Test			
A-D Test Statistic	1.561	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.168	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.728	k star (bias corrected MLE)	7.165
Theta hat (MLE)	0.0979	Theta star (bias corrected MLE)	0.106
nu hat (MLE)	618.2	nu star (bias corrected)	573.2
MLE Mean (bias corrected)	0.757	MLE Sd (bias corrected)	0.283
		Approximate Chi Square Value (0.05)	518.7
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	516.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.836	95% Adjusted Gamma UCL	0.839
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.897	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.158	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.796	Mean of logged Data	-0.345
Maximum of Logged Data	0.663	SD of logged Data	0.346
Assuming Lognormal Distribution			
95% H-UCL	0.832	90% Chebyshev (MVUE) UCL	0.877
95% Chebyshev (MVUE) UCL	0.934	97.5% Chebyshev (MVUE) UCL	1.014
99% Chebyshev (MVUE) UCL	1.169		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.84	95% BCA Bootstrap UCL	0.858
95% Standard Bootstrap UCL	0.838	95% Bootstrap-t UCL	0.864
95% Hall's Bootstrap UCL	0.879	95% Percentile Bootstrap UCL	0.844
90% Chebyshev(Mean, Sd) UCL	0.91	95% Chebyshev(Mean, Sd) UCL	0.979
97.5% Chebyshev(Mean, Sd) UCL	1.075	99% Chebyshev(Mean, Sd) UCL	1.264
Suggested UCL to Use			
95% Student's-t UCL	0.843		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Iron

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	25.8	Mean	46.01
Maximum	73.1	Median	44.3
SD	12.83	Std. Error of Mean	2.029
Coefficient of Variation	0.279	Skewness	0.3
Normal GOF Test			
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0844	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	49.43	95% Adjusted-CLT UCL (Chen-1995)	49.45
		95% Modified-t UCL (Johnson-1978)	49.44
Gamma GOF Test			
A-D Test Statistic	0.295	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0791	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.01	k star (bias corrected MLE)	12.05
Theta hat (MLE)	3.536	Theta star (bias corrected MLE)	3.817
nu hat (MLE)	1041	nu star (bias corrected)	964.2
MLE Mean (bias corrected)	46.01	MLE Sd (bias corrected)	13.25
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	893.1
		Adjusted Chi Square Value	890.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL	49.67	95% Adjusted Gamma UCL	49.81
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.963	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0906	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.25	Mean of logged Data	3.79
Maximum of Logged Data	4.292	SD of logged Data	0.285
Assuming Lognormal Distribution			
95% H-UCL	50	90% Chebyshev (MVUE) UCL	52.38
95% Chebyshev (MVUE) UCL	55.25	97.5% Chebyshev (MVUE) UCL	59.23
99% Chebyshev (MVUE) UCL	67.05		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	49.35	95% BCA Bootstrap UCL	49.48
95% Standard Bootstrap UCL	49.31	95% Bootstrap-t UCL	49.64
95% Hall's Bootstrap UCL	49.52	95% Percentile Bootstrap UCL	49.26
90% Chebyshev(Mean, Sd) UCL	52.09	95% Chebyshev(Mean, Sd) UCL	54.85
97.5% Chebyshev(Mean, Sd) UCL	58.68	99% Chebyshev(Mean, Sd) UCL	66.2
Suggested UCL to Use			
95% Student's-t UCL	49.43		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Lead

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	0.0062	Mean	0.0112
Maximum	0.0216	Median	0.0099
SD	0.00419	Std. Error of Mean	6.6311E-4
Coefficient of Variation	0.375	Skewness	0.883
Normal GOF Test			
Shapiro Wilk Test Statistic	0.894	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.18	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0123	95% Adjusted-CLT UCL (Chen-1995)	0.0124
		95% Modified-t UCL (Johnson-1978)	0.0123
Gamma GOF Test			
A-D Test Statistic	0.806	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.137	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	8.033	k star (bias corrected MLE)	7.448
Theta hat (MLE)	0.00139	Theta star (bias corrected MLE)	0.0015
nu hat (MLE)	642.7	nu star (bias corrected)	595.8
MLE Mean (bias corrected)	0.0112	MLE Sd (bias corrected)	0.0041
		Approximate Chi Square Value (0.05)	540.2
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	538.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0123	95% Adjusted Gamma UCL	0.0124
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.083	Mean of logged Data	-4.557
Maximum of Logged Data	-3.835	SD of logged Data	0.356
Assuming Lognormal Distribution			
95% H-UCL	0.0124	90% Chebyshev (MVUE) UCL	0.0131
95% Chebyshev (MVUE) UCL	0.014	97.5% Chebyshev (MVUE) UCL	0.0152
99% Chebyshev (MVUE) UCL	0.0176		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0123	95% BCA Bootstrap UCL	0.0124
95% Standard Bootstrap UCL	0.0123	95% Bootstrap-t UCL	0.0125
95% Hall's Bootstrap UCL	0.0124	95% Percentile Bootstrap UCL	0.0123
90% Chebyshev(Mean, Sd) UCL	0.0132	95% Chebyshev(Mean, Sd) UCL	0.0141
97.5% Chebyshev(Mean, Sd) UCL	0.0153	99% Chebyshev(Mean, Sd) UCL	0.0178
Suggested UCL to Use			
95% Adjusted Gamma UCL	0.0124		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lithium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	40
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Lithium was not processed!

Magnesium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	232	Mean	331.1
Maximum	442	Median	326
SD	46.36	Std. Error of Mean	7.33
Coefficient of Variation	0.14	Skewness	0.247

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.979	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.919	Lilliefors GOF Test	
Lilliefors Test Statistic	0.0877	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.162		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	343.5	95% Adjusted-CLT UCL (Chen-1995)	343.5
		95% Modified-t UCL (Johnson-1978)	343.5

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.271	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.746	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0868	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.139		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	52.15	k star (bias corrected MLE)	48.25
Theta hat (MLE)	6.35	Theta star (bias corrected MLE)	6.862
nu hat (MLE)	4172	nu star (bias corrected)	3860
MLE Mean (bias corrected)	331.1	MLE Sd (bias corrected)	47.67
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	3717
		Adjusted Chi Square Value	3711

Assuming Gamma Distribution

95% Approximate Gamma UCL	343.9	95% Adjusted Gamma UCL	344.4
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Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.979	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.949	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0917	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.128		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	5.447	Mean of logged Data	5.793
Maximum of Logged Data	6.091	SD of logged Data	0.141

Assuming Lognormal Distribution

95% H-UCL	344.3	90% Chebyshev (MVUE) UCL	353.4
95% Chebyshev (MVUE) UCL	363.4	97.5% Chebyshev (MVUE) UCL	377.4
99% Chebyshev (MVUE) UCL	404.9		

Nonparametric Distribution Free UCL Statistics

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	343.2	95% BCA Bootstrap UCL	343.9
95% Standard Bootstrap UCL	343.6	95% Bootstrap-t UCL	344.3
95% Hall's Bootstrap UCL	344.3	95% Percentile Bootstrap UCL	343.9
90% Chebyshev(Mean, Sd) UCL	353.1	95% Chebyshev(Mean, Sd) UCL	363.1
97.5% Chebyshev(Mean, Sd) UCL	376.9	99% Chebyshev(Mean, Sd) UCL	404

Suggested UCL to Use

95% Student's-t UCL 343.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Manganese

General Statistics

Total Number of Observations	40	Number of Distinct Observations	39
Minimum	4	Number of Missing Observations	0
Maximum	22.2	Mean	8.632
SD	3.623	Median	7.655
Coefficient of Variation	0.42	Std. Error of Mean	0.573
		Skewness	1.935

Normal GOF Test

Shapiro Wilk Test Statistic	0.838
1% Shapiro Wilk Critical Value	0.919
Lilliefors Test Statistic	0.164
1% Lilliefors Critical Value	0.162

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 9.597

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	9.762
95% Modified-t UCL (Johnson-1978)	9.626

Gamma GOF Test

A-D Test Statistic	0.678
5% A-D Critical Value	0.75
K-S Test Statistic	0.114
5% K-S Critical Value	0.14

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	7.325
Theta hat (MLE)	1.178
nu hat (MLE)	586
MLE Mean (bias corrected)	8.632
Adjusted Level of Significance	0.044

k star (bias corrected MLE)	6.793
Theta star (bias corrected MLE)	1.271
nu star (bias corrected)	543.4
MLE Sd (bias corrected)	3.312
Approximate Chi Square Value (0.05)	490.3
Adjusted Chi Square Value	488.5

Assuming Gamma Distribution

95% Approximate Gamma UCL 9.566

95% Adjusted Gamma UCL 9.603

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.966
10% Shapiro Wilk Critical Value	0.949
Lilliefors Test Statistic	0.0875
10% Lilliefors Critical Value	0.128

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.386
Maximum of Logged Data	3.1

Mean of logged Data	2.086
SD of logged Data	0.367

Assuming Lognormal Distribution

95% H-UCL	9.588
95% Chebyshev (MVUE) UCL	10.83
99% Chebyshev (MVUE) UCL	13.69

90% Chebyshev (MVUE) UCL	10.13
97.5% Chebyshev (MVUE) UCL	11.79

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Nonparametric Distribution Free UCLs			
95% CLT UCL	9.574	95% BCA Bootstrap UCL	9.857
95% Standard Bootstrap UCL	9.598	95% Bootstrap-t UCL	9.909
95% Hall's Bootstrap UCL	10.16	95% Percentile Bootstrap UCL	9.658
90% Chebyshev(Mean, Sd) UCL	10.35	95% Chebyshev(Mean, Sd) UCL	11.13
97.5% Chebyshev(Mean, Sd) UCL	12.21	99% Chebyshev(Mean, Sd) UCL	14.33

Suggested UCL to Use

95% Adjusted Gamma UCL 9.603

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Mercury

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	0.0192	Mean	0.067
Maximum	0.168	Median	0.0564
SD	0.0394	Std. Error of Mean	0.00623
Coefficient of Variation	0.588	Skewness	0.977
Normal GOF Test			
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.136	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0775	95% Adjusted-CLT UCL (Chen-1995)	0.0783
		95% Modified-t UCL (Johnson-1978)	0.0776
Gamma GOF Test			
A-D Test Statistic	0.337	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0866	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.185	k star (bias corrected MLE)	2.963
Theta hat (MLE)	0.021	Theta star (bias corrected MLE)	0.0226
nu hat (MLE)	254.8	nu star (bias corrected)	237.1
MLE Mean (bias corrected)	0.067	MLE Sd (bias corrected)	0.0389
		Approximate Chi Square Value (0.05)	202.4
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	201.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0785	95% Adjusted Gamma UCL	0.0789
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.969	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0622	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.953	Mean of logged Data	-2.868
Maximum of Logged Data	-1.784	SD of logged Data	0.589
Assuming Lognormal Distribution			
95% H-UCL	0.0815	90% Chebyshev (MVUE) UCL	0.0872
95% Chebyshev (MVUE) UCL	0.0963	97.5% Chebyshev (MVUE) UCL	0.109
99% Chebyshev (MVUE) UCL	0.134		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0772	95% BCA Bootstrap UCL	0.0785
95% Standard Bootstrap UCL	0.0775	95% Bootstrap-t UCL	0.0794
95% Hall's Bootstrap UCL	0.0787	95% Percentile Bootstrap UCL	0.0779
90% Chebyshev(Mean, Sd) UCL	0.0857	95% Chebyshev(Mean, Sd) UCL	0.0941
97.5% Chebyshev(Mean, Sd) UCL	0.106	99% Chebyshev(Mean, Sd) UCL	0.129
Suggested UCL to Use			
95% Student's-t UCL	0.0775		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methylmercury (as MeHg) (mg/kg)

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	0.0252	Mean	0.0877
Maximum	0.209	Median	0.0739
SD	0.0516	Std. Error of Mean	0.00816
Coefficient of Variation	0.589	Skewness	0.957
Normal GOF Test			
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.148	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.101	95% Adjusted-CLT UCL (Chen-1995)	0.102
		95% Modified-t UCL (Johnson-1978)	0.102
Gamma GOF Test			
A-D Test Statistic	0.404	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.103	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.176	k star (bias corrected MLE)	2.955
Theta hat (MLE)	0.0276	Theta star (bias corrected MLE)	0.0297
nu hat (MLE)	254.1	nu star (bias corrected)	236.4
MLE Mean (bias corrected)	0.0877	MLE Sd (bias corrected)	0.051
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	201.8
		Adjusted Chi Square Value	200.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.103	95% Adjusted Gamma UCL	0.103
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0698	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.681	Mean of logged Data	-2.6
Maximum of Logged Data	-1.565	SD of logged Data	0.589
Assuming Lognormal Distribution			
95% H-UCL	0.107	90% Chebyshev (MVUE) UCL	0.114
95% Chebyshev (MVUE) UCL	0.126	97.5% Chebyshev (MVUE) UCL	0.142
99% Chebyshev (MVUE) UCL	0.175		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.101	95% BCA Bootstrap UCL	0.103
95% Standard Bootstrap UCL	0.101	95% Bootstrap-t UCL	0.104
95% Hall's Bootstrap UCL	0.103	95% Percentile Bootstrap UCL	0.102
90% Chebyshev(Mean, Sd) UCL	0.112	95% Chebyshev(Mean, Sd) UCL	0.123
97.5% Chebyshev(Mean, Sd) UCL	0.139	99% Chebyshev(Mean, Sd) UCL	0.169
Suggested UCL to Use			
95% Student's-t UCL	0.101		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methylmercury (as MeHg)

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	25.2	Mean	87.66
Maximum	209	Median	73.85
SD	51.62	Std. Error of Mean	8.162
Coefficient of Variation	0.589	Skewness	0.957
Normal GOF Test			
Shapiro Wilk Test Statistic	0.889	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.148	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	101.4	95% Adjusted-CLT UCL (Chen-1995)	102.4
		95% Modified-t UCL (Johnson-1978)	101.6
Gamma GOF Test			
A-D Test Statistic	0.404	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.103	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.176	k star (bias corrected MLE)	2.955
Theta hat (MLE)	27.6	Theta star (bias corrected MLE)	29.67
nu hat (MLE)	254.1	nu star (bias corrected)	236.4
MLE Mean (bias corrected)	87.66	MLE Sd (bias corrected)	50.99
		Approximate Chi Square Value (0.05)	201.8
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	200.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL	102.7	95% Adjusted Gamma UCL	103.3
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0698	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.227	Mean of logged Data	4.308
Maximum of Logged Data	5.342	SD of logged Data	0.589
Assuming Lognormal Distribution			
95% H-UCL	106.6	90% Chebyshev (MVUE) UCL	114
95% Chebyshev (MVUE) UCL	125.9	97.5% Chebyshev (MVUE) UCL	142.3
99% Chebyshev (MVUE) UCL	174.6		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	101.1	95% BCA Bootstrap UCL	102.8
95% Standard Bootstrap UCL	101.4	95% Bootstrap-t UCL	103.7
95% Hall's Bootstrap UCL	103.1	95% Percentile Bootstrap UCL	101.8
90% Chebyshev(Mean, Sd) UCL	112.1	95% Chebyshev(Mean, Sd) UCL	123.2
97.5% Chebyshev(Mean, Sd) UCL	138.6	99% Chebyshev(Mean, Sd) UCL	168.9
Suggested UCL to Use			
95% Student's-t UCL	101.4		

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Molybdenum

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	0.0135	Mean	0.0274
Maximum	0.0883	Median	0.0218
SD	0.0164	Std. Error of Mean	0.00259
Coefficient of Variation	0.598	Skewness	2.295
Normal GOF Test			
Shapiro Wilk Test Statistic	0.698	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.261	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0318	95% Adjusted-CLT UCL (Chen-1995)	0.0327
		95% Modified-t UCL (Johnson-1978)	0.032
Gamma GOF Test			
A-D Test Statistic	2.492	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.195	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.462	k star (bias corrected MLE)	4.144
Theta hat (MLE)	0.00615	Theta star (bias corrected MLE)	0.00662
nu hat (MLE)	357	nu star (bias corrected)	331.5
MLE Mean (bias corrected)	0.0274	MLE Sd (bias corrected)	0.0135
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	290.3
		Adjusted Chi Square Value	288.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0313	95% Adjusted Gamma UCL	0.0315
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.871	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.305	Mean of logged Data	-3.712
Maximum of Logged Data	-2.427	SD of logged Data	0.446
Assuming Lognormal Distribution			
95% H-UCL	0.0309	90% Chebyshev (MVUE) UCL	0.0328
95% Chebyshev (MVUE) UCL	0.0355	97.5% Chebyshev (MVUE) UCL	0.0392
99% Chebyshev (MVUE) UCL	0.0465		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0317	95% BCA Bootstrap UCL	0.033
95% Standard Bootstrap UCL	0.0317	95% Bootstrap-t UCL	0.0336
95% Hall's Bootstrap UCL	0.0329	95% Percentile Bootstrap UCL	0.0319
90% Chebyshev(Mean, Sd) UCL	0.0352	95% Chebyshev(Mean, Sd) UCL	0.0387
97.5% Chebyshev(Mean, Sd) UCL	0.0436	99% Chebyshev(Mean, Sd) UCL	0.0532
Suggested UCL to Use			
95% Student's-t UCL	0.0318		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Nickel

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

General Statistics

Total Number of Observations	40	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	36
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	0.044	Minimum Non-Detect	0.04
Maximum Detect	0.05	Maximum Non-Detect	0.04
Variance Detects	7.0000E-6	Percent Non-Detects	90%
Mean Detects	0.0465	SD Detects	0.00265
Median Detects	0.046	CV Detects	0.0569
Skewness Detects	0.864	Kurtosis Detects	-0.286
Mean of Logged Detects	-3.069	SD of Logged Detects	0.0563

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.687	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.215	Lilliefors GOF Test
1% Lilliefors Critical Value	0.413	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0407	KM Standard Error of Mean	3.7980E-4
90KM SD	0.00208	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0413	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0413	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0418	95% KM Chebyshev UCL	0.0423
97.5% KM Chebyshev UCL	0.043	99% KM Chebyshev UCL	0.0444

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.273	Anderson-Darling GOF Test
5% A-D Critical Value	0.657	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.242	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	418	k star (bias corrected MLE)	104.7
Theta hat (MLE)	1.1124E-4	Theta star (bias corrected MLE)	4.4426E-4
nu hat (MLE)	3344	nu star (bias corrected)	837.3
Mean (detects)	0.0465		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.014	Mean	0.0312
Maximum	0.05	Median	0.031
SD	0.00847	CV	0.272
k hat (MLE)	13.09	k star (bias corrected MLE)	12.13
Theta hat (MLE)	0.00238	Theta star (bias corrected MLE)	0.00257
nu hat (MLE)	1047	nu star (bias corrected)	970.1
Adjusted Level of Significance (β)	0.044	Adjusted Chi Square Value (970.05, β)	896.2
Approximate Chi Square Value (970.05, α)	898.8	95% Gamma Adjusted UCL	N/A
95% Gamma Approximate UCL	0.0337		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0407	SD (KM)	0.00208
Variance (KM)	4.3275E-6	SE of Mean (KM)	3.7980E-4
k hat (KM)	381.8	k star (KM)	353.2
nu hat (KM)	30547	nu star (KM)	28258
theta hat (KM)	1.0646E-4	theta star (KM)	1.1508E-4
80% gamma percentile (KM)	0.0425	90% gamma percentile (KM)	0.0434
95% gamma percentile (KM)	0.0443	99% gamma percentile (KM)	0.0459

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	27868	Adjusted Chi Square Value (N/A, β)	27853
95% KM Approximate Gamma UCL	0.0412	95% KM Adjusted Gamma UCL	0.0412

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.792	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.213	Lilliefors GOF Test

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

10% Lilliefors Critical Value 0.346 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0337	Mean in Log Scale	-3.407
SD in Original Scale	0.00648	SD in Log Scale	0.19
95% t UCL (assumes normality of ROS data)	0.0354	95% Percentile Bootstrap UCL	0.0354
95% BCA Bootstrap UCL	0.0354	95% Bootstrap t UCL	0.0355
95% H-UCL (Log ROS)	0.0356		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.204	KM Geo Mean	0.0406
KM SD (logged)	0.0474	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00865	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0474	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00865		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0227
SD in Original Scale	0.00808
95% t UCL (Assumes normality)	0.0248

DL/2 Log-Transformed

Mean in Log Scale	-3.828
SD in Log Scale	0.256
95% H-Stat UCL	0.0242

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0413

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Phosphorus

General Statistics

Total Number of Observations	40	Number of Distinct Observations	37
Minimum	4080	Number of Missing Observations	0
Maximum	8200	Mean	6026
SD	759	Median	5900
Coefficient of Variation	0.126	Std. Error of Mean	120
		Skewness	0.148

Normal GOF Test

Shapiro Wilk Test Statistic	0.979
1% Shapiro Wilk Critical Value	0.919
Lilliefors Test Statistic	0.0866
1% Lilliefors Critical Value	0.162

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 6228

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 6226
95% Modified-t UCL (Johnson-1978) 6229

Gamma GOF Test

A-D Test Statistic	0.397
5% A-D Critical Value	0.746
K-S Test Statistic	0.0933
5% K-S Critical Value	0.139

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	63.73	k star (bias corrected MLE)	58.96
Theta hat (MLE)	94.56	Theta star (bias corrected MLE)	102.2
nu hat (MLE)	5098	nu star (bias corrected)	4717
MLE Mean (bias corrected)	6026	MLE Sd (bias corrected)	784.8
		Approximate Chi Square Value (0.05)	4558
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	4553

Assuming Gamma Distribution

95% Approximate Gamma UCL 6236

95% Adjusted Gamma UCL 6244

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

	Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test
Shapiro Wilk Test Statistic	0.975		Data appear Lognormal at 10% Significance Level
10% Shapiro Wilk Critical Value	0.949		Lilliefors Lognormal GOF Test
Lilliefors Test Statistic	0.0932		Data appear Lognormal at 10% Significance Level
10% Lilliefors Critical Value	0.128		

Data appear Lognormal at 10% Significance Level

	Lognormal Statistics		
Minimum of Logged Data	8.314	Mean of logged Data	8.696
Maximum of Logged Data	9.012	SD of logged Data	0.128

	Assuming Lognormal Distribution		
95% H-UCL	6243	90% Chebyshev (MVUE) UCL	6394
95% Chebyshev (MVUE) UCL	6560	97.5% Chebyshev (MVUE) UCL	6791
99% Chebyshev (MVUE) UCL	7244		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

	Nonparametric Distribution Free UCLs		
95% CLT UCL	6223	95% BCA Bootstrap UCL	6227
95% Standard Bootstrap UCL	6227	95% Bootstrap-t UCL	6238
95% Hall's Bootstrap UCL	6240	95% Percentile Bootstrap UCL	6227
90% Chebyshev(Mean, Sd) UCL	6386	95% Chebyshev(Mean, Sd) UCL	6549
97.5% Chebyshev(Mean, Sd) UCL	6775	99% Chebyshev(Mean, Sd) UCL	7220

Suggested UCL to Use
95% Student's-t UCL 6228

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Potassium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	2030	Mean	2875
Maximum	3390	Median	2900
SD	216.3	Std. Error of Mean	34.19
Coefficient of Variation	0.0752	Skewness	-1.143
Normal GOF Test			
Shapiro Wilk Test Statistic	0.919	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0939	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2933	95% Adjusted-CLT UCL (Chen-1995)	2925
		95% Modified-t UCL (Johnson-1978)	2932
Gamma GOF Test			
A-D Test Statistic	0.904	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.101	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	168	k star (bias corrected MLE)	155.4
Theta hat (MLE)	17.11	Theta star (bias corrected MLE)	18.5
nu hat (MLE)	13440	nu star (bias corrected)	12433
MLE Mean (bias corrected)	2875	MLE Sd (bias corrected)	230.6
		Approximate Chi Square Value (0.05)	12175
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	12165
Assuming Gamma Distribution			
95% Approximate Gamma UCL	2936	95% Adjusted Gamma UCL	2939
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.869	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.111	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	7.616	Mean of logged Data	7.961
Maximum of Logged Data	8.129	SD of logged Data	0.0799
Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	2985
95% Chebyshev (MVUE) UCL	3034	97.5% Chebyshev (MVUE) UCL	3103
99% Chebyshev (MVUE) UCL	3238		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2931	95% BCA Bootstrap UCL	2924
95% Standard Bootstrap UCL	2933	95% Bootstrap-t UCL	2930
95% Hall's Bootstrap UCL	2932	95% Percentile Bootstrap UCL	2931
90% Chebyshev(Mean, Sd) UCL	2978	95% Chebyshev(Mean, Sd) UCL	3024
97.5% Chebyshev(Mean, Sd) UCL	3089	99% Chebyshev(Mean, Sd) UCL	3215
Suggested UCL to Use			
95% Student's-t UCL	2933		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Rubidium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	40
Minimum	0.886	Number of Missing Observations	0
Maximum	10.6	Mean	4.435
SD	2.878	Median	3.225
Coefficient of Variation	0.649	Std. Error of Mean	0.455
		Skewness	0.642
Normal GOF Test			
Shapiro Wilk Test Statistic	0.853	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.201	95% Adjusted-CLT UCL (Chen-1995)	5.233
		95% Modified-t UCL (Johnson-1978)	5.209
Gamma GOF Test			
A-D Test Statistic	1.491	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.167	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.141	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.449	k star (bias corrected MLE)	2.282
Theta hat (MLE)	1.811	Theta star (bias corrected MLE)	1.943
nu hat (MLE)	196	nu star (bias corrected)	182.6
MLE Mean (bias corrected)	4.435	MLE Sd (bias corrected)	2.936
		Approximate Chi Square Value (0.05)	152.3
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	151.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL	5.316	95% Adjusted Gamma UCL	5.352
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.923	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.173	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.121	Mean of logged Data	1.272
Maximum of Logged Data	2.361	SD of logged Data	0.683
Assuming Lognormal Distribution			
95% H-UCL	5.649	90% Chebyshev (MVUE) UCL	6.042
95% Chebyshev (MVUE) UCL	6.754	97.5% Chebyshev (MVUE) UCL	7.742
99% Chebyshev (MVUE) UCL	9.682		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.183	95% BCA Bootstrap UCL	5.229
95% Standard Bootstrap UCL	5.164	95% Bootstrap-t UCL	5.226
95% Hall's Bootstrap UCL	5.175	95% Percentile Bootstrap UCL	5.196
90% Chebyshev(Mean, Sd) UCL	5.8	95% Chebyshev(Mean, Sd) UCL	6.418
97.5% Chebyshev(Mean, Sd) UCL	7.276	99% Chebyshev(Mean, Sd) UCL	8.962
Suggested UCL to Use			
95% Student's-t UCL	5.201		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Selenium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.128	Mean	0.214
Maximum	0.399	Median	0.189
SD	0.0704	Std. Error of Mean	0.0111
Coefficient of Variation	0.329	Skewness	1.403
Normal GOF Test			
Shapiro Wilk Test Statistic	0.819	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.219	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.232	95% Adjusted-CLT UCL (Chen-1995)	0.235
		95% Modified-t UCL (Johnson-1978)	0.233
Gamma GOF Test			
A-D Test Statistic	1.793	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.193	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	11.37	k star (bias corrected MLE)	10.54
Theta hat (MLE)	0.0188	Theta star (bias corrected MLE)	0.0203
nu hat (MLE)	909.8	nu star (bias corrected)	842.9
MLE Mean (bias corrected)	0.214	MLE Sd (bias corrected)	0.0658
		Approximate Chi Square Value (0.05)	776.5
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	774.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.232	95% Adjusted Gamma UCL	0.233
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.175	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.056	Mean of logged Data	-1.588
Maximum of Logged Data	-0.919	SD of logged Data	0.291
Assuming Lognormal Distribution			
95% H-UCL	0.232	90% Chebyshev (MVUE) UCL	0.243
95% Chebyshev (MVUE) UCL	0.256	97.5% Chebyshev (MVUE) UCL	0.275
99% Chebyshev (MVUE) UCL	0.312		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.232	95% BCA Bootstrap UCL	0.234
95% Standard Bootstrap UCL	0.232	95% Bootstrap-t UCL	0.236
95% Hall's Bootstrap UCL	0.235	95% Percentile Bootstrap UCL	0.233
90% Chebyshev(Mean, Sd) UCL	0.247	95% Chebyshev(Mean, Sd) UCL	0.262
97.5% Chebyshev(Mean, Sd) UCL	0.283	99% Chebyshev(Mean, Sd) UCL	0.325
Suggested UCL to Use			
95% Student's-t UCL	0.232		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Selenium (dwt)

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	0.592	Mean	0.958
Maximum	1.622	Median	0.879
SD	0.276	Std. Error of Mean	0.0436
Coefficient of Variation	0.288	Skewness	1.006
Normal GOF Test			
Shapiro Wilk Test Statistic	0.89	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.16	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.032	95% Adjusted-CLT UCL (Chen-1995)	1.038
		95% Modified-t UCL (Johnson-1978)	1.033
Gamma GOF Test			
A-D Test Statistic	0.806	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.132	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	13.77	k star (bias corrected MLE)	12.75
Theta hat (MLE)	0.0696	Theta star (bias corrected MLE)	0.0752
nu hat (MLE)	1101	nu star (bias corrected)	1020
MLE Mean (bias corrected)	0.958	MLE Sd (bias corrected)	0.268
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	946.9
		Adjusted Chi Square Value	944.3
Assuming Gamma Distribution			
95% Approximate Gamma UCL	1.032	95% Adjusted Gamma UCL	1.035
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.524	Mean of logged Data	-0.0792
Maximum of Logged Data	0.484	SD of logged Data	0.269
Assuming Lognormal Distribution			
95% H-UCL	1.034	90% Chebyshev (MVUE) UCL	1.081
95% Chebyshev (MVUE) UCL	1.137	97.5% Chebyshev (MVUE) UCL	1.215
99% Chebyshev (MVUE) UCL	1.368		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.03	95% BCA Bootstrap UCL	1.035
95% Standard Bootstrap UCL	1.03	95% Bootstrap-t UCL	1.043
95% Hall's Bootstrap UCL	1.04	95% Percentile Bootstrap UCL	1.033
90% Chebyshev(Mean, Sd) UCL	1.089	95% Chebyshev(Mean, Sd) UCL	1.149
97.5% Chebyshev(Mean, Sd) UCL	1.231	99% Chebyshev(Mean, Sd) UCL	1.392
Suggested UCL to Use			
95% Student's-t UCL	1.032		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Sodium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	635	Mean	960.1
Maximum	1190	Median	974.5
SD	119.4	Std. Error of Mean	18.87
Coefficient of Variation	0.124	Skewness	-0.318
Normal GOF Test			
Shapiro Wilk Test Statistic	0.982	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0754	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	991.9	95% Adjusted-CLT UCL (Chen-1995)	990.2
		95% Modified-t UCL (Johnson-1978)	991.8
Gamma GOF Test			
A-D Test Statistic	0.309	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0917	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	63.3	k star (bias corrected MLE)	58.57
Theta hat (MLE)	15.17	Theta star (bias corrected MLE)	16.39
nu hat (MLE)	5064	nu star (bias corrected)	4685
MLE Mean (bias corrected)	960.1	MLE Sd (bias corrected)	125.5
		Approximate Chi Square Value (0.05)	4527
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	4521
Assuming Gamma Distribution			
95% Approximate Gamma UCL	993.7	95% Adjusted Gamma UCL	994.9
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.102	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.454	Mean of logged Data	6.859
Maximum of Logged Data	7.082	SD of logged Data	0.129
Assuming Lognormal Distribution			
95% H-UCL	995.2	90% Chebyshev (MVUE) UCL	1019
95% Chebyshev (MVUE) UCL	1046	97.5% Chebyshev (MVUE) UCL	1083
99% Chebyshev (MVUE) UCL	1156		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	991.2	95% BCA Bootstrap UCL	989.5
95% Standard Bootstrap UCL	991.3	95% Bootstrap-t UCL	991.8
95% Hall's Bootstrap UCL	991.7	95% Percentile Bootstrap UCL	989.5
90% Chebyshev(Mean, Sd) UCL	1017	95% Chebyshev(Mean, Sd) UCL	1042
97.5% Chebyshev(Mean, Sd) UCL	1078	99% Chebyshev(Mean, Sd) UCL	1148
Suggested UCL to Use			
95% Student's-t UCL	991.9		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Strontium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	3.89	Mean	7.242
Maximum	14.3	Median	6.645
SD	2.332	Std. Error of Mean	0.369
Coefficient of Variation	0.322	Skewness	1.041
Normal GOF Test			
Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.135	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.864	95% Adjusted-CLT UCL (Chen-1995)	7.914
		95% Modified-t UCL (Johnson-1978)	7.874
Gamma GOF Test			
A-D Test Statistic	0.269	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.102	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	10.83	k star (bias corrected MLE)	10.04
Theta hat (MLE)	0.669	Theta star (bias corrected MLE)	0.722
nu hat (MLE)	866.5	nu star (bias corrected)	802.9
MLE Mean (bias corrected)	7.242	MLE Sd (bias corrected)	2.286
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	738.1
		Adjusted Chi Square Value	735.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL	7.878	95% Adjusted Gamma UCL	7.902
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.983	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0825	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.358	Mean of logged Data	1.933
Maximum of Logged Data	2.66	SD of logged Data	0.307
Assuming Lognormal Distribution			
95% H-UCL	7.912	90% Chebyshev (MVUE) UCL	8.308
95% Chebyshev (MVUE) UCL	8.794	97.5% Chebyshev (MVUE) UCL	9.468
99% Chebyshev (MVUE) UCL	10.79		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7.849	95% BCA Bootstrap UCL	7.916
95% Standard Bootstrap UCL	7.841	95% Bootstrap-t UCL	7.91
95% Hall's Bootstrap UCL	7.932	95% Percentile Bootstrap UCL	7.861
90% Chebyshev(Mean, Sd) UCL	8.349	95% Chebyshev(Mean, Sd) UCL	8.85
97.5% Chebyshev(Mean, Sd) UCL	9.545	99% Chebyshev(Mean, Sd) UCL	10.91
Suggested UCL to Use			
95% Student's-t UCL	7.864		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tellurium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	40
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tellurium was not processed!

Thallium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	0.00125	Mean	0.00388
Maximum	0.00781	Median	0.00373
SD	0.00186	Std. Error of Mean	2.9366E-4
Coefficient of Variation	0.479	Skewness	0.427

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.942	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.919		
Lilliefors Test Statistic	0.0861	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	0.00438
95% Student's-t UCL	0.00437	95% Modified-t UCL (Johnson-1978)	0.00438

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.436	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.752		
K-S Test Statistic	0.0893	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	4.136	k star (bias corrected MLE)	3.842
Theta hat (MLE)	9.3754E-4	Theta star (bias corrected MLE)	0.00101
nu hat (MLE)	330.8	nu star (bias corrected)	307.4
MLE Mean (bias corrected)	0.00388	MLE Sd (bias corrected)	0.00198
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	267.8
		Adjusted Chi Square Value	266.4

Assuming Gamma Distribution		Assuming Gamma Distribution	
95% Approximate Gamma UCL	0.00445	95% Adjusted Gamma UCL	0.00447

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.939	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.949		
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	

Data appear Approximate Lognormal at 10% Significance Level

Lognormal Statistics		Lognormal Statistics	
Minimum of Logged Data	-6.685	Mean of logged Data	-5.678
Maximum of Logged Data	-4.852	SD of logged Data	0.529

Assuming Lognormal Distribution			
95% H-UCL	0.00464	90% Chebyshev (MVUE) UCL	0.00495
95% Chebyshev (MVUE) UCL	0.00542	97.5% Chebyshev (MVUE) UCL	0.00607
99% Chebyshev (MVUE) UCL	0.00735		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Nonparametric Distribution Free UCLs			
95% CLT UCL	0.00436	95% BCA Bootstrap UCL	0.00438
95% Standard Bootstrap UCL	0.00436	95% Bootstrap-t UCL	0.00442
95% Hall's Bootstrap UCL	0.00441	95% Percentile Bootstrap UCL	0.00436
90% Chebyshev(Mean, Sd) UCL	0.00476	95% Chebyshev(Mean, Sd) UCL	0.00516
97.5% Chebyshev(Mean, Sd) UCL	0.00571	99% Chebyshev(Mean, Sd) UCL	0.0068

Suggested UCL to Use

95% Student's-t UCL 0.00437

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tin

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	0.025	Mean	0.0682
Maximum	0.145	Median	0.065
SD	0.0234	Std. Error of Mean	0.00369
Coefficient of Variation	0.342	Skewness	1.043

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.946	Data appear Normal at 1% Significance Level	
1% Shapiro Wilk Critical Value	0.919	Lilliefors GOF Test	
Lilliefors Test Statistic	0.103	Data appear Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.162		

Data appear Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0744	95% Adjusted-CLT UCL (Chen-1995)	0.0749
		95% Modified-t UCL (Johnson-1978)	0.0745

Gamma GOF Test			
A-D Test Statistic	0.204	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0663	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	9.241	k star (bias corrected MLE)	8.565
Theta hat (MLE)	0.00738	Theta star (bias corrected MLE)	0.00796
nu hat (MLE)	739.3	nu star (bias corrected)	685.2
MLE Mean (bias corrected)	0.0682	MLE Sd (bias corrected)	0.0233
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	625.4
		Adjusted Chi Square Value	623.3

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0747	95% Adjusted Gamma UCL	0.075

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.991	Data appear Lognormal at 10% Significance Level	
10% Shapiro Wilk Critical Value	0.949	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0755	Data appear Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.128		

Data appear Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	-3.689	Mean of logged Data	-2.74
Maximum of Logged Data	-1.931	SD of logged Data	0.339

Assuming Lognormal Distribution			
95% H-UCL	0.0754	90% Chebyshev (MVUE) UCL	0.0795
95% Chebyshev (MVUE) UCL	0.0846	97.5% Chebyshev (MVUE) UCL	0.0916
99% Chebyshev (MVUE) UCL	0.105		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0743	95% BCA Bootstrap UCL	0.0749
95% Standard Bootstrap UCL	0.0742	95% Bootstrap-t UCL	0.075
95% Hall's Bootstrap UCL	0.0754	95% Percentile Bootstrap UCL	0.0745
90% Chebyshev(Mean, Sd) UCL	0.0793	95% Chebyshev(Mean, Sd) UCL	0.0843
97.5% Chebyshev(Mean, Sd) UCL	0.0913	99% Chebyshev(Mean, Sd) UCL	0.105

Suggested UCL to Use

95% Student's-t UCL 0.0744

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Uranium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	5.6000E-4	Mean	0.00189
Maximum	0.00695	Median	0.00169
SD	0.00137	Std. Error of Mean	2.1663E-4
Coefficient of Variation	0.724	Skewness	1.764
Normal GOF Test			
Shapiro Wilk Test Statistic	0.827	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.178	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.00226	95% Adjusted-CLT UCL (Chen-1995)	0.00231
		95% Modified-t UCL (Johnson-1978)	0.00227
Gamma GOF Test			
A-D Test Statistic	0.698	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.124	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.141	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.481	k star (bias corrected MLE)	2.311
Theta hat (MLE)	7.6263E-4	Theta star (bias corrected MLE)	8.1852E-4
nu hat (MLE)	198.4	nu star (bias corrected)	184.9
MLE Mean (bias corrected)	0.00189	MLE Sd (bias corrected)	0.00124
		Approximate Chi Square Value (0.05)	154.4
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	153.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.00226	95% Adjusted Gamma UCL	0.00228
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.111	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-7.488	Mean of logged Data	-6.485
Maximum of Logged Data	-4.969	SD of logged Data	0.653
Assuming Lognormal Distribution			
95% H-UCL	0.00234	90% Chebyshev (MVUE) UCL	0.0025
95% Chebyshev (MVUE) UCL	0.00279	97.5% Chebyshev (MVUE) UCL	0.00318
99% Chebyshev (MVUE) UCL	0.00396		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.00225	95% BCA Bootstrap UCL	0.0023
95% Standard Bootstrap UCL	0.00225	95% Bootstrap-t UCL	0.00238
95% Hall's Bootstrap UCL	0.00241	95% Percentile Bootstrap UCL	0.00227
90% Chebyshev(Mean, Sd) UCL	0.00254	95% Chebyshev(Mean, Sd) UCL	0.00284
97.5% Chebyshev(Mean, Sd) UCL	0.00324	99% Chebyshev(Mean, Sd) UCL	0.00405
Suggested UCL to Use			
95% Adjusted Gamma UCL	0.00228		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Vanadium

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	0.02	Mean	0.0734
Maximum	0.141	Median	0.064
SD	0.0327	Std. Error of Mean	0.00516
Coefficient of Variation	0.445	Skewness	0.451
Normal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.151	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0821	95% Adjusted-CLT UCL (Chen-1995)	0.0823
		95% Modified-t UCL (Johnson-1978)	0.0822
Gamma GOF Test			
A-D Test Statistic	0.439	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.115	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.898	k star (bias corrected MLE)	4.547
Theta hat (MLE)	0.015	Theta star (bias corrected MLE)	0.0161
nu hat (MLE)	391.8	nu star (bias corrected)	363.8
MLE Mean (bias corrected)	0.0734	MLE Sd (bias corrected)	0.0344
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	320.6
		Adjusted Chi Square Value	319.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0833	95% Adjusted Gamma UCL	0.0837
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.955	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.121	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.912	Mean of logged Data	-2.717
Maximum of Logged Data	-1.959	SD of logged Data	0.483
Assuming Lognormal Distribution			
95% H-UCL	0.086	90% Chebyshev (MVUE) UCL	0.0917
95% Chebyshev (MVUE) UCL	0.0997	97.5% Chebyshev (MVUE) UCL	0.111
99% Chebyshev (MVUE) UCL	0.133		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0819	95% BCA Bootstrap UCL	0.0821
95% Standard Bootstrap UCL	0.0816	95% Bootstrap-t UCL	0.0825
95% Hall's Bootstrap UCL	0.0823	95% Percentile Bootstrap UCL	0.0816
90% Chebyshev(Mean, Sd) UCL	0.0889	95% Chebyshev(Mean, Sd) UCL	0.0959
97.5% Chebyshev(Mean, Sd) UCL	0.106	99% Chebyshev(Mean, Sd) UCL	0.125
Suggested UCL to Use			
95% Student's-t UCL	0.0821		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zinc

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

General Statistics			
Total Number of Observations	40	Number of Distinct Observations	39
Minimum	20.3	Number of Missing Observations	0
Maximum	96.4	Mean	56.3
SD	19.61	Median	60.05
Coefficient of Variation	0.348	Std. Error of Mean	3.1
		Skewness	0.0107
Normal GOF Test			
Shapiro Wilk Test Statistic	0.968	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.919	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.111	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.162	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	61.52	95% Adjusted-CLT UCL (Chen-1995)	61.4
		95% Modified-t UCL (Johnson-1978)	61.52
Gamma GOF Test			
A-D Test Statistic	0.531	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.148	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.14	Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.528	k star (bias corrected MLE)	6.98
Theta hat (MLE)	7.479	Theta star (bias corrected MLE)	8.066
nu hat (MLE)	602.2	nu star (bias corrected)	558.4
MLE Mean (bias corrected)	56.3	MLE Sd (bias corrected)	21.31
Adjusted Level of Significance	0.044	Approximate Chi Square Value (0.05)	504.6
		Adjusted Chi Square Value	502.7
Assuming Gamma Distribution			
95% Approximate Gamma UCL	62.3	95% Adjusted Gamma UCL	62.53
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.944	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.949	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.161	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.128	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	3.011	Mean of logged Data	3.963
Maximum of Logged Data	4.569	SD of logged Data	0.389
Assuming Lognormal Distribution			
95% H-UCL	63.65	90% Chebyshev (MVUE) UCL	67.39
95% Chebyshev (MVUE) UCL	72.27	97.5% Chebyshev (MVUE) UCL	79.04
99% Chebyshev (MVUE) UCL	92.34		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	61.39	95% BCA Bootstrap UCL	61.19
95% Standard Bootstrap UCL	61.23	95% Bootstrap-t UCL	61.54
95% Hall's Bootstrap UCL	61.38	95% Percentile Bootstrap UCL	61.03
90% Chebyshev(Mean, Sd) UCL	65.6	95% Chebyshev(Mean, Sd) UCL	69.81
97.5% Chebyshev(Mean, Sd) UCL	75.66	99% Chebyshev(Mean, Sd) UCL	87.14
Suggested UCL to Use			
95% Student's-t UCL	61.52		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zirconium

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples

Total Number of Observations	40	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	40
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**

The data set for variable Zirconium was not processed!

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

User Selected Options
 Date/Time of Computation ProUCL 5.2 2025-11-18 12:52:43 PM
 From File Small fish UCL input_a.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Moisture

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	47
		Number of Missing Observations	0
Minimum	70.8	Mean	75.28
Maximum	81.7	Median	75.15
SD	2.219	Std. Error of Mean	0.258
Coefficient of Variation	0.0295	Skewness	0.996

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.916	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	4.0775E-5	Lilliefors GOF Test	
Lilliefors Test Statistic	0.145	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.119		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	75.71	95% Adjusted-CLT UCL (Chen-1995)	75.74
		95% Modified-t UCL (Johnson-1978)	75.72

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.569	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.749	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.14	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.103		

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	1188	k star (bias corrected MLE)	1140
Theta hat (MLE)	0.0634	Theta star (bias corrected MLE)	0.0661
nu hat (MLE)	175795	nu star (bias corrected)	168669
MLE Mean (bias corrected)	75.28	MLE Sd (bias corrected)	2.23
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	167715
		Adjusted Chi Square Value	167697

Assuming Gamma Distribution			
95% Approximate Gamma UCL	75.71	95% Adjusted Gamma UCL	75.72

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.926	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	2.2270E-4	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.139	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0943		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	4.26	Mean of logged Data	4.321
Maximum of Logged Data	4.403	SD of logged Data	0.0291

Assuming Lognormal Distribution			
95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	76.05
95% Chebyshev (MVUE) UCL	76.39	97.5% Chebyshev (MVUE) UCL	76.87
99% Chebyshev (MVUE) UCL	77.82		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	75.71	95% BCA Bootstrap UCL	75.73
95% Standard Bootstrap UCL	75.7	95% Bootstrap-t UCL	75.77
95% Hall's Bootstrap UCL	75.78	95% Percentile Bootstrap UCL	75.71
90% Chebyshev(Mean, Sd) UCL	76.06	95% Chebyshev(Mean, Sd) UCL	76.41
97.5% Chebyshev(Mean, Sd) UCL	76.89	99% Chebyshev(Mean, Sd) UCL	77.85

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples
Suggested UCL to Use

95% Student's-t UCL 75.71

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Aluminum

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	72
		Number of Missing Observations	0
Minimum	0.53	Mean	11.49
Maximum	108	Median	5.76
SD	16.86	Std. Error of Mean	1.96
Coefficient of Variation	1.467	Skewness	3.657
Normal GOF Test			
Shapiro Wilk Test Statistic	0.614	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.76	95% Adjusted-CLT UCL (Chen-1995)	15.61
		95% Modified-t UCL (Johnson-1978)	14.9
Gamma GOF Test			
A-D Test Statistic	1.105	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.788	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.101	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.107	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.851	k star (bias corrected MLE)	0.826
Theta hat (MLE)	13.51	Theta star (bias corrected MLE)	13.92
nu hat (MLE)	126	nu star (bias corrected)	122.2
MLE Mean (bias corrected)	11.49	MLE Sd (bias corrected)	12.65
		Approximate Chi Square Value (0.05)	97.65
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	97.22
Assuming Gamma Distribution			
95% Approximate Gamma UCL	14.38	95% Adjusted Gamma UCL	14.45
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.41	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0529	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.635	Mean of logged Data	1.75
Maximum of Logged Data	4.682	SD of logged Data	1.204
Assuming Lognormal Distribution			
95% H-UCL	16.8	90% Chebyshev (MVUE) UCL	17.86
95% Chebyshev (MVUE) UCL	20.66	97.5% Chebyshev (MVUE) UCL	24.54
99% Chebyshev (MVUE) UCL	32.17		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	14.72	95% BCA Bootstrap UCL	15.73
95% Standard Bootstrap UCL	14.73	95% Bootstrap-t UCL	16.63
95% Hall's Bootstrap UCL	18.23	95% Percentile Bootstrap UCL	14.82
90% Chebyshev(Mean, Sd) UCL	17.38	95% Chebyshev(Mean, Sd) UCL	20.04
97.5% Chebyshev(Mean, Sd) UCL	23.74	99% Chebyshev(Mean, Sd) UCL	31
Suggested UCL to Use			
95% Approximate Gamma UCL	14.38		

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Antimony

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	14
Number of Detects	23	Number of Non-Detects	51
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	0.0022	Minimum Non-Detect	0.002
Maximum Detect	0.0053	Maximum Non-Detect	0.002
Variance Detects	7.8711E-7	Percent Non-Detects	68.92%
Mean Detects	0.00316	SD Detects	8.8719E-4
Median Detects	0.0028	CV Detects	0.281
Skewness Detects	1.234	Kurtosis Detects	0.621
Mean of Logged Detects	-5.791	SD of Logged Detects	0.255

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.847	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.881	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.209	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00236	KM Standard Error of Mean	8.5754E-5
90KM SD	7.2147E-4	95% KM (BCA) UCL	0.00249
95% KM (t) UCL	0.0025	95% KM (Percentile Bootstrap) UCL	0.0025
95% KM (z) UCL	0.0025	95% KM Bootstrap t UCL	0.00254
90% KM Chebyshev UCL	0.00262	95% KM Chebyshev UCL	0.00273
97.5% KM Chebyshev UCL	0.00289	99% KM Chebyshev UCL	0.00321

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.011	Anderson-Darling GOF Test	
5% A-D Critical Value	0.743	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.204	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.181	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	15.25	k star (bias corrected MLE)	13.29
Theta hat (MLE)	2.0697E-4	Theta star (bias corrected MLE)	2.3750E-4
nu hat (MLE)	701.5	nu star (bias corrected)	611.4
Mean (detects)	0.00316		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0022	Mean	0.00787
Maximum	0.01	Median	0.01
SD	0.00323	CV	0.41
k hat (MLE)	4.019	k star (bias corrected MLE)	3.865
Theta hat (MLE)	0.00196	Theta star (bias corrected MLE)	0.00204
nu hat (MLE)	594.7	nu star (bias corrected)	572
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (571.97, α)	517.5	Adjusted Chi Square Value (571.97, β)	516.5
95% Gamma Approximate UCL	0.0087	95% Gamma Adjusted UCL	0.00872

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00236	SD (KM)	7.2147E-4
Variance (KM)	5.2052E-7	SE of Mean (KM)	8.5754E-5
k hat (KM)	10.7	k star (KM)	10.27
nu hat (KM)	1583	nu star (KM)	1520
theta hat (KM)	2.2061E-4	theta star (KM)	2.2973E-4
80% gamma percentile (KM)	0.00295	90% gamma percentile (KM)	0.00334
95% gamma percentile (KM)	0.00369	99% gamma percentile (KM)	0.0044

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1431	Adjusted Chi Square Value (N/A, β)	1429
95% KM Approximate Gamma UCL	0.00251	95% KM Adjusted Gamma UCL	0.00251

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.904	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.928	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.189	Lilliefors GOF Test	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

10% Lilliefors Critical Value 0.165 Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00191	Mean in Log Scale	-6.394
SD in Original Scale	0.00104	SD in Log Scale	0.524
95% t UCL (assumes normality of ROS data)	0.00211	95% Percentile Bootstrap UCL	0.0021
95% BCA Bootstrap UCL	0.0021	95% Bootstrap t UCL	0.00214
95% H-UCL (Log ROS)	0.00215		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.083	KM Geo Mean	0.00228
KM SD (logged)	0.24	95% Critical H Value (KM-Log)	1.722
KM Standard Error of Mean (logged)	0.0286	95% H-UCL (KM -Log)	0.00246
KM SD (logged)	0.24	95% Critical H Value (KM-Log)	1.722
KM Standard Error of Mean (logged)	0.0286		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00167	Mean in Log Scale	-6.561
SD in Original Scale	0.00112	SD in Log Scale	0.539
95% t UCL (Assumes normality)	0.00189	95% H-Stat UCL	0.00184

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0025

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulation results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Arsenic

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	65
		Number of Missing Observations	0
Minimum	0.0556	Mean	0.201
Maximum	0.611	Median	0.198
SD	0.106	Std. Error of Mean	0.0124
Coefficient of Variation	0.528	Skewness	1.261
Normal GOF Test			
Shapiro Wilk Test Statistic	0.911	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	1.8383E-5	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.0926	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.222	95% Adjusted-CLT UCL (Chen-1995)	0.224
		95% Modified-t UCL (Johnson-1978)	0.222
Gamma GOF Test			
A-D Test Statistic	0.446	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0811	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.878	k star (bias corrected MLE)	3.73
Theta hat (MLE)	0.0519	Theta star (bias corrected MLE)	0.054
nu hat (MLE)	574	nu star (bias corrected)	552
MLE Mean (bias corrected)	0.201	MLE Sd (bias corrected)	0.104
		Approximate Chi Square Value (0.05)	498.5
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	497.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.223	95% Adjusted Gamma UCL	0.223
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.969	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.215	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.101	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.89	Mean of logged Data	-1.737
Maximum of Logged Data	-0.493	SD of logged Data	0.533
Assuming Lognormal Distribution			
95% H-UCL	0.228	90% Chebyshev (MVUE) UCL	0.242
95% Chebyshev (MVUE) UCL	0.26	97.5% Chebyshev (MVUE) UCL	0.286
99% Chebyshev (MVUE) UCL	0.335		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.222	95% BCA Bootstrap UCL	0.223
95% Standard Bootstrap UCL	0.222	95% Bootstrap-t UCL	0.224
95% Hall's Bootstrap UCL	0.225	95% Percentile Bootstrap UCL	0.222
90% Chebyshev(Mean, Sd) UCL	0.238	95% Chebyshev(Mean, Sd) UCL	0.255
97.5% Chebyshev(Mean, Sd) UCL	0.278	99% Chebyshev(Mean, Sd) UCL	0.324
Suggested UCL to Use			
95% Student's-t UCL	0.222		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	64
		Number of Missing Observations	0
Minimum	0.673	Mean	2.604
Maximum	12.7	Median	2.095
SD	2.136	Std. Error of Mean	0.248
Coefficient of Variation	0.82	Skewness	2.939
Normal GOF Test			
Shapiro Wilk Test Statistic	0.663	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.251	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.017	95% Adjusted-CLT UCL (Chen-1995)	3.103
		95% Modified-t UCL (Johnson-1978)	3.031
Gamma GOF Test			
A-D Test Statistic	2.685	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.105	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.652	k star (bias corrected MLE)	2.554
Theta hat (MLE)	0.982	Theta star (bias corrected MLE)	1.02
nu hat (MLE)	392.5	nu star (bias corrected)	378
MLE Mean (bias corrected)	2.604	MLE Sd (bias corrected)	1.629
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	333.9
		Adjusted Chi Square Value	333.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL	2.947	95% Adjusted Gamma UCL	2.954
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.945	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.00553	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.396	Mean of logged Data	0.757
Maximum of Logged Data	2.542	SD of logged Data	0.59
Assuming Lognormal Distribution			
95% H-UCL	2.894	90% Chebyshev (MVUE) UCL	3.088
95% Chebyshev (MVUE) UCL	3.341	97.5% Chebyshev (MVUE) UCL	3.692
99% Chebyshev (MVUE) UCL	4.382		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.012	95% BCA Bootstrap UCL	3.101
95% Standard Bootstrap UCL	3.007	95% Bootstrap-t UCL	3.144
95% Hall's Bootstrap UCL	3.141	95% Percentile Bootstrap UCL	3.034
90% Chebyshev(Mean, Sd) UCL	3.348	95% Chebyshev(Mean, Sd) UCL	3.686
97.5% Chebyshev(Mean, Sd) UCL	4.154	99% Chebyshev(Mean, Sd) UCL	5.074
Suggested UCL to Use			
95% Student's-t UCL	3.017		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Beryllium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	2
Number of Detects	1	Number of Non-Detects	73
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set! It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Beryllium was not processed!

Blismuth

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	6
Number of Detects	7	Number of Non-Detects	67
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.0021	Minimum Non-Detect	0.002
Maximum Detect	0.0028	Maximum Non-Detect	0.002
Variance Detects	7.4762E-8	Percent Non-Detects	90.54%
Mean Detects	0.00239	SD Detects	2.7343E-4
Median Detects	0.0023	CV Detects	0.115
Skewness Detects	0.619	Kurtosis Detects	-1.004
Mean of Logged Detects	-6.044	SD of Logged Detects	0.113

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.891	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.73	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.194	Lilliefors GOF Test
1% Lilliefors Critical Value	0.35	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00204	KM Standard Error of Mean	1.7218E-5
90KM SD	1.3713E-4	95% KM (BCA) UCL	0.00206
95% KM (t) UCL	0.00207	95% KM (Percentile Bootstrap) UCL	0.00206
95% KM (z) UCL	0.00206	95% KM Bootstrap t UCL	0.00207
90% KM Chebyshev UCL	0.00209	95% KM Chebyshev UCL	0.00211
97.5% KM Chebyshev UCL	0.00214	99% KM Chebyshev UCL	0.00221

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.405	Anderson-Darling GOF Test
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.194	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.311	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Note GOF tests may be unreliable for small sample sizes

Gamma Statistics on Detected Data Only

k hat (MLE)	91.18	k star (bias corrected MLE)	52.2
Theta hat (MLE)	2.6166E-5	Theta star (bias corrected MLE)	4.5707E-5
nu hat (MLE)	1276	nu star (bias corrected)	730.7
Mean (detects)	0.00239		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0021	Mean	0.00928
Maximum	0.01	Median	0.01
SD	0.00224	CV	0.242
k hat (MLE)	8.316	k star (bias corrected MLE)	7.988
Theta hat (MLE)	0.00112	Theta star (bias corrected MLE)	0.00116
nu hat (MLE)	1231	nu star (bias corrected)	1182
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (N/A, α)	1103	Adjusted Chi Square Value (N/A, β)	1102
95% Gamma Approximate UCL	0.00994	95% Gamma Adjusted UCL	0.00996

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00204	SD (KM)	1.3713E-4
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UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Variance (KM)	1.8804E-8	SE of Mean (KM)	1.7218E-5
k hat (KM)	220.6	k star (KM)	211.6
nu hat (KM)	32642	nu star (KM)	31320
theta hat (KM)	9.2335E-6	theta star (KM)	9.6232E-6
80% gamma percentile (KM)	0.00215	90% gamma percentile (KM)	0.00222
95% gamma percentile (KM)	0.00227	99% gamma percentile (KM)	0.00238

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	30910	Adjusted Chi Square Value (N/A, β)	30902
95% KM Approximate Gamma UCL	0.00206	95% KM Adjusted Gamma UCL	0.00206

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.899	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.838	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors GOF Test
10% Lilliefors Critical Value	0.28	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00136	Mean in Log Scale	-6.658
SD in Original Scale	4.7673E-4	SD in Log Scale	0.343
95% t UCL (assumes normality of ROS data)	0.00145	95% Percentile Bootstrap UCL	0.00145
95% BCA Bootstrap UCL	0.00145	95% Bootstrap t UCL	0.00146
95% H-UCL (Log ROS)	0.00146		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.198	KM Geo Mean	0.00203
KM SD (logged)	0.0594	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00746	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0594	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00746		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00113	Mean in Log Scale	-6.826
SD in Original Scale	4.1576E-4	SD in Log Scale	0.257
95% t UCL (Assumes normality)	0.00121	95% H-Stat UCL	0.00118

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.00207

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Boron

General Statistics

Total Number of Observations	74	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	74
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Boron was not processed!

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Cadmium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	56
Number of Detects	73	Number of Non-Detects	1
Number of Distinct Detects	55	Number of Distinct Non-Detects	1
Minimum Detect	0.0015	Minimum Non-Detect	0.001
Maximum Detect	0.0237	Maximum Non-Detect	0.001
Variance Detects	2.2742E-5	Percent Non-Detects	1.351%
Mean Detects	0.00752	SD Detects	0.00477
Median Detects	0.0066	CV Detects	0.634
Skewness Detects	1.152	Kurtosis Detects	1.505
Mean of Logged Detects	-5.101	SD of Logged Detects	0.692

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.907	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	1.0311E-5	Lilliefors GOF Test	
Lilliefors Test Statistic	0.125	Detected Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.12		

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00744	KM Standard Error of Mean	5.5763E-4
90KM SD	0.00476	95% KM (BCA) UCL	0.00836
95% KM (t) UCL	0.00837	95% KM (Percentile Bootstrap) UCL	0.00838
95% KM (z) UCL	0.00835	95% KM Bootstrap t UCL	0.00846
90% KM Chebyshev UCL	0.00911	95% KM Chebyshev UCL	0.00987
97.5% KM Chebyshev UCL	0.0109	99% KM Chebyshev UCL	0.013

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.406	Anderson-Darling GOF Test	
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0703	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.105	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.518	k star (bias corrected MLE)	2.424
Theta hat (MLE)	0.00299	Theta star (bias corrected MLE)	0.0031
nu hat (MLE)	367.7	nu star (bias corrected)	353.9
Mean (detects)	0.00752		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0015	Mean	0.00756
Maximum	0.0237	Median	0.0067
SD	0.00474	CV	0.628
k hat (MLE)	2.544	k star (bias corrected MLE)	2.45
Theta hat (MLE)	0.00297	Theta star (bias corrected MLE)	0.00309
nu hat (MLE)	376.5	nu star (bias corrected)	362.6
Adjusted Level of Significance (β)	0.0468	Adjusted Chi Square Value (362.58, β)	318.7
Approximate Chi Square Value (362.58, α)	319.4	95% Gamma Adjusted UCL	0.0086
95% Gamma Approximate UCL	0.00858		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00744	SD (KM)	0.00476
Variance (KM)	2.2695E-5	SE of Mean (KM)	5.5763E-4
k hat (KM)	2.437	k star (KM)	2.347
nu hat (KM)	360.6	nu star (KM)	347.3
theta hat (KM)	0.00305	theta star (KM)	0.00317
80% gamma percentile (KM)	0.0109	90% gamma percentile (KM)	0.0139
95% gamma percentile (KM)	0.0168	99% gamma percentile (KM)	0.023

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (347.35, α)	305.2	Adjusted Chi Square Value (347.35, β)	304.4
95% KM Approximate Gamma UCL	0.00846	95% KM Adjusted Gamma UCL	0.00849

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.946	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0.00799	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors GOF Test	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

10% Lilliefors Critical Value 0.0949 Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00744	Mean in Log Scale	-5.126
SD in Original Scale	0.0048	SD in Log Scale	0.719
95% t UCL (assumes normality of ROS data)	0.00837	95% Percentile Bootstrap UCL	0.0083
95% BCA Bootstrap UCL	0.00831	95% Bootstrap t UCL	0.00846
95% H-UCL (Log ROS)	0.00911		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.125	KM Geo Mean	0.00594
KM SD (logged)	0.713	95% Critical H Value (KM-Log)	1.997
KM Standard Error of Mean (logged)	0.0835	95% H-UCL (KM -Log)	0.00906
KM SD (logged)	0.713	95% Critical H Value (KM-Log)	1.997
KM Standard Error of Mean (logged)	0.0835		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00743	Mean in Log Scale	-5.135
SD in Original Scale	0.00481	SD in Log Scale	0.746
95% t UCL (Assumes normality)	0.00836	95% H-Stat UCL	0.00928

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.00846	95% GROS Approximate Gamma UCL	0.00858
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Calcium

General Statistics

Total Number of Observations	74	Number of Distinct Observations	63
		Number of Missing Observations	0
Minimum	6130	Mean	10167
Maximum	16900	Median	9850
SD	2431	Std. Error of Mean	282.6
Coefficient of Variation	0.239	Skewness	0.682

Normal GOF Test

Shapiro Wilk Test Statistic	0.952
1% Shapiro Wilk P Value	0.0174
Lilliefors Test Statistic	0.0844
1% Lilliefors Critical Value	0.119

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 10638

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 10656
95% Modified-t UCL (Johnson-1978) 10642

Gamma GOF Test

A-D Test Statistic	0.283
5% A-D Critical Value	0.75
K-S Test Statistic	0.0713
5% K-S Critical Value	0.103

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	18.46	k star (bias corrected MLE)	17.72
Theta hat (MLE)	550.7	Theta star (bias corrected MLE)	573.7
nu hat (MLE)	2732	nu star (bias corrected)	2623
MLE Mean (bias corrected)	10167	MLE Sd (bias corrected)	2415
		Approximate Chi Square Value (0.05)	2505
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	2503

Assuming Gamma Distribution

95% Approximate Gamma UCL 10646

95% Adjusted Gamma UCL 10656

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.976
10% Shapiro Wilk P Value 0.442
Lilliefors Test Statistic 0.0609
10% Lilliefors Critical Value 0.0943

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data 8.721
Maximum of Logged Data 9.735

Mean of logged Data 9.2
SD of logged Data 0.235

Assuming Lognormal Distribution

95% H-UCL 10661
95% Chebyshev (MVUE) UCL 11389
99% Chebyshev (MVUE) UCL 12959

90% Chebyshev (MVUE) UCL 11008
97.5% Chebyshev (MVUE) UCL 11919

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL 10632
95% Standard Bootstrap UCL 10627
95% Hall's Bootstrap UCL 10655
90% Chebyshev(Mean, Sd) UCL 11015
97.5% Chebyshev(Mean, Sd) UCL 11933

95% BCA Bootstrap UCL 10669
95% Bootstrap-t UCL 10665
95% Percentile Bootstrap UCL 10636
95% Chebyshev(Mean, Sd) UCL 11399
99% Chebyshev(Mean, Sd) UCL 12980

Suggested UCL to Use

95% Student's-t UCL 10638

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Cesium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	61
		Number of Missing Observations	0
Minimum	0.0018	Mean	0.0147
Maximum	0.0697	Median	0.0073
SD	0.0174	Std. Error of Mean	0.00203
Coefficient of Variation	1.189	Skewness	1.844
Normal GOF Test			
Shapiro Wilk Test Statistic	0.684	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.279	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.018	95% Adjusted-CLT UCL (Chen-1995)	0.0185
		95% Modified-t UCL (Johnson-1978)	0.0181
Gamma GOF Test			
A-D Test Statistic	3.124	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.78	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.152	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.107	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.061	k star (bias corrected MLE)	1.027
Theta hat (MLE)	0.0138	Theta star (bias corrected MLE)	0.0143
nu hat (MLE)	157	nu star (bias corrected)	152
MLE Mean (bias corrected)	0.0147	MLE Sd (bias corrected)	0.0145
		Approximate Chi Square Value (0.05)	124.5
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	124
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0179	95% Adjusted Gamma UCL	0.018
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	2.1118E-4	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0977	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-6.32	Mean of logged Data	-4.762
Maximum of Logged Data	-2.664	SD of logged Data	1.006
Assuming Lognormal Distribution			
95% H-UCL	0.0185	90% Chebyshev (MVUE) UCL	0.0199
95% Chebyshev (MVUE) UCL	0.0226	97.5% Chebyshev (MVUE) UCL	0.0263
99% Chebyshev (MVUE) UCL	0.0335		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.018	95% BCA Bootstrap UCL	0.0184
95% Standard Bootstrap UCL	0.018	95% Bootstrap-t UCL	0.0186
95% Hall's Bootstrap UCL	0.0183	95% Percentile Bootstrap UCL	0.0182
90% Chebyshev(Mean, Sd) UCL	0.0208	95% Chebyshev(Mean, Sd) UCL	0.0235
97.5% Chebyshev(Mean, Sd) UCL	0.0273	99% Chebyshev(Mean, Sd) UCL	0.0349
Suggested UCL to Use			
95% Student's-t UCL	0.018		

**The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.
Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	41
Number of Detects	65	Number of Non-Detects	9
Number of Distinct Detects	41	Number of Distinct Non-Detects	1
Minimum Detect	0.01	Minimum Non-Detect	0.01
Maximum Detect	0.275	Maximum Non-Detect	0.01
Variance Detects	0.00183	Percent Non-Detects	12.16%
Mean Detects	0.041	SD Detects	0.0428
Median Detects	0.029	CV Detects	1.045
Skewness Detects	3.515	Kurtosis Detects	15.51
Mean of Logged Detects	-3.501	SD of Logged Detects	0.73

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.641	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	0	Lilliefors GOF Test	
Lilliefors Test Statistic	0.235	Detected Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.127		

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0372	KM Standard Error of Mean	0.00481
90KM SD	0.0411	95% KM (BCA) UCL	0.0454
95% KM (t) UCL	0.0452	95% KM (Percentile Bootstrap) UCL	0.0453
95% KM (z) UCL	0.0451	95% KM Bootstrap t UCL	0.0494
90% KM Chebyshev UCL	0.0516	95% KM Chebyshev UCL	0.0582
97.5% KM Chebyshev UCL	0.0673	99% KM Chebyshev UCL	0.0851

Gamma GOF Tests on Detected Observations Only

Gamma GOF Tests on Detected Observations Only		Anderson-Darling GOF Test	
A-D Test Statistic	1.724	Detected Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.766	Kolmogorov-Smirnov GOF	
K-S Test Statistic	0.111	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.112		

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.782	k star (bias corrected MLE)	1.71
Theta hat (MLE)	0.023	Theta star (bias corrected MLE)	0.024
nu hat (MLE)	231.6	nu star (bias corrected)	222.3
Mean (detects)	0.041		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0372
Maximum	0.275	Median	0.026
SD	0.0414	CV	1.112
k hat (MLE)	1.6	k star (bias corrected MLE)	1.544
Theta hat (MLE)	0.0233	Theta star (bias corrected MLE)	0.0241
nu hat (MLE)	236.8	nu star (bias corrected)	228.5
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (228.53, α)	194.5	Adjusted Chi Square Value (228.53, β)	193.9
95% Gamma Approximate UCL	0.0437	95% Gamma Adjusted UCL	0.0438

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0372	SD (KM)	0.0411
Variance (KM)	0.00169	SE of Mean (KM)	0.00481
k hat (KM)	0.82	k star (KM)	0.795
nu hat (KM)	121.3	nu star (KM)	117.7
theta hat (KM)	0.0454	theta star (KM)	0.0468
80% gamma percentile (KM)	0.0608	90% gamma percentile (KM)	0.0906
95% gamma percentile (KM)	0.121	99% gamma percentile (KM)	0.193

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (117.72, α)	93.67	Adjusted Chi Square Value (117.72, β)	93.24
95% KM Approximate Gamma UCL	0.0468	95% KM Adjusted Gamma UCL	0.047

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.945	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0.012	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0915	Lilliefors GOF Test
10% Lilliefors Critical Value	0.1	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0367	Mean in Log Scale	-3.705
SD in Original Scale	0.0417	SD in Log Scale	0.885
95% t UCL (assumes normality of ROS data)	0.0448	95% Percentile Bootstrap UCL	0.0446
95% BCA Bootstrap UCL	0.0462	95% Bootstrap t UCL	0.0479
95% H-UCL (Log ROS)	0.0455		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.635	KM Geo Mean	0.0264
KM SD (logged)	0.769	95% Critical H Value (KM-Log)	2.045
KM Standard Error of Mean (logged)	0.0901	95% H-UCL (KM -Log)	0.0426
KM SD (logged)	0.769	95% Critical H Value (KM-Log)	2.045
KM Standard Error of Mean (logged)	0.0901		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0366	Mean in Log Scale	-3.72
SD in Original Scale	0.0418	SD in Log Scale	0.904
95% t UCL (Assumes normality)	0.0447	95% H-Stat UCL	0.0459

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0468	95% GROS Approximate Gamma UCL	0.0437
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

If the data were collected using judgmental or other non-random methods, then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Cobalt

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	72
		Number of Missing Observations	0
Minimum	0.0057	Mean	0.0622
Maximum	0.276	Median	0.0481
SD	0.052	Std. Error of Mean	0.00605
Coefficient of Variation	0.836	Skewness	1.238
Normal GOF Test			
Shapiro Wilk Test Statistic	0.883	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	1.2899E-7	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.139	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0723	95% Adjusted-CLT UCL (Chen-1995)	0.0731
		95% Modified-t UCL (Johnson-1978)	0.0724
Gamma GOF Test			
A-D Test Statistic	0.889	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.774	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.103	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.106	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.302	k star (bias corrected MLE)	1.258
Theta hat (MLE)	0.0478	Theta star (bias corrected MLE)	0.0495
nu hat (MLE)	192.7	nu star (bias corrected)	186.2
MLE Mean (bias corrected)	0.0622	MLE Sd (bias corrected)	0.0555
		Approximate Chi Square Value (0.05)	155.6
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	155.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0744	95% Adjusted Gamma UCL	0.0747
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.919	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	6.7279E-5	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.114	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-5.167	Mean of logged Data	-3.208
Maximum of Logged Data	-1.287	SD of logged Data	1.034
Assuming Lognormal Distribution			
95% H-UCL	0.091	90% Chebyshev (MVUE) UCL	0.0979
95% Chebyshev (MVUE) UCL	0.111	97.5% Chebyshev (MVUE) UCL	0.13
99% Chebyshev (MVUE) UCL	0.166		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0722	95% BCA Bootstrap UCL	0.0723
95% Standard Bootstrap UCL	0.072	95% Bootstrap-t UCL	0.0732
95% Hall's Bootstrap UCL	0.0733	95% Percentile Bootstrap UCL	0.0719
90% Chebyshev(Mean, Sd) UCL	0.0804	95% Chebyshev(Mean, Sd) UCL	0.0886
97.5% Chebyshev(Mean, Sd) UCL	0.1	99% Chebyshev(Mean, Sd) UCL	0.122
Suggested UCL to Use			
95% Approximate Gamma UCL	0.0744		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	72
		Number of Missing Observations	0
Minimum	0.352	Mean	0.813
Maximum	1.98	Median	0.733
SD	0.364	Std. Error of Mean	0.0423
Coefficient of Variation	0.448	Skewness	1.287
Normal GOF Test			
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	5.7587E-8	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.144	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.883	95% Adjusted-CLT UCL (Chen-1995)	0.889
		95% Modified-t UCL (Johnson-1978)	0.884
Gamma GOF Test			
A-D Test Statistic	1.016	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.129	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	5.92	k star (bias corrected MLE)	5.689
Theta hat (MLE)	0.137	Theta star (bias corrected MLE)	0.143
nu hat (MLE)	876.2	nu star (bias corrected)	842
MLE Mean (bias corrected)	0.813	MLE Sd (bias corrected)	0.341
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	775.7
		Adjusted Chi Square Value	774.4
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.882	95% Adjusted Gamma UCL	0.883
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.962	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.0776	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.044	Mean of logged Data	-0.294
Maximum of Logged Data	0.683	SD of logged Data	0.411
Assuming Lognormal Distribution			
95% H-UCL	0.884	90% Chebyshev (MVUE) UCL	0.93
95% Chebyshev (MVUE) UCL	0.984	97.5% Chebyshev (MVUE) UCL	1.06
99% Chebyshev (MVUE) UCL	1.209		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.882	95% BCA Bootstrap UCL	0.886
95% Standard Bootstrap UCL	0.882	95% Bootstrap-t UCL	0.891
95% Hall's Bootstrap UCL	0.89	95% Percentile Bootstrap UCL	0.882
90% Chebyshev(Mean, Sd) UCL	0.939	95% Chebyshev(Mean, Sd) UCL	0.997
97.5% Chebyshev(Mean, Sd) UCL	1.077	99% Chebyshev(Mean, Sd) UCL	1.233
Suggested UCL to Use			
95% Student's-t UCL	0.883		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Iron

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	71
		Number of Missing Observations	0
Minimum	13.1	Mean	51.92
Maximum	221	Median	46.2
SD	29.57	Std. Error of Mean	3.437
Coefficient of Variation	0.57	Skewness	3.048
Normal GOF Test			
Shapiro Wilk Test Statistic	0.774	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	8.882E-16	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.142	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	57.64	95% Adjusted-CLT UCL (Chen-1995)	58.87
		95% Modified-t UCL (Johnson-1978)	57.85
Gamma GOF Test			
A-D Test Statistic	0.746	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0806	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.241	k star (bias corrected MLE)	4.078
Theta hat (MLE)	12.24	Theta star (bias corrected MLE)	12.73
nu hat (MLE)	627.6	nu star (bias corrected)	603.5
MLE Mean (bias corrected)	51.92	MLE Sd (bias corrected)	25.71
		Approximate Chi Square Value (0.05)	547.5
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	546.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL	57.22	95% Adjusted Gamma UCL	57.33
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.117	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0813	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.573	Mean of logged Data	3.827
Maximum of Logged Data	5.398	SD of logged Data	0.497
Assuming Lognormal Distribution			
95% H-UCL	57.89	90% Chebyshev (MVUE) UCL	61.35
95% Chebyshev (MVUE) UCL	65.64	97.5% Chebyshev (MVUE) UCL	71.59
99% Chebyshev (MVUE) UCL	83.29		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	57.57	95% BCA Bootstrap UCL	59.11
95% Standard Bootstrap UCL	57.62	95% Bootstrap-t UCL	59.54
95% Hall's Bootstrap UCL	62.01	95% Percentile Bootstrap UCL	57.86
90% Chebyshev(Mean, Sd) UCL	62.23	95% Chebyshev(Mean, Sd) UCL	66.9
97.5% Chebyshev(Mean, Sd) UCL	73.38	99% Chebyshev(Mean, Sd) UCL	86.11
Suggested UCL to Use			
95% Approximate Gamma UCL	57.22		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Lead

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	63
Number of Detects	73	Number of Non-Detects	1
Number of Distinct Detects	62	Number of Distinct Non-Detects	1
Minimum Detect	0.005	Minimum Non-Detect	0.004
Maximum Detect	0.0523	Maximum Non-Detect	0.004
Variance Detects	1.0893E-4	Percent Non-Detects	1.351%
Mean Detects	0.0161	SD Detects	0.0104
Median Detects	0.0132	CV Detects	0.648
Skewness Detects	1.791	Kurtosis Detects	3.362
Mean of Logged Detects	-4.294	SD of Logged Detects	0.564

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.812	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	8.786E-13		
Lilliefors Test Statistic	0.172	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.12	Detected Data Not Normal at 1% Significance Level	

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.016	KM Standard Error of Mean	0.00122
90KM SD	0.0104	95% KM (BCA) UCL	0.018
95% KM (t) UCL	0.018	95% KM (Percentile Bootstrap) UCL	0.0179
95% KM (z) UCL	0.018	95% KM Bootstrap t UCL	0.0183
90% KM Chebyshev UCL	0.0196	95% KM Chebyshev UCL	0.0213
97.5% KM Chebyshev UCL	0.0235	99% KM Chebyshev UCL	0.0281

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.989	Anderson-Darling GOF Test	
5% A-D Critical Value	0.758	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0972	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.105	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.165	k star (bias corrected MLE)	3.044
Theta hat (MLE)	0.00509	Theta star (bias corrected MLE)	0.0053
nu hat (MLE)	462	nu star (bias corrected)	444.4
Mean (detects)	0.0161		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.005	Mean	0.016
Maximum	0.0523	Median	0.013
SD	0.0104	CV	0.648
k hat (MLE)	3.182	k star (bias corrected MLE)	3.062
Theta hat (MLE)	0.00504	Theta star (bias corrected MLE)	0.00524
nu hat (MLE)	470.9	nu star (bias corrected)	453.1
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (453.13, α)	404.8	Adjusted Chi Square Value (453.13, β)	403.9
95% Gamma Approximate UCL	0.018	95% Gamma Adjusted UCL	0.018

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.016	SD (KM)	0.0104
Variance (KM)	1.0794E-4	SE of Mean (KM)	0.00122
k hat (KM)	2.358	k star (KM)	2.271
nu hat (KM)	349	nu star (KM)	336.2
theta hat (KM)	0.00677	theta star (KM)	0.00702
80% gamma percentile (KM)	0.0235	90% gamma percentile (KM)	0.0301
95% gamma percentile (KM)	0.0364	99% gamma percentile (KM)	0.0501

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (336.18, α)	294.7	Adjusted Chi Square Value (336.18, β)	293.9
95% KM Approximate Gamma UCL	0.0182	95% KM Adjusted Gamma UCL	0.0182

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.964	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0.113	Detected Data appear Lognormal at 10% Significance Level	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Lilliefors Test Statistic	0.0562	Lilliefors GOF Test
10% Lilliefors Critical Value	0.0949	Detected Data appear Lognormal at 10% Significance Level
Detected Data appear Lognormal at 10% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0159	Mean in Log Scale	-4.315
SD in Original Scale	0.0105	SD in Log Scale	0.588
95% t UCL (assumes normality of ROS data)	0.018	95% Percentile Bootstrap UCL	0.0179
95% BCA Bootstrap UCL	0.0179	95% Bootstrap t UCL	0.0183
95% H-UCL (Log ROS)	0.0181		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.311	KM Geo Mean	0.0134
KM SD (logged)	0.575	95% Critical H Value (KM-Log)	1.902
KM Standard Error of Mean (logged)	0.0673	95% H-UCL (KM -Log)	0.018
KM SD (logged)	0.575	95% Critical H Value (KM-Log)	1.902
KM Standard Error of Mean (logged)	0.0673		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0159	Mean in Log Scale	-4.32
SD in Original Scale	0.0105	SD in Log Scale	0.603
95% t UCL (Assumes normality)	0.018	95% H-Stat UCL	0.0183

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0182	95% GROS Approximate Gamma UCL	0.018
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lithium

General Statistics

Total Number of Observations	74	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	71
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.11	Minimum Non-Detect	0.1
Maximum Detect	0.16	Maximum Non-Detect	0.1
Variance Detects	7.0000E-4	Percent Non-Detects	95.95%
Mean Detects	0.13	SD Detects	0.0265
Median Detects	0.12	CV Detects	0.204
Skewness Detects	1.458	Kurtosis Detects	N/A
Mean of Logged Detects	-2.053	SD of Logged Detects	0.196

Warning: Data set has only 3 Detected Values. This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.893	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.753	Detected Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.314	Lilliefors GOF Test
1% Lilliefors Critical Value	0.429	Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.101	KM Standard Error of Mean	0.00105
90KM SD	0.00734	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.103	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.103	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.104	95% KM Chebyshev UCL	0.106
97.5% KM Chebyshev UCL	0.108	99% KM Chebyshev UCL	0.112

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.38	Anderson-Darling GOF Test
5% A-D Critical Value	0.634	Detected data appear Gamma Distributed at 5% Significance Level

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

K-S Test Statistic 0.334 **Kolmogorov-Smirnov GOF**
 5% K-S Critical Value 0.431 Detected data appear Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	38.18	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0034	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	229.1	nu star (bias corrected)	N/A
Mean (detects)	0.13		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0185
Maximum	0.16	Median	0.01
SD	0.0265	CV	1.432
k hat (MLE)	1.522	k star (bias corrected MLE)	1.469
Theta hat (MLE)	0.0121	Theta star (bias corrected MLE)	0.0126
nu hat (MLE)	225.3	nu star (bias corrected)	217.5
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (217.46, α)	184.3	Adjusted Chi Square Value (217.46, β)	183.7
95% Gamma Approximate UCL	0.0218	95% Gamma Adjusted UCL	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.101	SD (KM)	0.00734
Variance (KM)	5.3926E-5	SE of Mean (KM)	0.00105
k hat (KM)	190	k star (KM)	182.3
nu hat (KM)	28117	nu star (KM)	26978
theta hat (KM)	5.3278E-4	theta star (KM)	5.5527E-4
80% gamma percentile (KM)	0.107	90% gamma percentile (KM)	0.111
95% gamma percentile (KM)	0.114	99% gamma percentile (KM)	0.119

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	26597	Adjusted Chi Square Value (N/A, β)	26590
95% KM Approximate Gamma UCL	0.103	95% KM Adjusted Gamma UCL	0.103

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.789	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.3	Lilliefors GOF Test
10% Lilliefors Critical Value	0.389	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Note GOF tests may be unreliable for small sample sizes

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0302	Mean in Log Scale	-3.837
SD in Original Scale	0.0281	SD in Log Scale	0.829
95% t UCL (assumes normality of ROS data)	0.0356	95% Percentile Bootstrap UCL	0.0353
95% BCA Bootstrap UCL	0.0355	95% Bootstrap t UCL	0.0368
95% H-UCL (Log ROS)	0.0373		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.292	KM Geo Mean	0.101
KM SD (logged)	0.0588	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00837	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0588	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00837		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0532	Mean in Log Scale	-2.958
SD in Original Scale	0.0165	SD in Log Scale	0.19
95% t UCL (Assumes normality)	0.0564	95% H-Stat UCL	0.0549

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.103

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Magnesium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	57
		Number of Missing Observations	0
Minimum	311	Mean	410
Maximum	551	Median	408
SD	51.66	Std. Error of Mean	6.005
Coefficient of Variation	0.126	Skewness	0.418
Normal GOF Test			
Shapiro Wilk Test Statistic	0.971	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	0.258	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.093	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	420	95% Adjusted-CLT UCL (Chen-1995)	420.2
		95% Modified-t UCL (Johnson-1978)	420.1
Gamma GOF Test			
A-D Test Statistic	0.302	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0763	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.103	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	64.94	k star (bias corrected MLE)	62.32
Theta hat (MLE)	6.313	Theta star (bias corrected MLE)	6.579
nu hat (MLE)	9611	nu star (bias corrected)	9223
MLE Mean (bias corrected)	410	MLE Sd (bias corrected)	51.94
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	9001
		Adjusted Chi Square Value	8996
Assuming Gamma Distribution			
95% Approximate Gamma UCL	420.1	95% Adjusted Gamma UCL	420.3
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.98	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.613	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.069	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	5.74	Mean of logged Data	6.008
Maximum of Logged Data	6.312	SD of logged Data	0.125
Assuming Lognormal Distribution			
95% H-UCL	420.2	90% Chebyshev (MVUE) UCL	427.9
95% Chebyshev (MVUE) UCL	436	97.5% Chebyshev (MVUE) UCL	447.3
99% Chebyshev (MVUE) UCL	469.4		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	419.9	95% BCA Bootstrap UCL	419.5
95% Standard Bootstrap UCL	419.6	95% Bootstrap-t UCL	420.3
95% Hall's Bootstrap UCL	420.2	95% Percentile Bootstrap UCL	419.5
90% Chebyshev(Mean, Sd) UCL	428	95% Chebyshev(Mean, Sd) UCL	436.2
97.5% Chebyshev(Mean, Sd) UCL	447.5	99% Chebyshev(Mean, Sd) UCL	469.8
Suggested UCL to Use			
95% Student's-t UCL	420		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Manganese

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	66
Minimum	2.75	Number of Missing Observations	0
Maximum	38.7	Mean	13.73
SD	8.246	Median	13.6
Coefficient of Variation	0.601	Std. Error of Mean	0.959
		Skewness	1.065
Normal GOF Test			
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	4.4535E-6	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.116	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15.32	95% Adjusted-CLT UCL (Chen-1995)	15.43
		95% Modified-t UCL (Johnson-1978)	15.34
Gamma GOF Test			
A-D Test Statistic	0.687	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.759	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.112	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.105	Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.806	k star (bias corrected MLE)	2.701
Theta hat (MLE)	4.893	Theta star (bias corrected MLE)	5.082
nu hat (MLE)	415.2	nu star (bias corrected)	399.7
MLE Mean (bias corrected)	13.73	MLE Sd (bias corrected)	8.352
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	354.4
		Adjusted Chi Square Value	353.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL	15.48	95% Adjusted Gamma UCL	15.52
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.95	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.0143	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.012	Mean of logged Data	2.431
Maximum of Logged Data	3.656	SD of logged Data	0.647
Assuming Lognormal Distribution			
95% H-UCL	16.25	90% Chebyshev (MVUE) UCL	17.4
95% Chebyshev (MVUE) UCL	18.95	97.5% Chebyshev (MVUE) UCL	21.1
99% Chebyshev (MVUE) UCL	25.34		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	15.3	95% BCA Bootstrap UCL	15.47
95% Standard Bootstrap UCL	15.32	95% Bootstrap-t UCL	15.54
95% Hall's Bootstrap UCL	15.54	95% Percentile Bootstrap UCL	15.38
90% Chebyshev(Mean, Sd) UCL	16.6	95% Chebyshev(Mean, Sd) UCL	17.9
97.5% Chebyshev(Mean, Sd) UCL	19.71	99% Chebyshev(Mean, Sd) UCL	23.26
Suggested UCL to Use			
95% Student's-t UCL	15.32		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mercury

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	65
		Number of Missing Observations	0
Minimum	0.0248	Mean	0.0779
Maximum	0.23	Median	0.0719
SD	0.0439	Std. Error of Mean	0.0051
Coefficient of Variation	0.563	Skewness	0.953
Normal GOF Test			
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	4.6405E-5	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0864	95% Adjusted-CLT UCL (Chen-1995)	0.0869
		95% Modified-t UCL (Johnson-1978)	0.0865
Gamma GOF Test			
A-D Test Statistic	0.695	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0772	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	3.246	k star (bias corrected MLE)	3.123
Theta hat (MLE)	0.024	Theta star (bias corrected MLE)	0.0249
nu hat (MLE)	480.4	nu star (bias corrected)	462.2
MLE Mean (bias corrected)	0.0779	MLE Sd (bias corrected)	0.0441
		Approximate Chi Square Value (0.05)	413.4
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	412.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0871	95% Adjusted Gamma UCL	0.0873
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.00209	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0934	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data appear Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.697	Mean of logged Data	-2.715
Maximum of Logged Data	-1.47	SD of logged Data	0.589
Assuming Lognormal Distribution			
95% H-UCL	0.0899	90% Chebyshev (MVUE) UCL	0.0959
95% Chebyshev (MVUE) UCL	0.104	97.5% Chebyshev (MVUE) UCL	0.115
99% Chebyshev (MVUE) UCL	0.136		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0863	95% BCA Bootstrap UCL	0.0863
95% Standard Bootstrap UCL	0.0861	95% Bootstrap-t UCL	0.0872
95% Hall's Bootstrap UCL	0.0871	95% Percentile Bootstrap UCL	0.0862
90% Chebyshev(Mean, Sd) UCL	0.0932	95% Chebyshev(Mean, Sd) UCL	0.1
97.5% Chebyshev(Mean, Sd) UCL	0.11	99% Chebyshev(Mean, Sd) UCL	0.129
Suggested UCL to Use			
95% Approximate Gamma UCL	0.0871		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methylmercury (as MeHg) (mg/kg)

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	70
		Number of Missing Observations	0
Minimum	0.0129	Mean	0.0725
Maximum	0.247	Median	0.0681
SD	0.0487	Std. Error of Mean	0.00566
Coefficient of Variation	0.672	Skewness	1.138
Normal GOF Test			
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	3.5511E-6	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0819	95% Adjusted-CLT UCL (Chen-1995)	0.0826
		95% Modified-t UCL (Johnson-1978)	0.082
Gamma GOF Test			
A-D Test Statistic	0.756	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.09	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.105	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.214	k star (bias corrected MLE)	2.133
Theta hat (MLE)	0.0327	Theta star (bias corrected MLE)	0.034
nu hat (MLE)	327.7	nu star (bias corrected)	315.7
MLE Mean (bias corrected)	0.0725	MLE Sd (bias corrected)	0.0496
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	275.5
		Adjusted Chi Square Value	274.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.083	95% Adjusted Gamma UCL	0.0833
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.00416	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.114	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.351	Mean of logged Data	-2.867
Maximum of Logged Data	-1.398	SD of logged Data	0.739
Assuming Lognormal Distribution			
95% H-UCL	0.089	90% Chebyshev (MVUE) UCL	0.0957
95% Chebyshev (MVUE) UCL	0.105	97.5% Chebyshev (MVUE) UCL	0.119
99% Chebyshev (MVUE) UCL	0.145		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0818	95% BCA Bootstrap UCL	0.0822
95% Standard Bootstrap UCL	0.0817	95% Bootstrap-t UCL	0.0828
95% Hall's Bootstrap UCL	0.0831	95% Percentile Bootstrap UCL	0.0817
90% Chebyshev(Mean, Sd) UCL	0.0895	95% Chebyshev(Mean, Sd) UCL	0.0971
97.5% Chebyshev(Mean, Sd) UCL	0.108	99% Chebyshev(Mean, Sd) UCL	0.129
Suggested UCL to Use			
95% Student's-t UCL	0.0819		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Methylmercury (as MeHg)

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	70
		Number of Missing Observations	0
Minimum	12.9	Mean	72.48
Maximum	247	Median	68.05
SD	48.68	Std. Error of Mean	5.659
Coefficient of Variation	0.672	Skewness	1.138
Normal GOF Test			
Shapiro Wilk Test Statistic	0.902	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	3.5511E-6	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	81.91	95% Adjusted-CLT UCL (Chen-1995)	82.59
		95% Modified-t UCL (Johnson-1978)	82.03
Gamma GOF Test			
A-D Test Statistic	0.756	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.762	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.09	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.105	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.214	k star (bias corrected MLE)	2.133
Theta hat (MLE)	32.74	Theta star (bias corrected MLE)	33.98
nu hat (MLE)	327.7	nu star (bias corrected)	315.7
MLE Mean (bias corrected)	72.48	MLE Sd (bias corrected)	49.62
		Approximate Chi Square Value (0.05)	275.5
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	274.8
Assuming Gamma Distribution			
95% Approximate Gamma UCL	83.04	95% Adjusted Gamma UCL	83.27
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.00416	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.114	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.557	Mean of logged Data	4.041
Maximum of Logged Data	5.509	SD of logged Data	0.739
Assuming Lognormal Distribution			
95% H-UCL	88.97	90% Chebyshev (MVUE) UCL	95.68
95% Chebyshev (MVUE) UCL	105.3	97.5% Chebyshev (MVUE) UCL	118.7
99% Chebyshev (MVUE) UCL	145		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	81.79	95% BCA Bootstrap UCL	82.19
95% Standard Bootstrap UCL	81.75	95% Bootstrap-t UCL	82.81
95% Hall's Bootstrap UCL	83.08	95% Percentile Bootstrap UCL	81.74
90% Chebyshev(Mean, Sd) UCL	89.45	95% Chebyshev(Mean, Sd) UCL	97.15
97.5% Chebyshev(Mean, Sd) UCL	107.8	99% Chebyshev(Mean, Sd) UCL	128.8
Suggested UCL to Use			
95% Student's-t UCL	81.91		

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Molybdenum

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	62
		Number of Missing Observations	0
Minimum	0.0115	Mean	0.0232
Maximum	0.0516	Median	0.0204
SD	0.00908	Std. Error of Mean	0.00106
Coefficient of Variation	0.391	Skewness	1.167
Normal GOF Test			
Shapiro Wilk Test Statistic	0.883	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	1.1971E-7	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.025	95% Adjusted-CLT UCL (Chen-1995)	0.0251
		95% Modified-t UCL (Johnson-1978)	0.025
Gamma GOF Test			
A-D Test Statistic	1.311	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.114	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	7.641	k star (bias corrected MLE)	7.34
Theta hat (MLE)	0.00304	Theta star (bias corrected MLE)	0.00316
nu hat (MLE)	1131	nu star (bias corrected)	1086
MLE Mean (bias corrected)	0.0232	MLE Sd (bias corrected)	0.00856
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	1011
		Adjusted Chi Square Value	1009
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0249	95% Adjusted Gamma UCL	0.025
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.00785	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.096	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.465	Mean of logged Data	-3.831
Maximum of Logged Data	-2.964	SD of logged Data	0.36
Assuming Lognormal Distribution			
95% H-UCL	0.0249	90% Chebyshev (MVUE) UCL	0.0261
95% Chebyshev (MVUE) UCL	0.0275	97.5% Chebyshev (MVUE) UCL	0.0293
99% Chebyshev (MVUE) UCL	0.033		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0249	95% BCA Bootstrap UCL	0.0251
95% Standard Bootstrap UCL	0.025	95% Bootstrap-t UCL	0.0251
95% Hall's Bootstrap UCL	0.0251	95% Percentile Bootstrap UCL	0.025
90% Chebyshev(Mean, Sd) UCL	0.0264	95% Chebyshev(Mean, Sd) UCL	0.0278
97.5% Chebyshev(Mean, Sd) UCL	0.0298	99% Chebyshev(Mean, Sd) UCL	0.0337

Suggested UCL to Use

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

95% Student's-t UCL 0.025

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Nickel

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	13
Number of Detects	19	Number of Non-Detects	55
Number of Distinct Detects	12	Number of Distinct Non-Detects	1
Minimum Detect	0.041	Minimum Non-Detect	0.04
Maximum Detect	0.162	Maximum Non-Detect	0.04
Variance Detects	9.2213E-4	Percent Non-Detects	74.32%
Mean Detects	0.0596	SD Detects	0.0304
Median Detects	0.049	CV Detects	0.509
Skewness Detects	2.677	Kurtosis Detects	7.376
Mean of Logged Detects	-2.898	SD of Logged Detects	0.366

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.615	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.863	Detected Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.296	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.229	Detected Data Not Normal at 1% Significance Level	
Detected Data Not Normal at 1% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.045	KM Standard Error of Mean	0.00206
90KM SD	0.0173	95% KM (BCA) UCL	0.0489
95% KM (t) UCL	0.0485	95% KM (Percentile Bootstrap) UCL	0.0487
95% KM (z) UCL	0.0484	95% KM Bootstrap t UCL	0.0537
90% KM Chebyshev UCL	0.0512	95% KM Chebyshev UCL	0.054
97.5% KM Chebyshev UCL	0.0579	99% KM Chebyshev UCL	0.0655

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.18	Anderson-Darling GOF Test	
5% A-D Critical Value	0.742	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.286	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.199	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	6.529	k star (bias corrected MLE)	5.533
Theta hat (MLE)	0.00913	Theta star (bias corrected MLE)	0.0108
nu hat (MLE)	248.1	nu star (bias corrected)	210.2
Mean (detects)	0.0596		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0235
Maximum	0.162	Median	0.01
SD	0.0263	CV	1.119
k hat (MLE)	1.524	k star (bias corrected MLE)	1.471
Theta hat (MLE)	0.0154	Theta star (bias corrected MLE)	0.016
nu hat (MLE)	225.6	nu star (bias corrected)	217.8
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (217.75, α)	184.6	Adjusted Chi Square Value (217.75, β)	184
95% Gamma Approximate UCL	0.0277	95% Gamma Adjusted UCL	0.0278

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.045	SD (KM)	0.0173
Variance (KM)	2.9785E-4	SE of Mean (KM)	0.00206
k hat (KM)	6.811	k star (KM)	6.544
nu hat (KM)	1008	nu star (KM)	968.5
theta hat (KM)	0.00661	theta star (KM)	0.00688
80% gamma percentile (KM)	0.0588	90% gamma percentile (KM)	0.0686
95% gamma percentile (KM)	0.0774	99% gamma percentile (KM)	0.0957

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (968.49, α)	897.3	Adjusted Chi Square Value (968.49, β)	895.9
95% KM Approximate Gamma UCL	0.0486	95% KM Adjusted Gamma UCL	0.0487

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.744	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.917	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.268	Lilliefors GOF Test	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

10% Lilliefors Critical Value 0.18 Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0279	Mean in Log Scale	-3.872
SD in Original Scale	0.0251	SD in Log Scale	0.768
95% t UCL (assumes normality of ROS data)	0.0328	95% Percentile Bootstrap UCL	0.0326
95% BCA Bootstrap UCL	0.0331	95% Bootstrap t UCL	0.0341
95% H-UCL (Log ROS)	0.0336		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.137	KM Geo Mean	0.0434
KM SD (logged)	0.228	95% Critical H Value (KM-Log)	1.717
KM Standard Error of Mean (logged)	0.0273	95% H-UCL (KM -Log)	0.0467
KM SD (logged)	0.228	95% Critical H Value (KM-Log)	1.717
KM Standard Error of Mean (logged)	0.0273		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0302	Mean in Log Scale	-3.652
SD in Original Scale	0.023	SD in Log Scale	0.482
95% t UCL (Assumes normality)	0.0346	95% H-Stat UCL	0.0323

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 0.0485

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Phosphorus

General Statistics

Total Number of Observations	74	Number of Distinct Observations	71
		Number of Missing Observations	0
Minimum	4880	Mean	7753
Maximum	11700	Median	7630
SD	1405	Std. Error of Mean	163.4
Coefficient of Variation	0.181	Skewness	0.501

Normal GOF Test

Shapiro Wilk Test Statistic	0.974
1% Shapiro Wilk P Value	0.364
Lilliefors Test Statistic	0.0728
1% Lilliefors Critical Value	0.119

Shapiro Wilk GOF Test

Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 8025

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 8032
95% Modified-t UCL (Johnson-1978) 8027

Gamma GOF Test

A-D Test Statistic	0.147
5% A-D Critical Value	0.749
K-S Test Statistic	0.0541
5% K-S Critical Value	0.103

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	31.38	k star (bias corrected MLE)	30.11
Theta hat (MLE)	247.1	Theta star (bias corrected MLE)	257.5
nu hat (MLE)	4644	nu star (bias corrected)	4457
MLE Mean (bias corrected)	7753	MLE Sd (bias corrected)	1413
		Approximate Chi Square Value (0.05)	4303
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	4300

Assuming Gamma Distribution

95% Approximate Gamma UCL 8031

95% Adjusted Gamma UCL 8037

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	0.918	Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0615	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.0943	Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.493	Mean of logged Data	8.94
Maximum of Logged Data	9.367	SD of logged Data	0.18

Assuming Lognormal Distribution

95% H-UCL	8039	90% Chebyshev (MVUE) UCL	8245
95% Chebyshev (MVUE) UCL	8467	97.5% Chebyshev (MVUE) UCL	8776
99% Chebyshev (MVUE) UCL	9383		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	8022	95% BCA Bootstrap UCL	8031
95% Standard Bootstrap UCL	8018	95% Bootstrap-t UCL	8039
95% Hall's Bootstrap UCL	8043	95% Percentile Bootstrap UCL	8018
90% Chebyshev(Mean, Sd) UCL	8243	95% Chebyshev(Mean, Sd) UCL	8465
97.5% Chebyshev(Mean, Sd) UCL	8773	99% Chebyshev(Mean, Sd) UCL	9379

Suggested UCL to Use

95% Student's-t UCL 8025

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Potassium

General Statistics

Total Number of Observations	74	Number of Distinct Observations	43
		Number of Missing Observations	0
Minimum	2100	Mean	2973
Maximum	3460	Median	2995
SD	219.4	Std. Error of Mean	25.5
Coefficient of Variation	0.0738	Skewness	-1.547

Normal GOF Test

Shapiro Wilk Test Statistic	0.878	Shapiro Wilk GOF Test
1% Shapiro Wilk P Value	4.6083E-8	Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.158	Lilliefors GOF Test
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level

Data Not Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3015	95% Adjusted-CLT UCL (Chen-1995)	3010
		95% Modified-t UCL (Johnson-1978)	3015

Gamma GOF Test

A-D Test Statistic	3.454	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.171	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.103	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	169.8	k star (bias corrected MLE)	163
Theta hat (MLE)	17.51	Theta star (bias corrected MLE)	18.24
nu hat (MLE)	25134	nu star (bias corrected)	24117
MLE Mean (bias corrected)	2973	MLE Sd (bias corrected)	232.9
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	23757
		Adjusted Chi Square Value	23750

Assuming Gamma Distribution

95% Approximate Gamma UCL	3018	95% Adjusted Gamma UCL	3019
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Lognormal GOF Test

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Shapiro Wilk Test Statistic	0.832	Shapiro Wilk Lognormal GOF Test
10% Shapiro Wilk P Value	1.563E-11	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.18	Lilliefors Lognormal GOF Test
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	7.65	Mean of logged Data	7.994
Maximum of Logged Data	8.149	SD of logged Data	0.0792

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	3056
95% Chebyshev (MVUE) UCL	3093	97.5% Chebyshev (MVUE) UCL	3145
99% Chebyshev (MVUE) UCL	3246		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	3015	95% BCA Bootstrap UCL	3009
95% Standard Bootstrap UCL	3014	95% Bootstrap-t UCL	3009
95% Hall's Bootstrap UCL	3010	95% Percentile Bootstrap UCL	3014
90% Chebyshev(Mean, Sd) UCL	3049	95% Chebyshev(Mean, Sd) UCL	3084
97.5% Chebyshev(Mean, Sd) UCL	3132	99% Chebyshev(Mean, Sd) UCL	3227

Suggested UCL to Use

95% Student's-t UCL 3015

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Rubidium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	70
		Number of Missing Observations	0
Minimum	0.783	Mean	5.921
Maximum	12.5	Median	5.135
SD	3.389	Std. Error of Mean	0.394
Coefficient of Variation	0.572	Skewness	0.235
Normal GOF Test			
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	9.3168E-4	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.102	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data appear Normal at 1% Significance Level	
Data appear Approximate Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.577	95% Adjusted-CLT UCL (Chen-1995)	6.58
		95% Modified-t UCL (Johnson-1978)	6.579
Gamma GOF Test			
A-D Test Statistic	1.096	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.104	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.105	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.388	k star (bias corrected MLE)	2.3
Theta hat (MLE)	2.479	Theta star (bias corrected MLE)	2.574
nu hat (MLE)	353.4	nu star (bias corrected)	340.4
MLE Mean (bias corrected)	5.921	MLE Sd (bias corrected)	3.904
		Approximate Chi Square Value (0.05)	298.7
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	297.9
Assuming Gamma Distribution			
95% Approximate Gamma UCL	6.749	95% Adjusted Gamma UCL	6.766
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.896	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.1357E-6	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.126	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.245	Mean of logged Data	1.555
Maximum of Logged Data	2.526	SD of logged Data	0.751
Assuming Lognormal Distribution			
95% H-UCL	7.499	90% Chebyshev (MVUE) UCL	8.068
95% Chebyshev (MVUE) UCL	8.893	97.5% Chebyshev (MVUE) UCL	10.04
99% Chebyshev (MVUE) UCL	12.29		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	6.569	95% BCA Bootstrap UCL	6.539
95% Standard Bootstrap UCL	6.553	95% Bootstrap-t UCL	6.544
95% Hall's Bootstrap UCL	6.533	95% Percentile Bootstrap UCL	6.574
90% Chebyshev(Mean, Sd) UCL	7.103	95% Chebyshev(Mean, Sd) UCL	7.638
97.5% Chebyshev(Mean, Sd) UCL	8.381	99% Chebyshev(Mean, Sd) UCL	9.84
Suggested UCL to Use			
95% Student's-t UCL	6.577		

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	61
		Number of Missing Observations	0
Minimum	0.134	Mean	0.238
Maximum	0.492	Median	0.207
SD	0.0898	Std. Error of Mean	0.0104
Coefficient of Variation	0.378	Skewness	1.556
Normal GOF Test			
Shapiro Wilk Test Statistic	0.77	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	4.441E-16	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.255	95% Adjusted-CLT UCL (Chen-1995)	0.257
		95% Modified-t UCL (Johnson-1978)	0.255
Gamma GOF Test			
A-D Test Statistic	4.413	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.187	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.019	k star (bias corrected MLE)	8.663
Theta hat (MLE)	0.0263	Theta star (bias corrected MLE)	0.0274
nu hat (MLE)	1335	nu star (bias corrected)	1282
MLE Mean (bias corrected)	0.238	MLE Sd (bias corrected)	0.0807
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	1200
		Adjusted Chi Square Value	1198
Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.254	95% Adjusted Gamma UCL	0.254
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.871	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	1.3972E-8	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.165	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.01	Mean of logged Data	-1.494
Maximum of Logged Data	-0.709	SD of logged Data	0.322
Assuming Lognormal Distribution			
95% H-UCL	0.253	90% Chebyshev (MVUE) UCL	0.263
95% Chebyshev (MVUE) UCL	0.276	97.5% Chebyshev (MVUE) UCL	0.293
99% Chebyshev (MVUE) UCL	0.326		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.255	95% BCA Bootstrap UCL	0.257
95% Standard Bootstrap UCL	0.255	95% Bootstrap-t UCL	0.258
95% Hall's Bootstrap UCL	0.257	95% Percentile Bootstrap UCL	0.256
90% Chebyshev(Mean, Sd) UCL	0.269	95% Chebyshev(Mean, Sd) UCL	0.283
97.5% Chebyshev(Mean, Sd) UCL	0.303	99% Chebyshev(Mean, Sd) UCL	0.341
Suggested UCL to Use			
95% Student's-t UCL	0.255		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Selenium (dwt)

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	69
		Number of Missing Observations	0
Minimum	0.495	Mean	0.962
Maximum	1.8	Median	0.815
SD	0.339	Std. Error of Mean	0.0394
Coefficient of Variation	0.353	Skewness	1.201
Normal GOF Test			
Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	2.598E-13	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.239	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.027	95% Adjusted-CLT UCL (Chen-1995)	1.032
		95% Modified-t UCL (Johnson-1978)	1.028
Gamma GOF Test			
A-D Test Statistic	4.414	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.209	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	9.669	k star (bias corrected MLE)	9.286
Theta hat (MLE)	0.0994	Theta star (bias corrected MLE)	0.104
nu hat (MLE)	1431	nu star (bias corrected)	1374
MLE Mean (bias corrected)	0.962	MLE Sd (bias corrected)	0.316
		Approximate Chi Square Value (0.05)	1289
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	1288
Assuming Gamma Distribution			
95% Approximate Gamma UCL	1.025	95% Adjusted Gamma UCL	1.026
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	5.9886E-8	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.192	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.703	Mean of logged Data	-0.0917
Maximum of Logged Data	0.588	SD of logged Data	0.315
Assuming Lognormal Distribution			
95% H-UCL	1.023	90% Chebyshev (MVUE) UCL	1.066
95% Chebyshev (MVUE) UCL	1.114	97.5% Chebyshev (MVUE) UCL	1.182
99% Chebyshev (MVUE) UCL	1.315		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.026	95% BCA Bootstrap UCL	1.032
95% Standard Bootstrap UCL	1.028	95% Bootstrap-t UCL	1.034
95% Hall's Bootstrap UCL	1.032	95% Percentile Bootstrap UCL	1.03
90% Chebyshev(Mean, Sd) UCL	1.08	95% Chebyshev(Mean, Sd) UCL	1.133
97.5% Chebyshev(Mean, Sd) UCL	1.208	99% Chebyshev(Mean, Sd) UCL	1.354
Suggested UCL to Use			
95% Student's-t UCL	1.027		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Sodium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	61
		Number of Missing Observations	0
Minimum	451	Mean	871.4
Maximum	1100	Median	908
SD	153.6	Std. Error of Mean	17.86
Coefficient of Variation	0.176	Skewness	-0.895
Normal GOF Test			
Shapiro Wilk Test Statistic	0.92	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	8.6429E-5	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.129	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	901.1	95% Adjusted-CLT UCL (Chen-1995)	898.8
		95% Modified-t UCL (Johnson-1978)	900.8
Gamma GOF Test			
A-D Test Statistic	2.35	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.142	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.103	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	28.01	k star (bias corrected MLE)	26.88
Theta hat (MLE)	31.11	Theta star (bias corrected MLE)	32.41
nu hat (MLE)	4145	nu star (bias corrected)	3979
MLE Mean (bias corrected)	871.4	MLE Sd (bias corrected)	168.1
		Approximate Chi Square Value (0.05)	3833
Adjusted Level of Significance	0.0468	Adjusted Chi Square Value	3830
Assuming Gamma Distribution			
95% Approximate Gamma UCL	904.5	95% Adjusted Gamma UCL	905.2
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.869	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	9.6674E-9	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.157	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	6.111	Mean of logged Data	6.752
Maximum of Logged Data	7.003	SD of logged Data	0.199
Assuming Lognormal Distribution			
95% H-UCL	908.5	90% Chebyshev (MVUE) UCL	934
95% Chebyshev (MVUE) UCL	961.7	97.5% Chebyshev (MVUE) UCL	1000
99% Chebyshev (MVUE) UCL	1076		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	900.8	95% BCA Bootstrap UCL	899.3
95% Standard Bootstrap UCL	900.6	95% Bootstrap-t UCL	900
95% Hall's Bootstrap UCL	899.5	95% Percentile Bootstrap UCL	899.9
90% Chebyshev(Mean, Sd) UCL	925	95% Chebyshev(Mean, Sd) UCL	949.2
97.5% Chebyshev(Mean, Sd) UCL	982.9	99% Chebyshev(Mean, Sd) UCL	1049
Suggested UCL to Use			
95% Student's-t UCL	901.1		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples
reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Strontium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	70
		Number of Missing Observations	0
Minimum	3.25	Mean	8.613
Maximum	20	Median	8.01
SD	3.542	Std. Error of Mean	0.412
Coefficient of Variation	0.411	Skewness	1.201
Normal GOF Test			
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk GOF Test	
1% Shapiro Wilk P Value	8.7886E-6	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.124	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.119	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	9.299	95% Adjusted-CLT UCL (Chen-1995)	9.351
		95% Modified-t UCL (Johnson-1978)	9.308
Gamma GOF Test			
A-D Test Statistic	0.402	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.753	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0789	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.104	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	6.706	k star (bias corrected MLE)	6.443
Theta hat (MLE)	1.284	Theta star (bias corrected MLE)	1.337
nu hat (MLE)	992.5	nu star (bias corrected)	953.6
MLE Mean (bias corrected)	8.613	MLE Sd (bias corrected)	3.393
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	882.9
		Adjusted Chi Square Value	881.6
Assuming Gamma Distribution			
95% Approximate Gamma UCL	9.302	95% Adjusted Gamma UCL	9.316
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.982	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk P Value	0.726	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0624	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.0943	Data appear Lognormal at 10% Significance Level	
Data appear Lognormal at 10% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.179	Mean of logged Data	2.077
Maximum of Logged Data	2.996	SD of logged Data	0.391
Assuming Lognormal Distribution			
95% H-UCL	9.35	90% Chebyshev (MVUE) UCL	9.817
95% Chebyshev (MVUE) UCL	10.37	97.5% Chebyshev (MVUE) UCL	11.13
99% Chebyshev (MVUE) UCL	12.63		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution			
Nonparametric Distribution Free UCLs			
95% CLT UCL	9.29	95% BCA Bootstrap UCL	9.344
95% Standard Bootstrap UCL	9.265	95% Bootstrap-t UCL	9.312
95% Hall's Bootstrap UCL	9.31	95% Percentile Bootstrap UCL	9.305
90% Chebyshev(Mean, Sd) UCL	9.848	95% Chebyshev(Mean, Sd) UCL	10.41
97.5% Chebyshev(Mean, Sd) UCL	11.18	99% Chebyshev(Mean, Sd) UCL	12.71
Suggested UCL to Use			
95% Approximate Gamma UCL	9.302		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tellurium

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	74
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tellurium was not processed!

Thallium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	64
		Number of Missing Observations	0
Minimum	0.00111	Mean	0.00347
Maximum	0.00957	Median	0.00302
SD	0.00196	Std. Error of Mean	2.2831E-4
Coefficient of Variation	0.565	Skewness	0.78

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.902	Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	3.2564E-6	Lilliefors GOF Test	
Lilliefors Test Statistic	0.148	Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.119		

Data Not Normal at 1% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.00386	95% Adjusted-CLT UCL (Chen-1995)	0.00387
		95% Modified-t UCL (Johnson-1978)	0.00386

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	1.401	Data Not Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.757	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.103	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.104		

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.274	k star (bias corrected MLE)	3.15
Theta hat (MLE)	0.00106	Theta star (bias corrected MLE)	0.0011
nu hat (MLE)	484.5	nu star (bias corrected)	466.2
MLE Mean (bias corrected)	0.00347	MLE Sd (bias corrected)	0.00196
Adjusted Level of Significance	0.0468	Approximate Chi Square Value (0.05)	417.2
		Adjusted Chi Square Value	416.3

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.00388	95% Adjusted Gamma UCL	0.00389

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.931	Data Not Lognormal at 10% Significance Level	
10% Shapiro Wilk P Value	5.4358E-4	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0992	Data Not Lognormal at 10% Significance Level	
10% Lilliefors Critical Value	0.0943		

Data Not Lognormal at 10% Significance Level

Lognormal Statistics			
Minimum of Logged Data	-6.803	Mean of logged Data	-5.823
Maximum of Logged Data	-4.649	SD of logged Data	0.578

Assuming Lognormal Distribution			
95% H-UCL	0.00398	90% Chebyshev (MVUE) UCL	0.00424
95% Chebyshev (MVUE) UCL	0.00458	97.5% Chebyshev (MVUE) UCL	0.00505
99% Chebyshev (MVUE) UCL	0.00598		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	0.00385	95% BCA Bootstrap UCL	0.00388
95% Standard Bootstrap UCL	0.00385	95% Bootstrap-t UCL	0.0039

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

95% Hall's Bootstrap UCL	0.00389	95% Percentile Bootstrap UCL	0.00386
90% Chebyshev(Mean, Sd) UCL	0.00416	95% Chebyshev(Mean, Sd) UCL	0.00447
97.5% Chebyshev(Mean, Sd) UCL	0.0049	99% Chebyshev(Mean, Sd) UCL	0.00575

Suggested UCL to Use

95% Approximate Gamma UCL 0.00388

When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Tin

General Statistics

Total Number of Observations	74	Number of Distinct Observations	60
Number of Detects	73	Number of Non-Detects	1
Number of Distinct Detects	59	Number of Distinct Non-Detects	1
Minimum Detect	0.023	Minimum Non-Detect	0.02
Maximum Detect	0.198	Maximum Non-Detect	0.02
Variance Detects	0.00174	Percent Non-Detects	1.351%
Mean Detects	0.0818	SD Detects	0.0418
Median Detects	0.072	CV Detects	0.511
Skewness Detects	0.713	Kurtosis Detects	-0.275
Mean of Logged Detects	-2.638	SD of Logged Detects	0.533

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.926
1% Shapiro Wilk P Value	2.9266E-4
Lilliefors Test Statistic	0.122
1% Lilliefors Critical Value	0.12

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0809	KM Standard Error of Mean	0.00489
90KM SD	0.0418	95% KM (BCA) UCL	0.0887
95% KM (t) UCL	0.0891	95% KM (Percentile Bootstrap) UCL	0.0888
95% KM (z) UCL	0.089	95% KM Bootstrap t UCL	0.0901
90% KM Chebyshev UCL	0.0956	95% KM Chebyshev UCL	0.102
97.5% KM Chebyshev UCL	0.111	99% KM Chebyshev UCL	0.13

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.443
5% A-D Critical Value	0.756
K-S Test Statistic	0.0604
5% K-S Critical Value	0.105

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.899
Theta hat (MLE)	0.021
nu hat (MLE)	569.2
Mean (detects)	0.0818

k star (bias corrected MLE)	3.748
Theta star (bias corrected MLE)	0.0218
nu star (bias corrected)	547.2

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0808
Maximum	0.198	Median	0.071
SD	0.0423	CV	0.524
k hat (MLE)	3.529	k star (bias corrected MLE)	3.395
Theta hat (MLE)	0.0229	Theta star (bias corrected MLE)	0.0238
nu hat (MLE)	522.2	nu star (bias corrected)	502.4
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (502.39, α)	451.4	Adjusted Chi Square Value (502.39, β)	450.5
95% Gamma Approximate UCL	0.0899	95% Gamma Adjusted UCL	0.0901

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0809	SD (KM)	0.0418
Variance (KM)	0.00175	SE of Mean (KM)	0.00489

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

k hat (KM)	3.746	k star (KM)	3.603
nu hat (KM)	554.4	nu star (KM)	533.2
theta hat (KM)	0.0216	theta star (KM)	0.0225
80% gamma percentile (KM)	0.113	90% gamma percentile (KM)	0.138
95% gamma percentile (KM)	0.161	99% gamma percentile (KM)	0.211

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (533.24, α)	480.7	Adjusted Chi Square Value (533.24, β)	479.7
95% KM Approximate Gamma UCL	0.0898	95% KM Adjusted Gamma UCL	0.09

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.961	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0.0708	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0603	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.0949	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0809	Mean in Log Scale	-2.657
SD in Original Scale	0.0422	SD in Log Scale	0.555
95% t UCL (assumes normality of ROS data)	0.089	95% Percentile Bootstrap UCL	0.0887
95% BCA Bootstrap UCL	0.0887	95% Bootstrap t UCL	0.0894
95% H-UCL (Log ROS)	0.0925		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.655	KM Geo Mean	0.0703
KM SD (logged)	0.546	95% Critical H Value (KM-Log)	1.883
KM Standard Error of Mean (logged)	0.0639	95% H-UCL (KM -Log)	0.092
KM SD (logged)	0.546	95% Critical H Value (KM-Log)	1.883
KM Standard Error of Mean (logged)	0.0639		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0808	Mean in Log Scale	-2.664
SD in Original Scale	0.0423	SD in Log Scale	0.577
95% t UCL (Assumes normality)	0.089	95% H-Stat UCL	0.0935

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0898	95% GROS Approximate Gamma UCL	0.0899
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Uranium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	70
Number of Detects	71	Number of Non-Detects	3
Number of Distinct Detects	69	Number of Distinct Non-Detects	1
Minimum Detect	4.1000E-4	Minimum Non-Detect	4.0000E-4
Maximum Detect	0.00878	Maximum Non-Detect	4.0000E-4
Variance Detects	3.0347E-6	Percent Non-Detects	4.054%
Mean Detects	0.00228	SD Detects	0.00174
Median Detects	0.00188	CV Detects	0.765
Skewness Detects	1.629	Kurtosis Detects	2.756
Mean of Logged Detects	-6.344	SD of Logged Detects	0.732

Normal GOF Test on Detects Only		Normal GOF Test on Detected Observations Only	
Shapiro Wilk Test Statistic	0.838	Detected Data Not Normal at 1% Significance Level	
1% Shapiro Wilk P Value	1.504E-10	Lilliefors GOF Test	
Lilliefors Test Statistic	0.169	Detected Data Not Normal at 1% Significance Level	
1% Lilliefors Critical Value	0.122	Detected Data Not Normal at 1% Significance Level	

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0022	KM Standard Error of Mean	2.0303E-4
90KM SD	0.00173	95% KM (BCA) UCL	0.00251
95% KM (t) UCL	0.00254	95% KM (Percentile Bootstrap) UCL	0.00252
95% KM (z) UCL	0.00253	95% KM Bootstrap t UCL	0.0026
90% KM Chebyshev UCL	0.00281	95% KM Chebyshev UCL	0.00309
97.5% KM Chebyshev UCL	0.00347	99% KM Chebyshev UCL	0.00422

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.585	Anderson-Darling GOF Test
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0819	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.107	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	2.085	k star (bias corrected MLE)	2.006
Theta hat (MLE)	0.00109	Theta star (bias corrected MLE)	0.00113
nu hat (MLE)	296.1	nu star (bias corrected)	284.9
Mean (detects)	0.00228		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.1000E-4	Mean	0.00259
Maximum	0.01	Median	0.0019
SD	0.00229	CV	0.886
k hat (MLE)	1.725	k star (bias corrected MLE)	1.664
Theta hat (MLE)	0.0015	Theta star (bias corrected MLE)	0.00156
nu hat (MLE)	255.4	nu star (bias corrected)	246.3
Adjusted Level of Significance (β)	0.0468	Adjusted Chi Square Value (246.33, β)	210.3
Approximate Chi Square Value (246.33, α)	211	95% Gamma Adjusted UCL	0.00303
95% Gamma Approximate UCL	0.00302		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0022	SD (KM)	0.00173
Variance (KM)	3.0075E-6	SE of Mean (KM)	2.0303E-4
k hat (KM)	1.609	k star (KM)	1.553
nu hat (KM)	238.2	nu star (KM)	229.9
theta hat (KM)	0.00137	theta star (KM)	0.00142
80% gamma percentile (KM)	0.00339	90% gamma percentile (KM)	0.00455
95% gamma percentile (KM)	0.00566	99% gamma percentile (KM)	0.00819

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (229.88, α)	195.8	Adjusted Chi Square Value (229.88, β)	195.2
95% KM Approximate Gamma UCL	0.00258	95% KM Adjusted Gamma UCL	0.00259

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.973	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0.324	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.069	Lilliefors GOF Test

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

10% Lilliefors Critical Value 0.0962 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0022	Mean in Log Scale	-6.416
SD in Original Scale	0.00175	SD in Log Scale	0.801
95% t UCL (assumes normality of ROS data)	0.00253	95% Percentile Bootstrap UCL	0.00251
95% BCA Bootstrap UCL	0.00253	95% Bootstrap t UCL	0.00258
95% H-UCL (Log ROS)	0.00274		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.404	KM Geo Mean	0.00166
KM SD (logged)	0.77	95% Critical H Value (KM-Log)	2.045
KM Standard Error of Mean (logged)	0.0901	95% H-UCL (KM -Log)	0.00268
KM SD (logged)	0.77	95% Critical H Value (KM-Log)	2.045
KM Standard Error of Mean (logged)	0.0901		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00219	Mean in Log Scale	-6.432
SD in Original Scale	0.00175	SD in Log Scale	0.837
95% t UCL (Assumes normality)	0.00253	95% H-Stat UCL	0.00281

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.00258	95% GROS Approximate Gamma UCL	0.00302
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics

Total Number of Observations	74	Number of Distinct Observations	51
Number of Detects	58	Number of Non-Detects	16
Number of Distinct Detects	50	Number of Distinct Non-Detects	1
Minimum Detect	0.022	Minimum Non-Detect	0.02
Maximum Detect	0.324	Maximum Non-Detect	0.02
Variance Detects	0.00314	Percent Non-Detects	21.62%
Mean Detects	0.0918	SD Detects	0.056
Median Detects	0.082	CV Detects	0.61
Skewness Detects	1.777	Kurtosis Detects	4.601
Mean of Logged Detects	-2.55	SD of Logged Detects	0.578

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.862	Normal GOF Test on Detected Observations Only
1% Shapiro Wilk P Value	4.4029E-7	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.158	Lilliefors GOF Test
1% Lilliefors Critical Value	0.134	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0763	KM Standard Error of Mean	0.00673
90KM SD	0.0574	95% KM (BCA) UCL	0.0871
95% KM (t) UCL	0.0875	95% KM (Percentile Bootstrap) UCL	0.0872
95% KM (z) UCL	0.0873	95% KM Bootstrap t UCL	0.0897
90% KM Chebyshev UCL	0.0964	95% KM Chebyshev UCL	0.106
97.5% KM Chebyshev UCL	0.118	99% KM Chebyshev UCL	0.143

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.411	Anderson-Darling GOF Test
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.085	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.118	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.248	k star (bias corrected MLE)	3.092
Theta hat (MLE)	0.0283	Theta star (bias corrected MLE)	0.0297
nu hat (MLE)	376.8	nu star (bias corrected)	358.6
Mean (detects)	0.0918		

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0744
Maximum	0.324	Median	0.069
SD	0.0596	CV	0.801
k hat (MLE)	1.493	k star (bias corrected MLE)	1.442
Theta hat (MLE)	0.0498	Theta star (bias corrected MLE)	0.0516
nu hat (MLE)	221	nu star (bias corrected)	213.4
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (213.38, α)	180.6	Adjusted Chi Square Value (213.38, β)	180
95% Gamma Approximate UCL	0.0879	95% Gamma Adjusted UCL	0.0882

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0763	SD (KM)	0.0574
Variance (KM)	0.00329	SE of Mean (KM)	0.00673
k hat (KM)	1.767	k star (KM)	1.705
nu hat (KM)	261.6	nu star (KM)	252.3
theta hat (KM)	0.0431	theta star (KM)	0.0447
80% gamma percentile (KM)	0.116	90% gamma percentile (KM)	0.154
95% gamma percentile (KM)	0.19	99% gamma percentile (KM)	0.272

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (252.31, α)	216.5	Adjusted Chi Square Value (252.31, β)	215.9
95% KM Approximate Gamma UCL	0.0889	95% KM Adjusted Gamma UCL	0.0891

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.98	Shapiro Wilk GOF Test	
10% Shapiro Wilk P Value	0.683	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0944	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.106	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0766	Mean in Log Scale	-2.835
SD in Original Scale	0.0574	SD in Log Scale	0.762
95% t UCL (assumes normality of ROS data)	0.0878	95% Percentile Bootstrap UCL	0.0869
95% BCA Bootstrap UCL	0.0874	95% Bootstrap t UCL	0.0896
95% H-UCL (Log ROS)	0.0941		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.845	KM Geo Mean	0.0582
KM SD (logged)	0.756	95% Critical H Value (KM-Log)	2.033
KM Standard Error of Mean (logged)	0.0887	95% H-UCL (KM -Log)	0.0927
KM SD (logged)	0.756	95% Critical H Value (KM-Log)	2.033
KM Standard Error of Mean (logged)	0.0887		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0741	Mean in Log Scale	-2.994
SD in Original Scale	0.06	SD in Log Scale	0.993
95% t UCL (Assumes normality)	0.0857	95% H-Stat UCL	0.106

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	0.0889	95% GROS Approximate Gamma UCL	0.0879
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
 Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
 However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Zinc

General Statistics

Total Number of Observations	74	Number of Distinct Observations	69
		Number of Missing Observations	0
Minimum	16.1	Mean	59.08

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Maximum	124	Median	53.1
SD	25.68	Std. Error of Mean	2.985
Coefficient of Variation	0.435	Skewness	0.629

Normal GOF Test

Shapiro Wilk Test Statistic	0.94
1% Shapiro Wilk P Value	0.00266
Lilliefors Test Statistic	0.119
1% Lilliefors Critical Value	0.119

Shapiro Wilk GOF Test

Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Data appear Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL	64.05
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95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995)	64.22
95% Modified-t UCL (Johnson-1978)	64.08

Gamma GOF Test

A-D Test Statistic	0.409
5% A-D Critical Value	0.754
K-S Test Statistic	0.0762
5% K-S Critical Value	0.104

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.358
Theta hat (MLE)	11.03
nu hat (MLE)	793
MLE Mean (bias corrected)	59.08
Adjusted Level of Significance	0.0468

k star (bias corrected MLE)	5.15
Theta star (bias corrected MLE)	11.47
nu star (bias corrected)	762.2
MLE Sd (bias corrected)	26.03
Approximate Chi Square Value (0.05)	699.1
Adjusted Chi Square Value	697.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	64.4
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95% Adjusted Gamma UCL	64.51
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974
10% Shapiro Wilk P Value	0.345
Lilliefors Test Statistic	0.0835
10% Lilliefors Critical Value	0.0943

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 10% Significance Level

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.779
Maximum of Logged Data	4.82

Mean of logged Data	3.983
SD of logged Data	0.451

Assuming Lognormal Distribution

95% H-UCL	65.42
95% Chebyshev (MVUE) UCL	73.48
99% Chebyshev (MVUE) UCL	91.65

90% Chebyshev (MVUE) UCL	69.07
97.5% Chebyshev (MVUE) UCL	79.61

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	63.99
95% Standard Bootstrap UCL	64.01
95% Hall's Bootstrap UCL	64.36
90% Chebyshev(Mean, Sd) UCL	68.03
97.5% Chebyshev(Mean, Sd) UCL	77.72

95% BCA Bootstrap UCL	64.24
95% Bootstrap-t UCL	64.51
95% Percentile Bootstrap UCL	64.22
95% Chebyshev(Mean, Sd) UCL	72.09
99% Chebyshev(Mean, Sd) UCL	88.77

Suggested UCL to Use

95% Student's-t UCL	64.05
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When a data set follows an approximate distribution passing only one of the GOF tests, it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

Zirconium

General Statistics			
Total Number of Observations	74	Number of Distinct Observations	11
Number of Detects	10	Number of Non-Detects	64
Number of Distinct Detects	10	Number of Distinct Non-Detects	1
Minimum Detect	0.041	Minimum Non-Detect	0.04
Maximum Detect	0.141	Maximum Non-Detect	0.04
Variance Detects	0.00152	Percent Non-Detects	86.49%
Mean Detects	0.0762	SD Detects	0.0389
Median Detects	0.064	CV Detects	0.511
Skewness Detects	0.975	Kurtosis Detects	-0.591
Mean of Logged Detects	-2.681	SD of Logged Detects	0.476

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.819	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.781	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.243	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.304	Detected Data appear Normal at 1% Significance Level	
Detected Data appear Normal at 1% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	0.0449	KM Standard Error of Mean	0.00225
90KM SD	0.0184	95% KM (BCA) UCL	0.0488
95% KM (t) UCL	0.0486	95% KM (Percentile Bootstrap) UCL	0.0486
95% KM (z) UCL	0.0486	95% KM Bootstrap t UCL	0.0514
90% KM Chebyshev UCL	0.0516	95% KM Chebyshev UCL	0.0547
97.5% KM Chebyshev UCL	0.0589	99% KM Chebyshev UCL	0.0673

Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.6	Anderson-Darling GOF Test	
5% A-D Critical Value	0.729	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.188	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only			
k hat (MLE)	4.83	k star (bias corrected MLE)	3.448
Theta hat (MLE)	0.0158	Theta star (bias corrected MLE)	0.0221
nu hat (MLE)	96.6	nu star (bias corrected)	68.95
Mean (detects)	0.0762		

Gamma ROS Statistics using Imputed Non-Detects
 GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.
 For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	0.0193
Maximum	0.141	Median	0.01
SD	0.0265	CV	1.376
k hat (MLE)	1.484	k star (bias corrected MLE)	1.433
Theta hat (MLE)	0.013	Theta star (bias corrected MLE)	0.0134
nu hat (MLE)	219.7	nu star (bias corrected)	212.1
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (212.10, α)	179.4	Adjusted Chi Square Value (212.10, β)	178.8
95% Gamma Approximate UCL	0.0228	95% Gamma Adjusted UCL	0.0229

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0449	SD (KM)	0.0184
Variance (KM)	3.3745E-4	SE of Mean (KM)	0.00225
k hat (KM)	5.972	k star (KM)	5.739
nu hat (KM)	883.9	nu star (KM)	849.4
theta hat (KM)	0.00752	theta star (KM)	0.00782
80% gamma percentile (KM)	0.0594	90% gamma percentile (KM)	0.07
95% gamma percentile (KM)	0.0795	99% gamma percentile (KM)	0.0995

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (849.38, α)	782.7	Adjusted Chi Square Value (849.38, β)	781.5
95% KM Approximate Gamma UCL	0.0487	95% KM Adjusted Gamma UCL	0.0488

Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.879	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.869	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.172	Lilliefors GOF Test	

UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples

10% Lilliefors Critical Value 0.241 Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0186	Mean in Log Scale	-4.765
SD in Original Scale	0.0278	SD in Log Scale	1.285
95% t UCL (assumes normality of ROS data)	0.024	95% Percentile Bootstrap UCL	0.0239
95% BCA Bootstrap UCL	0.0247	95% Bootstrap t UCL	0.0258
95% H-UCL (Log ROS)	0.0286		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.146	KM Geo Mean	0.043
KM SD (logged)	0.248	95% Critical H Value (KM-Log)	1.725
KM Standard Error of Mean (logged)	0.0304	95% H-UCL (KM -Log)	0.0466
KM SD (logged)	0.248	95% Critical H Value (KM-Log)	1.725
KM Standard Error of Mean (logged)	0.0304		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0276
SD in Original Scale	0.0237
95% t UCL (Assumes normality)	0.0322

DL/2 Log-Transformed

Mean in Log Scale	-3.746
SD in Log Scale	0.455
95% H-Stat UCL	0.0289

DL/2 Is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.0486

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

SUBATTACHMENT A3: PROUCL OUTPUTS

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A3-1. UCL Statistics for Baseline Soil Samples.

A3-2. UCL Statistics for Baseline Sediment Samples.

A3-3. UCL Statistics for Baseline Traditional Plant Samples.

A3-4. UCL Statistics for Baseline Fish Tissue (Northern Pike 40 -70 cm) Samples.

A3-5. UCL Statistics for Baseline Fish Tissue (Walleye 28 - 52 cm) Samples.

A3-6. UCL Statistics for Baseline Fish Tissue (Forage Fish > 25 cm) Samples.

A3-7. UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022-2023]) Samples.

A3-8. UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2022]) Samples.

A3-9. UCL Statistics for Baseline Fish Tissue (Small-Bodied Composite <25 cm [2023]) Samples.

Sub-Attachment A4

Baseline Data from Other Sources



Parameter		Lichen Tissue Concentrations							Summary Statistics								
Plot ID	Units1	KUG-14-12	KUG-14-14	KUG-14-27	KUG-14-4	KUG-14-6	KUG-14-7	KUG-14-9	Minimum	Maximum	Mean	95th Percentile	90th Percentile	75th Percentile	Sample Size	Number of Non-Detects	Percent Non-Detects
Parameter		Lichen ³	Lichen ³	Lichen ³	Lichen ³	Lichen ³	Lichen ³	Lichen ³									
Moisture	% (Percent)	8.1	7.3	11	15	41	21	3.4	3.4	41	15	35	29	18	7	0	0%
Aluminum	mg/kg dwt	471	490	713	340	195	230	184	184	713	375	646	579	481	7	0	0%
Antimony	mg/kg dwt	0.12	0.032	0.20	0.08	0.050	0.081	0.041	0.032	0.20	0.086	0.17	0.15	0.10	7	0	0%
Arsenic	mg/kg dwt	0.20	0.25	0.30	0.17	0.088	0.12	0.095	0.088	0.30	0.18	0.28	0.27	0.23	7	0	0%
Barium	mg/kg dwt	31	44	27	16	13	15	11	11	44	22	40	37	29	7	0	0%
Beryllium	mg/kg dwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.10	0.10	0.10	7	7	100%
Bismuth	mg/kg dwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.10	0.10	0.10	7	7	100%
Boron	mg/kg dwt	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	2.0	2.0	2.0	7	7	100%
Cadmium	mg/kg dwt	0.037	0.21	0.11	0.059	0.050	0.029	0.083	0.029	0.21	0.082	0.18	0.15	0.097	7	0	0%
Calcium	mg/kg dwt	1540	1520	826	447	380	1410	226	226	1540	907	1534	1528	1465	7	0	0%
Chromium	mg/kg dwt	0.31	0.51	0.60	0.33	0.24	0.30	<0.20	0.20	0.60	0.36	0.57	0.55	0.42	7	1	14%
Cobalt	mg/kg dwt	0.19	0.21	0.34	0.16	0.090	0.10	0.10	0.090	0.34	0.17	0.30	0.26	0.20	7	0	0%
Copper	mg/kg dwt	13	3.9	19	11	4.4	5.2	5.5	3.9	19	8.9	17	16	12	7	0	0%
Iron	mg/kg dwt	541	652	944	457	225	240	215	215	944	468	856	769	597	7	0	0%
Lead	mg/kg dwt	0.55	0.69	0.76	0.49	0.27	0.27	0.36	0.27	0.76	0.48	0.74	0.72	0.62	7	0	0%
Magnesium	mg/kg dwt	402	390	437	273	136	354	195	136	437	312	427	416	396	7	0	0%
Manganese	mg/kg dwt	72	50	58	41	31	188	20	20	188	66	153	118	65	7	0	0%
Mercury	mg/kg dwt	0.014	0.012	0.012	0.011	<0.010	<0.010	<0.010	<0.010	0.014	0.011	0.013	0.013	0.012	7	3	43%
Molybdenum	mg/kg dwt	0.91	0.24	1.6	1.1	0.30	0.49	0.45	0.24	1.6	0.73	1.5	1.3	1.0	7	0	0%
Nickel	mg/kg dwt	0.52	0.56	0.55	0.50	0.22	0.54	0.31	0.22	0.56	0.46	0.56	0.56	0.55	7	0	0%
Phosphorus	mg/kg dwt	682	541	606	526	272	553	515	272	682	528	659	636	580	7	0	0%
Potassium	mg/kg dwt	1330	1670	1830	1410	645	1180	1520	645	1830	1369	1782	1734	1595	7	0	0%
Selenium	mg/kg dwt	0.053	0.059	0.098	0.078	<0.050	<0.050	0.080	0.05	0.098	0.067	0.093	0.087	0.079	7	2	29%
Silver	mg/kg dwt	<0.020	0.030	0.029	0.041	<0.020	0.025	0.023	0.02	0.041	0.027	0.038	0.034	0.030	7	2	29%
Sodium	mg/kg dwt	16	32	18	22	<10	<10	14	<10	32	17	29	26	20	7	2	29%
Strontium	mg/kg dwt	11	15	4.3	3.7	3.6	5.9	2.5	2.45	15	6.5	14	12	8.2	7	0	0%
Tellurium	mg/kg dwt	0.0078	0.0044	0.010	0.0077	0.0041	0.013	0.0054	0.0041	0.0134	0.0076	0.012	0.012	0.0091	7	0	0%
Tin	mg/kg dwt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.10	0.10	0.10	7	7	100%
Titanium	mg/kg dwt	13	16	12	11	6.3	6.3	5.3	5.3	16	10	15	14	12	7	0	0%
Uranium	mg/kg dwt	0.019	0.016	0.044	0.020	0.0086	0.0098	0.0079	0.0079	0.044	0.018	0.037	0.030	0.019	7	0	0%
Vanadium	mg/kg dwt	0.99	1.1	1.5	0.88	0.43	0.45	0.36	0.36	1.5	0.81	1.4	1.3	1.1	7	0	0%
Zinc	mg/kg dwt	15	24	16	12	7.4	13	11	7.37	24	14	22	19	15	7	0	0%

Notes:

dwt = dry weight; mg/kg = milligram per kilogram; % = percent

1. Data are presented in mg/kg dry weight
2. Lichen samples collected as part of Kemess Underground Project (Ardea Biological Consulting Ltd. 2015)
3. Lichen species were not specified, but were dominated by a mixture of foam lichen [*Stereocaulon spp.*] and reindeer lichen [*Cladonia spp.*]

When a concentration in a sample was below the detection limit, it was considered to have a concentration at the detection limit for the purpose of statistics calculation.

Reference: Ardea Biological Consulting Ltd. 2015. Kemess Underground Project: Ecosystems and Vegetation Baseline Report. Prepared for AuRico Metals Inc. by Ardea Biological Consulting Ltd.: Smithers, British Columbia.

Table A4-1-2: Concentrations of Metals in Wild Game Tissues

Food Sample Name	Scientific Name	Number of Communities ^(a)	Moisture (%)	Metals Concentrations (µg/g wet weight) ^(a,b)										
				Chromium	Cobalt	Iron	Manganese	Molybdenum	Selenium	Arsenic	Cadmium	Lead	Mercury	Methyl Mercury
Caribou, fat	Rangifer ssp.	1	3.89	0.020	0.0020	13	0.22	0.0020	0.020	0.0020	0.0020	0.070	0.0020	-
Caribou, fetus	Rangifer ssp.	1	81.5	0.35	0.0020	16	0.27	0.020	0.060	0.010	0.0020	0.010	0.0020	-
Caribou, heart	Rangifer ssp.	2	70.6	0.010	0.012	65	0.59	0.0030	0.29	0.010	0.010	0.010	0.010	-
Caribou, kidney	Rangifer ssp.	1	70.7	0.0020	0.038	39	1.4	0.18	0.84	0.010	3.9	0.080	0.65	-
Caribou, liver	Rangifer ssp.	1	70.1	0.0020	0.046	239	2.9	0.69	0.40	0.010	1.1	0.18	0.20	-
Caribou, meat	Rangifer ssp.	8	63.7	0.47	0.0084	53	0.45	0.010	0.25	0.020	0.010	0.27	0.010	0.010
Caribou, meat, dried	Rangifer ssp.	1	52.7	0.64	0.0095	68	0.84	0.030	0.30	0.28	0.010	0.020	0.010	-
Caribou, stomach	Rangifer ssp.	1	49.7	0.0020	0.0020	28	11	0.0020	0.070	0.010	0.010	0.050	0.010	-
Deer, heart	Odocoileus spp.	1	-	0.080	0.0096	54	0.34	0.010	0.35	0.010	0.010	0.0020	0.0020	-
Deer, kidney	Odocoileus spp.	2	-	0.48	0.023	95	0.66	0.070	0.56	0.020	4.4	0.010	0.080	0.0020
Deer, liver	Odocoileus spp.	2	-	0.31	0.078	100	3.8	0.25	0.54	0.020	0.79	0.0050	0.020	0.0020
Deer, meat	Odocoileus spp.	8	68.1	0.10	0.0020	34	0.21	0.0030	0.15	0.010	0.010	0.010	0.0020	0.0020
Deer, tongue	Odocoileus spp.	2	-	0.94	0.0082	40	0.81	0.020	0.19	0.030	0.010	0.11	0.0020	-
Elk, meat	Cervus canadensis	1	74.2	0.010	0.0046	24	0.18	0.0020	0.040	0.0020	0.010	0.010	0.0020	-
Hare/rabbit, heart	Lepus spp.	2	72.7	0.020	0.020	63	1.7	0.010	0.18	0.0030	0.21	0.010	0.010	-
Hare/rabbit, intestines	Lepus spp.	1	81.2	0.0020	0.0093	63	48	0.010	0.15	0.0020	0.030	0.010	0.0020	-
Hare/rabbit, liver	Lepus spp.	2	73.4	0.030	0.051	255	4.0	0.37	0.26	0.0020	0.37	0.040	0.010	-
Hare/rabbit, meat	Lepus spp.	13	73.7	0.11	0.013	37	0.93	0.040	0.18	0.020	0.21	0.020	0.0040	0.0020
Moose, fat	Alces alces	4	17.5	0.060	0.0020	12	0.18	0.0020	0.020	0.010	0.010	0.030	0.0020	-
Moose, heart	Alces alces	6	75.5	0.050	0.027	52	0.45	0.010	0.18	0.0030	0.020	0.29	0.0020	0.0020
Moose, intestine	Alces alces	3	6.75	0.060	0.0080	13	1.9	0.0030	0.030	0.020	0.010	0.010	0.0020	-
Moose, kidney	Alces alces	9	77.4	0.10	0.072	63	1.7	0.26	0.70	0.030	14	0.35	0.020	0.0020
Moose, liver	Alces alces	14	68.2	0.12	0.077	167	2.6	0.82	0.35	0.020	2.1	0.040	0.010	0.0030
Moose, meat	Alces alces	20	74.5	0.15	0.0096	33	0.35	0.0050	0.10	0.010	0.010	0.70	0.0030	0.0020
Moose, meat, dried	Alces alces	3	46.2	2.3	0.028	88	1.7	0.10	0.29	0.020	0.010	0.060	0.010	-
Moose, nose	Alces alces	1	74.7	0.090	0.0078	20	0.33	0.010	0.060	0.0020	0.030	0.010	0.0020	-
Moose, tongue	Alces alces	5	74.7	0.26	0.0057	29	0.49	0.020	0.090	0.030	0.050	0.46	0.0020	-
Muskrat, meat	Ondatra zibethica	3	65.2	0.39	0.0085	76	0.69	0.010	0.10	0.020	0.0040	0.17	0.0040	0.0020
Porcupine, meat	Erethizon dorsatum	1	72.6	0.17	0.018	59	0.37	0.020	0.040	0.0040	0.19	0.0040	0.0020	-
Squirrel, meat	Tamiasciurus hudsonicus, Urocyon richardsonii	1	73.2	0.0020	0.0044	25	0.59	0.010	0.19	0.010	0.060	1.5	0.010	-
BOREAL SHIELD - WILD BIRDS														
Arctic tern/stern, egg	Sterna paradisaea	1	76	0.0020	0.0089	39	0.19	0.040	0.54	0.060	0.0020	0.0020	0.050	0.040
Duck, black quailmot, meat	Cephus grylle	1	72.6	0.020	0.0083	67	0.44	0.030	0.60	0.36	0.0020	0.010	0.10	0.10
Duck, bufflehead, meat	Bucephala albeola	2	-	0.17	0.011	68	0.89	0.020	0.16	0.11	0.0030	0.040	0.040	-
Duck, eider, liver	Somateria spp.	1	74.5	0.010	0.031	232	3.7	0.37	2.7	0.41	0.46	0.010	0.12	0.14
Duck, eider, meat	Somateria spp.	1	71.6	0.030	0.0094	40	0.33	0.010	0.58	0.29	0.010	2.6	0.060	0.050
Duck, gadwall, meat	Anas strepera	1	53.7	0.15	0.0074	52	0.63	0.020	0.26	0.010	0.0050	0.020	0.18	-
Duck, goldeneye, meat	Bucephala clangula	2	71.5	0.060	0.0061	52	0.33	0.020	0.25	0.020	0.080	0.0040	0.060	0.030
Duck, mallard, meat	Anas platyrhynchos	6	53.8	0.12	0.013	70	0.87	0.030	0.50	0.070	0.010	19	0.030	0.020
Duck, scoter, meat	Melanitta nigra	1	69.2	0.090	0.013	74	0.59	0.020	1.9	0.25	0.020	0.010	0.080	0.060
Duck, teal, meat	Anas spp.	2	-	0.23	0.0098	56	0.45	0.040	0.56	0.11	0.010	3.8	0.090	0.070
Duck, unidentified, meat		3	77	0.10	0.0038	47	0.56	0.010	0.31	0.020	0.010	0.27	0.050	0.080
Goose, Canada, kidney	Branta canadensis	1	-	0.63	0.045	156	1.6	0.050	0.25	0.050	0.020	0.030	0.0020	0.0020
Goose, Canada, meat	Branta canadensis	11	62.1	0.21	0.0045	54	0.36	0.020	0.20	0.020	0.0030	1.8	0.0020	0.0020
Goose, snow, meat	Chen caerulescens	2	-	0.090	0.0069	51	0.53	0.020	0.29	0.010	0.0040	0.090	0.0020	0.0020
Goose, unidentified, fat		2	0	0.15	0.0020	15	0.17	0.010	0.040	0.010	0.020	0.010	0.0020	-
Grouse/ptarmigan, meat	Falco canadensis, Bona saumbellus, Perdix perdix, Lagopus Lagopus spp.	28	71.4	0.18	0.0035	31	0.64	0.030	0.22	0.010	0.020	7.9	0.010	0.0020

Notes:

µg/g = micrograms per gram; % = percent

(a) Measured food sample concentrations from the First Nations Food, Nutrition & Environment Study, Comprehensive Technical Report - Supplemental Data, Boreal Shield Ecozone (Chan et al. 2021)

(b) 1-5 samples from each community were pooled and analysed. The data are mean concentrations of the number of pooled samples or communities

SUBATTACHMENT A4: BASELINE DATA FROM OTHER SOURCES

Table of Contents:

A4-1. Concentrations of Metals in Lichen Tissues - Kemess Underground Project: Sample data and summary statistics used to characterize baseline parameter concentrations in lichen.

A4-2. Concentrations of Metals in Wild Game Tissues: Measured wild game meat concentrations from the First Nations Food, Nutrition & Environment Study for the Boreal Shield Ecozone (Chan et al. 2021).

Attachment B
Predicted Environmental Media
Concentrations



1 PREDICTED AIR QUALITY

1.1 POINTS OF RECEPTION

For the purposes of the Air Quality Assessment, the term point of reception (POR) is defined as a location with human activity, which may include traditional knowledge and land use study (TKLUS). The PORs consist of residences, potential recreational use areas, cabins, lodges, places of special interest and camp sites identified through field work and a review of the Ministry of Natural Resources Geospatial Ontario (formerly Land Information Ontario) geospatial datasets. These locations were conservatively identified primarily within the local study area (LSA) but also included some locations outside the LSA but within the regional study area (RSA). In some cases where a land use covered a large area, representative points were selected. No PORs were characterized within the Project Area (PA); as it was assumed that only commercial mine workers would be present within the PA. These workers would be protected under a Health, Safety and Environment protocol that would prevent exposure to unacceptable levels of risk.

The PORs evaluated for air quality exposure in the inhalation assessment are listed in Table B-1 below and presented in Figure 4-1 of the Human Health and Ecological Risk Assessment (HHERA) report . They include:

- Initial Air Quality PORs: PORs 1-29 which consist of primarily long-term stay locations (e.g., cottage, cabin, lodge, camp), with the exception of POR1, which is a short term stay storage area.
- Additional PORs: PORs 30-41. PORs 30-38 and 40 consist of primarily short-term stay locations (e.g., fishing area, hunting area, gathering area, cultural area) identified through TKLU reports or chosen to represent potential exposure on water bodies. POR 39 was identified as a location where people may stay overnight and was therefore considered a long-term stay location. POR41 was also added near Red Lake to represent residences (long term stay) located in this area within the RSA.
- Maximum Point of Impingement (MPOI): The MPOI is a theoretical point where maximum air emissions are predicted outside of the Project property boundaries, in close proximity to the PA. This point is not a specific non-static location, but rather varies for various parameters, assessment phase and emission sources, and is typically used for the human health worst-case short-term scenario. It represents the highest predicted ground level air concentrations anticipated to occur in close proximity to the PA. It is noted that human receptors in the LSA are not expected to spend an appreciable amount of time at the MPOI and, therefore, the PORs that represent short-term and long-term stay areas (including from TLKU) more accurately represent potential exposure to humans. For the Project, the MPOI is consistent with the O. Reg. 419/05: Air Pollution – Local Air Quality definition. A “point of impingement” is defined in Section 2 of O. Reg. 419/05 and includes the following:
 - Any point off site; and
 - Any point on site that is on a childcare facility or on a structure that serves primarily as a health care facility, a senior citizens’ residence and/or long-term care facility, or an educational facility; and
 - Any point on the same structure as the source of a contaminant that does not belong to the facility.

Given that there are no childcare, health care or senior citizens’ facilities within the Project Leased Claims Boundary the MPOI was appropriately considered for the identification of parameters of potential concern (POPCs). Evaluation of the MPOI is a typical (conservative) approach to air quality assessments where the maximum off-site concentration is compared to air quality criteria, regardless of whether receptors are

ATTACHMENT B: Predicted Environmental Media Concentrations

expected to be present at this location. Use or access of the MPOI location at the time of the predicted concentration by the public is considered to be on a rare or infrequent basis.

Table B-1: Points of Receptions

POR ID	Exposure Type	Easting	Northing
Initial Air Quality PORs			
POR1	Acute	456965	5639223
POR2	Chronic	465624	5635180
POR3	Chronic	465611	5635303
POR4	Chronic	451915	5639044
POR5	Chronic	451671	5630891
POR6	Chronic	465139	5634939
POR7	Chronic	467085	5631026
POR8	Chronic	447866	5639124
POR9	Chronic	451051	5639187
POR10	Chronic	452237	5640215
POR11	Chronic	458555	5640149
POR12	Chronic	450762	5642634
POR13	Chronic	447708	5641952
POR14	Chronic	446385	5641886
POR15	Chronic	446675	5642960
POR16	Chronic	447897	5645762
POR17	Chronic	446102	5646375
POR18	Chronic	465476	5635383
POR19	Chronic	446876	5642540
POR20	Chronic	447444	5642109
POR21	Chronic	447961	5637216
POR22	Chronic	469646	5628897
POR23	Chronic	469091	5623932
POR24	Chronic	470572	5630691
POR25	Chronic	463047	5614594
POR26	Chronic	467430	5631399
POR27	Chronic	468788	5623627
POR28	Chronic	465478	5635052
POR29	Chronic	447525	5643902
Additional PORs			
POR30	Acute	445667	5649233
POR31	Acute	457668	5647234
POR32	Acute	473668	5637233
POR33	Acute	460268	5633434
POR34	Acute	460863	5633431
POR35	Acute	461466	5633437

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POR ID	Exposure Type	Easting	Northing
POR36	Acute	466166	5629732
POR37	Acute	466167	5628231
POR38	Acute	467656	5627233
POR39	Chronic	450668	5634484
POR40	Acute	452918	5632234
POR41	Chronic	440829	5650824

Notes:

ID= Identification; POR= Point of reception.

As the inhalation assessment consists of evaluating acute (i.e., 1-hour, 8-hour and/or 24-hour) and chronic (i.e., annual) exposures, PORs were grouped by anticipated exposure duration (acute or chronic). PORs in which receptors would reside overnight or long-term (e.g., cottage, cabin, lodge, camp, overnight stay area) are assessed as chronic while PORs in which receptors will spend their time short-term (e.g., fishing area, hunting area, gathering area, cultural area) are assessed as acute. Use or access of the MPOI by the public is considered to be on an infrequent basis, hence the MPOI was evaluated as acute only. For chronic PORs, it was conservatively assumed that the Indigenous Resident receptor could be present in the LSA or RSA continuously throughout their entire lifetime.

1.2 AIR QUALITY MODEL DESCRIPTION

Air dispersion modelling was completed using AERMOD (U.S. EPA version 22112), the regulatory model approved by the Ontario Ministry of the Environment, Conservation and Parks (MECP). AERMOD was selected for its suitability in representing dispersion from point, area, volume, and line sources under a range of meteorological conditions (WSP 2025a).

The modelling incorporated 3 years of site-specific (2022-2025), and five years of MECP-approved meteorological data (1996–2000, International Falls dataset), including wind speed, wind direction, temperature, stability class, and precipitation. Local topography was integrated using publicly available digital elevation models to reflect terrain variability within the modelling domain. Further details on the methods used to model air quality predictions can be found in the Air Quality Assessment (WSP 2025a).

A comprehensive emissions inventory was developed for each Project phase. Emission sources included:

- Mobile and stationary fuel combustion;
- Drilling and blasting;
- Material handling;
- Crushing and ore processing;
- Stockpiles and tailings management facility activities;
- Road dust from onsite vehicle activity;
- Wind erosion;
- Fugitive dust and metals;
- Concrete batch plant, cemented rockfill plant, and paste plant;
- Fuel storage;
- Cyanide process tanks, vent raises, and assay lab operations.

Using this dispersion model and emissions inventory, modelled results of airborne parameters as particulate deposition and inhalable volatiles were predicted for the construction and operations phases of the Project.

1.3 AIR QUALITY MODEL RESULTS

The air dispersion modelling predicted ground-level concentrations of key air parameters for the construction and operations phases of the Project. The results reflect conservative modelling assumptions, including maximum emission scenarios and worst-case meteorological conditions.

Modelled results were output as hourly parameter concentrations over the lifespan of the Project. Statistics that are representative of a conservative exposure level for each averaging period (1-hour, 24-hours, annual) were calculated by the Air Quality Discipline at each POR and are presented in Table B1-1 (Attachment B1) for inhalation exposures, and Table B1-4 for particulate deposition rates. Statistics were then calculated across PORs to represent conservative levels of exposure for the HHERA; these can be found in Table B1-2 (Attachment B1) for inhalation exposures, and Table B1-3 (Attachment B1) for particulate deposition rates. Rationale for the selection of specific statistics can be found in the Air Quality Assessment (WSP 2025a), and were selected in alignment with the screening criteria applied (see Attachment C). In some instances, the concentration of a parameter was predicted in the air dispersion model when no baseline air quality data was collected. This was due to the fact that the dispersion model predicts many parameters based on the results of an ore composition assay. Some elements present in the local geology may not have been detected or measured during baseline sampling.

For the purposes of screening and identification of POPCs, maximum predicted inhalation concentrations at the MPOI (Table B1-1) were compared against selected screening criteria. Additionally, predicted soil concentrations at the POR with the maximum deposition rate (Table B1-4) was summed with the maximum baseline soil concentration collected during the Baseline Soil and vegetation Sampling Program (Attachment A), and compared to selected soil screening criteria. Sample calculations of this can be found in Section 2 of this Attachment. Details on the identification of POPCs can be found in Attachment C.

For the purposes of the human health risk assessment, the exposure point concentrations (EPC) for the inhalation assessment (Attachment B1, Table B1-2) were selected as the maximum modelled concentration among initial air quality PORs and additional PORs, for each averaging period (1-hour, 24-hour and annual). Only chronic (long term stay) POR locations were considered for annual averaging period EPCs, while all PORs were considered for 1-hour and 24-hour averaging period EPCs.

For the purpose of modelling deposition of airborne particles to soil and plant surfaces, the maximum deposition rate across all PORs was taken as the EPC for each parameter (Attachment B1, Table B1-3). Methods for the calculation of plant surface and soil particle deposition were obtained from the United States Environmental Protection Agency (US EPA) (2005), and are outlined in Attachment E.

2 PREDICTED SOIL QUALITY

2.1 AIRBORNE DEPOSITION TO SOIL

Predicted soil concentrations were calculated for the purposes of POPC screening for the HHERA. As a conservative approach, maximum deposition rates of all parameters provided by the Air Quality Discipline were used to predict soil concentrations for each Project phase. The concentration of parameters deposited to soil were then summed with the maximum soil concentrations measured in the Soil and Vegetation Sampling Program. These predictions were prepared for all PORs to identify the maximum predicted soil concentration within the LSA/ RSA for use in POPC screening. Soil concentrations for the HHERA multi-media models were calculated using EPC statistics discussed in Appendices E and F. Maximum deposition rates and baseline soil concentrations can be found in Table B1-4 (Attachment B1).

Soil concentrations resulting from airborne particulate deposition were calculated using methods described by US EPA (2005). Standard and conservative assumptions were made for variables used in the US EPA calculation. Bulk density and surface soil depth were based on standards recommended by US EPA (2005). Deposition period was assumed to be the length of the Project phase. Closure phase deposition rates were not provided and were conservatively assumed to be the same as the construction phase. Predicted concentrations of parameters deposited to soil were calculated for construction, operations, and closure. These Project related concentrations were summed with maximum baseline soil concentrations to calculate a predicted total soil concentration for each parameter at each POR. Deposition rates, and calculations can be found in Table B1-1-4 of this Attachment.

The US EPA (2005) method for calculating airborne particle deposition to soil is as follows:

$$Soil_{dep} = \frac{Q}{Z \times BD} \times \frac{1 - e^{(-ks \times t)}}{ks}$$

Where:

$Soil_{dep}$ = Estimated concentration of POPC in soil attributed to particulate deposition from air (mg/kg)

Q = Rate of airborne particle deposition (mg/m²/year)

Z = Soil depth (m)

BD = Bulk density of soil (kg/m³)

ks = Soil loss constant (year⁻¹)

t = Time period of deposition (years)

The following is a worked example of the calculation for deposition of arsenic to soil at POR 1, the over-land POR with the highest arsenic deposition rate.

Example 2-1: Deposition of Arsenic to Surface Soil in the Operations Phase at POR 1

$$Soil_{dep} = \frac{1.51 \text{ mg/m}^2/\text{year}}{0.02 \text{ m} \times 1500 \text{ kg/m}^3} \times \frac{1 - e^{(-0.014 \text{ year}^{-1} \times 26 \text{ years})}}{0.014 \text{ year}^{-1}}$$

$$Soil_{dep} = 1.10 \text{ mg/kg}$$

For polycyclic aromatic hydrocarbons (PAHs), deposition rates were only provided by the Air Quality discipline for benzo(a)pyrene for the construction, operations and closure phases. As such, predicted soil concentrations for other carcinogenic PAHs considered as part of the benzo(a)pyrene (B(a)P) total potency equivalent (TPE) calculation were estimated based on the Project-related incremental change for benzo(a)pyrene. Since B(a)P TPE is the sum of all carcinogenic PAH concentrations estimated based on their potency equivalency factor (PEF) relative to benzo(a)pyrene, it was assumed that the ratio of the predicted incremental change in the soil concentration of benzo(a)pyrene relative to its baseline concentration could be applied to all the other carcinogenic PAHs. The ratio of change in concentration

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for benzo(a)pyrene was multiplied by each carcinogenic PAH's respective baseline concentration to predict its respective Project-related incremental change.

3 PREDICTED SURFACE WATER QUALITY

3.1 SURFACE WATER MODELLING NODES

To characterize the potential influence of Project-related interactions on existing surface water quality, model predictions were generated at strategically selected nodes. Information used to identify node locations is outlined in the Receiver Water Quality Modelling report (WSP 2025b). These nodes represent locations where the Project is expected to interact with the surface water receiving environment. This node-based approach is an industry standard practice and provides a structured framework for evaluating potential water quality changes.

A total of 20 modelling nodes were identified within the Dixie Creek, Chukuni River and Pakwash Lake watersheds. UN-1, UN-2 and UN-4 will be compensated for and UN-6 was determined to not be materially affected by the Project. Therefore, these nodes were not considered in the tiered screening and HHERA. The modelling nodes are described in Table B-2, below, and illustrated on Figure 3-2 of the HHERA.

Table B-2: Waterbodies Assessed in the Human Health and Ecological Risk Assessment

Waterbody	Model Node	Baseline Monitoring Station	Description
Chukuni River	CHK-1	CR-FDP	Chukuni River, Project effluent discharge location.
	CHK-2	CR-DS	Downstream of Project effluent discharge location and confluence with Dixie Creek.
Dixie Creek	DIX-1	DC-US	Outlet of Dixie Lake to Dixie Creek.
	DIX-2	SW-03	Dixie Creek after confluence with Unnamed Watercourse 1.
	DIX-3	SW-08	Dixie Creek, south of the proposed LP Central Pit.
	DIX-4	SW-08 (assumed to be similar to the upstream node, DIX-3)	Dixie Creek after confluence with Unnamed Watercourse 7.
	DIX-5	SW-15	Dixie Creek after confluence with Unnamed Watercourse 6.
Genessee Lake	GEN-1	SW-GL	Outlet of Genessee Lake to Unnamed Watercourse 11.
	GEN-L	SW-GL	Genessee Lake
Pakwash Lake	PAK-IN	PL-01	Inlet to Pakwash Lake from the Chukuni River.
	PAK-L	PL-03	Pakwash Lake
	PAK-OUT	PL-04	Outlet of Pakwash Lake.
	PAK-IN-2	PL-01	Upstream node on Pakwash Lake
Small Unnamed waterbodies and watercourses	UN-3	SW-14	Outlet of Unnamed Waterbody 6 to Unnamed Watercourse 6.
	UN-5	GL-TRIB	Unnamed Watercourse 11.
	UN-L6	SW-14	Unnamed Waterbody 6.

3.2 SURFACE WATER MODEL DESCRIPTION

The receiver water quality model was developed using mass-balance calculations in GoldSim to simulate the transport and concentration of chemical species over the life of the Project. Model predictions were generated over a timeseries of consecutive monthly timesteps, aligned to the water balance (WSP 2025c,d) for all Project phases. In addition, long-term equilibrium conditions representing the post-closure steady-state were modelled.

The Receiver Water Quality Model predicted surface water conditions during the Project phases outlined in Table B-3.

Table B-3: Project Phases Assessed in the Receiver Water Quality Model

Model Phase	Model Period	Description
Model Baseline (Existing Conditions)	2024 - 2026	Existing conditions of Project area watercourses and waterbodies, including the Chukuni River are equivalent to monthly median (or average) baseline concentrations, where the number of samples available for each month were greater than three. In cases where only one or two baseline data samples were available for that month, source term inputs for unnamed watercourses were instead developed as seasonal inputs. For unnamed waterbodies, if less than three datapoints per month were available, source terms were developed for under ice vs. open water seasons.
Construction	2027 - 2029	During construction, non-contact water will be diverted to minimize water entering the Project site. Runoff from areas disturbed by construction will be managed locally. Runoff from areas that may contain potentially deleterious material will be collected and treated by the Advanced Exploration Program (AEX) effluent treatment plant or water treatment plant (WTP) prior to discharge or stored for process plant commissioning and start-up.
Operations	2030 - 2056	During operations, water from the entire Project site and process plant is actively managed. In the first 15 years, contact water from the Project's watershed is directed to the tailings management facility (TMF) pond, the AEX mine water pond, and the West Viggo management facility (VMF). Treated effluent from both treatment streams is conveyed to the AEX treated water pond prior to discharge to the receiving environment. Starting in Year 16, the mine water pond (MWP) will be constructed to support ongoing site water management.
Closure	Including active closure and passive closure periods; 2057 - 2063	<p>During closure, fresh water will be drawn from the Chukuni River through the treated effluent pipeline, to actively fill the LP Central pit, the VMF and the underground workings with water. There are no treated effluent discharges to the Chukuni river during this time; all pit filling is completed by the end of Year 30.</p> <p>It has been assumed that passive closure will extend approximately three calendar years after the LP Central pit and VMF have been filled; it is assumed that water from the LP Central pit lake and Viggo pit lake will require treatment and discharge to the Chukuni River.</p>

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Post Closure	2064 - 2099	Once water quality objectives for the closure phase are achieved, post-closure will be initiated. During post-closure, the WTP and related infrastructure will be decommissioned, and the site will passively discharge to the environment.
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Notes:

AEX = advanced exploration program; MWP = mine water pond; TMF = tailings management facility; VMF = Viggo management facility; WTP = water treatment plant.

In the receiver water quality model, the Project interacts with the surface water environment through the following six general pathways:

- Diverted non-contact water
- Water taking
- Fugitive seepage from Project components
- Treated effluent discharge to the receiving environment (the Chukuni River)
- Passive discharge from reclaimed Project catchment areas
- Fugitive dust deposition.

Further details on the parameters and configuration of the receiver water quality model can be found in the Receiver Water Quality Modelling Report (WSP 2025b).

3.3 SURFACE WATER MODEL RESULTS

Modelled surface water quality results were provided as monthly average concentrations for baseline (i.e., existing conditions), and for all Project phases over the lifetime of the Project. Modelled results were provided for each node listed in Table B-2. Statistics (i.e., maximum, average) were calculated from the monthly average data to characterize EPCs for the human health and ecological risk assessments. The calculated statistics can be found in Table B1-5 (Attachment B1).

Statistics were selected to reflect reasonable maximum exposures across all relevant water model nodes (see Table B-2). The statistic selected for the human health risk assessment (HHRA) is the highest of the annual averages calculated at each node and phase in the LSA, while the maximum monthly average at each node and phase in the LSA was selected for the ecological risk assessment (ERA). Details on EPC calculations can be found in Attachment E for human health, and F for wildlife. For the aquatic life risk assessment, maximums from individual model nodes were used as the EPC. The aquatic life EPCs can be found in Table C1-12 (Attachment C). Further details on the results of the Receiver Water Quality Model can be found in the Receiver Water Quality Modelling Report (WSP 2025b).

4 REFERENCES

- US EPA. 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Final. U.S. EPA Region VI. Multi-media Planning and Permitting Division. Center for Combustion Science and Engineering. Office of Solid Waste.
- WSP Canada (WSP). 2025a. Great Bear Project, Air Quality Assessment Report. Project No. OMEMA2303. Prepared by WSP Canada Inc. for Great Bear Resources Ltd. October 2025.
- WSP 2025b. Great Bear Project, Receiver Water Quality Modelling Report, Rev 1. Project No. OMEMA2303. Prepared by WSP Canada Inc. for Great Bear Resources Ltd. December 2025.
- WSP 2025c. Great Bear Project, Mine Site Water Balance - Interim. Project No. OMEMA2303. Prepared by WSP Canada Inc. for Great Bear Resources Ltd. September 2025.
- WSP 2025d. Great Bear Project, Receiver Water Balance. Project No. OMEMA2303. Prepared by WSP Canada Inc. for Great Bear Resources Ltd. September 2025.

Sub-Attachment B1
Predicted Environmental Media
Concentration Results



SUBATTACHMENT B1: CONCENTRATIONS OF POPCS IN AIR, WATER, AND PARTICULATES

Table of Contents:

B1-1. Summary of Air Quality Concentrations at Each POR: Predicted air quality concentrations of NO₂ and DPM at each POR and MPOI for Construction/Closure, and Operations.

B1-2. Summary of Air Quality Exposure Point Concentrations used in the HHRA: POPC concentrations used to characterize human exposure in the human health Inhalation Model.

B1-3. Summary of Predicted Air Particle Deposition Rates: Summary statistics of deposition rates used to characterize predicted soil concentrations exposed to human receptors in the Multi-media Model.

B1-4. Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs: Predicted deposition rates of parameters at all PORs and resulting estimated soil concentrations.

B1-5. Summary of Modelled Surface Water Quality Exposure Point Concentrations used in the HHERA Modeling: Surface water quality statistics used to characterize human and wildlife exposure in all phases.

Table B1-1: Summary of Air Quality Concentrations at Each POR

Phase	POR ID	Parameter	Averaging Period	Units	Statistic ¹	Concentration
Construction	POR1	DPM	Annual	µg/m ³	Mean	0.08432
Construction	POR2	DPM	Annual	µg/m ³	Mean	0.02921
Construction	POR3	DPM	Annual	µg/m ³	Mean	0.02867
Construction	POR4	DPM	Annual	µg/m ³	Mean	0.05328
Construction	POR5	DPM	Annual	µg/m ³	Mean	0.04225
Construction	POR6	DPM	Annual	µg/m ³	Mean	0.03412
Construction	POR7	DPM	Annual	µg/m ³	Mean	0.01721
Construction	POR8	DPM	Annual	µg/m ³	Mean	0.02209
Construction	POR9	DPM	Annual	µg/m ³	Mean	0.04246
Construction	POR10	DPM	Annual	µg/m ³	Mean	0.04215
Construction	POR11	DPM	Annual	µg/m ³	Mean	0.05319
Construction	POR12	DPM	Annual	µg/m ³	Mean	0.02279
Construction	POR13	DPM	Annual	µg/m ³	Mean	0.01699
Construction	POR14	DPM	Annual	µg/m ³	Mean	0.01469
Construction	POR15	DPM	Annual	µg/m ³	Mean	0.01379
Construction	POR16	DPM	Annual	µg/m ³	Mean	0.01217
Construction	POR17	DPM	Annual	µg/m ³	Mean	0.01008
Construction	POR18	DPM	Annual	µg/m ³	Mean	0.0291
Construction	POR19	DPM	Annual	µg/m ³	Mean	0.01461
Construction	POR20	DPM	Annual	µg/m ³	Mean	0.0162
Construction	POR21	DPM	Annual	µg/m ³	Mean	0.02361
Construction	POR22	DPM	Annual	µg/m ³	Mean	0.011
Construction	POR23	DPM	Annual	µg/m ³	Mean	0.00844
Construction	POR24	DPM	Annual	µg/m ³	Mean	0.01112
Construction	POR25	DPM	Annual	µg/m ³	Mean	0.0053
Construction	POR26	DPM	Annual	µg/m ³	Mean	0.01686
Construction	POR27	DPM	Annual	µg/m ³	Mean	0.00837
Construction	POR28	DPM	Annual	µg/m ³	Mean	0.03097
Construction	POR29	DPM	Annual	µg/m ³	Mean	0.01379
Construction	POR30	DPM	Annual	µg/m ³	Mean	0.009452433
Construction	POR31	DPM	Annual	µg/m ³	Mean	0.017979452
Construction	POR32	DPM	Annual	µg/m ³	Mean	0.009782937
Construction	GENL (Not a POR)	DPM	Annual	µg/m ³	Mean	0.108575401
Construction	POR33	DPM	Annual	µg/m ³	Mean	0.125261258
Construction	POR34	DPM	Annual	µg/m ³	Mean	0.08976506
Construction	POR35	DPM	Annual	µg/m ³	Mean	0.069736479
Construction	POR36	DPM	Annual	µg/m ³	Mean	0.018309957
Construction	POR37	DPM	Annual	µg/m ³	Mean	0.016479648
Construction	POR38	DPM	Annual	µg/m ³	Mean	0.013170482
Construction	POR1	NO2	1hr	µg/m ³	90th Percentile	82.03961
Construction	POR2	NO2	1hr	µg/m ³	90th Percentile	29.96203
Construction	POR3	NO2	1hr	µg/m ³	90th Percentile	29.94673
Construction	POR4	NO2	1hr	µg/m ³	90th Percentile	51.33311
Construction	POR5	NO2	1hr	µg/m ³	90th Percentile	58.31444
Construction	POR6	NO2	1hr	µg/m ³	90th Percentile	32.68088
Construction	POR7	NO2	1hr	µg/m ³	90th Percentile	49.74771
Construction	POR8	NO2	1hr	µg/m ³	90th Percentile	62.41403
Construction	POR9	NO2	1hr	µg/m ³	90th Percentile	48.35677
Construction	POR10	NO2	1hr	µg/m ³	90th Percentile	46.86341
Construction	POR11	NO2	1hr	µg/m ³	90th Percentile	56.86401
Construction	POR12	NO2	1hr	µg/m ³	90th Percentile	30.70919
Construction	POR13	NO2	1hr	µg/m ³	90th Percentile	29.03164
Construction	POR14	NO2	1hr	µg/m ³	90th Percentile	35.50429
Construction	POR15	NO2	1hr	µg/m ³	90th Percentile	24.52095
Construction	POR16	NO2	1hr	µg/m ³	90th Percentile	27.92084
Construction	POR17	NO2	1hr	µg/m ³	90th Percentile	19.80388
Construction	POR18	NO2	1hr	µg/m ³	90th Percentile	31.26637
Construction	POR19	NO2	1hr	µg/m ³	90th Percentile	25.90557
Construction	POR20	NO2	1hr	µg/m ³	90th Percentile	27.94179
Construction	POR21	NO2	1hr	µg/m ³	90th Percentile	57.6012
Construction	POR22	NO2	1hr	µg/m ³	90th Percentile	45.21872
Construction	POR23	NO2	1hr	µg/m ³	90th Percentile	33.03428
Construction	POR24	NO2	1hr	µg/m ³	90th Percentile	46.66194
Construction	POR25	NO2	1hr	µg/m ³	90th Percentile	15.6809
Construction	POR26	NO2	1hr	µg/m ³	90th Percentile	51.68207
Construction	POR27	NO2	1hr	µg/m ³	90th Percentile	36.16106
Construction	POR28	NO2	1hr	µg/m ³	90th Percentile	30.85223
Construction	POR29	NO2	1hr	µg/m ³	90th Percentile	23.57989
Construction	POR30	NO2	1hr	µg/m ³	90th Percentile	25.78
Construction	POR31	NO2	1hr	µg/m ³	90th Percentile	20.65
Construction	POR32	NO2	1hr	µg/m ³	90th Percentile	25.04
Construction	GENL (Not a POR)	NO2	1hr	µg/m ³	90th Percentile	63.32
Construction	POR33	NO2	1hr	µg/m ³	90th Percentile	83.06
Construction	POR34	NO2	1hr	µg/m ³	90th Percentile	70.39
Construction	POR35	NO2	1hr	µg/m ³	90th Percentile	61.8
Construction	POR36	NO2	1hr	µg/m ³	90th Percentile	69.61
Construction	POR37	NO2	1hr	µg/m ³	90th Percentile	55.35
Construction	POR38	NO2	1hr	µg/m ³	90th Percentile	50.67

Table B1-1: Summary of Air Quality Concentrations at Each POR

Phase	POR ID	Parameter	Averaging Period	Units	Statistic ¹	Concentration
Construction	POR1	DPM	1hr	µg/m ³	90th Percentile	4.35501
Construction	POR2	DPM	1hr	µg/m ³	90th Percentile	2.52487
Construction	POR3	DPM	1hr	µg/m ³	90th Percentile	2.56884
Construction	POR4	DPM	1hr	µg/m ³	90th Percentile	3.1344
Construction	POR5	DPM	1hr	µg/m ³	90th Percentile	3.44193
Construction	POR6	DPM	1hr	µg/m ³	90th Percentile	2.42483
Construction	POR7	DPM	1hr	µg/m ³	90th Percentile	3.01267
Construction	POR8	DPM	1hr	µg/m ³	90th Percentile	2.37508
Construction	POR9	DPM	1hr	µg/m ³	90th Percentile	2.77452
Construction	POR10	DPM	1hr	µg/m ³	90th Percentile	2.65074
Construction	POR11	DPM	1hr	µg/m ³	90th Percentile	3.17181
Construction	POR12	DPM	1hr	µg/m ³	90th Percentile	1.84996
Construction	POR13	DPM	1hr	µg/m ³	90th Percentile	1.55932
Construction	POR14	DPM	1hr	µg/m ³	90th Percentile	1.49525
Construction	POR15	DPM	1hr	µg/m ³	90th Percentile	1.27471
Construction	POR16	DPM	1hr	µg/m ³	90th Percentile	1.51448
Construction	POR17	DPM	1hr	µg/m ³	90th Percentile	1.38107
Construction	POR18	DPM	1hr	µg/m ³	90th Percentile	2.6139
Construction	POR19	DPM	1hr	µg/m ³	90th Percentile	1.35919
Construction	POR20	DPM	1hr	µg/m ³	90th Percentile	1.47841
Construction	POR21	DPM	1hr	µg/m ³	90th Percentile	4.62224
Construction	POR22	DPM	1hr	µg/m ³	90th Percentile	1.36519
Construction	POR23	DPM	1hr	µg/m ³	90th Percentile	1.39832
Construction	POR24	DPM	1hr	µg/m ³	90th Percentile	2.9909
Construction	POR25	DPM	1hr	µg/m ³	90th Percentile	1.04479
Construction	POR26	DPM	1hr	µg/m ³	90th Percentile	3.38749
Construction	POR27	DPM	1hr	µg/m ³	90th Percentile	1.17324
Construction	POR28	DPM	1hr	µg/m ³	90th Percentile	2.46207
Construction	POR29	DPM	1hr	µg/m ³	90th Percentile	1.62974
Construction	POR30	DPM	1hr	µg/m ³	90th Percentile	0.274389531
Construction	POR31	DPM	1hr	µg/m ³	90th Percentile	0.365852708
Construction	POR32	DPM	1hr	µg/m ³	90th Percentile	0.300521867
Construction	GENL (Not a POR)	DPM	1hr	µg/m ³	90th Percentile	3.109748015
Construction	POR33	DPM	1hr	µg/m ³	90th Percentile	2.286579423
Construction	POR34	DPM	1hr	µg/m ³	90th Percentile	1.763932697
Construction	POR35	DPM	1hr	µg/m ³	90th Percentile	1.424212326
Construction	POR36	DPM	1hr	µg/m ³	90th Percentile	0.339720371
Construction	POR37	DPM	1hr	µg/m ³	90th Percentile	0.522646725
Construction	POR38	DPM	1hr	µg/m ³	90th Percentile	0.470382053
Construction	POR39	DPM	Annual	µg/m ³	Mean	0.075468376
Construction	POR39	NO2	1hr	µg/m ³	90th Percentile	79.82
Construction	POR39	DPM	1hr	µg/m ³	90th Percentile	2.299645591
Construction	POR40	DPM	Annual	µg/m ³	Mean	0.085113729
Construction	POR40	NO2	1hr	µg/m ³	90th Percentile	80.13
Construction	POR40	DPM	1hr	µg/m ³	90th Percentile	1.463410831
Construction	POR41	DPM	Annual	µg/m ³	Mean	0.00559
Construction	POR41	NO2	1hr	µg/m ³	90th Percentile	19.06
Construction	POR41	DPM	1hr	µg/m ³	90th Percentile	1.24
Construction	Absolute Max	DPM	Annual	µg/m ³	Mean	0.65934
Construction	Absolute Max	NO2	1hr	µg/m ³	90th Percentile	125.75525
Construction	Absolute Max	DPM	1hr	µg/m ³	90th Percentile	38.29343
Construction	Max (with MET removed)	NO2	1hr	µg/m ³	90th Percentile	94.62982
Construction	Max (with MET removed)	DPM	1hr	µg/m ³	90th Percentile	28.34106

Table B1-1: Summary of Air Quality Concentrations at Each POR

Phase	POR ID	Parameter	Averaging Period	Units	Statistic ¹	Concentration
Operations	POR1	DPM	Annual	µg/m ³	Mean	0.06451
Operations	POR2	DPM	Annual	µg/m ³	Mean	0.02468
Operations	POR3	DPM	Annual	µg/m ³	Mean	0.02415
Operations	POR4	DPM	Annual	µg/m ³	Mean	0.04445
Operations	POR5	DPM	Annual	µg/m ³	Mean	0.03859
Operations	POR6	DPM	Annual	µg/m ³	Mean	0.02903
Operations	POR7	DPM	Annual	µg/m ³	Mean	0.01413
Operations	POR8	DPM	Annual	µg/m ³	Mean	0.01863
Operations	POR9	DPM	Annual	µg/m ³	Mean	0.03529
Operations	POR10	DPM	Annual	µg/m ³	Mean	0.03562
Operations	POR11	DPM	Annual	µg/m ³	Mean	0.04225
Operations	POR12	DPM	Annual	µg/m ³	Mean	0.01927
Operations	POR13	DPM	Annual	µg/m ³	Mean	0.01444
Operations	POR14	DPM	Annual	µg/m ³	Mean	0.01253
Operations	POR15	DPM	Annual	µg/m ³	Mean	0.01172
Operations	POR16	DPM	Annual	µg/m ³	Mean	0.01029
Operations	POR17	DPM	Annual	µg/m ³	Mean	0.00852
Operations	POR18	DPM	Annual	µg/m ³	Mean	0.02445
Operations	POR19	DPM	Annual	µg/m ³	Mean	0.01242
Operations	POR20	DPM	Annual	µg/m ³	Mean	0.01376
Operations	POR21	DPM	Annual	µg/m ³	Mean	0.01968
Operations	POR22	DPM	Annual	µg/m ³	Mean	0.00911
Operations	POR23	DPM	Annual	µg/m ³	Mean	0.00707
Operations	POR24	DPM	Annual	µg/m ³	Mean	0.0092
Operations	POR25	DPM	Annual	µg/m ³	Mean	0.00446
Operations	POR26	DPM	Annual	µg/m ³	Mean	0.01387
Operations	POR27	DPM	Annual	µg/m ³	Mean	0.00701
Operations	POR28	DPM	Annual	µg/m ³	Mean	0.02628
Operations	POR29	DPM	Annual	µg/m ³	Mean	0.01168
Operations	POR30	DPM	Annual	µg/m ³	Mean	0.008100033
Operations	POR31	DPM	Annual	µg/m ³	Mean	0.015019659
Operations	POR32	DPM	Annual	µg/m ³	Mean	0.008167872
Operations	GENL (Not a POR)	DPM	Annual	µg/m ³	Mean	0.087248345
Operations	POR33	DPM	Annual	µg/m ³	Mean	0.07278497
Operations	POR34	DPM	Annual	µg/m ³	Mean	0.058592952
Operations	POR35	DPM	Annual	µg/m ³	Mean	0.048600198
Operations	POR36	DPM	Annual	µg/m ³	Mean	0.014843277
Operations	POR37	DPM	Annual	µg/m ³	Mean	0.013452567
Operations	POR38	DPM	Annual	µg/m ³	Mean	0.010935723
Operations	POR1	NO2	1hr	µg/m ³	90th Percentile	85.62261
Operations	POR2	NO2	1hr	µg/m ³	90th Percentile	64.40234
Operations	POR3	NO2	1hr	µg/m ³	90th Percentile	67.71583
Operations	POR4	NO2	1hr	µg/m ³	90th Percentile	54.01556
Operations	POR5	NO2	1hr	µg/m ³	90th Percentile	63.04577
Operations	POR6	NO2	1hr	µg/m ³	90th Percentile	62.11501
Operations	POR7	NO2	1hr	µg/m ³	90th Percentile	47.05975
Operations	POR8	NO2	1hr	µg/m ³	90th Percentile	48.61883
Operations	POR9	NO2	1hr	µg/m ³	90th Percentile	57.04717
Operations	POR10	NO2	1hr	µg/m ³	90th Percentile	55.8766
Operations	POR11	NO2	1hr	µg/m ³	90th Percentile	50.89083
Operations	POR12	NO2	1hr	µg/m ³	90th Percentile	52.45519
Operations	POR13	NO2	1hr	µg/m ³	90th Percentile	35.81689
Operations	POR14	NO2	1hr	µg/m ³	90th Percentile	34.23339
Operations	POR15	NO2	1hr	µg/m ³	90th Percentile	29.2323
Operations	POR16	NO2	1hr	µg/m ³	90th Percentile	36.97929
Operations	POR17	NO2	1hr	µg/m ³	90th Percentile	25.01608
Operations	POR18	NO2	1hr	µg/m ³	90th Percentile	71.07528
Operations	POR19	NO2	1hr	µg/m ³	90th Percentile	30.54539
Operations	POR20	NO2	1hr	µg/m ³	90th Percentile	33.66707
Operations	POR21	NO2	1hr	µg/m ³	90th Percentile	67.90431
Operations	POR22	NO2	1hr	µg/m ³	90th Percentile	22.12012
Operations	POR23	NO2	1hr	µg/m ³	90th Percentile	25.70851
Operations	POR24	NO2	1hr	µg/m ³	90th Percentile	53.61326
Operations	POR25	NO2	1hr	µg/m ³	90th Percentile	14.55545
Operations	POR26	NO2	1hr	µg/m ³	90th Percentile	61.39436
Operations	POR27	NO2	1hr	µg/m ³	90th Percentile	20.35063
Operations	POR28	NO2	1hr	µg/m ³	90th Percentile	62.03842
Operations	POR29	NO2	1hr	µg/m ³	90th Percentile	28.11764
Operations	POR30	NO2	1hr	µg/m ³	90th Percentile	26.21
Operations	POR31	NO2	1hr	µg/m ³	90th Percentile	29.14
Operations	POR32	NO2	1hr	µg/m ³	90th Percentile	56.28
Operations	GENL (Not a POR)	NO2	1hr	µg/m ³	90th Percentile	84
Operations	POR33	NO2	1hr	µg/m ³	90th Percentile	82.81
Operations	POR34	NO2	1hr	µg/m ³	90th Percentile	72.35
Operations	POR35	NO2	1hr	µg/m ³	90th Percentile	64.84
Operations	POR36	NO2	1hr	µg/m ³	90th Percentile	29.11
Operations	POR37	NO2	1hr	µg/m ³	90th Percentile	48.58
Operations	POR38	NO2	1hr	µg/m ³	90th Percentile	44.89

Table B1-1: Summary of Air Quality Concentrations at Each POR

Phase	POR ID	Parameter	Averaging Period	Units	Statistic ¹	Concentration
Operations	POR1	DPM	1hr	µg/m ³	90th Percentile	3.66269
Operations	POR2	DPM	1hr	µg/m ³	90th Percentile	2.59733
Operations	POR3	DPM	1hr	µg/m ³	90th Percentile	2.59003
Operations	POR4	DPM	1hr	µg/m ³	90th Percentile	3.10518
Operations	POR5	DPM	1hr	µg/m ³	90th Percentile	3.38025
Operations	POR6	DPM	1hr	µg/m ³	90th Percentile	2.55216
Operations	POR7	DPM	1hr	µg/m ³	90th Percentile	2.53063
Operations	POR8	DPM	1hr	µg/m ³	90th Percentile	2.163
Operations	POR9	DPM	1hr	µg/m ³	90th Percentile	2.74734
Operations	POR10	DPM	1hr	µg/m ³	90th Percentile	2.59821
Operations	POR11	DPM	1hr	µg/m ³	90th Percentile	2.48626
Operations	POR12	DPM	1hr	µg/m ³	90th Percentile	2.08132
Operations	POR13	DPM	1hr	µg/m ³	90th Percentile	1.5104
Operations	POR14	DPM	1hr	µg/m ³	90th Percentile	1.42561
Operations	POR15	DPM	1hr	µg/m ³	90th Percentile	1.29107
Operations	POR16	DPM	1hr	µg/m ³	90th Percentile	1.70175
Operations	POR17	DPM	1hr	µg/m ³	90th Percentile	1.07455
Operations	POR18	DPM	1hr	µg/m ³	90th Percentile	2.59318
Operations	POR19	DPM	1hr	µg/m ³	90th Percentile	1.26382
Operations	POR20	DPM	1hr	µg/m ³	90th Percentile	1.40206
Operations	POR21	DPM	1hr	µg/m ³	90th Percentile	4.23081
Operations	POR22	DPM	1hr	µg/m ³	90th Percentile	1.20877
Operations	POR23	DPM	1hr	µg/m ³	90th Percentile	1.46218
Operations	POR24	DPM	1hr	µg/m ³	90th Percentile	2.7654
Operations	POR25	DPM	1hr	µg/m ³	90th Percentile	0.89048
Operations	POR26	DPM	1hr	µg/m ³	90th Percentile	3.1732
Operations	POR27	DPM	1hr	µg/m ³	90th Percentile	1.11188
Operations	POR28	DPM	1hr	µg/m ³	90th Percentile	2.57436
Operations	POR29	DPM	1hr	µg/m ³	90th Percentile	1.45502
Operations	POR30	DPM	1hr	µg/m ³	90th Percentile	0.240570397
Operations	POR31	DPM	1hr	µg/m ³	90th Percentile	0.302610006
Operations	POR32	DPM	1hr	µg/m ³	90th Percentile	0.241944205
Operations	GENL (Not a POR)	DPM	1hr	µg/m ³	90th Percentile	2.352972871
Operations	POR33	DPM	1hr	µg/m ³	90th Percentile	1.542028384
Operations	POR34	DPM	1hr	µg/m ³	90th Percentile	1.243321532
Operations	POR35	DPM	1hr	µg/m ³	90th Percentile	1.03641584
Operations	POR36	DPM	1hr	µg/m ³	90th Percentile	0.268495925
Operations	POR37	DPM	1hr	µg/m ³	90th Percentile	0.374381822
Operations	POR38	DPM	1hr	µg/m ³	90th Percentile	0.338213449
Operations	POR39	NO2	1hr	µg/m ³	90th Percentile	82.18
Operations	POR39	DPM	1hr	µg/m ³	90th Percentile	2.239994619
Operations	POR40	NO2	1hr	µg/m ³	90th Percentile	80.66
Operations	POR40	DPM	1hr	µg/m ³	90th Percentile	1.655648197
Operations	POR41	NO2	1hr	µg/m ³	90th Percentile	21.03
Operations	POR41	DPM	1hr	µg/m ³	90th Percentile	1.05
Operations	Absolute Max	NO2	1hr	µg/m ³	90th Percentile	114.77486
Operations	Absolute Max	DPM	1hr	µg/m ³	90th Percentile	29.57473322
Operations	Max (with MET removed)	NO2	1hr	µg/m ³	90th Percentile	94.59789
Operations	Max (with MET removed)	DPM	1hr	µg/m ³	90th Percentile	28.60842267
Construction	POR1	NO2	1hr	µg/m ³	CAAQS	43.98338667
Construction	POR2	NO2	1hr	µg/m ³	CAAQS	12.73183333
Construction	POR3	NO2	1hr	µg/m ³	CAAQS	12.41478
Construction	POR4	NO2	1hr	µg/m ³	CAAQS	23.47811333
Construction	POR5	NO2	1hr	µg/m ³	CAAQS	20.00833667
Construction	POR6	NO2	1hr	µg/m ³	CAAQS	12.60154667
Construction	POR7	NO2	1hr	µg/m ³	CAAQS	9.7663
Construction	POR8	NO2	1hr	µg/m ³	CAAQS	16.48500667
Construction	POR9	NO2	1hr	µg/m ³	CAAQS	20.41911
Construction	POR10	NO2	1hr	µg/m ³	CAAQS	20.73392667
Construction	POR11	NO2	1hr	µg/m ³	CAAQS	26.78296333
Construction	POR12	NO2	1hr	µg/m ³	CAAQS	14.11450667
Construction	POR13	NO2	1hr	µg/m ³	CAAQS	12.13411667
Construction	POR14	NO2	1hr	µg/m ³	CAAQS	11.27435667
Construction	POR15	NO2	1hr	µg/m ³	CAAQS	10.26764667
Construction	POR16	NO2	1hr	µg/m ³	CAAQS	8.903533333
Construction	POR17	NO2	1hr	µg/m ³	CAAQS	7.42922
Construction	POR18	NO2	1hr	µg/m ³	CAAQS	12.22902667
Construction	POR19	NO2	1hr	µg/m ³	CAAQS	10.93826
Construction	POR20	NO2	1hr	µg/m ³	CAAQS	11.78193
Construction	POR21	NO2	1hr	µg/m ³	CAAQS	17.65140667
Construction	POR22	NO2	1hr	µg/m ³	CAAQS	6.957056667
Construction	POR23	NO2	1hr	µg/m ³	CAAQS	6.392263333
Construction	POR24	NO2	1hr	µg/m ³	CAAQS	7.220886667
Construction	POR25	NO2	1hr	µg/m ³	CAAQS	4.75703
Construction	POR26	NO2	1hr	µg/m ³	CAAQS	9.513243333
Construction	POR27	NO2	1hr	µg/m ³	CAAQS	6.057293333
Construction	POR28	NO2	1hr	µg/m ³	CAAQS	12.29081
Construction	POR29	NO2	1hr	µg/m ³	CAAQS	9.486966667
Construction	POR41	NO2	1hr	µg/m ³	CAAQS	4.735563333

Table B1-1: Summary of Air Quality Concentrations at Each POR

Phase	POR ID	Parameter	Averaging Period	Units	Statistic ¹	Concentration
Construction	POR30	NO2	1hr	µg/m ³	CAAQS	7.49809
Construction	POR31	NO2	1hr	µg/m ³	CAAQS	11.12701667
Construction	POR32	NO2	1hr	µg/m ³	CAAQS	6.800603333
Construction	GENL (Not a POR)	NO2	1hr	µg/m ³	CAAQS	37.7564
Construction	POR33	NO2	1hr	µg/m ³	CAAQS	50.13072667
Construction	POR34	NO2	1hr	µg/m ³	CAAQS	40.87794333
Construction	POR35	NO2	1hr	µg/m ³	CAAQS	33.94436333
Construction	POR36	NO2	1hr	µg/m ³	CAAQS	10.30285667
Construction	POR37	NO2	1hr	µg/m ³	CAAQS	9.324303333
Construction	POR38	NO2	1hr	µg/m ³	CAAQS	7.80074
Construction	POR39	NO2	1hr	µg/m ³	CAAQS	43.05644
Construction	POR40	NO2	1hr	µg/m ³	CAAQS	34.75805
Construction	Absolute Max	NO2	1hr	µg/m ³	CAAQS	85.60775667
Construction	Max (with MET removed)	NO2	1hr	µg/m ³	CAAQS	85.60775667
Operations	POR1	NO2	1hr	µg/m ³	CAAQS	44.66589
Operations	POR2	NO2	1hr	µg/m ³	CAAQS	13.97483667
Operations	POR3	NO2	1hr	µg/m ³	CAAQS	13.96476667
Operations	POR4	NO2	1hr	µg/m ³	CAAQS	29.65093667
Operations	POR5	NO2	1hr	µg/m ³	CAAQS	26.63571333
Operations	POR6	NO2	1hr	µg/m ³	CAAQS	14.71908333
Operations	POR7	NO2	1hr	µg/m ³	CAAQS	10.64725
Operations	POR8	NO2	1hr	µg/m ³	CAAQS	20.33799667
Operations	POR9	NO2	1hr	µg/m ³	CAAQS	25.40213667
Operations	POR10	NO2	1hr	µg/m ³	CAAQS	26.58777
Operations	POR11	NO2	1hr	µg/m ³	CAAQS	29.09485333
Operations	POR12	NO2	1hr	µg/m ³	CAAQS	17.77068667
Operations	POR13	NO2	1hr	µg/m ³	CAAQS	13.97091
Operations	POR14	NO2	1hr	µg/m ³	CAAQS	12.98873333
Operations	POR15	NO2	1hr	µg/m ³	CAAQS	11.17529
Operations	POR16	NO2	1hr	µg/m ³	CAAQS	10.50379
Operations	POR17	NO2	1hr	µg/m ³	CAAQS	9.541746667
Operations	POR18	NO2	1hr	µg/m ³	CAAQS	14.15589333
Operations	POR19	NO2	1hr	µg/m ³	CAAQS	11.70249
Operations	POR20	NO2	1hr	µg/m ³	CAAQS	13.06584667
Operations	POR21	NO2	1hr	µg/m ³	CAAQS	21.60686
Operations	POR22	NO2	1hr	µg/m ³	CAAQS	8.64491
Operations	POR23	NO2	1hr	µg/m ³	CAAQS	7.39915
Operations	POR24	NO2	1hr	µg/m ³	CAAQS	8.578913333
Operations	POR25	NO2	1hr	µg/m ³	CAAQS	5.571433333
Operations	POR26	NO2	1hr	µg/m ³	CAAQS	11.09325
Operations	POR27	NO2	1hr	µg/m ³	CAAQS	6.948843333
Operations	POR28	NO2	1hr	µg/m ³	CAAQS	14.05204333
Operations	POR29	NO2	1hr	µg/m ³	CAAQS	11.47018333
Operations	POR41	NO2	1hr	µg/m ³	CAAQS	5.945926667
Operations	POR30	NO2	1hr	µg/m ³	CAAQS	8.883006667
Operations	POR31	NO2	1hr	µg/m ³	CAAQS	13.81147667
Operations	POR32	NO2	1hr	µg/m ³	CAAQS	8.126406667
Operations	GENL (Not a POR)	NO2	1hr	µg/m ³	CAAQS	40.01815667
Operations	POR33	NO2	1hr	µg/m ³	CAAQS	38.90394667
Operations	POR34	NO2	1hr	µg/m ³	CAAQS	33.08048
Operations	POR35	NO2	1hr	µg/m ³	CAAQS	28.66485667
Operations	POR36	NO2	1hr	µg/m ³	CAAQS	11.98364667
Operations	POR37	NO2	1hr	µg/m ³	CAAQS	10.02072333
Operations	POR38	NO2	1hr	µg/m ³	CAAQS	8.486466667
Operations	POR39	NO2	1hr	µg/m ³	CAAQS	50.74030667
Operations	POR40	NO2	1hr	µg/m ³	CAAQS	45.92022333
Operations	Absolute Max	NO2	1hr	µg/m ³	CAAQS	28.207
Operations	Max (with MET removed)	NO2	1hr	µg/m ³	CAAQS	28.207

Table B1-2: Summary of Air Quality Exposure Point Concentrations used in the HHRA					
Parameter	Unit	Averaging Period	Receptor Type	Selected EPC¹	POR²
Construction:					
Diesel Particulate Matter (DPM)	µg/m ³	1-hour	MPOI ³	28	MPOI
		1-hour	Initial Air Quality PORs	4.6	POR21
		Annual		0.053	POR4
		1-hour	Additional PORs	2.30	POR39
		Annual		0.0890	POR39
Nitrogen Dioxide (NO ₂)	µg/m ³	1-hour	MPOI ³	95	MPOI
		1-hour	Initial Air Quality PORs ⁴	44	POR1
		1-hour	Additional PORs ⁴	50	POR33
Operations:					
Diesel Particulate Matter (DPM)	µg/m ³	1-hour	MPOI ³	29	MPOI
		1-hour	Initial Air Quality PORs	4.2	POR21
		Annual		0.044	POR4
		1-hour	Additional PORs	2.24	POR39
		Annual		0.0755	POR39
Nitrogen Dioxide (NO ₂)	µg/m ³	1-hour	MPOI ³	95	MPOI
		1-hour	Initial Air Quality PORs ⁴	45	POR1
		1-hour	Additional PORs ⁴	39	POR33

Notes:

µg/m³ = micrograms per cubic meter; DPM = diesel particulate matter; EPC = exposure point; concentration NO₂ = nitrogen dioxide; MPOI = maximum point of impingement; POR = Point of Reception

- 1) Selected EPC is the maximum predicted air quality concentration for the POPC across all PORs within a receptor type. See Table B1-1 for predicted air quality concentrations at all PORs.
- 2) The POR indicated in this column represents the POR where the EPC (maximum predicted air quality concentration across all PORs) occurs.
- 3) The statistical form of the MPOI is the maximum with meteorological anomalies removed. To calculate this the 8 highest predicted values are removed from each year of projected data in the model. The maximum is taken from the remainder across the 5 years of the model run.
- 4) The maximum EPC for NO₂ at PORs is presented as the statistical form prescribed by the CAAQS. It is calculated as the maximum average of predicted 98th percentile results for 3 consecutive years.

Table B1-3: Summary of Predicted Air Particle Deposition Rates

POPC	Construction (mg/m ² /year)			Operations (mg/m ² /year)		
	Maximum	Minimum	Average	Maximum	Minimum	Average
Aluminum	1.96E+02	8.95E+00	5.24E+01	1.72E+02	7.07E+00	4.42E+01
Arsenic	1.71E+00	7.84E-02	4.99E-01	1.51E+00	6.20E-02	4.21E-01
Barium	1.19E+00	5.44E-02	3.46E-01	1.04E+00	4.30E-02	2.92E-01
Beryllium	2.70E-03	1.23E-04	7.85E-04	2.37E-03	9.75E-05	6.62E-04
Cadmium	2.98E-02	1.37E-03	8.69E-03	2.62E-02	1.08E-03	7.32E-03
Chromium	2.95E-01	1.35E-02	8.60E-02	2.59E-01	1.07E-02	7.15E-02
Cobalt	1.13E-01	5.19E-03	3.30E-02	9.96E-02	4.10E-03	2.78E-02
Copper	6.65E-01	3.04E-02	1.94E-01	5.84E-01	2.40E-02	1.63E-01
Lead	9.80E-01	4.49E-02	2.86E-01	1.01E+00	4.17E-02	2.83E-01
Manganese (in SPM)	6.05E+00	2.77E-01	1.76E+00	5.30E+00	2.18E-01	1.48E+00
Manganese (in PM10)	2.31E+00	1.14E-01	7.16E-01	1.97E+00	8.81E-02	6.00E-01
Manganese (in PM2.5)	1.48E-01	8.65E-03	5.19E-02	1.17E-01	7.10E-03	4.23E-02
Molybdenum	1.06E-02	4.87E-04	3.10E-03	9.35E-03	3.85E-04	2.61E-03
Nickel (in SPM)	2.11E-01	9.65E-03	6.14E-02	1.86E-01	7.67E-03	5.20E-02
Nickel (in PM10)	2.05E-01	1.01E-02	6.34E-02	1.82E-01	8.14E-03	5.55E-02
Selenium	2.00E-02	9.16E-04	5.83E-03	1.76E-02	7.24E-04	4.91E-03
Thallium	2.01E-03	9.20E-05	5.86E-04	1.77E-03	7.27E-05	4.94E-04
Uranium	5.23E-03	2.40E-04	1.53E-03	4.60E-03	1.89E-04	1.29E-03
Vanadium	6.35E-01	2.91E-02	1.85E-01	5.58E-01	2.30E-02	1.56E-01
Zinc	4.76E+00	2.18E-01	1.39E+00	4.18E+00	1.72E-01	1.17E+00
Mercury	5.63E-04	2.58E-05	1.64E-04	4.94E-04	2.03E-05	1.38E-04
Iron	2.89E+02	1.32E+01	8.42E+01	2.53E+02	1.04E+01	7.08E+01
Silver	1.12E-02	5.12E-04	3.26E-03	9.84E-03	4.05E-04	2.75E-03
Bismuth	1.08E-02	4.94E-04	3.14E-03	9.47E-03	3.90E-04	2.65E-03
Calcium	1.42E+02	6.50E+00	4.14E+01	1.25E+02	5.14E+00	3.49E+01
Potassium	7.67E+01	3.51E+00	2.24E+01	6.74E+01	2.78E+00	1.88E+01
Magnesium	5.48E+01	2.51E+00	1.60E+01	4.82E+01	1.98E+00	1.35E+01
Phosphorus	1.58E+00	7.22E-02	4.59E-01	1.38E+00	5.70E-02	3.87E-01
Sulfur	1.16E+02	5.29E+00	3.37E+01	1.02E+02	4.18E+00	2.84E+01
Antimony	4.57E-03	2.09E-04	1.33E-03	4.01E-03	1.65E-04	1.12E-03
Tin	1.37E-02	6.27E-04	3.99E-03	1.20E-02	4.96E-04	3.37E-03
Strontium	7.31E-01	3.35E-02	2.13E-01	6.42E-01	2.64E-02	1.79E-01
Thorium	6.57E-02	3.01E-03	1.91E-02	5.77E-02	2.38E-03	1.61E-02
Titanium	1.46E+01	6.67E-01	4.25E+00	1.28E+01	5.27E-01	3.58E+00
Tungsten	2.20E-02	1.01E-03	6.40E-03	1.93E-02	7.95E-04	5.40E-03
Yttrium	4.75E-02	2.18E-03	1.38E-02	4.18E-02	1.72E-03	1.17E-02
Zirconium	6.26E-01	2.87E-02	1.82E-01	5.50E-01	2.26E-02	1.54E-01
Boron	9.14E-03	4.18E-04	2.66E-03	8.03E-03	3.30E-04	2.24E-03
Benzo(a)pyrene	1.78E-05	6.00E-07	2.68E-06	1.12E-08	6.00E-07	3.25E-09

Notes:

mg/m²/year = milligrams per square meter per year; PM_{2.5} = particulate matter less than 2.5 micron in diameter; PM₁₀ = particulate matter less than 10 micron in diameter; POPC = parameter of potential concern; SPM = suspended particulate matter.

These deposition rates were used to model deposition of airborne particulates to soil and plant surfaces in the HHERA modeling

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+02	1.7E+02	1.9E+01	1.3E+02	1.9E+01	13963.33
POR2	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E+01	3.9E+01	5.4E+00	2.9E+01	5.4E+00	13839.29
POR3	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E+01	3.9E+01	5.4E+00	2.9E+01	5.4E+00	13839.45
POR4	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	1.2E+02	1.3E+01	8.9E+01	1.3E+01	13913.89
POR5	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E+01	7.6E+01	8.3E+00	5.5E+01	8.3E+00	13871.94
POR6	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E+01	4.3E+01	6.0E+00	3.2E+01	6.0E+00	13843.55
POR7	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E+01	2.8E+01	3.8E+00	2.0E+01	3.8E+00	13827.63
POR8	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E+01	3.4E+01	3.7E+00	2.5E+01	3.7E+00	13831.96
POR9	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E+01	7.9E+01	8.4E+00	5.8E+01	8.4E+00	13874.52
POR10	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E+01	8.1E+01	8.5E+00	5.9E+01	8.5E+00	13875.57
POR11	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+02	9.7E+01	1.2E+01	7.0E+01	1.2E+01	13893.39
POR12	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E+01	3.6E+01	3.9E+00	2.6E+01	3.9E+00	13833.89
POR13	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+01	2.4E+01	2.7E+00	1.8E+01	2.7E+00	13822.95
POR14	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	2.0E+01	2.2E+00	1.4E+01	2.2E+00	13818.53
POR15	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.9E+01	2.1E+00	1.4E+01	2.1E+00	13817.95
POR16	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+01	1.6E+01	1.9E+00	1.2E+01	1.9E+00	13815.68
POR17	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.3E+01	1.4E+00	9.3E+00	1.4E+00	13812.15
POR18	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E+01	4.1E+01	5.5E+00	3.0E+01	5.5E+00	13840.60
POR19	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+01	2.0E+01	2.3E+00	1.5E+01	2.3E+00	13819.20
POR20	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+01	2.3E+01	2.5E+00	1.7E+01	2.5E+00	13821.74
POR21	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E+01	4.1E+01	4.4E+00	3.0E+01	4.4E+00	13838.53
POR22	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+01	1.7E+01	2.3E+00	1.2E+01	2.3E+00	13816.97
POR23	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.3E+01	1.7E+00	9.4E+00	1.7E+00	13812.77
POR24	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+01	1.7E+01	2.3E+00	1.3E+01	2.3E+00	13817.04
POR25	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.0E+00	7.1E+00	8.8E-01	5.1E+00	8.8E-01	13806.90
POR26	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E+01	2.7E+01	3.7E+00	2.0E+01	3.7E+00	13826.83
POR27	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.3E+01	1.7E+00	9.4E+00	1.7E+00	13812.78
POR28	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E+01	4.0E+01	5.5E+00	2.9E+01	5.5E+00	13840.45
POR29	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.9E+01	2.1E+00	1.4E+01	2.1E+00	13818.23
POR30	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	9.9E+00	1.1E+00	7.2E+00	1.1E+00	13809.43
POR31	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E+01	2.4E+01	2.8E+00	1.7E+01	2.8E+00	13822.92
POR32	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.2E+01	1.5E+00	8.7E+00	1.5E+00	13811.62
POR33	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E+02	2.0E+02	4.5E+01	1.4E+02	4.5E+01	14034.53
POR34	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E+02	1.5E+02	2.9E+01	1.1E+02	2.9E+01	13969.97
POR35	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+02	1.2E+02	2.1E+01	8.8E+01	2.1E+01	13930.17
POR36	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E+01	2.9E+01	4.1E+00	2.1E+01	4.1E+00	13829.45
POR37	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E+01	2.6E+01	3.5E+00	1.9E+01	3.5E+00	13825.93
POR38	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+01	2.0E+01	2.7E+00	1.4E+01	2.7E+00	13819.75
POR39	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	1.1E+02	1.2E+01	8.0E+01	1.2E+01	13904.74
POR40	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+02	1.5E+02	1.6E+01	1.1E+02	1.6E+01	13943.99
POR41	Aluminum	13800	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E+00	6.0E+00	6.9E-01	4.3E+00	6.9E-01	13805.71

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.5E+00	1.7E-01	1.1E+00	1.7E-01	19.33
POR2	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-01	3.4E-01	4.7E-02	2.5E-01	4.7E-02	18.24
POR3	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-01	3.5E-01	4.7E-02	2.5E-01	4.7E-02	18.25
POR4	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	1.1E+00	1.1E-01	7.8E-01	1.1E-01	18.90
POR5	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-01	6.7E-01	7.3E-02	4.8E-01	7.3E-02	18.53
POR6	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-01	3.8E-01	5.3E-02	2.8E-01	5.3E-02	18.28
POR7	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-01	2.4E-01	3.3E-02	1.8E-01	3.3E-02	18.14
POR8	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-01	3.0E-01	3.2E-02	2.2E-01	3.2E-02	18.18
POR9	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-01	7.0E-01	7.3E-02	5.1E-01	7.3E-02	18.55
POR10	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.6E-01	7.1E-01	7.4E-02	5.1E-01	7.4E-02	18.56
POR11	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+00	8.5E-01	1.0E-01	6.2E-01	1.0E-01	18.72
POR12	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-01	3.1E-01	3.4E-02	2.3E-01	3.4E-02	18.20
POR13	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-01	2.1E-01	2.4E-02	1.5E-01	2.4E-02	18.10
POR14	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.7E-01	1.9E-02	1.2E-01	1.9E-02	18.06
POR15	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.7E-01	1.9E-02	1.2E-01	1.9E-02	18.06
POR16	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.4E-01	1.6E-02	1.0E-01	1.6E-02	18.04
POR17	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.1E-01	1.3E-02	8.1E-02	1.3E-02	18.01
POR18	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-01	3.6E-01	4.8E-02	2.6E-01	4.8E-02	18.26
POR19	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.8E-01	2.0E-02	1.3E-01	2.0E-02	18.07
POR20	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	2.0E-01	2.2E-02	1.5E-01	2.2E-02	18.09
POR21	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-01	3.6E-01	3.9E-02	2.6E-01	3.9E-02	18.24
POR22	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.5E-01	2.0E-02	1.1E-01	2.0E-02	18.05
POR23	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.1E-01	1.5E-02	8.2E-02	1.5E-02	18.01
POR24	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.5E-01	2.0E-02	1.1E-01	2.0E-02	18.05
POR25	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-02	6.2E-02	7.7E-03	4.5E-02	7.7E-03	17.96
POR26	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-01	2.3E-01	3.2E-02	1.7E-01	3.2E-02	18.14
POR27	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.1E-01	1.5E-02	8.2E-02	1.5E-02	18.01
POR28	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-01	3.5E-01	4.9E-02	2.6E-01	4.9E-02	18.25
POR29	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.7E-01	1.9E-02	1.2E-01	1.9E-02	18.06
POR30	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	8.7E-02	9.8E-03	6.3E-02	9.8E-03	17.98
POR31	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-01	2.1E-01	2.5E-02	1.5E-01	2.5E-02	18.10
POR32	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.0E-01	1.3E-02	7.6E-02	1.3E-02	18.00
POR33	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E+00	1.7E+00	3.9E-01	1.3E+00	3.9E-01	19.95
POR34	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+00	1.3E+00	2.6E-01	9.8E-01	2.6E-01	19.39
POR35	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+00	1.1E+00	1.8E-01	7.7E-01	1.8E-01	19.04
POR36	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-01	2.6E-01	3.6E-02	1.9E-01	3.6E-02	18.16
POR37	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	2.3E-01	3.1E-02	1.7E-01	3.1E-02	18.13
POR38	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-01	1.7E-01	2.3E-02	1.3E-01	2.3E-02	18.07
POR39	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	9.6E-01	1.1E-01	7.0E-01	1.1E-01	18.82
POR40	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+00	1.4E+00	1.4E-01	9.8E-01	1.4E-01	19.16
POR41	Arsenic	17.9	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-02	5.2E-02	6.0E-03	3.8E-02	6.0E-03	17.95

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	1.0E+00	1.2E-01	7.6E-01	1.2E-01	97.39
POR2	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-01	2.4E-01	3.3E-02	1.7E-01	3.3E-02	96.64
POR3	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-01	2.4E-01	3.3E-02	1.7E-01	3.3E-02	96.64
POR4	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-01	7.4E-01	7.6E-02	5.4E-01	7.6E-02	97.09
POR5	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-01	4.6E-01	5.1E-02	3.4E-01	5.1E-02	96.84
POR6	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-01	2.6E-01	3.7E-02	1.9E-01	3.7E-02	96.66
POR7	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	1.7E-01	2.3E-02	1.2E-01	2.3E-02	96.57
POR8	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	2.1E-01	2.2E-02	1.5E-01	2.2E-02	96.59
POR9	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-01	4.8E-01	5.1E-02	3.5E-01	5.1E-02	96.85
POR10	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-01	4.9E-01	5.2E-02	3.6E-01	5.2E-02	96.86
POR11	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-01	5.9E-01	7.0E-02	4.3E-01	7.0E-02	96.97
POR12	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-01	2.2E-01	2.4E-02	1.6E-01	2.4E-02	96.61
POR13	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.5E-01	1.6E-02	1.1E-01	1.6E-02	96.54
POR14	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.2E-01	1.3E-02	8.6E-02	1.3E-02	96.51
POR15	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.1E-01	1.3E-02	8.3E-02	1.3E-02	96.51
POR16	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.0E-01	1.1E-02	7.3E-02	1.1E-02	96.50
POR17	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-02	7.7E-02	8.7E-03	5.6E-02	8.7E-03	96.47
POR18	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-01	2.5E-01	3.4E-02	1.8E-01	3.4E-02	96.65
POR19	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.2E-01	1.4E-02	8.9E-02	1.4E-02	96.52
POR20	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-01	1.4E-01	1.5E-02	1.0E-01	1.5E-02	96.53
POR21	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.5E-01	2.7E-02	1.8E-01	2.7E-02	96.63
POR22	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.5E-02	1.4E-02	96.50
POR23	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	7.8E-02	1.0E-02	5.7E-02	1.0E-02	96.48
POR24	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.6E-02	1.4E-02	96.50
POR25	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-02	4.3E-02	5.3E-03	3.1E-02	5.3E-03	96.44
POR26	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	1.6E-01	2.2E-02	1.2E-01	2.2E-02	96.56
POR27	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	7.8E-02	1.0E-02	5.7E-02	1.0E-02	96.48
POR28	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-01	2.5E-01	3.4E-02	1.8E-01	3.4E-02	96.65
POR29	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.2E-01	1.3E-02	8.5E-02	1.3E-02	96.51
POR30	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-02	6.0E-02	6.8E-03	4.4E-02	6.8E-03	96.46
POR31	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.4E-01	1.7E-02	1.1E-01	1.7E-02	96.54
POR32	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-02	7.2E-02	9.0E-03	5.3E-02	9.0E-03	96.47
POR33	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+00	1.2E+00	2.7E-01	8.8E-01	2.7E-01	97.82
POR34	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E+00	9.3E-01	1.8E-01	6.8E-01	1.8E-01	97.43
POR35	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	7.3E-01	1.3E-01	5.3E-01	1.3E-01	97.19
POR36	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-01	1.8E-01	2.5E-02	1.3E-01	2.5E-02	96.58
POR37	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-01	1.6E-01	2.1E-02	1.1E-01	2.1E-02	96.56
POR38	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-01	1.2E-01	1.6E-02	8.8E-02	1.6E-02	96.52
POR39	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.7E-01	6.7E-01	7.5E-02	4.9E-01	7.5E-02	97.04
POR40	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.8E-01	9.4E-01	9.6E-02	6.8E-01	9.6E-02	97.27
POR41	Barium	96.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-02	3.6E-02	4.2E-03	2.6E-02	4.2E-03	96.43

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-03	2.4E-03	2.6E-04	1.7E-03	2.6E-04	0.43
POR2	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-04	5.4E-04	7.4E-05	3.9E-04	7.4E-05	0.43
POR3	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.6E-04	5.4E-04	7.4E-05	4.0E-04	7.4E-05	0.43
POR4	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-03	1.7E-03	1.7E-04	1.2E-03	1.7E-04	0.43
POR5	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.0E-03	1.1E-04	7.6E-04	1.1E-04	0.43
POR6	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E-04	6.0E-04	8.3E-05	4.3E-04	8.3E-05	0.43
POR7	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-04	3.8E-04	5.2E-05	2.8E-04	5.2E-05	0.43
POR8	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-04	4.7E-04	5.1E-05	3.4E-04	5.1E-05	0.43
POR9	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	8.0E-04	1.2E-04	0.43
POR10	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	8.1E-04	1.2E-04	0.43
POR11	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.3E-03	1.6E-04	9.7E-04	1.6E-04	0.43
POR12	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-04	4.9E-04	5.4E-05	3.6E-04	5.4E-05	0.43
POR13	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-04	3.3E-04	3.7E-05	2.4E-04	3.7E-05	0.43
POR14	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-04	2.7E-04	3.0E-05	2.0E-04	3.0E-05	0.43
POR15	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-04	2.6E-04	2.9E-05	1.9E-04	2.9E-05	0.43
POR16	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-04	2.3E-04	2.6E-05	1.7E-04	2.6E-05	0.43
POR17	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-04	1.8E-04	2.0E-05	1.3E-04	2.0E-05	0.43
POR18	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-04	5.6E-04	7.6E-05	4.1E-04	7.6E-05	0.43
POR19	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-04	2.8E-04	3.1E-05	2.0E-04	3.1E-05	0.43
POR20	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-04	3.2E-04	3.5E-05	2.3E-04	3.5E-05	0.43
POR21	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-04	5.6E-04	6.1E-05	4.1E-04	6.1E-05	0.43
POR22	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-04	2.4E-04	3.1E-05	1.7E-04	3.1E-05	0.43
POR23	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-04	1.8E-04	2.3E-05	1.3E-04	2.3E-05	0.43
POR24	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-04	2.4E-04	3.1E-05	1.7E-04	3.1E-05	0.43
POR25	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-04	9.7E-05	1.2E-05	7.1E-05	1.2E-05	0.43
POR26	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-04	3.7E-04	5.0E-05	2.7E-04	5.0E-05	0.43
POR27	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-04	1.8E-04	2.3E-05	1.3E-04	2.3E-05	0.43
POR28	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-04	5.6E-04	7.6E-05	4.0E-04	7.6E-05	0.43
POR29	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-04	2.6E-04	3.0E-05	1.9E-04	3.0E-05	0.43
POR30	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.4E-04	1.5E-05	9.9E-05	1.5E-05	0.43
POR31	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-04	3.3E-04	3.9E-05	2.4E-04	3.9E-05	0.43
POR32	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-04	1.6E-04	2.0E-05	1.2E-04	2.0E-05	0.43
POR33	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-03	2.7E-03	6.2E-04	2.0E-03	6.2E-04	0.43
POR34	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-03	2.1E-03	4.0E-04	1.5E-03	4.0E-04	0.43
POR35	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	1.7E-03	2.9E-04	1.2E-03	2.9E-04	0.43
POR36	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-04	4.0E-04	5.6E-05	2.9E-04	5.6E-05	0.43
POR37	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-04	3.6E-04	4.9E-05	2.6E-04	4.9E-05	0.43
POR38	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-04	2.7E-04	3.7E-05	2.0E-04	3.7E-05	0.43
POR39	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.5E-03	1.7E-04	1.1E-03	1.7E-04	0.43
POR40	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	2.1E-03	2.2E-04	1.5E-03	2.2E-04	0.43
POR41	Beryllium	0.43	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.6E-05	8.2E-05	9.4E-06	6.0E-05	9.4E-06	0.43

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.6E-02	2.9E-03	1.9E-02	2.9E-03	0.70
POR2	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-03	6.0E-03	8.2E-04	4.4E-03	8.2E-04	0.68
POR3	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-03	6.0E-03	8.2E-04	4.4E-03	8.2E-04	0.68
POR4	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-02	1.9E-02	1.9E-03	1.4E-02	1.9E-03	0.69
POR5	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	8.4E-03	1.3E-03	0.69
POR6	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-03	6.6E-03	9.2E-04	4.8E-03	9.2E-04	0.68
POR7	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-03	4.2E-03	5.8E-04	3.1E-03	5.8E-04	0.68
POR8	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-03	5.2E-03	5.6E-04	3.8E-03	5.6E-04	0.68
POR9	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	8.8E-03	1.3E-03	0.69
POR10	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	8.9E-03	1.3E-03	0.69
POR11	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-02	1.5E-02	1.8E-03	1.1E-02	1.8E-03	0.69
POR12	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-03	5.5E-03	6.0E-04	4.0E-03	6.0E-04	0.68
POR13	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-03	3.7E-03	4.1E-04	2.7E-03	4.1E-04	0.68
POR14	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-03	3.0E-03	3.3E-04	2.2E-03	3.3E-04	0.68
POR15	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-03	2.9E-03	3.2E-04	2.1E-03	3.2E-04	0.68
POR16	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-03	2.5E-03	2.8E-04	1.8E-03	2.8E-04	0.68
POR17	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.9E-03	2.2E-04	1.4E-03	2.2E-04	0.68
POR18	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-03	6.2E-03	8.4E-04	4.5E-03	8.4E-04	0.68
POR19	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-03	3.1E-03	3.4E-04	2.2E-03	3.4E-04	0.68
POR20	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-03	3.5E-03	3.9E-04	2.5E-03	3.9E-04	0.68
POR21	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-03	6.2E-03	6.8E-04	4.5E-03	6.8E-04	0.68
POR22	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-03	2.6E-03	3.5E-04	1.9E-03	3.5E-04	0.68
POR23	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	2.0E-03	2.6E-04	1.4E-03	2.6E-04	0.68
POR24	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-03	2.6E-03	3.5E-04	1.9E-03	3.5E-04	0.68
POR25	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-03	1.1E-03	1.3E-04	7.9E-04	1.3E-04	0.68
POR26	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-03	4.1E-03	5.6E-04	3.0E-03	5.6E-04	0.68
POR27	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	2.0E-03	2.6E-04	1.4E-03	2.6E-04	0.68
POR28	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-03	6.2E-03	8.5E-04	4.5E-03	8.5E-04	0.68
POR29	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-03	2.9E-03	3.3E-04	2.1E-03	3.3E-04	0.68
POR30	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.5E-03	1.7E-04	1.1E-03	1.7E-04	0.68
POR31	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-03	3.6E-03	4.3E-04	2.6E-03	4.3E-04	0.68
POR32	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	1.8E-03	2.3E-04	1.3E-03	2.3E-04	0.68
POR33	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-02	3.0E-02	6.8E-03	2.2E-02	6.8E-03	0.71
POR34	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-02	2.3E-02	4.5E-03	1.7E-02	4.5E-03	0.70
POR35	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	1.8E-02	3.2E-03	1.3E-02	3.2E-03	0.70
POR36	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-03	4.5E-03	6.2E-04	3.3E-03	6.2E-04	0.68
POR37	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-03	4.0E-03	5.4E-04	2.9E-03	5.4E-04	0.68
POR38	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-03	3.0E-03	4.0E-04	2.2E-03	4.0E-04	0.68
POR39	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.7E-02	1.9E-03	1.2E-02	1.9E-03	0.69
POR40	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	2.4E-02	2.4E-03	1.7E-02	2.4E-03	0.70
POR41	Cadmium	0.676	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	9.1E-04	1.0E-04	6.6E-04	1.0E-04	0.68

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-01	2.6E-01	2.9E-02	1.9E-01	2.9E-02	27.55
POR2	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E-02	5.9E-02	8.1E-03	4.3E-02	8.1E-03	27.36
POR3	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E-02	6.0E-02	8.1E-03	4.3E-02	8.1E-03	27.36
POR4	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.8E-01	1.9E-02	1.3E-01	1.9E-02	27.47
POR5	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.1E-01	1.3E-02	8.3E-02	1.3E-02	27.41
POR6	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E-02	6.5E-02	9.1E-03	4.8E-02	9.1E-03	27.37
POR7	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-02	4.2E-02	5.7E-03	3.0E-02	5.7E-03	27.34
POR8	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-02	5.1E-02	5.6E-03	3.7E-02	5.6E-03	27.35
POR9	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.2E-01	1.3E-02	8.7E-02	1.3E-02	27.41
POR10	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.2E-01	1.3E-02	8.8E-02	1.3E-02	27.41
POR11	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.5E-01	1.7E-02	1.1E-01	1.7E-02	27.44
POR12	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-02	5.4E-02	5.9E-03	3.9E-02	5.9E-03	27.35
POR13	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-02	3.6E-02	4.1E-03	2.7E-02	4.1E-03	27.33
POR14	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.9E-02	3.3E-03	2.1E-02	3.3E-03	27.33
POR15	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.8E-02	3.2E-03	2.1E-02	3.2E-03	27.33
POR16	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.5E-02	2.8E-03	1.8E-02	2.8E-03	27.32
POR17	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.9E-02	2.2E-03	1.4E-02	2.2E-03	27.32
POR18	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E-02	6.1E-02	8.3E-03	4.5E-02	8.3E-03	27.36
POR19	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-02	3.0E-02	3.4E-03	2.2E-02	3.4E-03	27.33
POR20	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-02	3.4E-02	3.8E-03	2.5E-02	3.8E-03	27.33
POR21	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E-02	6.1E-02	6.7E-03	4.5E-02	6.7E-03	27.36
POR22	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-02	2.6E-02	3.4E-03	1.9E-02	3.4E-03	27.33
POR23	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	1.9E-02	2.6E-03	1.4E-02	2.6E-03	27.32
POR24	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-02	2.6E-02	3.4E-03	1.9E-02	3.4E-03	27.33
POR25	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	1.1E-02	1.3E-03	7.8E-03	1.3E-03	27.31
POR26	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-02	4.0E-02	5.5E-03	2.9E-02	5.5E-03	27.34
POR27	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	1.9E-02	2.6E-03	1.4E-02	2.6E-03	27.32
POR28	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-02	6.1E-02	8.4E-03	4.4E-02	8.4E-03	27.36
POR29	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.9E-02	3.2E-03	2.1E-02	3.2E-03	27.33
POR30	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-02	1.4E-02	1.7E-03	9.8E-03	1.7E-03	27.31
POR31	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-02	3.3E-02	4.2E-03	2.4E-02	4.2E-03	27.33
POR32	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	1.8E-02	2.2E-03	1.3E-02	2.2E-03	27.32
POR33	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-01	2.8E-01	6.8E-02	2.1E-01	6.8E-02	27.64
POR34	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-01	2.2E-01	4.4E-02	1.6E-01	4.4E-02	27.55
POR35	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	1.7E-01	3.2E-02	1.2E-01	3.2E-02	27.49
POR36	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-02	4.0E-02	6.1E-03	2.9E-02	6.1E-03	27.34
POR37	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-02	3.6E-02	5.3E-03	2.6E-02	5.3E-03	27.34
POR38	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-02	2.7E-02	4.0E-03	2.0E-02	4.0E-03	27.33
POR39	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.4E-01	1.9E-02	1.0E-01	1.9E-02	27.44
POR40	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-01	2.1E-01	2.4E-02	1.6E-01	2.4E-02	27.50
POR41	Chromium	27.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	8.3E-03	1.0E-03	6.0E-03	1.0E-03	27.31

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.0E-01	1.1E-02	7.2E-02	1.1E-02	12.09
POR2	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-02	2.3E-02	3.1E-03	1.7E-02	3.1E-03	12.02
POR3	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-02	2.3E-02	3.1E-03	1.7E-02	3.1E-03	12.02
POR4	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-02	7.1E-02	7.3E-03	5.1E-02	7.3E-03	12.07
POR5	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-02	4.4E-02	4.8E-03	3.2E-02	4.8E-03	12.04
POR6	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-02	2.5E-02	3.5E-03	1.8E-02	3.5E-03	12.03
POR7	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.6E-02	2.2E-03	1.2E-02	2.2E-03	12.02
POR8	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	2.0E-02	2.1E-03	1.4E-02	2.1E-03	12.02
POR9	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-02	4.6E-02	4.8E-03	3.3E-02	4.8E-03	12.04
POR10	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-02	4.7E-02	4.9E-03	3.4E-02	4.9E-03	12.04
POR11	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E-02	5.6E-02	6.7E-03	4.1E-02	6.7E-03	12.05
POR12	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	2.1E-02	2.3E-03	1.5E-02	2.3E-03	12.02
POR13	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-02	1.4E-02	1.6E-03	1.0E-02	1.6E-03	12.01
POR14	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.1E-02	1.3E-03	8.2E-03	1.3E-03	12.01
POR15	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.1E-02	1.2E-03	8.0E-03	1.2E-03	12.01
POR16	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	9.5E-03	1.1E-03	6.9E-03	1.1E-03	12.01
POR17	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E-03	7.4E-03	8.3E-04	5.4E-03	8.3E-04	12.01
POR18	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.4E-02	3.2E-03	1.7E-02	3.2E-03	12.02
POR19	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	8.5E-03	1.3E-03	12.01
POR20	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-02	1.3E-02	1.5E-03	9.6E-03	1.5E-03	12.01
POR21	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	2.4E-02	2.6E-03	1.7E-02	2.6E-03	12.02
POR22	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	9.9E-03	1.3E-03	7.2E-03	1.3E-03	12.01
POR23	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-02	7.5E-03	9.8E-04	5.4E-03	9.8E-04	12.01
POR24	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.0E-02	1.3E-03	7.2E-03	1.3E-03	12.01
POR25	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-03	4.1E-03	5.1E-04	3.0E-03	5.1E-04	12.00
POR26	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.6E-02	2.1E-03	1.1E-02	2.1E-03	12.02
POR27	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-02	7.5E-03	9.8E-04	5.4E-03	9.8E-04	12.01
POR28	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.3E-02	3.2E-03	1.7E-02	3.2E-03	12.02
POR29	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.1E-02	1.2E-03	8.1E-03	1.2E-03	12.01
POR30	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-03	5.7E-03	6.5E-04	4.2E-03	6.5E-04	12.01
POR31	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-02	1.4E-02	1.6E-03	1.0E-02	1.6E-03	12.01
POR32	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-03	6.9E-03	8.6E-04	5.0E-03	8.6E-04	12.01
POR33	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-01	1.2E-01	2.6E-02	8.4E-02	2.6E-02	12.14
POR34	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	8.9E-02	1.7E-02	6.5E-02	1.7E-02	12.10
POR35	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	7.0E-02	1.2E-02	5.1E-02	1.2E-02	12.08
POR36	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-02	1.7E-02	2.4E-03	1.2E-02	2.4E-03	12.02
POR37	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	1.5E-02	2.0E-03	1.1E-02	2.0E-03	12.02
POR38	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-02	1.1E-02	1.5E-03	8.4E-03	1.5E-03	12.01
POR39	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-02	6.4E-02	7.2E-03	4.6E-02	7.2E-03	12.06
POR40	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-02	8.9E-02	9.2E-03	6.5E-02	9.2E-03	12.08
POR41	Cobalt	12	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-03	3.5E-03	4.0E-04	2.5E-03	4.0E-04	12.00

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-01	5.8E-01	6.5E-02	4.2E-01	6.5E-02	22.16
POR2	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.3E-01	1.8E-02	9.7E-02	1.8E-02	21.73
POR3	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.3E-01	1.8E-02	9.8E-02	1.8E-02	21.73
POR4	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-01	4.2E-01	4.3E-02	3.0E-01	4.3E-02	21.99
POR5	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.6E-01	2.8E-02	1.9E-01	2.8E-02	21.84
POR6	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.5E-01	2.0E-02	1.1E-01	2.0E-02	21.75
POR7	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	9.4E-02	1.3E-02	6.8E-02	1.3E-02	21.69
POR8	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.1E-01	1.3E-02	8.4E-02	1.3E-02	21.71
POR9	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.7E-01	2.8E-02	2.0E-01	2.8E-02	21.85
POR10	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.7E-01	2.9E-02	2.0E-01	2.9E-02	21.86
POR11	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-01	3.3E-01	3.9E-02	2.4E-01	3.9E-02	21.92
POR12	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.2E-01	1.3E-02	8.9E-02	1.3E-02	21.72
POR13	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E-02	8.2E-02	9.1E-03	6.0E-02	9.1E-03	21.68
POR14	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-02	6.6E-02	7.4E-03	4.8E-02	7.4E-03	21.66
POR15	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-02	6.4E-02	7.2E-03	4.7E-02	7.2E-03	21.66
POR16	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-02	5.6E-02	6.3E-03	4.1E-02	6.3E-03	21.65
POR17	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-02	4.3E-02	4.9E-03	3.2E-02	4.9E-03	21.64
POR18	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.4E-01	1.9E-02	1.0E-01	1.9E-02	21.74
POR19	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-02	6.9E-02	7.7E-03	5.0E-02	7.7E-03	21.67
POR20	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-02	7.8E-02	8.7E-03	5.7E-02	8.7E-03	21.67
POR21	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.4E-01	1.5E-02	1.0E-01	1.5E-02	21.73
POR22	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.9E-02	5.8E-02	7.7E-03	4.2E-02	7.7E-03	21.66
POR23	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-02	4.4E-02	5.7E-03	3.2E-02	5.7E-03	21.64
POR24	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.9E-02	5.8E-02	7.7E-03	4.3E-02	7.7E-03	21.66
POR25	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.4E-02	3.0E-03	1.7E-02	3.0E-03	21.62
POR26	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	9.1E-02	1.2E-02	6.6E-02	1.2E-02	21.69
POR27	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-02	4.4E-02	5.7E-03	3.2E-02	5.7E-03	21.64
POR28	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.4E-01	1.9E-02	1.0E-01	1.9E-02	21.74
POR29	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-02	6.5E-02	7.3E-03	4.7E-02	7.3E-03	21.66
POR30	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-02	3.4E-02	3.8E-03	2.4E-02	3.8E-03	21.63
POR31	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-02	8.1E-02	9.5E-03	5.9E-02	9.5E-03	21.68
POR32	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-02	4.0E-02	5.0E-03	2.9E-02	5.0E-03	21.64
POR33	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+00	6.8E-01	1.5E-01	4.9E-01	1.5E-01	22.40
POR34	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+00	5.2E-01	1.0E-01	3.8E-01	1.0E-01	22.18
POR35	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-01	4.1E-01	7.2E-02	3.0E-01	7.2E-02	22.04
POR36	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.2E-02	1.4E-02	21.70
POR37	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	8.8E-02	1.2E-02	6.4E-02	1.2E-02	21.69
POR38	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-02	6.7E-02	9.0E-03	4.9E-02	9.0E-03	21.67
POR39	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-01	3.7E-01	4.2E-02	2.7E-01	4.2E-02	21.96
POR40	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-01	5.2E-01	5.4E-02	3.8E-01	5.4E-02	22.09
POR41	Copper	21.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-02	2.0E-02	2.3E-03	1.5E-02	2.3E-03	21.62

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.8E-01	1.0E+00	9.6E-02	7.4E-01	9.6E-02	17.53
POR2	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-01	2.3E-01	2.7E-02	1.7E-01	2.7E-02	16.82
POR3	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-01	2.3E-01	2.7E-02	1.7E-01	2.7E-02	16.82
POR4	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-01	7.2E-01	6.3E-02	5.2E-01	6.3E-02	17.25
POR5	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-01	4.5E-01	4.2E-02	3.3E-01	4.2E-02	17.01
POR6	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-01	2.6E-01	3.0E-02	1.9E-01	3.0E-02	16.85
POR7	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.6E-01	1.9E-02	1.2E-01	1.9E-02	16.76
POR8	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	2.0E-01	1.8E-02	1.5E-01	1.8E-02	16.78
POR9	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-01	4.7E-01	4.2E-02	3.4E-01	4.2E-02	17.03
POR10	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-01	4.8E-01	4.3E-02	3.5E-01	4.3E-02	17.03
POR11	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-01	5.7E-01	5.8E-02	4.1E-01	5.8E-02	17.13
POR12	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	2.1E-01	2.0E-02	1.5E-01	2.0E-02	16.79
POR13	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.4E-01	1.3E-02	1.0E-01	1.3E-02	16.73
POR14	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.2E-01	1.1E-02	8.4E-02	1.1E-02	16.71
POR15	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.1E-01	1.1E-02	8.1E-02	1.1E-02	16.70
POR16	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.5E-02	9.7E-02	9.3E-03	7.1E-02	9.3E-03	16.69
POR17	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-02	7.5E-02	7.2E-03	5.5E-02	7.2E-03	16.67
POR18	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.4E-01	2.8E-02	1.7E-01	2.8E-02	16.83
POR19	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.2E-01	1.1E-02	8.7E-02	1.1E-02	16.71
POR20	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.4E-01	1.3E-02	9.8E-02	1.3E-02	16.72
POR21	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	2.4E-01	2.2E-02	1.8E-01	2.2E-02	16.82
POR22	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.0E-01	1.1E-02	7.3E-02	1.1E-02	16.70
POR23	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-02	7.6E-02	8.5E-03	5.5E-02	8.5E-03	16.67
POR24	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.0E-01	1.1E-02	7.4E-02	1.1E-02	16.70
POR25	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-02	4.2E-02	4.4E-03	3.0E-02	4.4E-03	16.64
POR26	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.6E-01	1.8E-02	1.2E-01	1.8E-02	16.75
POR27	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-02	7.6E-02	8.5E-03	5.5E-02	8.5E-03	16.67
POR28	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.4E-01	2.8E-02	1.7E-01	2.8E-02	16.83
POR29	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.1E-01	1.1E-02	8.2E-02	1.1E-02	16.70
POR30	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-02	5.8E-02	5.6E-03	4.2E-02	5.6E-03	16.65
POR31	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.4E-01	1.4E-02	1.0E-01	1.4E-02	16.73
POR32	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.6E-02	7.0E-02	7.4E-03	5.1E-02	7.4E-03	16.67
POR33	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+00	1.2E+00	2.2E-01	8.6E-01	2.2E-01	17.90
POR34	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+00	9.0E-01	1.5E-01	6.6E-01	1.5E-01	17.55
POR35	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	7.1E-01	1.1E-01	5.2E-01	1.1E-01	17.33
POR36	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.7E-01	2.0E-02	1.3E-01	2.0E-02	16.77
POR37	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.5E-01	1.8E-02	1.1E-01	1.8E-02	16.75
POR38	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.2E-01	1.3E-02	8.5E-02	1.3E-02	16.71
POR39	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-01	6.5E-01	6.2E-02	4.7E-01	6.2E-02	17.20
POR40	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E-01	9.1E-01	7.9E-02	6.6E-01	7.9E-02	17.42
POR41	Lead	16.6	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-02	3.5E-02	3.4E-03	2.6E-02	3.4E-03	16.63

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E+00	5.3E+00	5.9E-01	3.9E+00	5.9E-01	1495.04
POR2	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.2E+00	1.7E-01	8.8E-01	1.7E-01	1491.21
POR3	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.2E+00	1.7E-01	8.9E-01	1.7E-01	1491.22
POR4	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E+00	3.8E+00	3.9E-01	2.7E+00	3.9E-01	1493.52
POR5	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+00	2.3E+00	2.6E-01	1.7E+00	2.6E-01	1492.22
POR6	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+00	1.3E+00	1.9E-01	9.7E-01	1.9E-01	1491.35
POR7	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	8.5E-01	1.2E-01	6.2E-01	1.2E-01	1490.85
POR8	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	1.0E+00	1.1E-01	7.6E-01	1.1E-01	1490.99
POR9	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+00	2.5E+00	2.6E-01	1.8E+00	2.6E-01	1492.30
POR10	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+00	2.5E+00	2.6E-01	1.8E+00	2.6E-01	1492.33
POR11	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E+00	3.0E+00	3.6E-01	2.2E+00	3.6E-01	1492.88
POR12	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	1.1E+00	1.2E-01	8.0E-01	1.2E-01	1491.05
POR13	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E-01	7.5E-01	8.3E-02	5.4E-01	8.3E-02	1490.71
POR14	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E-01	6.0E-01	6.7E-02	4.4E-01	6.7E-02	1490.57
POR15	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-01	5.8E-01	6.5E-02	4.2E-01	6.5E-02	1490.55
POR16	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-01	5.1E-01	5.7E-02	3.7E-01	5.7E-02	1490.48
POR17	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-01	3.9E-01	4.5E-02	2.9E-01	4.5E-02	1490.38
POR18	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.3E+00	1.7E-01	9.1E-01	1.7E-01	1491.25
POR19	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.1E-01	6.2E-01	7.0E-02	4.5E-01	7.0E-02	1490.59
POR20	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.0E-01	7.1E-01	7.9E-02	5.1E-01	7.9E-02	1490.67
POR21	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+00	1.3E+00	1.4E-01	9.2E-01	1.4E-01	1491.19
POR22	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-01	5.3E-01	7.0E-02	3.8E-01	7.0E-02	1490.52
POR23	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-01	4.0E-01	5.2E-02	2.9E-01	5.2E-02	1490.39
POR24	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-01	5.3E-01	7.0E-02	3.9E-01	7.0E-02	1490.53
POR25	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.2E-01	2.7E-02	1.6E-01	2.7E-02	1490.21
POR26	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	8.3E-01	1.1E-01	6.0E-01	1.1E-01	1490.83
POR27	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-01	4.0E-01	5.2E-02	2.9E-01	5.2E-02	1490.39
POR28	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E+00	1.2E+00	1.7E-01	9.1E-01	1.7E-01	1491.25
POR29	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E-01	5.9E-01	6.6E-02	4.3E-01	6.6E-02	1490.56
POR30	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-01	3.0E-01	3.5E-02	2.2E-01	3.5E-02	1490.29
POR31	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-01	7.3E-01	8.7E-02	5.3E-01	8.7E-02	1490.71
POR32	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-01	3.7E-01	4.6E-02	2.7E-01	4.6E-02	1490.36
POR33	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+01	6.1E+00	1.4E+00	4.5E+00	1.4E+00	1497.25
POR34	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E+00	4.7E+00	9.1E-01	3.4E+00	9.1E-01	1495.25
POR35	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E+00	3.7E+00	6.5E-01	2.7E+00	6.5E-01	1494.02
POR36	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	9.0E-01	1.3E-01	6.6E-01	1.3E-01	1490.91
POR37	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	8.0E-01	1.1E-01	5.8E-01	1.1E-01	1490.80
POR38	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-01	6.1E-01	8.2E-02	4.5E-01	8.2E-02	1490.61
POR39	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E+00	3.4E+00	3.8E-01	2.5E+00	3.8E-01	1493.24
POR40	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E+00	4.8E+00	4.9E-01	3.5E+00	4.9E-01	1494.45
POR41	Manganese (in SPM)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-01	1.8E-01	2.1E-02	1.3E-01	2.1E-02	1490.18

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+00	2.0E+00	2.3E-01	1.4E+00	2.3E-01	1491.88
POR2	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-01	4.6E-01	6.3E-02	3.3E-01	6.3E-02	1490.46
POR3	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-01	4.6E-01	6.3E-02	3.3E-01	6.3E-02	1490.46
POR4	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+00	1.9E+00	1.9E-01	1.4E+00	1.9E-01	1491.74
POR5	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+00	9.0E-01	1.0E-01	6.6E-01	1.0E-01	1490.86
POR6	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-01	5.1E-01	7.1E-02	3.7E-01	7.1E-02	1490.51
POR7	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-01	3.3E-01	4.6E-02	2.4E-01	4.6E-02	1490.33
POR8	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-01	4.4E-01	4.9E-02	3.2E-01	4.9E-02	1490.42
POR9	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	1.1E+00	1.2E-01	8.2E-01	1.2E-01	1491.05
POR10	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+00	1.1E+00	1.2E-01	8.2E-01	1.2E-01	1491.05
POR11	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+00	1.1E+00	1.4E-01	8.1E-01	1.4E-01	1491.09
POR12	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-01	4.7E-01	5.2E-02	3.4E-01	5.2E-02	1490.45
POR13	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-01	3.1E-01	3.5E-02	2.3E-01	3.5E-02	1490.30
POR14	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.5E-01	2.9E-02	1.8E-01	2.9E-02	1490.24
POR15	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.4E-01	2.7E-02	1.8E-01	2.7E-02	1490.23
POR16	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-01	2.1E-01	2.4E-02	1.6E-01	2.4E-02	1490.20
POR17	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.6E-01	1.9E-02	1.2E-01	1.9E-02	1490.16
POR18	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-01	4.7E-01	6.4E-02	3.4E-01	6.4E-02	1490.47
POR19	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-01	2.6E-01	2.9E-02	1.9E-01	2.9E-02	1490.25
POR20	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-01	2.9E-01	3.3E-02	2.1E-01	3.3E-02	1490.28
POR21	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-01	5.3E-01	5.8E-02	3.9E-01	5.8E-02	1490.50
POR22	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.1E-01	2.8E-02	1.5E-01	2.8E-02	1490.21
POR23	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.6E-01	2.1E-02	1.1E-01	2.1E-02	1490.16
POR24	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.0E-01	2.7E-02	1.5E-01	2.7E-02	1490.20
POR25	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	8.8E-02	1.1E-02	6.4E-02	1.1E-02	1490.09
POR26	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-01	3.2E-01	4.4E-02	2.3E-01	4.4E-02	1490.32
POR27	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.6E-01	2.1E-02	1.1E-01	2.1E-02	1490.16
POR28	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-01	4.7E-01	6.5E-02	3.4E-01	6.5E-02	1490.47
POR29	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.5E-01	2.8E-02	1.8E-01	2.8E-02	1490.24
POR30	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.3E-01	1.5E-02	9.4E-02	1.5E-02	1490.12
POR31	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-01	2.9E-01	3.5E-02	2.1E-01	3.5E-02	1490.28
POR32	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.4E-01	1.8E-02	1.0E-01	1.8E-02	1490.14
POR33	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E+00	2.2E+00	5.1E-01	1.6E+00	5.1E-01	1492.65
POR34	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+00	1.7E+00	3.3E-01	1.3E+00	3.3E-01	1491.93
POR35	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E+00	1.4E+00	2.4E-01	1.0E+00	2.4E-01	1491.48
POR36	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-01	3.5E-01	4.9E-02	2.5E-01	4.9E-02	1490.35
POR37	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-01	3.1E-01	4.3E-02	2.3E-01	4.3E-02	1490.31
POR38	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-01	2.4E-01	3.3E-02	1.7E-01	3.3E-02	1490.24
POR39	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+00	1.4E+00	1.6E-01	1.0E+00	1.6E-01	1491.35
POR40	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+00	1.8E+00	2.0E-01	1.3E+00	2.0E-01	1491.71
POR41	Manganese (in PM10)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E-02	7.8E-02	9.1E-03	5.6E-02	9.1E-03	1490.07

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.2E-01	1.5E-02	8.5E-02	1.5E-02	1490.11
POR2	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-02	3.7E-02	4.4E-03	2.7E-02	4.4E-03	1490.04
POR3	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-02	3.6E-02	4.3E-03	2.6E-02	4.3E-03	1490.03
POR4	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.2E-01	1.4E-02	8.5E-02	1.4E-02	1490.11
POR5	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.7E-02	6.8E-02	7.6E-03	4.9E-02	7.6E-03	1490.06
POR6	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-02	4.6E-02	5.4E-03	3.3E-02	5.4E-03	1490.04
POR7	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-02	2.4E-02	3.0E-03	1.8E-02	3.0E-03	1490.02
POR8	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-02	3.5E-02	4.1E-03	2.5E-02	4.1E-03	1490.03
POR9	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	8.3E-02	9.8E-03	6.0E-02	9.8E-03	1490.08
POR10	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-02	7.4E-02	8.7E-03	5.4E-02	8.7E-03	1490.07
POR11	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-02	6.5E-02	8.2E-03	4.8E-02	8.2E-03	1490.06
POR12	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-02	3.3E-02	3.9E-03	2.4E-02	3.9E-03	1490.03
POR13	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.5E-02	2.9E-03	1.8E-02	2.9E-03	1490.02
POR14	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-02	2.0E-02	2.4E-03	1.5E-02	2.4E-03	1490.02
POR15	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	1.9E-02	2.2E-03	1.4E-02	2.2E-03	1490.02
POR16	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.6E-02	1.9E-03	1.1E-02	1.9E-03	1490.02
POR17	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-02	1.2E-02	1.5E-03	9.1E-03	1.5E-03	1490.01
POR18	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-02	3.7E-02	4.4E-03	2.7E-02	4.4E-03	1490.04
POR19	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	2.0E-02	2.4E-03	1.5E-02	2.4E-03	1490.02
POR20	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-02	2.3E-02	2.7E-03	1.7E-02	2.7E-03	1490.02
POR21	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-02	4.3E-02	5.1E-03	3.1E-02	5.1E-03	1490.04
POR22	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.5E-02	1.9E-03	1.1E-02	1.9E-03	1490.01
POR23	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-02	1.2E-02	1.4E-03	8.4E-03	1.4E-03	1490.01
POR24	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-02	1.4E-02	1.8E-03	1.0E-02	1.8E-03	1490.01
POR25	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-03	7.1E-03	8.5E-04	5.2E-03	8.5E-04	1490.01
POR26	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.3E-02	2.9E-03	1.7E-02	2.9E-03	1490.02
POR27	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	1.2E-02	1.4E-03	8.4E-03	1.4E-03	1490.01
POR28	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-02	4.0E-02	4.7E-03	2.9E-02	4.7E-03	1490.04
POR29	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	1.9E-02	2.2E-03	1.4E-02	2.2E-03	1490.02
POR30	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	9.4E-03	1.1E-03	6.8E-03	1.1E-03	1490.01
POR31	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	1.9E-02	2.3E-03	1.4E-02	2.3E-03	1490.02
POR32	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	9.5E-03	1.1E-03	6.9E-03	1.1E-03	1490.01
POR33	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+00	1.5E-01	2.3E-01	1.1E-01	2.3E-01	1490.56
POR34	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.1E-01	1.7E-02	8.1E-02	1.7E-02	1490.12
POR35	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	8.9E-02	1.3E-01	6.5E-02	1.3E-01	1490.32
POR36	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.6E-02	3.2E-03	1.9E-02	3.2E-03	1490.03
POR37	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.2E-02	2.8E-03	1.6E-02	2.8E-03	1490.02
POR38	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.7E-02	2.2E-03	1.3E-02	2.2E-03	1490.02
POR39	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.1E-01	1.3E-02	8.0E-02	1.3E-02	1490.11
POR40	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-01	1.4E-01	1.6E-02	1.0E-01	1.6E-02	1490.14
POR41	Manganese (in PM2.5)	1490	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-03	6.2E-03	7.3E-04	4.5E-03	7.3E-04	1490.01

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	9.4E-03	1.0E-03	6.8E-03	1.0E-03	1.50
POR2	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.1E-03	2.9E-04	1.6E-03	2.9E-04	1.49
POR3	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.1E-03	2.9E-04	1.6E-03	2.9E-04	1.49
POR4	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-03	6.6E-03	6.8E-04	4.8E-03	6.8E-04	1.50
POR5	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-03	4.1E-03	4.5E-04	3.0E-03	4.5E-04	1.49
POR6	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-03	2.4E-03	3.3E-04	1.7E-03	3.3E-04	1.49
POR7	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.5E-03	2.1E-04	1.1E-03	2.1E-04	1.49
POR8	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.8E-03	2.0E-04	1.3E-03	2.0E-04	1.49
POR9	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-03	4.3E-03	4.6E-04	3.1E-03	4.6E-04	1.49
POR10	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-03	4.4E-03	4.6E-04	3.2E-03	4.6E-04	1.49
POR11	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-03	5.3E-03	6.3E-04	3.8E-03	6.3E-04	1.50
POR12	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.9E-03	2.1E-04	1.4E-03	2.1E-04	1.49
POR13	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.3E-03	1.5E-04	9.6E-04	1.5E-04	1.49
POR14	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	7.7E-04	1.2E-04	1.49
POR15	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.0E-03	1.2E-04	7.5E-04	1.2E-04	1.49
POR16	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	9.0E-04	1.0E-04	6.5E-04	1.0E-04	1.49
POR17	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.0E-04	6.9E-04	7.8E-05	5.0E-04	7.8E-05	1.49
POR18	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.2E-03	3.0E-04	1.6E-03	3.0E-04	1.49
POR19	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.2E-04	8.0E-04	1.2E-04	1.49
POR20	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-03	1.2E-03	1.4E-04	9.1E-04	1.4E-04	1.49
POR21	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-03	2.2E-03	2.4E-04	1.6E-03	2.4E-04	1.49
POR22	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.3E-04	1.2E-04	6.8E-04	1.2E-04	1.49
POR23	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-04	7.0E-04	9.2E-05	5.1E-04	9.2E-05	1.49
POR24	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.4E-04	1.2E-04	6.8E-04	1.2E-04	1.49
POR25	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-04	3.8E-04	4.8E-05	2.8E-04	4.8E-05	1.49
POR26	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.5E-03	2.0E-04	1.1E-03	2.0E-04	1.49
POR27	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-04	7.0E-04	9.2E-05	5.1E-04	9.2E-05	1.49
POR28	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.2E-03	3.0E-04	1.6E-03	3.0E-04	1.49
POR29	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.0E-03	1.2E-04	7.6E-04	1.2E-04	1.49
POR30	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-04	5.4E-04	6.1E-05	3.9E-04	6.1E-05	1.49
POR31	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.3E-03	1.5E-04	9.4E-04	1.5E-04	1.49
POR32	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.2E-04	6.5E-04	8.1E-05	4.7E-04	8.1E-05	1.49
POR33	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	1.1E-02	2.4E-03	7.9E-03	2.4E-03	1.50
POR34	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-02	8.3E-03	1.6E-03	6.1E-03	1.6E-03	1.50
POR35	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	6.6E-03	1.1E-03	4.8E-03	1.1E-03	1.50
POR36	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	1.6E-03	2.2E-04	1.2E-03	2.2E-04	1.49
POR37	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.4E-03	1.9E-04	1.0E-03	1.9E-04	1.49
POR38	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.1E-03	1.4E-04	7.9E-04	1.4E-04	1.49
POR39	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-03	6.0E-03	6.7E-04	4.4E-03	6.7E-04	1.50
POR40	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-03	8.4E-03	8.6E-04	6.1E-03	8.6E-04	1.50
POR41	Molybdenum	1.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-04	3.2E-04	3.7E-05	2.4E-04	3.7E-05	1.49

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.9E-01	2.1E-02	1.4E-01	2.1E-02	17.28
POR2	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-02	4.3E-02	5.8E-03	3.1E-02	5.8E-03	17.14
POR3	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-02	4.3E-02	5.8E-03	3.1E-02	5.8E-03	17.14
POR4	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.3E-01	1.3E-02	9.6E-02	1.3E-02	17.22
POR5	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-02	8.2E-02	9.0E-03	6.0E-02	9.0E-03	17.18
POR6	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-02	4.7E-02	6.5E-03	3.4E-02	6.5E-03	17.15
POR7	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-02	3.0E-02	4.1E-03	2.2E-02	4.1E-03	17.13
POR8	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-02	3.7E-02	4.0E-03	2.7E-02	4.0E-03	17.13
POR9	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-02	8.6E-02	9.0E-03	6.3E-02	9.0E-03	17.18
POR10	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E-02	8.7E-02	9.2E-03	6.4E-02	9.2E-03	17.18
POR11	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.0E-01	1.2E-02	7.6E-02	1.2E-02	17.20
POR12	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-02	3.9E-02	4.2E-03	2.8E-02	4.2E-03	17.14
POR13	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.6E-02	2.9E-03	1.9E-02	2.9E-03	17.12
POR14	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-02	2.1E-02	2.3E-03	1.5E-02	2.3E-03	17.12
POR15	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	2.0E-02	2.3E-03	1.5E-02	2.3E-03	17.12
POR16	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-02	1.8E-02	2.0E-03	1.3E-02	2.0E-03	17.12
POR17	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-02	1.4E-02	1.6E-03	1.0E-02	1.6E-03	17.11
POR18	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-02	4.4E-02	5.9E-03	3.2E-02	5.9E-03	17.14
POR19	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	2.2E-02	2.4E-03	1.6E-02	2.4E-03	17.12
POR20	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-02	2.5E-02	2.7E-03	1.8E-02	2.7E-03	17.12
POR21	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-02	4.4E-02	4.8E-03	3.2E-02	4.8E-03	17.14
POR22	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	1.9E-02	2.4E-03	1.3E-02	2.4E-03	17.12
POR23	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.4E-02	1.8E-03	1.0E-02	1.8E-03	17.11
POR24	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	1.9E-02	2.4E-03	1.4E-02	2.4E-03	17.12
POR25	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.6E-03	7.7E-03	9.4E-04	5.6E-03	9.4E-04	17.11
POR26	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-02	2.9E-02	3.9E-03	2.1E-02	3.9E-03	17.13
POR27	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.4E-02	1.8E-03	1.0E-02	1.8E-03	17.11
POR28	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-02	4.4E-02	6.0E-03	3.2E-02	6.0E-03	17.14
POR29	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-02	2.1E-02	2.3E-03	1.5E-02	2.3E-03	17.12
POR30	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	1.1E-02	1.2E-03	7.8E-03	1.2E-03	17.11
POR31	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-02	2.6E-02	3.0E-03	1.9E-02	3.0E-03	17.12
POR32	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-02	1.3E-02	1.6E-03	9.4E-03	1.6E-03	17.11
POR33	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-01	2.2E-01	4.8E-02	1.6E-01	4.8E-02	17.35
POR34	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	1.7E-01	3.2E-02	1.2E-01	3.2E-02	17.28
POR35	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	1.3E-01	2.3E-02	9.5E-02	2.3E-02	17.24
POR36	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-02	3.2E-02	4.4E-03	2.3E-02	4.4E-03	17.13
POR37	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-02	2.8E-02	3.8E-03	2.0E-02	3.8E-03	17.13
POR38	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.2E-02	2.9E-03	1.6E-02	2.9E-03	17.12
POR39	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.2E-01	1.3E-02	8.7E-02	1.3E-02	17.21
POR40	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.7E-01	1.7E-02	1.2E-01	1.7E-02	17.26
POR41	Nickel (in SPM)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-03	6.5E-03	7.4E-04	4.7E-03	7.4E-04	17.11

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.8E-01	2.0E-02	1.3E-01	2.0E-02	17.27
POR2	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-02	4.2E-02	5.6E-03	3.1E-02	5.6E-03	17.14
POR3	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-02	4.2E-02	5.6E-03	3.1E-02	5.6E-03	17.14
POR4	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.7E-01	1.7E-02	1.3E-01	1.7E-02	17.26
POR5	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E-02	8.3E-02	9.1E-03	6.1E-02	9.1E-03	17.18
POR6	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-02	4.7E-02	6.3E-03	3.4E-02	6.3E-03	17.15
POR7	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-02	3.0E-02	4.0E-03	2.2E-02	4.0E-03	17.13
POR8	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-02	4.1E-02	4.3E-03	3.0E-02	4.3E-03	17.14
POR9	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.0E-01	1.0E-02	7.6E-02	1.0E-02	17.20
POR10	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	1.0E-01	1.0E-02	7.5E-02	1.0E-02	17.20
POR11	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.0E-01	1.2E-02	7.5E-02	1.2E-02	17.20
POR12	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-02	4.4E-02	4.6E-03	3.2E-02	4.6E-03	17.14
POR13	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-02	2.9E-02	3.1E-03	2.1E-02	3.1E-03	17.13
POR14	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	2.3E-02	2.5E-03	1.7E-02	2.5E-03	17.12
POR15	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	2.2E-02	2.4E-03	1.6E-02	2.4E-03	17.12
POR16	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	2.0E-02	2.2E-03	1.4E-02	2.2E-03	17.12
POR17	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-02	1.5E-02	1.7E-03	1.1E-02	1.7E-03	17.11
POR18	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-02	4.4E-02	5.7E-03	3.2E-02	5.7E-03	17.14
POR19	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	2.4E-02	2.6E-03	1.7E-02	2.6E-03	17.12
POR20	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.7E-02	2.9E-03	2.0E-02	2.9E-03	17.13
POR21	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-02	4.9E-02	5.1E-03	3.6E-02	5.1E-03	17.15
POR22	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	1.9E-02	2.5E-03	1.4E-02	2.5E-03	17.12
POR23	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.4E-02	1.9E-03	1.1E-02	1.9E-03	17.11
POR24	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	1.9E-02	2.4E-03	1.4E-02	2.4E-03	17.12
POR25	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-02	8.1E-03	9.9E-04	5.9E-03	9.9E-04	17.11
POR26	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-02	2.9E-02	3.9E-03	2.1E-02	3.9E-03	17.13
POR27	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.4E-02	1.9E-03	1.1E-02	1.9E-03	17.11
POR28	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-02	4.4E-02	5.8E-03	3.2E-02	5.8E-03	17.14
POR29	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	2.3E-02	2.5E-03	1.7E-02	2.5E-03	17.12
POR30	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	8.6E-03	1.3E-03	17.11
POR31	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-02	2.7E-02	3.1E-03	1.9E-02	3.1E-03	17.13
POR32	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-02	1.3E-02	1.6E-03	9.5E-03	1.6E-03	17.11
POR33	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-01	2.1E-01	4.5E-02	1.5E-01	4.5E-02	17.34
POR34	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-01	1.6E-01	3.0E-02	1.2E-01	3.0E-02	17.28
POR35	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-01	1.3E-01	2.1E-02	9.2E-02	2.1E-02	17.24
POR36	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-02	3.2E-02	4.4E-03	2.3E-02	4.4E-03	17.13
POR37	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-02	2.9E-02	3.8E-03	2.1E-02	3.8E-03	17.13
POR38	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-02	2.2E-02	2.9E-03	1.6E-02	2.9E-03	17.12
POR39	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.3E-01	1.4E-02	9.6E-02	1.4E-02	17.22
POR40	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.7E-01	1.7E-02	1.2E-01	1.7E-02	17.26
POR41	Nickel (in PM10)	17.1	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.2E-03	7.2E-03	8.1E-04	5.2E-03	8.1E-04	17.11

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-02	1.8E-02	2.0E-03	1.3E-02	2.0E-03	0.51
POR2	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-03	4.0E-03	5.5E-04	2.9E-03	5.5E-04	0.49
POR3	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-03	4.0E-03	5.5E-04	2.9E-03	5.5E-04	0.49
POR4	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	9.1E-03	1.3E-03	0.50
POR5	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-03	7.8E-03	8.5E-04	5.7E-03	8.5E-04	0.50
POR6	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-03	4.4E-03	6.2E-04	3.2E-03	6.2E-04	0.49
POR7	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-03	2.8E-03	3.9E-04	2.1E-03	3.9E-04	0.49
POR8	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-03	3.5E-03	3.8E-04	2.5E-03	3.8E-04	0.49
POR9	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-03	8.1E-03	8.6E-04	5.9E-03	8.6E-04	0.50
POR10	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-03	8.2E-03	8.7E-04	6.0E-03	8.7E-04	0.50
POR11	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	9.9E-03	1.2E-03	7.2E-03	1.2E-03	0.50
POR12	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-03	3.7E-03	4.0E-04	2.7E-03	4.0E-04	0.49
POR13	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-03	2.5E-03	2.7E-04	1.8E-03	2.7E-04	0.49
POR14	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	2.0E-03	2.2E-04	1.5E-03	2.2E-04	0.49
POR15	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.9E-03	2.2E-04	1.4E-03	2.2E-04	0.49
POR16	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.7E-03	1.9E-04	1.2E-03	1.9E-04	0.49
POR17	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.3E-03	1.5E-04	9.5E-04	1.5E-04	0.49
POR18	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-03	4.2E-03	5.6E-04	3.0E-03	5.6E-04	0.49
POR19	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-03	2.1E-03	2.3E-04	1.5E-03	2.3E-04	0.49
POR20	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-03	2.3E-03	2.6E-04	1.7E-03	2.6E-04	0.49
POR21	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-03	4.2E-03	4.5E-04	3.0E-03	4.5E-04	0.49
POR22	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-03	1.7E-03	2.3E-04	1.3E-03	2.3E-04	0.49
POR23	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-03	1.3E-03	1.7E-04	9.6E-04	1.7E-04	0.49
POR24	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-03	1.8E-03	2.3E-04	1.3E-03	2.3E-04	0.49
POR25	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-04	7.2E-04	9.0E-05	5.3E-04	9.0E-05	0.49
POR26	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-03	2.7E-03	3.7E-04	2.0E-03	3.7E-04	0.49
POR27	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-03	1.3E-03	1.7E-04	9.6E-04	1.7E-04	0.49
POR28	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-03	4.1E-03	5.7E-04	3.0E-03	5.7E-04	0.49
POR29	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	2.0E-03	2.2E-04	1.4E-03	2.2E-04	0.49
POR30	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.0E-03	1.1E-04	7.4E-04	1.1E-04	0.49
POR31	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-03	2.4E-03	2.9E-04	1.8E-03	2.9E-04	0.49
POR32	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.2E-03	1.5E-04	8.9E-04	1.5E-04	0.49
POR33	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-02	2.0E-02	4.6E-03	1.5E-02	4.6E-03	0.51
POR34	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-02	1.6E-02	3.0E-03	1.1E-02	3.0E-03	0.51
POR35	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.2E-02	2.2E-03	9.0E-03	2.2E-03	0.50
POR36	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-03	3.0E-03	4.2E-04	2.2E-03	4.2E-04	0.49
POR37	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-03	2.7E-03	3.6E-04	1.9E-03	3.6E-04	0.49
POR38	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-03	2.0E-03	2.7E-04	1.5E-03	2.7E-04	0.49
POR39	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.1E-02	1.3E-03	8.2E-03	1.3E-03	0.50
POR40	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-02	1.6E-02	1.6E-03	1.1E-02	1.6E-03	0.50
POR41	Selenium	0.49	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-04	6.1E-04	7.0E-05	4.4E-04	7.0E-05	0.49

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.8E-03	2.0E-04	1.3E-03	2.0E-04	0.18
POR2	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-04	4.0E-04	5.5E-05	2.9E-04	5.5E-05	0.18
POR3	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-04	4.1E-04	5.5E-05	3.0E-04	5.5E-05	0.18
POR4	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.3E-03	1.3E-04	9.1E-04	1.3E-04	0.18
POR5	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-04	7.8E-04	8.6E-05	5.7E-04	8.6E-05	0.18
POR6	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-04	4.5E-04	6.2E-05	3.2E-04	6.2E-05	0.18
POR7	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-04	2.8E-04	3.9E-05	2.1E-04	3.9E-05	0.18
POR8	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-04	3.5E-04	3.8E-05	2.5E-04	3.8E-05	0.18
POR9	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-04	8.2E-04	8.6E-05	5.9E-04	8.6E-05	0.18
POR10	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-04	8.3E-04	8.7E-05	6.0E-04	8.7E-05	0.18
POR11	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	9.9E-04	1.2E-04	7.2E-04	1.2E-04	0.18
POR12	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-04	3.7E-04	4.0E-05	2.7E-04	4.0E-05	0.18
POR13	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-04	2.5E-04	2.8E-05	1.8E-04	2.8E-05	0.18
POR14	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-04	2.0E-04	2.2E-05	1.5E-04	2.2E-05	0.18
POR15	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-04	1.9E-04	2.2E-05	1.4E-04	2.2E-05	0.18
POR16	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-04	1.7E-04	1.9E-05	1.2E-04	1.9E-05	0.18
POR17	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-04	1.3E-04	1.5E-05	9.5E-05	1.5E-05	0.18
POR18	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-04	4.2E-04	5.7E-05	3.0E-04	5.7E-05	0.18
POR19	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-04	2.1E-04	2.3E-05	1.5E-04	2.3E-05	0.18
POR20	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-04	2.4E-04	2.6E-05	1.7E-04	2.6E-05	0.18
POR21	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-04	4.2E-04	4.6E-05	3.0E-04	4.6E-05	0.18
POR22	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-04	1.8E-04	2.3E-05	1.3E-04	2.3E-05	0.18
POR23	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-04	1.3E-04	1.7E-05	9.7E-05	1.7E-05	0.18
POR24	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-04	1.8E-04	2.3E-05	1.3E-04	2.3E-05	0.18
POR25	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-05	7.3E-05	9.0E-06	5.3E-05	9.0E-06	0.18
POR26	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-04	2.8E-04	3.8E-05	2.0E-04	3.8E-05	0.18
POR27	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-04	1.3E-04	1.7E-05	9.7E-05	1.7E-05	0.18
POR28	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-04	4.1E-04	5.7E-05	3.0E-04	5.7E-05	0.18
POR29	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-04	2.0E-04	2.2E-05	1.4E-04	2.2E-05	0.18
POR30	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-04	1.0E-04	1.2E-05	7.4E-05	1.2E-05	0.18
POR31	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-04	2.4E-04	2.9E-05	1.8E-04	2.9E-05	0.18
POR32	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.2E-04	1.5E-05	8.9E-05	1.5E-05	0.18
POR33	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-03	2.0E-03	4.6E-04	1.5E-03	4.6E-04	0.18
POR34	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	1.6E-03	3.0E-04	1.1E-03	3.0E-04	0.18
POR35	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.2E-03	2.2E-04	9.1E-04	2.2E-04	0.18
POR36	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-04	3.0E-04	4.2E-05	2.2E-04	4.2E-05	0.18
POR37	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-04	2.7E-04	3.6E-05	1.9E-04	3.6E-05	0.18
POR38	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-04	2.0E-04	2.7E-05	1.5E-04	2.7E-05	0.18
POR39	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.3E-04	8.2E-04	1.3E-04	0.18
POR40	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.6E-03	1.6E-04	1.2E-03	1.6E-04	0.18
POR41	Thallium	0.182	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-05	6.1E-05	7.0E-06	4.5E-05	7.0E-06	0.18

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-03	4.6E-03	5.1E-04	3.3E-03	5.1E-04	0.86
POR2	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.1E-03	1.4E-04	7.6E-04	1.4E-04	0.85
POR3	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.1E-03	1.4E-04	7.7E-04	1.4E-04	0.85
POR4	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-03	3.3E-03	3.4E-04	2.4E-03	3.4E-04	0.85
POR5	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	2.0E-03	2.2E-04	1.5E-03	2.2E-04	0.85
POR6	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.2E-03	1.6E-04	8.4E-04	1.6E-04	0.85
POR7	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	7.4E-04	1.0E-04	5.4E-04	1.0E-04	0.85
POR8	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	9.0E-04	9.9E-05	6.6E-04	9.9E-05	0.85
POR9	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	2.1E-03	2.2E-04	1.5E-03	2.2E-04	0.85
POR10	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	2.2E-03	2.3E-04	1.6E-03	2.3E-04	0.85
POR11	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-03	2.6E-03	3.1E-04	1.9E-03	3.1E-04	0.85
POR12	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	9.6E-04	1.1E-04	7.0E-04	1.1E-04	0.85
POR13	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-04	6.5E-04	7.2E-05	4.7E-04	7.2E-05	0.85
POR14	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-04	5.2E-04	5.8E-05	3.8E-04	5.8E-05	0.85
POR15	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-04	5.0E-04	5.7E-05	3.7E-04	5.7E-05	0.85
POR16	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-04	4.4E-04	5.0E-05	3.2E-04	5.0E-05	0.85
POR17	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-04	3.4E-04	3.9E-05	2.5E-04	3.9E-05	0.85
POR18	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.1E-03	1.5E-04	7.9E-04	1.5E-04	0.85
POR19	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-04	5.4E-04	6.0E-05	3.9E-04	6.0E-05	0.85
POR20	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-04	6.1E-04	6.8E-05	4.5E-04	6.8E-05	0.85
POR21	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	7.9E-04	1.2E-04	0.85
POR22	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-04	4.6E-04	6.1E-05	3.3E-04	6.1E-05	0.85
POR23	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-04	3.5E-04	4.5E-05	2.5E-04	4.5E-05	0.85
POR24	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-04	4.6E-04	6.1E-05	3.3E-04	6.1E-05	0.85
POR25	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-04	1.9E-04	2.3E-05	1.4E-04	2.3E-05	0.85
POR26	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	7.2E-04	9.8E-05	5.2E-04	9.8E-05	0.85
POR27	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-04	3.5E-04	4.5E-05	2.5E-04	4.5E-05	0.85
POR28	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.1E-03	1.5E-04	7.9E-04	1.5E-04	0.85
POR29	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-04	5.1E-04	5.8E-05	3.7E-04	5.8E-05	0.85
POR30	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-04	2.6E-04	3.0E-05	1.9E-04	3.0E-05	0.85
POR31	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.7E-04	6.4E-04	7.5E-05	4.6E-04	7.5E-05	0.85
POR32	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-04	3.2E-04	4.0E-05	2.3E-04	4.0E-05	0.85
POR33	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	5.3E-03	1.2E-03	3.9E-03	1.2E-03	0.86
POR34	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.0E-03	4.1E-03	7.9E-04	3.0E-03	7.9E-04	0.86
POR35	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-03	3.2E-03	5.6E-04	2.4E-03	5.6E-04	0.85
POR36	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	7.8E-04	1.1E-04	5.7E-04	1.1E-04	0.85
POR37	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-04	6.9E-04	9.5E-05	5.0E-04	9.5E-05	0.85
POR38	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-04	5.3E-04	7.1E-05	3.9E-04	7.1E-05	0.85
POR39	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-03	2.9E-03	3.3E-04	2.1E-03	3.3E-04	0.85
POR40	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-03	4.1E-03	4.2E-04	3.0E-03	4.2E-04	0.85
POR41	Uranium	0.851	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-04	1.6E-04	1.8E-05	1.2E-04	1.8E-05	0.85

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-01	5.6E-01	6.2E-02	4.1E-01	6.2E-02	45.93
POR2	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.7E-02	9.3E-02	1.7E-02	45.53
POR3	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.7E-02	9.3E-02	1.7E-02	45.53
POR4	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-01	4.0E-01	4.1E-02	2.9E-01	4.1E-02	45.77
POR5	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.5E-01	2.7E-02	1.8E-01	2.7E-02	45.63
POR6	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.4E-01	2.0E-02	1.0E-01	2.0E-02	45.54
POR7	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	9.0E-02	1.2E-02	6.5E-02	1.2E-02	45.49
POR8	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.1E-01	1.2E-02	8.0E-02	1.2E-02	45.50
POR9	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.6E-01	2.7E-02	1.9E-01	2.7E-02	45.64
POR10	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.6E-01	2.8E-02	1.9E-01	2.8E-02	45.65
POR11	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-01	3.1E-01	3.8E-02	2.3E-01	3.8E-02	45.70
POR12	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.2E-01	1.3E-02	8.5E-02	1.3E-02	45.51
POR13	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-02	7.8E-02	8.7E-03	5.7E-02	8.7E-03	45.47
POR14	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-02	6.3E-02	7.0E-03	4.6E-02	7.0E-03	45.46
POR15	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-02	6.1E-02	6.9E-03	4.5E-02	6.9E-03	45.46
POR16	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-02	5.3E-02	6.0E-03	3.9E-02	6.0E-03	45.45
POR17	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-02	4.1E-02	4.7E-03	3.0E-02	4.7E-03	45.44
POR18	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.8E-02	9.6E-02	1.8E-02	45.53
POR19	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-02	6.6E-02	7.3E-03	4.8E-02	7.3E-03	45.46
POR20	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-02	7.4E-02	8.3E-03	5.4E-02	8.3E-03	45.47
POR21	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.3E-01	1.4E-02	9.6E-02	1.4E-02	45.53
POR22	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-02	5.5E-02	7.4E-03	4.0E-02	7.4E-03	45.46
POR23	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-02	4.2E-02	5.5E-03	3.1E-02	5.5E-03	45.44
POR24	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-02	5.6E-02	7.4E-03	4.1E-02	7.4E-03	45.46
POR25	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.3E-02	2.8E-03	1.7E-02	2.8E-03	45.42
POR26	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	8.7E-02	1.2E-02	6.3E-02	1.2E-02	45.49
POR27	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-02	4.2E-02	5.5E-03	3.1E-02	5.5E-03	45.44
POR28	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.8E-02	9.5E-02	1.8E-02	45.53
POR29	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.1E-02	6.2E-02	7.0E-03	4.5E-02	7.0E-03	45.46
POR30	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-02	3.2E-02	3.6E-03	2.3E-02	3.6E-03	45.43
POR31	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E-02	7.7E-02	9.1E-03	5.6E-02	9.1E-03	45.47
POR32	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-02	3.9E-02	4.8E-03	2.8E-02	4.8E-03	45.44
POR33	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+00	6.5E-01	1.5E-01	4.7E-01	1.5E-01	46.16
POR34	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-01	5.0E-01	9.5E-02	3.6E-01	9.5E-02	45.95
POR35	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-01	3.9E-01	6.8E-02	2.9E-01	6.8E-02	45.82
POR36	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	9.5E-02	1.3E-02	6.9E-02	1.3E-02	45.50
POR37	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	8.4E-02	1.1E-02	6.1E-02	1.1E-02	45.48
POR38	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-02	6.4E-02	8.6E-03	4.7E-02	8.6E-03	45.46
POR39	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-01	3.6E-01	4.0E-02	2.6E-01	4.0E-02	45.74
POR40	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-01	5.0E-01	5.1E-02	3.6E-01	5.1E-02	45.87
POR41	Vanadium	45.4	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-02	1.9E-02	2.2E-03	1.4E-02	2.2E-03	45.42

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E+00	4.2E+00	4.7E-01	3.0E+00	4.7E-01	63.27
POR2	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	9.6E-01	1.3E-01	7.0E-01	1.3E-01	60.26
POR3	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	9.6E-01	1.3E-01	7.0E-01	1.3E-01	60.26
POR4	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E+00	3.0E+00	3.0E-01	2.2E+00	3.0E-01	62.07
POR5	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+00	1.8E+00	2.0E-01	1.3E+00	2.0E-01	61.05
POR6	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+00	1.1E+00	1.5E-01	7.7E-01	1.5E-01	60.36
POR7	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-01	6.7E-01	9.2E-02	4.9E-01	9.2E-02	59.97
POR8	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-01	8.2E-01	9.0E-02	6.0E-01	9.0E-02	60.08
POR9	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+00	1.9E+00	2.0E-01	1.4E+00	2.0E-01	61.11
POR10	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+00	2.0E+00	2.1E-01	1.4E+00	2.1E-01	61.14
POR11	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E+00	2.3E+00	2.8E-01	1.7E+00	2.8E-01	61.57
POR12	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-01	8.7E-01	9.5E-02	6.3E-01	9.5E-02	60.12
POR13	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-01	5.9E-01	6.5E-02	4.3E-01	6.5E-02	59.86
POR14	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-01	4.7E-01	5.3E-02	3.5E-01	5.3E-02	59.75
POR15	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-01	4.6E-01	5.1E-02	3.3E-01	5.1E-02	59.74
POR16	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-01	4.0E-01	4.5E-02	2.9E-01	4.5E-02	59.68
POR17	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-01	3.1E-01	3.5E-02	2.3E-01	3.5E-02	59.60
POR18	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+00	9.9E-01	1.3E-01	7.2E-01	1.3E-01	60.29
POR19	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-01	4.9E-01	5.5E-02	3.6E-01	5.5E-02	59.77
POR20	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-01	5.6E-01	6.2E-02	4.1E-01	6.2E-02	59.83
POR21	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	9.9E-01	1.1E-01	7.2E-01	1.1E-01	60.24
POR22	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-01	4.2E-01	5.5E-02	3.0E-01	5.5E-02	59.71
POR23	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-01	3.1E-01	4.1E-02	2.3E-01	4.1E-02	59.61
POR24	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-01	4.2E-01	5.5E-02	3.0E-01	5.5E-02	59.71
POR25	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-01	1.7E-01	2.1E-02	1.3E-01	2.1E-02	59.47
POR26	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E-01	6.5E-01	8.9E-02	4.7E-01	8.9E-02	59.95
POR27	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-01	3.1E-01	4.1E-02	2.3E-01	4.1E-02	59.61
POR28	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+00	9.8E-01	1.3E-01	7.1E-01	1.3E-01	60.28
POR29	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-01	4.7E-01	5.2E-02	3.4E-01	5.2E-02	59.74
POR30	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.4E-01	2.7E-02	1.7E-01	2.7E-02	59.53
POR31	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-01	5.8E-01	6.8E-02	4.2E-01	6.8E-02	59.86
POR32	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-01	2.9E-01	3.6E-02	2.1E-01	3.6E-02	59.58
POR33	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	4.8E+00	1.1E+00	3.5E+00	1.1E+00	65.01
POR34	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E+00	3.7E+00	7.1E-01	2.7E+00	7.1E-01	63.44
POR35	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E+00	2.9E+00	5.1E-01	2.1E+00	5.1E-01	62.47
POR36	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+00	7.1E-01	9.9E-02	5.2E-01	9.9E-02	60.02
POR37	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-01	6.3E-01	8.6E-02	4.6E-01	8.6E-02	59.93
POR38	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-01	4.8E-01	6.5E-02	3.5E-01	6.5E-02	59.78
POR39	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E+00	2.7E+00	3.0E-01	1.9E+00	3.0E-01	61.85
POR40	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E+00	3.8E+00	3.8E-01	2.7E+00	3.8E-01	62.80
POR41	Zinc	59.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.4E-01	1.7E-02	1.1E-01	1.7E-02	59.44

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-04	4.9E-04	5.5E-05	3.6E-04	5.5E-05	0.19
POR2	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.1E-04	1.5E-05	8.2E-05	1.5E-05	0.19
POR3	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.1E-04	1.5E-05	8.3E-05	1.5E-05	0.19
POR4	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-04	3.5E-04	3.6E-05	2.6E-04	3.6E-05	0.19
POR5	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-04	2.2E-04	2.4E-05	1.6E-04	2.4E-05	0.19
POR6	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-04	1.2E-04	1.7E-05	9.1E-05	1.7E-05	0.19
POR7	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-04	7.9E-05	1.1E-05	5.8E-05	1.1E-05	0.19
POR8	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-04	9.7E-05	1.1E-05	7.1E-05	1.1E-05	0.19
POR9	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-04	2.3E-04	2.4E-05	1.7E-04	2.4E-05	0.19
POR10	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-04	2.3E-04	2.4E-05	1.7E-04	2.4E-05	0.19
POR11	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-04	2.8E-04	3.3E-05	2.0E-04	3.3E-05	0.19
POR12	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-04	1.0E-04	1.1E-05	7.5E-05	1.1E-05	0.19
POR13	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.9E-05	6.9E-05	7.7E-06	5.1E-05	7.7E-06	0.19
POR14	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-05	5.6E-05	6.2E-06	4.1E-05	6.2E-06	0.19
POR15	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-05	5.4E-05	6.1E-06	3.9E-05	6.1E-06	0.19
POR16	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-05	4.7E-05	5.3E-06	3.4E-05	5.3E-06	0.19
POR17	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-05	3.7E-05	4.1E-06	2.7E-05	4.1E-06	0.19
POR18	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.2E-04	1.6E-05	8.5E-05	1.6E-05	0.19
POR19	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-05	5.8E-05	6.5E-06	4.2E-05	6.5E-06	0.19
POR20	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-05	6.6E-05	7.3E-06	4.8E-05	7.3E-06	0.19
POR21	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-04	1.2E-04	1.3E-05	8.5E-05	1.3E-05	0.19
POR22	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-05	4.9E-05	6.5E-06	3.6E-05	6.5E-06	0.19
POR23	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-05	3.7E-05	4.9E-06	2.7E-05	4.9E-06	0.19
POR24	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-05	4.9E-05	6.5E-06	3.6E-05	6.5E-06	0.19
POR25	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-05	2.0E-05	2.5E-06	1.5E-05	2.5E-06	0.19
POR26	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-04	7.7E-05	1.1E-05	5.6E-05	1.1E-05	0.19
POR27	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-05	3.7E-05	4.9E-06	2.7E-05	4.9E-06	0.19
POR28	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.2E-04	1.6E-05	8.4E-05	1.6E-05	0.19
POR29	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-05	5.5E-05	6.2E-06	4.0E-05	6.2E-06	0.19
POR30	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-05	2.8E-05	3.2E-06	2.1E-05	3.2E-06	0.19
POR31	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.2E-05	6.8E-05	8.1E-06	5.0E-05	8.1E-06	0.19
POR32	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-05	3.4E-05	4.3E-06	2.5E-05	4.3E-06	0.19
POR33	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	5.7E-04	1.3E-04	4.2E-04	1.3E-04	0.19
POR34	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-04	4.4E-04	8.4E-05	3.2E-04	8.4E-05	0.19
POR35	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-04	3.5E-04	6.1E-05	2.5E-04	6.1E-05	0.19
POR36	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-04	8.4E-05	1.2E-05	6.1E-05	1.2E-05	0.19
POR37	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-04	7.5E-05	1.0E-05	5.4E-05	1.0E-05	0.19
POR38	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-05	5.7E-05	7.6E-06	4.2E-05	7.6E-06	0.19
POR39	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-04	3.2E-04	3.6E-05	2.3E-04	3.6E-05	0.19
POR40	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-04	4.4E-04	4.6E-05	3.2E-04	4.6E-05	0.19
POR41	Mercury	0.191	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-05	1.7E-05	2.0E-06	1.2E-05	2.0E-06	0.19

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E+02	2.5E+02	2.8E+01	1.8E+02	2.8E+01	18341.03
POR2	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E+01	5.8E+01	7.9E+00	4.2E+01	7.9E+00	18157.99
POR3	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E+01	5.8E+01	7.9E+00	4.2E+01	7.9E+00	18158.22
POR4	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+02	1.8E+02	1.9E+01	1.3E+02	1.9E+01	18268.07
POR5	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	1.1E+02	1.2E+01	8.2E+01	1.2E+01	18206.17
POR6	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E+01	6.4E+01	8.9E+00	4.6E+01	8.9E+00	18164.27
POR7	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E+01	4.1E+01	5.6E+00	3.0E+01	5.6E+00	18140.77
POR8	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E+01	5.0E+01	5.5E+00	3.6E+01	5.5E+00	18147.17
POR9	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	1.2E+02	1.2E+01	8.5E+01	1.2E+01	18209.98
POR10	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	1.2E+02	1.3E+01	8.6E+01	1.3E+01	18211.52
POR11	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+02	1.4E+02	1.7E+01	1.0E+02	1.7E+01	18237.83
POR12	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E+01	5.3E+01	5.8E+00	3.8E+01	5.8E+00	18150.02
POR13	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+01	3.6E+01	4.0E+00	2.6E+01	4.0E+00	18133.87
POR14	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+01	2.9E+01	3.2E+00	2.1E+01	3.2E+00	18127.34
POR15	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E+01	2.8E+01	3.1E+00	2.0E+01	3.1E+00	18126.49
POR16	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+01	2.4E+01	2.7E+00	1.8E+01	2.7E+00	18123.14
POR17	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.9E+01	2.1E+00	1.4E+01	2.1E+00	18117.93
POR18	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E+01	6.0E+01	8.2E+00	4.4E+01	8.2E+00	18159.92
POR19	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+01	3.0E+01	3.3E+00	2.2E+01	3.3E+00	18128.34
POR20	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E+01	3.4E+01	3.8E+00	2.5E+01	3.8E+00	18132.09
POR21	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E+01	6.0E+01	6.6E+00	4.4E+01	6.6E+00	18156.86
POR22	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+01	2.5E+01	3.4E+00	1.8E+01	3.4E+00	18125.05
POR23	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E+01	1.9E+01	2.5E+00	1.4E+01	2.5E+00	18118.85
POR24	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+01	2.5E+01	3.4E+00	1.8E+01	3.4E+00	18125.16
POR25	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	1.0E+01	1.3E+00	7.6E+00	1.3E+00	18110.18
POR26	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E+01	4.0E+01	5.4E+00	2.9E+01	5.4E+00	18139.59
POR27	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E+01	1.9E+01	2.5E+00	1.4E+01	2.5E+00	18118.86
POR28	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E+01	5.9E+01	8.2E+00	4.3E+01	8.2E+00	18159.70
POR29	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E+01	2.8E+01	3.2E+00	2.1E+01	3.2E+00	18126.91
POR30	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.5E+01	1.7E+00	1.1E+01	1.7E+00	18113.92
POR31	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E+01	3.5E+01	4.1E+00	2.6E+01	4.1E+00	18133.82
POR32	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.8E+01	2.2E+00	1.3E+01	2.2E+00	18117.15
POR33	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E+02	2.9E+02	6.6E+01	2.1E+02	6.6E+01	18446.24
POR34	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E+02	2.3E+02	4.3E+01	1.6E+02	4.3E+01	18350.90
POR35	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E+02	1.8E+02	3.1E+01	1.3E+02	3.1E+01	18292.14
POR36	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E+01	4.3E+01	6.0E+00	3.1E+01	6.0E+00	18143.46
POR37	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E+01	3.8E+01	5.2E+00	2.8E+01	5.2E+00	18138.26
POR38	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E+01	2.9E+01	3.9E+00	2.1E+01	3.9E+00	18129.15
POR39	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+02	1.6E+02	1.8E+01	1.2E+02	1.8E+01	18254.57
POR40	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+02	2.3E+02	2.3E+01	1.7E+02	2.3E+01	18312.48
POR41	Iron	18100	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+01	8.8E+00	1.0E+00	6.4E+00	1.0E+00	18108.42

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	9.8E-03	1.1E-03	7.2E-03	1.1E-03	0.25
POR2	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.2E-03	3.1E-04	1.6E-03	3.1E-04	0.24
POR3	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.3E-03	3.1E-04	1.6E-03	3.1E-04	0.24
POR4	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-03	7.0E-03	7.2E-04	5.1E-03	7.2E-04	0.25
POR5	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-03	4.3E-03	4.8E-04	3.2E-03	4.8E-04	0.24
POR6	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-03	2.5E-03	3.4E-04	1.8E-03	3.4E-04	0.24
POR7	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.6E-03	2.2E-04	1.1E-03	2.2E-04	0.24
POR8	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.9E-03	2.1E-04	1.4E-03	2.1E-04	0.24
POR9	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-03	4.5E-03	4.8E-04	3.3E-03	4.8E-04	0.24
POR10	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-03	4.6E-03	4.9E-04	3.4E-03	4.9E-04	0.24
POR11	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E-03	5.5E-03	6.6E-04	4.0E-03	6.6E-04	0.25
POR12	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	2.0E-03	2.2E-04	1.5E-03	2.2E-04	0.24
POR13	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.4E-03	1.5E-04	1.0E-03	1.5E-04	0.24
POR14	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.2E-04	8.1E-04	1.2E-04	0.24
POR15	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	7.9E-04	1.2E-04	0.24
POR16	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	9.4E-04	1.1E-04	6.9E-04	1.1E-04	0.24
POR17	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-04	7.3E-04	8.2E-05	5.3E-04	8.2E-05	0.24
POR18	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-03	2.3E-03	3.2E-04	1.7E-03	3.2E-04	0.24
POR19	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.2E-03	1.3E-04	8.4E-04	1.3E-04	0.24
POR20	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.3E-03	1.5E-04	9.5E-04	1.5E-04	0.24
POR21	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	2.3E-03	2.5E-04	1.7E-03	2.5E-04	0.24
POR22	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.8E-04	1.3E-04	7.1E-04	1.3E-04	0.24
POR23	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.9E-04	7.4E-04	9.7E-05	5.4E-04	9.7E-05	0.24
POR24	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.8E-04	1.3E-04	7.2E-04	1.3E-04	0.24
POR25	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-04	4.0E-04	5.0E-05	2.9E-04	5.0E-05	0.24
POR26	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.5E-03	2.1E-04	1.1E-03	2.1E-04	0.24
POR27	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.9E-04	7.4E-04	9.7E-05	5.4E-04	9.7E-05	0.24
POR28	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-03	2.3E-03	3.2E-04	1.7E-03	3.2E-04	0.24
POR29	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.2E-04	8.0E-04	1.2E-04	0.24
POR30	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-04	5.7E-04	6.4E-05	4.1E-04	6.4E-05	0.24
POR31	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.4E-03	1.6E-04	9.9E-04	1.6E-04	0.24
POR32	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-04	6.8E-04	8.5E-05	5.0E-04	8.5E-05	0.24
POR33	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	1.1E-02	2.6E-03	8.3E-03	2.6E-03	0.25
POR34	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-02	8.8E-03	1.7E-03	6.4E-03	1.7E-03	0.25
POR35	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	6.9E-03	1.2E-03	5.0E-03	1.2E-03	0.25
POR36	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-03	1.7E-03	2.3E-04	1.2E-03	2.3E-04	0.24
POR37	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.5E-03	2.0E-04	1.1E-03	2.0E-04	0.24
POR38	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.1E-03	1.5E-04	8.3E-04	1.5E-04	0.24
POR39	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-03	6.3E-03	7.1E-04	4.6E-03	7.1E-04	0.25
POR40	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-03	8.8E-03	9.1E-04	6.4E-03	9.1E-04	0.25
POR41	Silver	0.24	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-04	3.4E-04	3.9E-05	2.5E-04	3.9E-05	0.24

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	9.5E-03	1.1E-03	6.9E-03	1.1E-03	0.21
POR2	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.2E-03	3.0E-04	1.6E-03	3.0E-04	0.20
POR3	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.2E-03	3.0E-04	1.6E-03	3.0E-04	0.20
POR4	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.1E-03	6.7E-03	6.9E-04	4.9E-03	6.9E-04	0.21
POR5	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-03	4.2E-03	4.6E-04	3.0E-03	4.6E-04	0.20
POR6	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-03	2.4E-03	3.3E-04	1.7E-03	3.3E-04	0.20
POR7	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.5E-03	2.1E-04	1.1E-03	2.1E-04	0.20
POR8	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.9E-03	2.0E-04	1.4E-03	2.0E-04	0.20
POR9	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-03	4.4E-03	4.6E-04	3.2E-03	4.6E-04	0.20
POR10	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-03	4.4E-03	4.7E-04	3.2E-03	4.7E-04	0.20
POR11	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E-03	5.3E-03	6.4E-04	3.9E-03	6.4E-04	0.21
POR12	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	2.0E-03	2.2E-04	1.4E-03	2.2E-04	0.20
POR13	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.3E-03	1.5E-04	9.7E-04	1.5E-04	0.20
POR14	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	7.8E-04	1.2E-04	0.20
POR15	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.0E-03	1.2E-04	7.6E-04	1.2E-04	0.20
POR16	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	9.1E-04	1.0E-04	6.6E-04	1.0E-04	0.20
POR17	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E-04	7.0E-04	7.9E-05	5.1E-04	7.9E-05	0.20
POR18	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.2E-03	3.0E-04	1.6E-03	3.0E-04	0.20
POR19	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.2E-04	8.1E-04	1.2E-04	0.20
POR20	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-03	1.3E-03	1.4E-04	9.2E-04	1.4E-04	0.20
POR21	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-03	2.2E-03	2.4E-04	1.6E-03	2.4E-04	0.20
POR22	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.4E-04	1.3E-04	6.9E-04	1.3E-04	0.20
POR23	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.5E-04	7.1E-04	9.3E-05	5.2E-04	9.3E-05	0.20
POR24	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.5E-04	1.3E-04	6.9E-04	1.3E-04	0.20
POR25	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-04	3.9E-04	4.8E-05	2.8E-04	4.8E-05	0.20
POR26	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.5E-03	2.0E-04	1.1E-03	2.0E-04	0.20
POR27	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.5E-04	7.1E-04	9.3E-05	5.2E-04	9.3E-05	0.20
POR28	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.2E-03	3.1E-04	1.6E-03	3.1E-04	0.20
POR29	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	7.7E-04	1.2E-04	0.20
POR30	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-04	5.4E-04	6.2E-05	4.0E-04	6.2E-05	0.20
POR31	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.3E-03	1.5E-04	9.5E-04	1.5E-04	0.20
POR32	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E-04	6.6E-04	8.2E-05	4.8E-04	8.2E-05	0.20
POR33	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-02	1.1E-02	2.5E-03	8.0E-03	2.5E-03	0.21
POR34	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-02	8.4E-03	1.6E-03	6.1E-03	1.6E-03	0.21
POR35	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	6.7E-03	1.2E-03	4.9E-03	1.2E-03	0.21
POR36	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-03	1.6E-03	2.2E-04	1.2E-03	2.2E-04	0.20
POR37	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.4E-03	1.9E-04	1.0E-03	1.9E-04	0.20
POR38	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.1E-03	1.5E-04	8.0E-04	1.5E-04	0.20
POR39	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-03	6.1E-03	6.8E-04	4.4E-03	6.8E-04	0.21
POR40	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E-03	8.5E-03	8.7E-04	6.2E-03	8.7E-04	0.21
POR41	Bismuth	0.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-04	3.3E-04	3.8E-05	2.4E-04	3.8E-05	0.20

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+02	1.2E+02	1.4E+01	9.1E+01	1.4E+01	5028.68
POR2	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E+01	2.9E+01	3.9E+00	2.1E+01	3.9E+00	4938.55
POR3	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E+01	2.9E+01	3.9E+00	2.1E+01	3.9E+00	4938.67
POR4	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.3E+01	8.9E+01	9.1E+00	6.5E+01	9.1E+00	4992.76
POR5	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E+01	5.5E+01	6.1E+00	4.0E+01	6.1E+00	4962.27
POR6	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E+01	3.1E+01	4.4E+00	2.3E+01	4.4E+00	4941.64
POR7	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+01	2.0E+01	2.7E+00	1.5E+01	2.7E+00	4930.07
POR8	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+01	2.5E+01	2.7E+00	1.8E+01	2.7E+00	4933.23
POR9	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E+01	5.8E+01	6.1E+00	4.2E+01	6.1E+00	4964.15
POR10	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E+01	5.9E+01	6.2E+00	4.3E+01	6.2E+00	4964.91
POR11	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E+01	7.0E+01	8.4E+00	5.1E+01	8.4E+00	4977.86
POR12	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E+01	2.6E+01	2.9E+00	1.9E+01	2.9E+00	4934.63
POR13	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+01	1.8E+01	2.0E+00	1.3E+01	2.0E+00	4926.67
POR14	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.4E+01	1.6E+00	1.0E+01	1.6E+00	4923.46
POR15	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.4E+01	1.5E+00	1.0E+01	1.5E+00	4923.04
POR16	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+01	1.2E+01	1.3E+00	8.7E+00	1.3E+00	4921.40
POR17	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	9.3E+00	1.0E+00	6.7E+00	1.0E+00	4918.83
POR18	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+01	3.0E+01	4.0E+00	2.1E+01	4.0E+00	4939.50
POR19	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.5E+01	1.6E+00	1.1E+01	1.6E+00	4923.95
POR20	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+01	1.7E+01	1.9E+00	1.2E+01	1.9E+00	4925.80
POR21	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+01	3.0E+01	3.2E+00	2.2E+01	3.2E+00	4938.00
POR22	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.2E+01	1.7E+00	9.0E+00	1.7E+00	4922.33
POR23	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	9.4E+00	1.2E+00	6.8E+00	1.2E+00	4919.28
POR24	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.2E+01	1.6E+00	9.1E+00	1.6E+00	4922.39
POR25	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+00	5.1E+00	6.4E-01	3.7E+00	6.4E-01	4915.01
POR26	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+01	1.9E+01	2.7E+00	1.4E+01	2.7E+00	4929.49
POR27	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	9.4E+00	1.2E+00	6.8E+00	1.2E+00	4919.29
POR28	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+01	2.9E+01	4.0E+00	2.1E+01	4.0E+00	4939.39
POR29	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.4E+01	1.6E+00	1.0E+01	1.6E+00	4923.25
POR30	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E+00	7.2E+00	8.1E-01	5.2E+00	8.1E-01	4916.85
POR31	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+01	1.7E+01	2.0E+00	1.3E+01	2.0E+00	4926.65
POR32	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	8.6E+00	1.1E+00	6.3E+00	1.1E+00	4918.44
POR33	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+02	1.4E+02	3.3E+01	1.1E+02	3.3E+01	5080.42
POR34	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+02	1.1E+02	2.1E+01	8.1E+01	2.1E+01	5033.51
POR35	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+02	8.8E+01	1.5E+01	6.4E+01	1.5E+01	5004.59
POR36	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E+01	2.1E+01	3.0E+00	1.5E+01	3.0E+00	4931.40
POR37	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+01	1.9E+01	2.6E+00	1.4E+01	2.6E+00	4928.84
POR38	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+01	1.4E+01	1.9E+00	1.0E+01	1.9E+00	4924.35
POR39	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E+01	8.0E+01	9.0E+00	5.8E+01	9.0E+00	4986.11
POR40	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+02	1.1E+02	1.1E+01	8.2E+01	1.1E+01	5014.63
POR41	Calcium	4910	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E+00	4.3E+00	5.0E-01	3.2E+00	5.0E-01	4914.15

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.7E+01	6.7E+01	7.5E+00	4.9E+01	7.5E+00	2204.11
POR2	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+01	1.5E+01	2.1E+00	1.1E+01	2.1E+00	2155.42
POR3	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.5E+01	2.1E+00	1.1E+01	2.1E+00	2155.48
POR4	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E+01	4.8E+01	4.9E+00	3.5E+01	4.9E+00	2184.71
POR5	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+01	3.0E+01	3.3E+00	2.2E+01	3.3E+00	2168.24
POR6	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+01	1.7E+01	2.4E+00	1.2E+01	2.4E+00	2157.09
POR7	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.1E+01	1.5E+00	7.9E+00	1.5E+00	2150.84
POR8	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.3E+01	1.4E+00	9.7E+00	1.4E+00	2152.55
POR9	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+01	3.1E+01	3.3E+00	2.3E+01	3.3E+00	2169.25
POR10	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+01	3.2E+01	3.3E+00	2.3E+01	3.3E+00	2169.66
POR11	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E+01	3.8E+01	4.5E+00	2.8E+01	4.5E+00	2176.66
POR12	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.4E+01	1.5E+00	1.0E+01	1.5E+00	2153.30
POR13	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	9.5E+00	1.1E+00	6.9E+00	1.1E+00	2149.01
POR14	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E+00	7.7E+00	8.5E-01	5.6E+00	8.5E-01	2147.27
POR15	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E+00	7.4E+00	8.3E-01	5.4E+00	8.3E-01	2147.05
POR16	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E+00	6.5E+00	7.3E-01	4.7E+00	7.3E-01	2146.16
POR17	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E+00	5.0E+00	5.7E-01	3.6E+00	5.7E-01	2144.77
POR18	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.6E+01	2.2E+00	1.2E+01	2.2E+00	2155.94
POR19	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.0E+00	7.9E+00	8.9E-01	5.8E+00	8.9E-01	2147.54
POR20	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+01	9.0E+00	1.0E+00	6.5E+00	1.0E+00	2148.53
POR21	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E+01	1.6E+01	1.7E+00	1.2E+01	1.7E+00	2155.12
POR22	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E+00	6.7E+00	8.9E-01	4.9E+00	8.9E-01	2146.66
POR23	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E+00	5.1E+00	6.6E-01	3.7E+00	6.6E-01	2145.01
POR24	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E+00	6.7E+00	8.9E-01	4.9E+00	8.9E-01	2146.69
POR25	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E+00	2.8E+00	3.4E-01	2.0E+00	3.4E-01	2142.71
POR26	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.1E+01	1.4E+00	7.7E+00	1.4E+00	2150.53
POR27	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E+00	5.1E+00	6.6E-01	3.7E+00	6.6E-01	2145.02
POR28	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.6E+01	2.2E+00	1.2E+01	2.2E+00	2155.88
POR29	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E+00	7.5E+00	8.4E-01	5.5E+00	8.4E-01	2147.16
POR30	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E+00	3.9E+00	4.4E-01	2.8E+00	4.4E-01	2143.70
POR31	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	9.3E+00	1.1E+00	6.8E+00	1.1E+00	2148.99
POR32	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E+00	4.7E+00	5.8E-01	3.4E+00	5.8E-01	2144.56
POR33	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E+02	7.8E+01	1.8E+01	5.7E+01	1.8E+01	2232.06
POR34	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+02	6.0E+01	1.2E+01	4.4E+01	1.2E+01	2206.72
POR35	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E+01	4.7E+01	8.3E+00	3.5E+01	8.3E+00	2191.09
POR36	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.1E+01	1.6E+00	8.4E+00	1.6E+00	2151.56
POR37	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+01	1.0E+01	1.4E+00	7.4E+00	1.4E+00	2150.18
POR38	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	7.8E+00	1.0E+00	5.7E+00	1.0E+00	2147.75
POR39	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E+01	4.3E+01	4.8E+00	3.1E+01	4.8E+00	2181.11
POR40	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E+01	6.1E+01	6.2E+00	4.4E+01	6.2E+00	2196.52
POR41	Potassium	2140	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+00	2.3E+00	2.7E-01	1.7E+00	2.7E-01	2142.24

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E+01	4.8E+01	5.4E+00	3.5E+01	5.4E+00	5555.79
POR2	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.1E+01	1.5E+00	8.0E+00	1.5E+00	5521.02
POR3	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.1E+01	1.5E+00	8.1E+00	1.5E+00	5521.06
POR4	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E+01	3.4E+01	3.5E+00	2.5E+01	3.5E+00	5541.93
POR5	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+01	2.1E+01	2.3E+00	1.5E+01	2.3E+00	5530.17
POR6	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.2E+01	1.7E+00	8.8E+00	1.7E+00	5522.21
POR7	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	7.7E+00	1.1E+00	5.6E+00	1.1E+00	5517.75
POR8	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	9.5E+00	1.0E+00	6.9E+00	1.0E+00	5518.96
POR9	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+01	2.2E+01	2.3E+00	1.6E+01	2.3E+00	5530.89
POR10	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+01	2.3E+01	2.4E+00	1.6E+01	2.4E+00	5531.19
POR11	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+01	2.7E+01	3.2E+00	2.0E+01	3.2E+00	5536.18
POR12	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	1.0E+01	1.1E+00	7.3E+00	1.1E+00	5519.50
POR13	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.7E+00	6.8E+00	7.5E-01	4.9E+00	7.5E-01	5516.43
POR14	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E+00	5.5E+00	6.1E-01	4.0E+00	6.1E-01	5515.19
POR15	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E+00	5.3E+00	5.9E-01	3.8E+00	5.9E-01	5515.03
POR16	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E+00	4.6E+00	5.2E-01	3.4E+00	5.2E-01	5514.40
POR17	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+00	3.6E+00	4.0E-01	2.6E+00	4.0E-01	5513.41
POR18	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.1E+01	1.5E+00	8.3E+00	1.5E+00	5521.38
POR19	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+00	5.7E+00	6.3E-01	4.1E+00	6.3E-01	5515.38
POR20	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E+00	6.4E+00	7.1E-01	4.7E+00	7.1E-01	5516.10
POR21	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	1.1E+01	1.2E+00	8.3E+00	1.2E+00	5520.80
POR22	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+00	4.8E+00	6.4E-01	3.5E+00	6.4E-01	5514.76
POR23	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E+00	3.6E+00	4.7E-01	2.6E+00	4.7E-01	5513.58
POR24	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+00	4.8E+00	6.4E-01	3.5E+00	6.4E-01	5514.78
POR25	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E+00	2.0E+00	2.5E-01	1.4E+00	2.5E-01	5511.93
POR26	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+01	7.5E+00	1.0E+00	5.5E+00	1.0E+00	5517.52
POR27	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E+00	3.6E+00	4.7E-01	2.6E+00	4.7E-01	5513.58
POR28	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.1E+01	1.6E+00	8.2E+00	1.6E+00	5521.34
POR29	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E+00	5.4E+00	6.0E-01	3.9E+00	6.0E-01	5515.11
POR30	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E+00	2.8E+00	3.1E-01	2.0E+00	3.1E-01	5512.64
POR31	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.0E+00	6.7E+00	7.9E-01	4.9E+00	7.9E-01	5516.42
POR32	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E+00	3.3E+00	4.2E-01	2.4E+00	4.2E-01	5513.26
POR33	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	5.6E+01	1.3E+01	4.1E+01	1.3E+01	5575.76
POR34	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E+01	4.3E+01	8.2E+00	3.1E+01	8.2E+00	5557.66
POR35	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.0E+01	3.4E+01	5.9E+00	2.5E+01	5.9E+00	5546.50
POR36	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+01	8.2E+00	1.1E+00	6.0E+00	1.1E+00	5518.26
POR37	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+01	7.3E+00	9.9E-01	5.3E+00	9.9E-01	5517.27
POR38	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.6E+00	5.6E+00	7.4E-01	4.0E+00	7.4E-01	5515.54
POR39	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E+01	3.1E+01	3.5E+00	2.2E+01	3.5E+00	5539.37
POR40	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E+01	4.3E+01	4.4E+00	3.1E+01	4.4E+00	5550.37
POR41	Magnesium	5510	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+00	1.7E+00	1.9E-01	1.2E+00	1.9E-01	5511.60

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+00	1.4E+00	1.5E-01	1.0E+00	1.5E-01	760.32
POR2	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-01	3.2E-01	4.3E-02	2.3E-01	4.3E-02	759.32
POR3	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-01	3.2E-01	4.3E-02	2.3E-01	4.3E-02	759.32
POR4	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+00	9.8E-01	1.0E-01	7.2E-01	1.0E-01	759.92
POR5	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-01	6.1E-01	6.7E-02	4.5E-01	6.7E-02	759.58
POR6	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-01	3.5E-01	4.8E-02	2.5E-01	4.8E-02	759.35
POR7	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-01	2.2E-01	3.0E-02	1.6E-01	3.0E-02	759.22
POR8	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-01	2.7E-01	3.0E-02	2.0E-01	3.0E-02	759.26
POR9	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-01	6.4E-01	6.7E-02	4.7E-01	6.7E-02	759.60
POR10	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-01	6.5E-01	6.8E-02	4.7E-01	6.8E-02	759.61
POR11	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.5E-01	7.8E-01	9.3E-02	5.7E-01	9.3E-02	759.75
POR12	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	2.9E-01	3.2E-02	2.1E-01	3.2E-02	759.27
POR13	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-01	1.9E-01	2.2E-02	1.4E-01	2.2E-02	759.18
POR14	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.6E-01	1.7E-02	1.1E-01	1.7E-02	759.15
POR15	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.5E-01	1.7E-02	1.1E-01	1.7E-02	759.14
POR16	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.3E-01	1.5E-02	9.7E-02	1.5E-02	759.13
POR17	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.0E-01	1.2E-02	7.5E-02	1.2E-02	759.10
POR18	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-01	3.3E-01	4.4E-02	2.4E-01	4.4E-02	759.33
POR19	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.6E-01	1.8E-02	1.2E-01	1.8E-02	759.15
POR20	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.8E-01	2.1E-02	1.3E-01	2.1E-02	759.18
POR21	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-01	3.3E-01	3.6E-02	2.4E-01	3.6E-02	759.31
POR22	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.4E-01	1.8E-02	1.0E-01	1.8E-02	759.14
POR23	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.6E-02	1.4E-02	759.10
POR24	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-01	1.4E-01	1.8E-02	1.0E-01	1.8E-02	759.14
POR25	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-02	5.7E-02	7.1E-03	4.1E-02	7.1E-03	759.06
POR26	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-01	2.2E-01	2.9E-02	1.6E-01	2.9E-02	759.22
POR27	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.6E-02	1.4E-02	759.10
POR28	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-01	3.3E-01	4.5E-02	2.4E-01	4.5E-02	759.33
POR29	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.5E-01	1.7E-02	1.1E-01	1.7E-02	759.15
POR30	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-02	8.0E-02	9.0E-03	5.8E-02	9.0E-03	759.08
POR31	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	1.9E-01	2.3E-02	1.4E-01	2.3E-02	759.18
POR32	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	9.6E-02	1.2E-02	7.0E-02	1.2E-02	759.09
POR33	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E+00	1.6E+00	3.6E-01	1.2E+00	3.6E-01	760.89
POR34	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+00	1.2E+00	2.4E-01	9.0E-01	2.4E-01	760.37
POR35	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	9.8E-01	1.7E-01	7.1E-01	1.7E-01	760.05
POR36	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-01	2.4E-01	3.3E-02	1.7E-01	3.3E-02	759.24
POR37	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-01	2.1E-01	2.9E-02	1.5E-01	2.9E-02	759.21
POR38	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-01	1.6E-01	2.1E-02	1.2E-01	2.1E-02	759.16
POR39	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+00	8.9E-01	9.9E-02	6.5E-01	9.9E-02	759.84
POR40	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	1.2E+00	1.3E-01	9.1E-01	1.3E-01	760.16
POR41	Phosphorus	759	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-02	4.8E-02	5.5E-03	3.5E-02	5.5E-03	759.05

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+02	1.0E+02	1.1E+01	7.4E+01	1.1E+01	1296.55
POR2	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E+01	2.3E+01	3.2E+00	1.7E+01	3.2E+00	1223.23
POR3	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E+01	2.3E+01	3.2E+00	1.7E+01	3.2E+00	1223.32
POR4	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.6E+01	7.2E+01	7.4E+00	5.3E+01	7.4E+00	1267.32
POR5	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E+01	4.5E+01	4.9E+00	3.3E+01	4.9E+00	1242.53
POR6	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E+01	2.6E+01	3.6E+00	1.9E+01	3.6E+00	1225.74
POR7	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+01	1.6E+01	2.2E+00	1.2E+01	2.2E+00	1216.33
POR8	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	2.0E+01	2.2E+00	1.5E+01	2.2E+00	1218.90
POR9	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E+01	4.7E+01	4.9E+00	3.4E+01	4.9E+00	1244.05
POR10	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E+01	4.8E+01	5.0E+00	3.5E+01	5.0E+00	1244.67
POR11	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E+01	5.7E+01	6.8E+00	4.2E+01	6.8E+00	1255.21
POR12	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E+01	2.1E+01	2.3E+00	1.5E+01	2.3E+00	1220.04
POR13	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.4E+01	1.6E+00	1.0E+01	1.6E+00	1213.57
POR14	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	1.2E+01	1.3E+00	8.4E+00	1.3E+00	1210.95
POR15	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	1.1E+01	1.2E+00	8.1E+00	1.2E+00	1210.61
POR16	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+01	9.7E+00	1.1E+00	7.1E+00	1.1E+00	1209.27
POR17	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E+00	7.5E+00	8.5E-01	5.5E+00	8.5E-01	1207.18
POR18	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+01	2.4E+01	3.3E+00	1.7E+01	3.3E+00	1224.00
POR19	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+01	1.2E+01	1.3E+00	8.7E+00	1.3E+00	1211.35
POR20	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.4E+01	1.5E+00	9.8E+00	1.5E+00	1212.85
POR21	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+01	2.4E+01	2.6E+00	1.8E+01	2.6E+00	1222.78
POR22	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+01	1.0E+01	1.3E+00	7.3E+00	1.3E+00	1210.03
POR23	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+01	7.6E+00	1.0E+00	5.6E+00	1.0E+00	1207.55
POR24	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+01	1.0E+01	1.3E+00	7.4E+00	1.3E+00	1210.08
POR25	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E+00	4.2E+00	5.2E-01	3.0E+00	5.2E-01	1204.08
POR26	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.6E+01	2.2E+00	1.2E+01	2.2E+00	1215.86
POR27	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+01	7.6E+00	1.0E+00	5.6E+00	1.0E+00	1207.55
POR28	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+01	2.4E+01	3.3E+00	1.7E+01	3.3E+00	1223.91
POR29	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+01	1.1E+01	1.3E+00	8.2E+00	1.3E+00	1210.78
POR30	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.8E+00	5.8E+00	6.6E-01	4.2E+00	6.6E-01	1205.58
POR31	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+01	1.4E+01	1.7E+00	1.0E+01	1.7E+00	1213.55
POR32	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.9E+00	7.0E+00	8.8E-01	5.1E+00	8.8E-01	1206.87
POR33	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+02	1.2E+02	2.6E+01	8.6E+01	2.6E+01	1338.64
POR34	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E+02	9.0E+01	1.7E+01	6.6E+01	1.7E+01	1300.47
POR35	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+02	7.2E+01	1.2E+01	5.2E+01	1.2E+01	1276.95
POR36	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E+01	1.7E+01	2.4E+00	1.3E+01	2.4E+00	1217.41
POR37	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+01	1.5E+01	2.1E+00	1.1E+01	2.1E+00	1215.33
POR38	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	1.2E+01	1.6E+00	8.5E+00	1.6E+00	1211.67
POR39	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E+01	6.5E+01	7.3E+00	4.7E+01	7.3E+00	1261.91
POR40	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.5E+01	9.1E+01	9.4E+00	6.6E+01	9.4E+00	1285.11
POR41	Sulfur	1200	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+00	3.5E+00	4.1E-01	2.6E+00	4.1E-01	1203.37

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-03	4.0E-03	4.5E-04	2.9E-03	4.5E-04	1.44
POR2	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.2E-04	1.3E-04	6.7E-04	1.3E-04	1.44
POR3	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.2E-04	1.3E-04	6.7E-04	1.3E-04	1.44
POR4	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.9E-03	2.9E-04	2.1E-03	2.9E-04	1.44
POR5	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.8E-03	1.9E-04	1.3E-03	1.9E-04	1.44
POR6	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-03	1.0E-03	1.4E-04	7.4E-04	1.4E-04	1.44
POR7	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.0E-04	6.4E-04	8.8E-05	4.7E-04	8.8E-05	1.44
POR8	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-04	7.9E-04	8.6E-05	5.7E-04	8.6E-05	1.44
POR9	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.9E-03	2.0E-04	1.4E-03	2.0E-04	1.44
POR10	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.9E-03	2.0E-04	1.4E-03	2.0E-04	1.44
POR11	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-03	2.3E-03	2.7E-04	1.6E-03	2.7E-04	1.44
POR12	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-04	8.4E-04	9.2E-05	6.1E-04	9.2E-05	1.44
POR13	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-04	5.6E-04	6.3E-05	4.1E-04	6.3E-05	1.44
POR14	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-04	4.6E-04	5.1E-05	3.3E-04	5.1E-05	1.44
POR15	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-04	4.4E-04	4.9E-05	3.2E-04	4.9E-05	1.44
POR16	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-04	3.8E-04	4.3E-05	2.8E-04	4.3E-05	1.44
POR17	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-04	3.0E-04	3.4E-05	2.2E-04	3.4E-05	1.44
POR18	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.5E-04	1.3E-04	6.9E-04	1.3E-04	1.44
POR19	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-04	4.7E-04	5.3E-05	3.4E-04	5.3E-05	1.44
POR20	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-04	5.3E-04	6.0E-05	3.9E-04	6.0E-05	1.44
POR21	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	9.5E-04	1.0E-04	6.9E-04	1.0E-04	1.44
POR22	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-04	4.0E-04	5.3E-05	2.9E-04	5.3E-05	1.44
POR23	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-04	3.0E-04	3.9E-05	2.2E-04	3.9E-05	1.44
POR24	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-04	4.0E-04	5.3E-05	2.9E-04	5.3E-05	1.44
POR25	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-04	1.7E-04	2.0E-05	1.2E-04	2.0E-05	1.44
POR26	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-04	6.3E-04	8.5E-05	4.6E-04	8.5E-05	1.44
POR27	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-04	3.0E-04	3.9E-05	2.2E-04	3.9E-05	1.44
POR28	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.4E-04	1.3E-04	6.9E-04	1.3E-04	1.44
POR29	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-04	4.5E-04	5.0E-05	3.3E-04	5.0E-05	1.44
POR30	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-04	2.3E-04	2.6E-05	1.7E-04	2.6E-05	1.44
POR31	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-04	5.6E-04	6.6E-05	4.0E-04	6.6E-05	1.44
POR32	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.5E-04	2.8E-04	3.5E-05	2.0E-04	3.5E-05	1.44
POR33	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	4.7E-03	1.0E-03	3.4E-03	1.0E-03	1.45
POR34	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-03	3.6E-03	6.9E-04	2.6E-03	6.9E-04	1.44
POR35	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.0E-03	2.8E-03	4.9E-04	2.1E-03	4.9E-04	1.44
POR36	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-04	6.8E-04	9.5E-05	5.0E-04	9.5E-05	1.44
POR37	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.4E-04	6.1E-04	8.3E-05	4.4E-04	8.3E-05	1.44
POR38	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-04	4.6E-04	6.2E-05	3.4E-04	6.2E-05	1.44
POR39	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-03	2.6E-03	2.9E-04	1.9E-03	2.9E-04	1.44
POR40	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-03	3.6E-03	3.7E-04	2.6E-03	3.7E-04	1.44
POR41	Antimony	1.44	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-04	1.4E-04	1.6E-05	1.0E-04	1.6E-05	1.44

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	1.2E-02	1.3E-03	8.8E-03	1.3E-03	2.01
POR2	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-03	2.8E-03	3.8E-04	2.0E-03	3.8E-04	2.00
POR3	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-03	2.8E-03	3.8E-04	2.0E-03	3.8E-04	2.00
POR4	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.0E-03	8.6E-03	8.8E-04	6.2E-03	8.8E-04	2.01
POR5	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.0E-03	5.3E-03	5.8E-04	3.9E-03	5.8E-04	2.01
POR6	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-03	3.0E-03	4.2E-04	2.2E-03	4.2E-04	2.00
POR7	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-03	1.9E-03	2.7E-04	1.4E-03	2.7E-04	2.00
POR8	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	2.4E-03	2.6E-04	1.7E-03	2.6E-04	2.00
POR9	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.0E-03	5.6E-03	5.9E-04	4.1E-03	5.9E-04	2.01
POR10	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-03	5.6E-03	6.0E-04	4.1E-03	6.0E-04	2.01
POR11	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E-03	6.8E-03	8.1E-04	4.9E-03	8.1E-04	2.01
POR12	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-03	2.5E-03	2.8E-04	1.8E-03	2.8E-04	2.00
POR13	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.7E-03	1.9E-04	1.2E-03	1.9E-04	2.00
POR14	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.4E-03	1.5E-04	1.0E-03	1.5E-04	2.00
POR15	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.3E-03	1.5E-04	9.6E-04	1.5E-04	2.00
POR16	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.2E-03	1.3E-04	8.4E-04	1.3E-04	2.00
POR17	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	8.9E-04	1.0E-04	6.5E-04	1.0E-04	2.00
POR18	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-03	2.8E-03	3.9E-04	2.1E-03	3.9E-04	2.00
POR19	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.4E-03	1.6E-04	1.0E-03	1.6E-04	2.00
POR20	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-03	1.6E-03	1.8E-04	1.2E-03	1.8E-04	2.00
POR21	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-03	2.9E-03	3.1E-04	2.1E-03	3.1E-04	2.00
POR22	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.2E-03	1.6E-04	8.7E-04	1.6E-04	2.00
POR23	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	9.0E-04	1.2E-04	6.6E-04	1.2E-04	2.00
POR24	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-03	1.2E-03	1.6E-04	8.8E-04	1.6E-04	2.00
POR25	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-04	5.0E-04	6.1E-05	3.6E-04	6.1E-05	2.00
POR26	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.9E-03	2.6E-04	1.4E-03	2.6E-04	2.00
POR27	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	9.1E-04	1.2E-04	6.6E-04	1.2E-04	2.00
POR28	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-03	2.8E-03	3.9E-04	2.1E-03	3.9E-04	2.00
POR29	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-03	1.3E-03	1.5E-04	9.8E-04	1.5E-04	2.00
POR30	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.0E-04	6.9E-04	7.9E-05	5.0E-04	7.9E-05	2.00
POR31	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-03	1.7E-03	2.0E-04	1.2E-03	2.0E-04	2.00
POR32	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	8.3E-04	1.0E-04	6.1E-04	1.0E-04	2.00
POR33	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-02	1.4E-02	3.1E-03	1.0E-02	3.1E-03	2.02
POR34	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	1.1E-02	2.1E-03	7.8E-03	2.1E-03	2.01
POR35	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-02	8.5E-03	1.5E-03	6.2E-03	1.5E-03	2.01
POR36	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-03	2.1E-03	2.9E-04	1.5E-03	2.9E-04	2.00
POR37	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-03	1.8E-03	2.5E-04	1.3E-03	2.5E-04	2.00
POR38	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.4E-03	1.9E-04	1.0E-03	1.9E-04	2.00
POR39	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-03	7.7E-03	8.6E-04	5.6E-03	8.6E-04	2.01
POR40	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	1.1E-02	1.1E-03	7.9E-03	1.1E-03	2.01
POR41	Tin	2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-04	4.2E-04	4.8E-05	3.0E-04	4.8E-05	2.00

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-01	6.4E-01	7.2E-02	4.7E-01	7.2E-02	26.41
POR2	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.5E-01	2.0E-02	1.1E-01	2.0E-02	25.95
POR3	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.5E-01	2.0E-02	1.1E-01	2.0E-02	25.95
POR4	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-01	4.6E-01	4.7E-02	3.3E-01	4.7E-02	26.23
POR5	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	2.8E-01	3.1E-02	2.1E-01	3.1E-02	26.07
POR6	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E-01	1.6E-01	2.2E-02	1.2E-01	2.2E-02	25.96
POR7	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.5E-02	1.4E-02	25.90
POR8	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.3E-01	1.4E-02	9.2E-02	1.4E-02	25.92
POR9	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	3.0E-01	3.1E-02	2.2E-01	3.1E-02	26.08
POR10	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-01	3.0E-01	3.2E-02	2.2E-01	3.2E-02	26.08
POR11	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E-01	3.6E-01	4.3E-02	2.6E-01	4.3E-02	26.15
POR12	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.3E-01	1.5E-02	9.7E-02	1.5E-02	25.93
POR13	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	9.0E-02	1.0E-02	6.6E-02	1.0E-02	25.89
POR14	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E-02	7.3E-02	8.1E-03	5.3E-02	8.1E-03	25.87
POR15	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E-02	7.0E-02	7.9E-03	5.1E-02	7.9E-03	25.87
POR16	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.1E-02	6.2E-02	6.9E-03	4.5E-02	6.9E-03	25.86
POR17	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-02	4.8E-02	5.4E-03	3.5E-02	5.4E-03	25.85
POR18	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.5E-01	2.1E-02	1.1E-01	2.1E-02	25.95
POR19	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.6E-02	7.5E-02	8.4E-03	5.5E-02	8.4E-03	25.87
POR20	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-02	8.6E-02	9.5E-03	6.2E-02	9.5E-03	25.88
POR21	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-01	1.5E-01	1.7E-02	1.1E-01	1.7E-02	25.94
POR22	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-02	6.4E-02	8.5E-03	4.6E-02	8.5E-03	25.86
POR23	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-02	4.8E-02	6.3E-03	3.5E-02	6.3E-03	25.85
POR24	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-02	6.4E-02	8.5E-03	4.7E-02	8.5E-03	25.86
POR25	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-02	2.6E-02	3.3E-03	1.9E-02	3.3E-03	25.83
POR26	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-01	1.0E-01	1.4E-02	7.3E-02	1.4E-02	25.90
POR27	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-02	4.8E-02	6.3E-03	3.5E-02	6.3E-03	25.85
POR28	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-01	1.5E-01	2.1E-02	1.1E-01	2.1E-02	25.95
POR29	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.2E-02	7.2E-02	8.0E-03	5.2E-02	8.0E-03	25.87
POR30	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-02	3.7E-02	4.2E-03	2.7E-02	4.2E-03	25.84
POR31	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	8.9E-02	1.0E-02	6.5E-02	1.0E-02	25.89
POR32	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.7E-02	4.4E-02	5.5E-03	3.2E-02	5.5E-03	25.84
POR33	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	7.4E-01	1.7E-01	5.4E-01	1.7E-01	26.68
POR34	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	5.7E-01	1.1E-01	4.2E-01	1.1E-01	26.44
POR35	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.0E-01	4.5E-01	7.9E-02	3.3E-01	7.9E-02	26.29
POR36	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E-01	1.1E-01	1.5E-02	8.0E-02	1.5E-02	25.91
POR37	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	9.7E-02	1.3E-02	7.0E-02	1.3E-02	25.90
POR38	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	7.4E-02	9.9E-03	5.4E-02	9.9E-03	25.87
POR39	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-01	4.1E-01	4.6E-02	3.0E-01	4.6E-02	26.19
POR40	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.0E-01	5.8E-01	5.9E-02	4.2E-01	5.9E-02	26.34
POR41	Strontium	25.8	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-02	2.2E-02	2.6E-03	1.6E-02	2.6E-03	25.82

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-02	5.8E-02	6.4E-03	4.2E-02	6.4E-03	0.05
POR2	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-02	1.3E-02	1.8E-03	9.6E-03	1.8E-03	0.01
POR3	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-02	1.3E-02	1.8E-03	9.6E-03	1.8E-03	0.01
POR4	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-02	4.1E-02	4.2E-03	3.0E-02	4.2E-03	0.04
POR5	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.6E-02	2.8E-03	1.9E-02	2.8E-03	0.02
POR6	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	1.5E-02	2.0E-03	1.1E-02	2.0E-03	0.01
POR7	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	9.3E-03	1.3E-03	6.7E-03	1.3E-03	0.01
POR8	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.1E-02	1.2E-03	8.3E-03	1.2E-03	0.01
POR9	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.7E-02	2.8E-03	1.9E-02	2.8E-03	0.03
POR10	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.7E-02	2.9E-03	2.0E-02	2.9E-03	0.03
POR11	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-02	3.2E-02	3.9E-03	2.4E-02	3.9E-03	0.03
POR12	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.2E-02	1.3E-03	8.8E-03	1.3E-03	0.01
POR13	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-03	8.1E-03	9.0E-04	5.9E-03	9.0E-04	0.01
POR14	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-03	6.6E-03	7.3E-04	4.8E-03	7.3E-04	0.01
POR15	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-03	6.3E-03	7.1E-04	4.6E-03	7.1E-04	0.01
POR16	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-03	5.5E-03	6.2E-04	4.0E-03	6.2E-04	0.01
POR17	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E-03	4.3E-03	4.8E-04	3.1E-03	4.8E-04	0.00
POR18	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.4E-02	1.9E-03	9.9E-03	1.9E-03	0.01
POR19	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.7E-03	6.8E-03	7.6E-04	4.9E-03	7.6E-04	0.01
POR20	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-03	7.7E-03	8.6E-04	5.6E-03	8.6E-04	0.01
POR21	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-02	1.4E-02	1.5E-03	1.0E-02	1.5E-03	0.01
POR22	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-03	5.7E-03	7.6E-04	4.2E-03	7.6E-04	0.01
POR23	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-03	4.3E-03	5.7E-04	3.2E-03	5.7E-04	0.00
POR24	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.8E-03	5.8E-03	7.6E-04	4.2E-03	7.6E-04	0.01
POR25	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.4E-03	2.9E-04	1.7E-03	2.9E-04	0.00
POR26	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	9.0E-03	1.2E-03	6.6E-03	1.2E-03	0.01
POR27	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.8E-03	4.3E-03	5.7E-04	3.2E-03	5.7E-04	0.00
POR28	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-02	1.4E-02	1.9E-03	9.9E-03	1.9E-03	0.01
POR29	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-03	6.4E-03	7.2E-04	4.7E-03	7.2E-04	0.01
POR30	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-03	3.3E-03	3.8E-04	2.4E-03	3.8E-04	0.00
POR31	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.6E-03	8.0E-03	9.4E-04	5.8E-03	9.4E-04	0.01
POR32	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-03	4.0E-03	5.0E-04	2.9E-03	5.0E-04	0.00
POR33	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	6.7E-02	1.5E-02	4.9E-02	1.5E-02	0.08
POR34	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-01	5.1E-02	9.9E-03	3.7E-02	9.9E-03	0.06
POR35	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.2E-02	4.1E-02	7.1E-03	3.0E-02	7.1E-03	0.04
POR36	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	9.8E-03	1.4E-03	7.2E-03	1.4E-03	0.01
POR37	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-02	8.7E-03	1.2E-03	6.3E-03	1.2E-03	0.01
POR38	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E-03	6.7E-03	8.9E-04	4.9E-03	8.9E-04	0.01
POR39	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-02	3.7E-02	4.1E-03	2.7E-02	4.1E-03	0.04
POR40	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-02	5.2E-02	5.3E-03	3.8E-02	5.3E-03	0.05
POR41	Thorium	NA	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-03	2.0E-03	2.3E-04	1.5E-03	2.3E-04	0.00

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+01	1.3E+01	1.4E+00	9.3E+00	1.4E+00	965.17
POR2	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+00	2.9E+00	4.0E-01	2.1E+00	4.0E-01	955.93
POR3	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E+00	2.9E+00	4.0E-01	2.1E+00	4.0E-01	955.94
POR4	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.5E+00	9.1E+00	9.3E-01	6.6E+00	9.3E-01	961.49
POR5	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E+00	5.7E+00	6.2E-01	4.1E+00	6.2E-01	958.36
POR6	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E+00	3.2E+00	4.5E-01	2.3E+00	4.5E-01	956.25
POR7	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E+00	2.1E+00	2.8E-01	1.5E+00	2.8E-01	955.06
POR8	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+00	2.5E+00	2.7E-01	1.8E+00	2.7E-01	955.38
POR9	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E+00	5.9E+00	6.2E-01	4.3E+00	6.2E-01	958.55
POR10	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+00	6.0E+00	6.3E-01	4.4E+00	6.3E-01	958.63
POR11	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E+00	7.2E+00	8.6E-01	5.2E+00	8.6E-01	959.96
POR12	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E+00	2.7E+00	2.9E-01	1.9E+00	2.9E-01	955.53
POR13	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+00	1.8E+00	2.0E-01	1.3E+00	2.0E-01	954.71
POR14	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+00	1.5E+00	1.6E-01	1.1E+00	1.6E-01	954.38
POR15	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+00	1.4E+00	1.6E-01	1.0E+00	1.6E-01	954.34
POR16	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+00	1.2E+00	1.4E-01	8.9E-01	1.4E-01	954.17
POR17	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	9.5E-01	1.1E-01	6.9E-01	1.1E-01	953.91
POR18	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E+00	3.0E+00	4.1E-01	2.2E+00	4.1E-01	956.03
POR19	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.5E+00	1.7E-01	1.1E+00	1.7E-01	954.43
POR20	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E+00	1.7E+00	1.9E-01	1.2E+00	1.9E-01	954.62
POR21	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+00	3.0E+00	3.3E-01	2.2E+00	3.3E-01	955.87
POR22	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.3E+00	1.7E-01	9.3E-01	1.7E-01	954.27
POR23	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	9.6E-01	1.3E-01	7.0E-01	1.3E-01	953.95
POR24	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+00	1.3E+00	1.7E-01	9.3E-01	1.7E-01	954.27
POR25	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-01	5.3E-01	6.5E-02	3.8E-01	6.5E-02	953.51
POR26	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+00	2.0E+00	2.7E-01	1.5E+00	2.7E-01	955.00
POR27	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E+00	9.6E-01	1.3E-01	7.0E-01	1.3E-01	953.95
POR28	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E+00	3.0E+00	4.1E-01	2.2E+00	4.1E-01	956.01
POR29	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+00	1.4E+00	1.6E-01	1.0E+00	1.6E-01	954.36
POR30	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.5E-01	7.4E-01	8.4E-02	5.4E-01	8.4E-02	953.70
POR31	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E+00	1.8E+00	2.1E-01	1.3E+00	2.1E-01	954.71
POR32	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+00	8.9E-01	1.1E-01	6.5E-01	1.1E-01	953.87
POR33	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+01	1.5E+01	3.3E+00	1.1E+01	3.3E+00	970.48
POR34	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+01	1.1E+01	2.2E+00	8.3E+00	2.2E+00	965.67
POR35	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.6E+01	9.0E+00	1.6E+00	6.6E+00	1.6E+00	962.70
POR36	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E+00	2.2E+00	3.0E-01	1.6E+00	3.0E-01	955.19
POR37	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+00	1.9E+00	2.6E-01	1.4E+00	2.6E-01	954.93
POR38	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+00	1.5E+00	2.0E-01	1.1E+00	2.0E-01	954.47
POR39	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E+00	8.2E+00	9.2E-01	6.0E+00	9.2E-01	960.81
POR40	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E+01	1.2E+01	1.2E+00	8.4E+00	1.2E+00	963.73
POR41	Titanium	953	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-01	4.4E-01	5.1E-02	3.2E-01	5.1E-02	953.43

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.9E-02	2.2E-03	1.4E-02	2.2E-03	1.13
POR2	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-03	4.4E-03	6.0E-04	3.2E-03	6.0E-04	1.11
POR3	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.2E-03	4.4E-03	6.0E-04	3.2E-03	6.0E-04	1.11
POR4	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	1.4E-02	1.4E-03	1.0E-02	1.4E-03	1.12
POR5	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.6E-03	8.5E-03	9.4E-04	6.2E-03	9.4E-04	1.12
POR6	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-03	4.9E-03	6.8E-04	3.5E-03	6.8E-04	1.11
POR7	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E-03	3.1E-03	4.3E-04	2.3E-03	4.3E-04	1.11
POR8	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-03	3.8E-03	4.1E-04	2.8E-03	4.1E-04	1.11
POR9	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.6E-03	8.9E-03	9.4E-04	6.5E-03	9.4E-04	1.12
POR10	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-03	9.0E-03	9.5E-04	6.6E-03	9.5E-04	1.12
POR11	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	1.1E-02	1.3E-03	7.9E-03	1.3E-03	1.12
POR12	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E-03	4.0E-03	4.4E-04	2.9E-03	4.4E-04	1.11
POR13	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-03	2.7E-03	3.0E-04	2.0E-03	3.0E-04	1.11
POR14	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-03	2.2E-03	2.4E-04	1.6E-03	2.4E-04	1.11
POR15	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-03	2.1E-03	2.4E-04	1.5E-03	2.4E-04	1.11
POR16	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.9E-03	2.1E-04	1.3E-03	2.1E-04	1.11
POR17	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.4E-03	1.6E-04	1.0E-03	1.6E-04	1.11
POR18	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-03	4.6E-03	6.2E-04	3.3E-03	6.2E-04	1.11
POR19	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	2.3E-03	2.5E-04	1.7E-03	2.5E-04	1.11
POR20	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-03	2.6E-03	2.9E-04	1.9E-03	2.9E-04	1.11
POR21	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-03	4.6E-03	5.0E-04	3.3E-03	5.0E-04	1.11
POR22	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.9E-03	2.6E-04	1.4E-03	2.6E-04	1.11
POR23	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.5E-03	1.9E-04	1.1E-03	1.9E-04	1.11
POR24	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.9E-03	2.6E-04	1.4E-03	2.6E-04	1.11
POR25	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	7.9E-04	9.9E-05	5.8E-04	9.9E-05	1.11
POR26	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-03	3.0E-03	4.1E-04	2.2E-03	4.1E-04	1.11
POR27	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.5E-03	1.9E-04	1.1E-03	1.9E-04	1.11
POR28	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.4E-03	4.5E-03	6.2E-04	3.3E-03	6.2E-04	1.11
POR29	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.5E-03	2.2E-03	2.4E-04	1.6E-03	2.4E-04	1.11
POR30	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.3E-04	8.1E-04	1.3E-04	1.11
POR31	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.2E-03	2.7E-03	3.2E-04	1.9E-03	3.2E-04	1.11
POR32	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.3E-03	1.7E-04	9.7E-04	1.7E-04	1.11
POR33	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.1E-02	2.2E-02	5.0E-03	1.6E-02	5.0E-03	1.14
POR34	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E-02	1.7E-02	3.3E-03	1.3E-02	3.3E-03	1.13
POR35	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.4E-02	1.4E-02	2.4E-03	9.9E-03	2.4E-03	1.12
POR36	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-03	3.3E-03	4.6E-04	2.4E-03	4.6E-04	1.11
POR37	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-03	2.9E-03	4.0E-04	2.1E-03	4.0E-04	1.11
POR38	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.0E-03	2.2E-03	3.0E-04	1.6E-03	3.0E-04	1.11
POR39	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	1.2E-02	1.4E-03	9.0E-03	1.4E-03	1.12
POR40	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-02	1.7E-02	1.8E-03	1.3E-02	1.8E-03	1.13
POR41	Tungsten	1.11	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.9E-04	6.7E-04	7.7E-05	4.9E-04	7.7E-05	1.11

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-02	4.2E-02	4.7E-03	3.0E-02	4.7E-03	0.04
POR2	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	9.5E-03	1.3E-03	6.9E-03	1.3E-03	0.01
POR3	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-02	9.6E-03	1.3E-03	7.0E-03	1.3E-03	0.01
POR4	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-02	3.0E-02	3.0E-03	2.2E-02	3.0E-03	0.03
POR5	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	1.8E-02	2.0E-03	1.3E-02	2.0E-03	0.02
POR6	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-02	1.1E-02	1.5E-03	7.7E-03	1.5E-03	0.01
POR7	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.4E-03	6.7E-03	9.2E-04	4.9E-03	9.2E-04	0.01
POR8	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-03	8.2E-03	9.0E-04	6.0E-03	9.0E-04	0.01
POR9	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	1.9E-02	2.0E-03	1.4E-02	2.0E-03	0.02
POR10	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	2.0E-02	2.1E-03	1.4E-02	2.1E-03	0.02
POR11	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.3E-02	2.8E-03	1.7E-02	2.8E-03	0.02
POR12	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.7E-03	8.7E-03	9.5E-04	6.3E-03	9.5E-04	0.01
POR13	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E-03	5.9E-03	6.5E-04	4.3E-03	6.5E-04	0.01
POR14	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E-03	4.7E-03	5.3E-04	3.5E-03	5.3E-04	0.00
POR15	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-03	4.6E-03	5.1E-04	3.3E-03	5.1E-04	0.00
POR16	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E-03	4.0E-03	4.5E-04	2.9E-03	4.5E-04	0.00
POR17	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E-03	3.1E-03	3.5E-04	2.3E-03	3.5E-04	0.00
POR18	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	9.9E-03	1.3E-03	7.2E-03	1.3E-03	0.01
POR19	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-03	4.9E-03	5.5E-04	3.6E-03	5.5E-04	0.00
POR20	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-03	5.6E-03	6.2E-04	4.0E-03	6.2E-04	0.01
POR21	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-02	9.9E-03	1.1E-03	7.2E-03	1.1E-03	0.01
POR22	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-03	4.1E-03	5.5E-04	3.0E-03	5.5E-04	0.00
POR23	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-03	3.1E-03	4.1E-04	2.3E-03	4.1E-04	0.00
POR24	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.6E-03	4.2E-03	5.5E-04	3.0E-03	5.5E-04	0.00
POR25	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-03	1.7E-03	2.1E-04	1.3E-03	2.1E-04	0.00
POR26	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E-03	6.5E-03	8.9E-04	4.7E-03	8.9E-04	0.01
POR27	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-03	3.1E-03	4.1E-04	2.3E-03	4.1E-04	0.00
POR28	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	9.8E-03	1.3E-03	7.1E-03	1.3E-03	0.01
POR29	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-03	4.7E-03	5.2E-04	3.4E-03	5.2E-04	0.00
POR30	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-03	2.4E-03	2.7E-04	1.7E-03	2.7E-04	0.00
POR31	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-03	5.8E-03	6.8E-04	4.2E-03	6.8E-04	0.01
POR32	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-03	2.9E-03	3.6E-04	2.1E-03	3.6E-04	0.00
POR33	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-01	4.8E-02	1.1E-02	3.5E-02	1.1E-02	0.06
POR34	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E-02	3.7E-02	7.1E-03	2.7E-02	7.1E-03	0.04
POR35	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-02	2.9E-02	5.1E-03	2.1E-02	5.1E-03	0.03
POR36	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-02	7.1E-03	9.9E-04	5.2E-03	9.9E-04	0.01
POR37	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-03	6.3E-03	8.6E-04	4.6E-03	8.6E-04	0.01
POR38	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.6E-03	4.8E-03	6.4E-04	3.5E-03	6.4E-04	0.00
POR39	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E-02	2.7E-02	3.0E-03	1.9E-02	3.0E-03	0.03
POR40	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.9E-02	3.8E-02	3.8E-03	2.7E-02	3.8E-03	0.03
POR41	Yttrium	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.4E-03	1.7E-04	1.1E-03	1.7E-04	0.00

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.3E-01	5.5E-01	6.1E-02	4.0E-01	6.1E-02	3.72
POR2	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.7E-02	9.1E-02	1.7E-02	3.33
POR3	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.7E-02	9.2E-02	1.7E-02	3.33
POR4	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-01	3.9E-01	4.0E-02	2.8E-01	4.0E-02	3.56
POR5	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-01	2.4E-01	2.7E-02	1.8E-01	2.7E-02	3.43
POR6	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E-01	1.4E-01	1.9E-02	1.0E-01	1.9E-02	3.34
POR7	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	8.8E-02	1.2E-02	6.4E-02	1.2E-02	3.29
POR8	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	1.1E-01	1.2E-02	7.9E-02	1.2E-02	3.30
POR9	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E-01	2.5E-01	2.7E-02	1.8E-01	2.7E-02	3.44
POR10	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E-01	2.6E-01	2.7E-02	1.9E-01	2.7E-02	3.44
POR11	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.8E-01	3.1E-01	3.7E-02	2.2E-01	3.7E-02	3.50
POR12	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	1.1E-01	1.3E-02	8.3E-02	1.3E-02	3.31
POR13	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-02	7.7E-02	8.6E-03	5.6E-02	8.6E-03	3.27
POR14	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.1E-02	6.2E-02	6.9E-03	4.5E-02	6.9E-03	3.26
POR15	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-02	6.0E-02	6.8E-03	4.4E-02	6.8E-03	3.26
POR16	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.1E-02	5.3E-02	5.9E-03	3.8E-02	5.9E-03	3.25
POR17	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.7E-02	4.1E-02	4.6E-03	3.0E-02	4.6E-03	3.24
POR18	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.8E-02	9.5E-02	1.8E-02	3.33
POR19	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-02	6.5E-02	7.2E-03	4.7E-02	7.2E-03	3.26
POR20	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.3E-02	7.3E-02	8.2E-03	5.3E-02	8.2E-03	3.27
POR21	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E-01	1.3E-01	1.4E-02	9.5E-02	1.4E-02	3.32
POR22	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-02	5.5E-02	7.3E-03	4.0E-02	7.3E-03	3.25
POR23	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-02	4.1E-02	5.4E-03	3.0E-02	5.4E-03	3.24
POR24	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.4E-02	5.5E-02	7.3E-03	4.0E-02	7.3E-03	3.25
POR25	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-02	2.3E-02	2.8E-03	1.6E-02	2.8E-03	3.22
POR26	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	8.6E-02	1.2E-02	6.2E-02	1.2E-02	3.29
POR27	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-02	4.1E-02	5.4E-03	3.0E-02	5.4E-03	3.24
POR28	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-01	1.3E-01	1.8E-02	9.4E-02	1.8E-02	3.33
POR29	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.0E-02	6.1E-02	6.9E-03	4.5E-02	6.9E-03	3.26
POR30	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.7E-02	3.2E-02	3.6E-03	2.3E-02	3.6E-03	3.23
POR31	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.2E-02	7.6E-02	9.0E-03	5.5E-02	9.0E-03	3.27
POR32	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E-02	3.8E-02	4.7E-03	2.8E-02	4.7E-03	3.24
POR33	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+00	6.4E-01	1.4E-01	4.6E-01	1.4E-01	3.95
POR34	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.6E-01	4.9E-01	9.4E-02	3.6E-01	9.4E-02	3.74
POR35	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-01	3.9E-01	6.7E-02	2.8E-01	6.7E-02	3.62
POR36	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-01	9.4E-02	1.3E-02	6.8E-02	1.3E-02	3.29
POR37	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-01	8.3E-02	1.1E-02	6.0E-02	1.1E-02	3.28
POR38	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.7E-02	6.4E-02	8.5E-03	4.6E-02	8.5E-03	3.26
POR39	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-01	3.5E-01	3.9E-02	2.6E-01	3.9E-02	3.54
POR40	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.2E-01	4.9E-01	5.1E-02	3.6E-01	5.1E-02	3.66
POR41	Zirconium	3.2	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E-02	1.9E-02	2.2E-03	1.4E-02	2.2E-03	3.22

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	9.1E-03	8.0E-03	8.9E-04	5.8E-03	8.9E-04	5.31
POR2	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.8E-03	2.5E-04	1.3E-03	2.5E-04	5.30
POR3	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.8E-03	2.5E-04	1.3E-03	2.5E-04	5.30
POR4	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.0E-03	5.7E-03	5.9E-04	4.2E-03	5.9E-04	5.31
POR5	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-03	3.5E-03	3.9E-04	2.6E-03	3.9E-04	5.30
POR6	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.9E-03	2.0E-03	2.8E-04	1.5E-03	2.8E-04	5.30
POR7	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-03	1.3E-03	1.8E-04	9.4E-04	1.8E-04	5.30
POR8	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E-03	1.6E-03	1.7E-04	1.1E-03	1.7E-04	5.30
POR9	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.0E-03	3.7E-03	3.9E-04	2.7E-03	3.9E-04	5.30
POR10	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.1E-03	3.8E-03	4.0E-04	2.7E-03	4.0E-04	5.30
POR11	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.5E-03	4.5E-03	5.4E-04	3.3E-03	5.4E-04	5.30
POR12	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.7E-03	1.8E-04	1.2E-03	1.8E-04	5.30
POR13	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.3E-04	8.2E-04	1.3E-04	5.30
POR14	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	9.1E-04	1.0E-04	6.6E-04	1.0E-04	5.30
POR15	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	8.8E-04	9.9E-05	6.4E-04	9.9E-05	5.30
POR16	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.8E-04	7.7E-04	8.7E-05	5.6E-04	8.7E-05	5.30
POR17	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.9E-04	6.0E-04	6.7E-05	4.3E-04	6.7E-05	5.30
POR18	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.9E-03	2.6E-04	1.4E-03	2.6E-04	5.30
POR19	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	9.4E-04	1.1E-04	6.9E-04	1.1E-04	5.30
POR20	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.2E-03	1.1E-03	1.2E-04	7.8E-04	1.2E-04	5.30
POR21	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-03	1.9E-03	2.1E-04	1.4E-03	2.1E-04	5.30
POR22	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	8.0E-04	1.1E-04	5.8E-04	1.1E-04	5.30
POR23	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E-04	6.0E-04	7.9E-05	4.4E-04	7.9E-05	5.30
POR24	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E-03	8.0E-04	1.1E-04	5.8E-04	1.1E-04	5.30
POR25	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.2E-04	3.3E-04	4.1E-05	2.4E-04	4.1E-05	5.30
POR26	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.3E-03	1.7E-04	9.1E-04	1.7E-04	5.30
POR27	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	8.1E-04	6.0E-04	7.9E-05	4.4E-04	7.9E-05	5.30
POR28	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E-03	1.9E-03	2.6E-04	1.4E-03	2.6E-04	5.30
POR29	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-03	8.9E-04	1.0E-04	6.5E-04	1.0E-04	5.30
POR30	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.3E-04	4.6E-04	5.2E-05	3.4E-04	5.2E-05	5.30
POR31	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	1.1E-03	1.3E-04	8.1E-04	1.3E-04	5.30
POR32	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.1E-04	5.6E-04	6.9E-05	4.0E-04	6.9E-05	5.30
POR33	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.1E-02	9.3E-03	2.1E-03	6.8E-03	2.1E-03	5.31
POR34	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E-02	7.1E-03	1.4E-03	5.2E-03	1.4E-03	5.31
POR35	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E-02	5.7E-03	9.8E-04	4.1E-03	9.8E-04	5.31
POR36	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.9E-03	1.4E-03	1.9E-04	1.0E-03	1.9E-04	5.30
POR37	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E-03	1.2E-03	1.7E-04	8.8E-04	1.7E-04	5.30
POR38	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.3E-03	9.3E-04	1.2E-04	6.7E-04	1.2E-04	5.30
POR39	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.9E-03	5.1E-03	5.8E-04	3.7E-03	5.8E-04	5.30
POR40	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.5E-03	7.2E-03	7.4E-04	5.2E-03	7.4E-04	5.31
POR41	Boron	5.3	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E-04	2.8E-04	3.2E-05	2.0E-04	3.2E-05	5.30

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.3E+03	2.0E+03	2.3E+02	1.5E+03	2.3E+02	NC
POR2	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+02	4.6E+02	6.4E+01	3.4E+02	6.4E+01	NC
POR3	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.5E+02	4.7E+02	6.4E+01	3.4E+02	6.4E+01	NC
POR4	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.5E+03	1.4E+03	1.5E+02	1.1E+03	1.5E+02	NC
POR5	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+03	9.0E+02	9.9E+01	6.5E+02	9.9E+01	NC
POR6	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	7.3E+02	5.1E+02	7.1E+01	3.7E+02	7.1E+01	NC
POR7	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.6E+02	3.3E+02	4.5E+01	2.4E+02	4.5E+01	NC
POR8	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.5E+02	4.0E+02	4.4E+01	2.9E+02	4.4E+01	NC
POR9	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+03	9.4E+02	9.9E+01	6.8E+02	9.9E+01	NC
POR10	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.0E+03	9.5E+02	1.0E+02	6.9E+02	1.0E+02	NC
POR11	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+03	1.1E+03	1.4E+02	8.3E+02	1.4E+02	NC
POR12	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.8E+02	4.2E+02	4.7E+01	3.1E+02	4.7E+01	NC
POR13	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.3E+02	2.9E+02	3.2E+01	2.1E+02	3.2E+01	NC
POR14	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+02	2.3E+02	2.6E+01	1.7E+02	2.6E+01	NC
POR15	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+02	2.2E+02	2.5E+01	1.6E+02	2.5E+01	NC
POR16	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.2E+02	1.9E+02	2.2E+01	1.4E+02	2.2E+01	NC
POR17	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.7E+02	1.5E+02	1.7E+01	1.1E+02	1.7E+01	NC
POR18	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E+02	4.8E+02	6.6E+01	3.5E+02	6.6E+01	NC
POR19	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.7E+02	2.4E+02	2.7E+01	1.7E+02	2.7E+01	NC
POR20	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.1E+02	2.7E+02	3.0E+01	2.0E+02	3.0E+01	NC
POR21	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E+02	4.8E+02	5.3E+01	3.5E+02	5.3E+01	NC
POR22	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+02	2.0E+02	2.7E+01	1.5E+02	2.7E+01	NC
POR23	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+02	1.5E+02	2.0E+01	1.1E+02	2.0E+01	NC
POR24	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.8E+02	2.0E+02	2.7E+01	1.5E+02	2.7E+01	NC
POR25	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.1E+02	8.4E+01	1.0E+01	6.1E+01	1.0E+01	NC
POR26	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.4E+02	3.2E+02	4.3E+01	2.3E+02	4.3E+01	NC
POR27	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.0E+02	1.5E+02	2.0E+01	1.1E+02	2.0E+01	NC
POR28	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	6.7E+02	4.8E+02	6.6E+01	3.5E+02	6.6E+01	NC
POR29	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+02	2.3E+02	2.6E+01	1.6E+02	2.6E+01	NC
POR30	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.4E+02	1.2E+02	1.3E+01	8.5E+01	1.3E+01	NC
POR31	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.4E+02	2.8E+02	3.3E+01	2.0E+02	3.3E+01	NC
POR32	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	1.8E+02	1.4E+02	1.8E+01	1.0E+02	1.8E+01	NC
POR33	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	5.4E+03	2.4E+03	5.3E+02	1.7E+03	5.3E+02	NC
POR34	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	3.6E+03	1.8E+03	3.5E+02	1.3E+03	3.5E+02	NC
POR35	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	2.6E+03	1.4E+03	2.5E+02	1.0E+03	2.5E+02	NC
POR36	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.9E+02	3.5E+02	4.8E+01	2.5E+02	4.8E+01	NC
POR37	TSP	NV	1.5E+03	2.0E-02	3.2E+01	1.4E-02	4.3E+02	3.1E+02	4.2E+01	2.2E+02	4.2E+01	NC
POR38	TSP	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.2E+02	2.3E+02	1.7E+01	1.6E+01	1.7E+01	NC
POR39	TSP	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E+03	1.3E+03	7.9E+01	9.0E+01	7.9E+01	NC
POR40	TSP	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.9E+03	1.8E+03	1.0E+02	1.3E+02	1.0E+02	NC
POR41	TSP	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.3E+01	7.0E+01	4.4E+00	4.9E+00	4.4E+00	NC

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.9E+02	7.5E+02	4.7E+01	5.2E+01	4.7E+01	NC
POR2	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.5E+02	1.8E+02	1.3E+01	1.2E+01	1.3E+01	NC
POR3	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.5E+02	1.8E+02	1.3E+01	1.2E+01	1.3E+01	NC
POR4	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.4E+02	7.2E+02	3.9E+01	5.0E+01	3.9E+01	NC
POR5	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.0E+02	3.5E+02	2.1E+01	2.4E+01	2.1E+01	NC
POR6	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.8E+02	1.9E+02	1.5E+01	1.4E+01	1.5E+01	NC
POR7	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E+02	1.2E+02	9.5E+00	8.7E+00	9.5E+00	NC
POR8	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.9E+02	1.7E+02	1.0E+01	1.2E+01	1.0E+01	NC
POR9	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.6E+02	4.3E+02	2.4E+01	3.0E+01	2.4E+01	NC
POR10	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.6E+02	4.3E+02	2.5E+01	3.0E+01	2.5E+01	NC
POR11	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.3E+02	4.3E+02	2.8E+01	3.0E+01	2.8E+01	NC
POR12	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.0E+02	1.8E+02	1.1E+01	1.3E+01	1.1E+01	NC
POR13	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E+02	1.2E+02	7.3E+00	8.3E+00	7.3E+00	NC
POR14	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+02	9.7E+01	5.9E+00	6.7E+00	5.9E+00	NC
POR15	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+02	9.2E+01	5.7E+00	6.4E+00	5.7E+00	NC
POR16	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.6E+01	8.2E+01	5.1E+00	5.7E+00	5.1E+00	NC
POR17	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.4E+01	6.3E+01	3.9E+00	4.4E+00	3.9E+00	NC
POR18	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.5E+02	1.8E+02	1.3E+01	1.3E+01	1.3E+01	NC
POR19	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+02	9.9E+01	6.1E+00	6.9E+00	6.1E+00	NC
POR20	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+02	1.1E+02	6.9E+00	7.8E+00	6.9E+00	NC
POR21	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.3E+02	2.0E+02	1.2E+01	1.4E+01	1.2E+01	NC
POR22	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+02	7.9E+01	5.8E+00	5.5E+00	5.8E+00	NC
POR23	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.2E+01	6.0E+01	4.3E+00	4.2E+00	4.3E+00	NC
POR24	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+02	7.8E+01	5.7E+00	5.4E+00	5.7E+00	NC
POR25	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.4E+01	3.4E+01	2.3E+00	2.3E+00	2.3E+00	NC
POR26	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+02	1.2E+02	9.1E+00	8.4E+00	9.1E+00	NC
POR27	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.2E+01	6.0E+01	4.3E+00	4.2E+00	4.3E+00	NC
POR28	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.6E+02	1.8E+02	1.4E+01	1.3E+01	1.4E+01	NC
POR29	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+02	9.5E+01	5.8E+00	6.6E+00	5.8E+00	NC
POR30	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.8E+01	4.9E+01	3.1E+00	3.4E+00	3.1E+00	NC
POR31	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E+02	1.1E+02	7.2E+00	7.7E+00	7.2E+00	NC
POR32	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.0E+01	5.4E+01	3.7E+00	3.7E+00	3.7E+00	NC
POR33	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.0E+03	8.6E+02	1.1E+02	6.0E+01	1.1E+02	NC
POR34	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+03	6.6E+02	6.9E+01	4.6E+01	6.9E+01	NC
POR35	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.5E+02	5.3E+02	5.0E+01	3.7E+01	5.0E+01	NC
POR36	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.9E+02	1.3E+02	1.0E+01	9.2E+00	1.0E+01	NC
POR37	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+02	1.2E+02	9.0E+00	8.2E+00	9.0E+00	NC
POR38	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+02	9.1E+01	6.8E+00	6.4E+00	6.8E+00	NC
POR39	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.1E+02	5.5E+02	3.2E+01	3.8E+01	3.2E+01	NC
POR40	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.6E+02	6.9E+02	4.0E+01	4.8E+01	4.0E+01	NC
POR41	PM10	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.6E+01	3.0E+01	1.9E+00	2.1E+00	1.9E+00	NC
POR1	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.7E+01	4.5E+01	3.0E+00	3.1E+00	3.0E+00	NC
POR2	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+01	1.4E+01	9.2E-01	9.8E-01	9.2E-01	NC
POR3	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+01	1.4E+01	9.0E-01	9.6E-01	9.0E-01	NC
POR4	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.3E+01	4.5E+01	2.8E+00	3.1E+00	2.8E+00	NC
POR5	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.0E+01	2.6E+01	1.6E+00	1.8E+00	1.6E+00	NC
POR6	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.1E+01	1.8E+01	1.1E+00	1.2E+00	1.1E+00	NC
POR7	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.2E+01	9.3E+00	6.3E-01	6.5E-01	6.3E-01	NC
POR8	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.6E+01	1.3E+01	8.5E-01	9.2E-01	8.5E-01	NC
POR9	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.8E+01	3.2E+01	2.0E+00	2.2E+00	2.0E+00	NC
POR10	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.4E+01	2.8E+01	1.8E+00	2.0E+00	1.8E+00	NC
POR11	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.2E+01	2.5E+01	1.7E+00	1.7E+00	1.7E+00	NC
POR12	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E+01	1.3E+01	8.2E-01	8.8E-01	8.2E-01	NC

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR13	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+01	9.4E+00	6.0E-01	6.5E-01	6.0E-01	NC
POR14	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.3E+00	7.7E+00	4.9E-01	5.4E-01	4.9E-01	NC
POR15	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.8E+00	7.3E+00	4.7E-01	5.1E-01	4.7E-01	NC
POR16	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.3E+00	6.0E+00	3.9E-01	4.2E-01	3.9E-01	NC
POR17	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.8E+00	4.8E+00	3.1E-01	3.3E-01	3.1E-01	NC
POR18	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+01	1.4E+01	9.2E-01	9.8E-01	9.2E-01	NC
POR19	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.5E+00	7.8E+00	5.0E-01	5.4E-01	5.0E-01	NC
POR20	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+01	8.9E+00	5.7E-01	6.2E-01	5.7E-01	NC
POR21	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.0E+01	1.6E+01	1.1E+00	1.1E+00	1.1E+00	NC
POR22	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.4E+00	5.8E+00	3.9E-01	4.0E-01	3.9E-01	NC
POR23	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.6E+00	4.4E+00	3.0E-01	3.1E-01	3.0E-01	NC
POR24	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.9E+00	5.5E+00	3.7E-01	3.8E-01	3.7E-01	NC
POR25	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.3E+00	2.7E+00	1.8E-01	1.9E-01	1.8E-01	NC
POR26	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+01	9.0E+00	6.0E-01	6.2E-01	6.0E-01	NC
POR27	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.6E+00	4.4E+00	2.9E-01	3.1E-01	2.9E-01	NC
POR28	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.9E+01	1.5E+01	9.8E-01	1.1E+00	9.8E-01	NC
POR29	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.8E+00	7.2E+00	4.6E-01	5.0E-01	4.6E-01	NC
POR30	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.4E+00	3.6E+00	2.3E-01	2.5E-01	2.3E-01	NC
POR31	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.8E+00	7.2E+00	4.7E-01	5.0E-01	4.7E-01	NC
POR32	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.5E+00	3.6E+00	2.4E-01	2.5E-01	2.4E-01	NC
POR33	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.9E+02	5.6E+01	4.7E+01	3.9E+00	4.7E+01	NC
POR34	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.8E+01	4.3E+01	3.6E+00	3.0E+00	3.6E+00	NC
POR35	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.0E+02	3.4E+01	2.6E+01	2.4E+00	2.6E+01	NC
POR36	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+01	9.8E+00	6.7E-01	6.8E-01	6.7E-01	NC
POR37	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+01	8.6E+00	5.8E-01	6.0E-01	5.8E-01	NC
POR38	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.4E+00	6.6E+00	4.5E-01	4.6E-01	4.5E-01	NC
POR39	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.2E+01	4.2E+01	2.7E+00	2.9E+00	2.7E+00	NC
POR40	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.1E+01	5.5E+01	3.2E+00	3.8E+00	3.2E+00	NC
POR41	PM2.5	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.9E+00	2.4E+00	1.5E-01	1.6E-01	1.5E-01	NC
POR1	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.5E+01	2.6E+01	1.9E+00	1.8E+00	1.9E+00	NC

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR2	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.2E+01	9.7E+00	6.1E-01	6.7E-01	6.1E-01	NC
POR3	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+01	9.4E+00	6.0E-01	6.5E-01	6.0E-01	NC
POR4	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.3E+01	1.9E+01	1.2E+00	1.3E+00	1.2E+00	NC
POR5	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E+01	1.6E+01	9.5E-01	1.1E+00	9.5E-01	NC
POR6	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E+01	1.3E+01	7.8E-01	8.8E-01	7.8E-01	NC
POR7	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.9E+00	5.6E+00	3.7E-01	3.9E-01	3.7E-01	NC
POR8	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.6E+00	7.2E+00	4.6E-01	5.0E-01	4.6E-01	NC
POR9	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E+01	1.5E+01	9.6E-01	1.0E+00	9.6E-01	NC
POR10	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+01	1.4E+01	8.9E-01	9.7E-01	8.9E-01	NC
POR11	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.0E+01	1.6E+01	1.1E+00	1.1E+00	1.1E+00	NC
POR12	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.1E+00	6.8E+00	4.3E-01	4.7E-01	4.3E-01	NC
POR13	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.1E+00	5.2E+00	3.2E-01	3.6E-01	3.2E-01	NC
POR14	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.1E+00	4.3E+00	2.7E-01	3.0E-01	2.7E-01	NC
POR15	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.8E+00	4.1E+00	2.5E-01	2.8E-01	2.5E-01	NC
POR16	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.9E+00	3.3E+00	2.1E-01	2.3E-01	2.1E-01	NC
POR17	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.2E+00	2.7E+00	1.7E-01	1.9E-01	1.7E-01	NC
POR18	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E+01	9.6E+00	6.1E-01	6.7E-01	6.1E-01	NC
POR19	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.1E+00	4.4E+00	2.7E-01	3.0E-01	2.7E-01	NC
POR20	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.8E+00	4.9E+00	3.1E-01	3.4E-01	3.1E-01	NC
POR21	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.0E+01	8.7E+00	5.5E-01	6.0E-01	5.5E-01	NC
POR22	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.1E+00	3.3E+00	2.2E-01	2.3E-01	2.2E-01	NC
POR23	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.0E+00	2.5E+00	1.6E-01	1.7E-01	1.6E-01	NC
POR24	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.9E+00	3.2E+00	2.1E-01	2.2E-01	2.1E-01	NC
POR25	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E+00	1.5E+00	9.6E-02	1.1E-01	9.6E-02	NC
POR26	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.7E+00	5.5E+00	3.5E-01	3.8E-01	3.5E-01	NC
POR27	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.0E+00	2.5E+00	1.6E-01	1.7E-01	1.6E-01	NC
POR28	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+01	1.1E+01	6.7E-01	7.4E-01	6.7E-01	NC
POR29	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.7E+00	4.0E+00	2.5E-01	2.8E-01	2.5E-01	NC
POR30	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.9E+00	2.5E+00	1.5E-01	1.7E-01	1.5E-01	NC
POR31	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.9E+00	4.9E+00	3.1E-01	3.4E-01	3.1E-01	NC
POR32	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.0E+00	2.5E+00	1.6E-01	1.7E-01	1.6E-01	NC
POR33	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.7E+02	3.8E+01	3.0E+01	2.7E+00	3.0E+01	NC
POR34	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.5E+01	2.9E+01	2.4E+00	2.0E+00	2.4E+00	NC
POR35	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.3E+02	2.3E+01	1.7E+01	1.6E+00	1.7E+01	NC
POR36	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.5E+00	6.7E+00	4.5E-01	4.7E-01	4.5E-01	NC
POR37	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.4E+00	5.9E+00	3.9E-01	4.1E-01	3.9E-01	NC
POR38	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.7E+00	4.5E+00	3.0E-01	3.2E-01	3.0E-01	NC
POR39	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.3E+01	2.0E+01	1.8E+00	1.4E+00	1.8E+00	NC
POR40	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.1E+01	3.0E+01	2.2E+00	2.1E+00	2.2E+00	NC
POR41	DPM	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.6E+00	1.4E+00	8.5E-02	9.4E-02	8.5E-02	NC

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.6E+01	5.7E+01	3.5E+00	3.9E+00	3.5E+00	NC
POR2	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E+01	1.3E+01	9.8E-01	9.1E-01	9.8E-01	NC
POR3	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E+01	1.3E+01	9.8E-01	9.1E-01	9.8E-01	NC
POR4	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.6E+01	5.4E+01	3.0E+00	3.7E+00	3.0E+00	NC
POR5	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.0E+01	2.6E+01	1.6E+00	1.8E+00	1.6E+00	NC
POR6	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.1E+01	1.5E+01	1.1E+00	1.0E+00	1.1E+00	NC
POR7	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+01	9.3E+00	7.1E-01	6.5E-01	7.1E-01	NC
POR8	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E+01	1.3E+01	7.6E-01	8.8E-01	7.6E-01	NC
POR9	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.4E+01	3.2E+01	1.8E+00	2.2E+00	1.8E+00	NC
POR10	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.5E+01	3.2E+01	1.8E+00	2.2E+00	1.8E+00	NC
POR11	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.0E+01	3.2E+01	2.1E+00	2.2E+00	2.1E+00	NC
POR12	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E+01	1.4E+01	8.1E-01	9.4E-01	8.1E-01	NC
POR13	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.0E+01	8.9E+00	5.4E-01	6.2E-01	5.4E-01	NC
POR14	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.4E+00	7.3E+00	4.4E-01	5.0E-01	4.4E-01	NC
POR15	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.1E+00	6.9E+00	4.3E-01	4.8E-01	4.3E-01	NC
POR16	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.2E+00	6.1E+00	3.8E-01	4.3E-01	3.8E-01	NC
POR17	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.6E+00	4.7E+00	2.9E-01	3.3E-01	2.9E-01	NC
POR18	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.9E+01	1.4E+01	1.0E+00	9.4E-01	1.0E+00	NC
POR19	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.6E+00	7.4E+00	4.6E-01	5.2E-01	4.6E-01	NC
POR20	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.7E+00	8.5E+00	5.2E-01	5.9E-01	5.2E-01	NC
POR21	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E+01	1.5E+01	9.0E-01	1.1E+00	9.0E-01	NC
POR22	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.2E+00	5.9E+00	4.4E-01	4.1E-01	4.4E-01	NC
POR23	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.1E+00	4.5E+00	3.3E-01	3.1E-01	3.3E-01	NC
POR24	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.1E+00	5.8E+00	4.3E-01	4.1E-01	4.3E-01	NC
POR25	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.3E+00	2.5E+00	1.7E-01	1.8E-01	1.7E-01	NC
POR26	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+01	9.1E+00	6.8E-01	6.3E-01	6.8E-01	NC
POR27	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.1E+00	4.5E+00	3.3E-01	3.1E-01	3.3E-01	NC
POR28	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.9E+01	1.4E+01	1.0E+00	9.4E-01	1.0E+00	NC
POR29	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.3E+00	7.1E+00	4.4E-01	4.9E-01	4.4E-01	NC
POR30	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.4E+00	3.7E+00	2.3E-01	2.6E-01	2.3E-01	NC
POR31	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.0E+01	8.3E+00	5.4E-01	5.7E-01	5.4E-01	NC
POR32	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.2E+00	4.0E+00	2.8E-01	2.8E-01	2.8E-01	NC
POR33	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E+02	6.4E+01	7.9E+00	4.5E+00	7.9E+00	NC
POR34	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.8E+01	5.0E+01	5.2E+00	3.5E+00	5.2E+00	NC
POR35	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.1E+01	3.9E+01	3.8E+00	2.7E+00	3.8E+00	NC
POR36	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E+01	1.0E+01	7.7E-01	6.9E-01	7.7E-01	NC
POR37	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E+01	8.9E+00	6.7E-01	6.2E-01	6.7E-01	NC
POR38	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.6E+00	6.9E+00	5.1E-01	4.8E-01	5.1E-01	NC
POR39	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.6E+01	4.1E+01	2.4E+00	2.8E+00	2.4E+00	NC
POR40	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.7E+01	5.2E+01	3.0E+00	3.6E+00	3.0E+00	NC
POR41	SILICA	NV	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.7E+00	2.2E+00	1.4E-01	1.5E-01	1.4E-01	NC

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.4E-06	6.7E-06	2.9E-07	4.7E-07	2.9E-07	0.025
POR2	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.2E-06	2.4E-06	1.2E-07	1.7E-07	1.2E-07	0.025
POR3	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.1E-06	2.4E-06	1.1E-07	1.7E-07	1.1E-07	0.025
POR4	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E-05	1.1E-05	5.7E-07	7.8E-07	5.7E-07	0.025
POR5	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.9E-06	3.7E-06	1.5E-07	2.6E-07	1.5E-07	0.025
POR6	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.5E-06	2.8E-06	1.3E-07	1.9E-07	1.3E-07	0.025
POR7	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E-06	1.8E-06	9.5E-08	1.2E-07	9.5E-08	0.025
POR8	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.2E-06	2.4E-06	1.2E-07	1.7E-07	1.2E-07	0.025
POR9	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.1E-06	6.5E-06	3.2E-07	4.5E-07	3.2E-07	0.025
POR10	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.8E-06	6.3E-06	3.1E-07	4.4E-07	3.1E-07	0.025
POR11	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	3.9E-06	4.6E-06	2.1E-07	3.2E-07	2.1E-07	0.025
POR12	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.4E-06	2.7E-06	1.3E-07	1.9E-07	1.3E-07	0.025
POR13	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E-06	1.9E-06	9.0E-08	1.3E-07	9.0E-08	0.025
POR14	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E-06	1.6E-06	7.4E-08	1.1E-07	7.4E-08	0.025
POR15	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E-06	1.5E-06	7.4E-08	1.0E-07	7.4E-08	0.025
POR16	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.3E-06	1.5E-06	6.9E-08	1.0E-07	6.9E-08	0.025
POR17	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.0E-06	1.1E-06	5.3E-08	7.6E-08	5.3E-08	0.025
POR18	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.2E-06	2.4E-06	1.2E-07	1.7E-07	1.2E-07	0.025
POR19	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E-06	1.6E-06	7.9E-08	1.1E-07	7.9E-08	0.025
POR20	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.6E-06	1.8E-06	8.5E-08	1.2E-07	8.5E-08	0.025
POR21	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.5E-06	2.7E-06	1.3E-07	1.9E-07	1.3E-07	0.025
POR22	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E-06	1.2E-06	5.8E-08	8.3E-08	5.8E-08	0.025
POR23	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.0E-07	1.0E-06	4.8E-08	6.9E-08	4.8E-08	0.025
POR24	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E-06	1.3E-06	5.8E-08	9.0E-08	5.8E-08	0.025
POR25	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	6.0E-07	6.0E-07	3.2E-08	4.2E-08	3.2E-08	0.025
POR26	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E-06	1.8E-06	9.0E-08	1.2E-07	9.0E-08	0.025
POR27	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	9.0E-07	1.0E-06	4.8E-08	6.9E-08	4.8E-08	0.025
POR28	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	2.3E-06	2.6E-06	1.2E-07	1.8E-07	1.2E-07	0.025
POR29	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.4E-06	1.6E-06	7.4E-08	1.1E-07	7.4E-08	0.025
POR30	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	8.0E-07	9.0E-07	4.2E-08	6.2E-08	4.2E-08	0.025
POR31	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.6E-06	1.9E-06	8.5E-08	1.3E-07	8.5E-08	0.025
POR32	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.0E-07	8.0E-07	3.7E-08	5.6E-08	3.7E-08	0.025
POR33	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.8E-05	9.2E-06	9.4E-07	6.4E-07	9.4E-07	0.025
POR34	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.1E-05	7.2E-06	5.8E-07	5.0E-07	5.8E-07	0.025
POR35	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	7.7E-06	5.9E-06	4.1E-07	4.1E-07	4.1E-07	0.025
POR36	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.7E-06	1.9E-06	9.0E-08	1.3E-07	9.0E-08	0.025
POR37	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.5E-06	1.9E-06	7.9E-08	1.3E-07	7.9E-08	0.025
POR38	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	1.2E-06	1.5E-06	6.4E-08	1.0E-07	6.4E-08	0.025
POR39	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.7E-06	6.4E-06	3.0E-07	4.4E-07	3.0E-07	0.025
POR40	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	4.6E-06	6.5E-06	2.4E-07	4.5E-07	2.4E-07	0.025
POR41	Benzo(a)pyrene	0.025	1.5E+03	2.0E-02	3.2E+01	4.8E-01	5.0E-07	6.0E-07	2.6E-08	4.2E-08	2.6E-08	0.025

Table B1-4: Summary of Maximum Predicted Soil Concentrations Calculated Based on Air Particle Deposition Rates at All PORs

Receptor ID	Parameter	Baseline Soil Concentration ¹	Bulk Density Soil	Surface Soil Depth	Period Deposition ²	Soil Loss Constant	Deposition Rate		Deposition to Soil ³			Predicted Total Soil Concentration
		[mg/kg]	[kg/m ³]	[m]	[Years]	[Year ⁻¹]	[mg/m ² /year]		[mg/kg]			[mg/kg]
							Construction	Operations	Construction	Operations	Closure	
POR1	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR2	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR3	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR4	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR5	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR6	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR7	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR8	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR9	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR10	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR11	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR12	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR13	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR14	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR15	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR16	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR17	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR18	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR19	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR20	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR21	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR22	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR23	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR24	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR25	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR26	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR27	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR28	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR29	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR30	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR31	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR32	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR33	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR34	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR35	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR36	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR37	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR38	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR39	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR40	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60
POR41	Lithium	16.6	1.5E+03	2.0E-02	3.2E+01	4.8E-01	NV	NV	NC	NC	NC	16.60

Notes:

kg/m³ = kilograms per cubic metre; m= metres; mg/m²/year= milligrams per square metre per year; mg/kg= milligrams per kilogram; POR= Point of Reception; PM2.5 = particulate matter less than 2.5 micron in diameter; PM10 = particulate matter less than

1) Baseline soil concentrations are the maximum soil concentrations measured during the Baseline Soil and Vegetation Sampling program (Attachment A2)

2) Deposition period represented as the sum of all Project phases anticipated to experience Project related deposition. Calculation of deposition is performed with phase specific periods as follows: construction= 3 years; operations= 26 years; closure= 3 years.

3) Deposition to soil concentrations are calculated using equations outlined in US EPA 2005.

Attachment C
**Identification of Parameters of Potential
Concern**



1 INTRODUCTION

This Attachment provides the details of the screening approach and criteria used to identify parameters of potential concern (POPCs) for the Human Health and Ecological Risk Assessment (HHERA) conducted for the Great Bear Gold Project (Project). The purpose of the screening process is to identify POPCs in each environmental media for inclusion in the HHERA based on changes to environmental quality as a result of the Project. This Attachment outlines the approach, criteria and screening results for the POPC screening process (hereafter referred to as the Tier 1 screening) used to identify POPCs for the multi-media and inhalation assessments in the Human Health Risk Assessment (HHRA), as well as the multi-media (food chain) assessment in the Ecological Risk Assessment (ERA). Measured soil, sediment, surface water, fish tissue, vegetation tissue and wild game tissue quality data were used in the multi-media modelling for both human (Attachment E) and ecological receptors (Attachment F) to characterize baseline exposure point concentrations (EPCs), and the multi-media modelling included the addition of predicted air, dust deposition to soil, and water predictions from the Project. The air quality assessment included baseline and Project data to define EPCs for the human health inhalation model (Attachment D). The overall goal is to provide a comprehensive environmental (i.e., air, soil and water) screening process that identifies POPCs for detailed assessment in the HHERA.

Health Canada Impact Assessment Guidance (2023) outlines parameters associated with specific mining operations that should be considered in the identification of POPCs. For gold mining, specifically extractions (not smelting), Health Canada identified arsenic, cadmium, chromium, cyanide, mercury and polycyclic aromatic hydrocarbons (PAHs) as potential parameters of concern. These parameters were specifically considered in the HHERA screening described in this section.

It is noted that groundwater was not directly assessed in the HHERA but potential impacts from groundwater to surface water interactions were assessed through the Receiver Water Quality modeling (WSP 2025a). It was assumed in the HHRA that individuals would only have access to groundwater via groundwater wells. As discussed in WSP (2025b) and WSP (2025c), there are no groundwater drinking water wells present within the groundwater zone of influence (ZOI) of the Project since existing drinking water wells are located across a groundwater divide. Groundwater exposure pathways were therefore considered to be incomplete for human health, and groundwater was not considered in the HHRA multi-media model. In the ERA, it was assumed that groundwater exposure pathways would be insignificant for terrestrial ecological receptors in comparison to surface water exposure pathways and groundwater was not implicitly considered in the ERA multi-media (food chain) model. For aquatic life receptors, the assessment of surface water directly is considered to be protective of groundwater discharge to surface water.

Environmental quality criteria or guidelines from the Canadian Council of Ministers of the Environment (CCME), Health Canada, Ontario Ministry of the Environment, Conservation and Parks (MECP), and other provincial and international jurisdictions where necessary, were used to identify POPCs for the HHERA. The Project is undergoing a federal review process and is located in Ontario; therefore, primary sources of screening criteria were MECP, CCME and Health Canada. Secondary sources of screening criteria included other provincial and international (e.g., United States Environmental Protection Agency (US EPA)) jurisdictions. Background concentrations were also used for screening soil and sediment, where available (MOE 2011a). Ontario background concentrations were not available for comparison against air, fish tissue, vegetation tissue and wild game tissue concentrations in the Tier 1 screening. It is noted that some parameters were screened out during the Tier 1 screening process and therefore were not considered POPCs due to their essentiality, low toxicity, ubiquity in the environment and/or limited toxicological information; a discussion on the parameters excluded from consideration in the Tier 1 screening is provided in Section 2.0. The selection of environmental quality criteria is discussed below by media type in Sections 3.0 to 7.0. A summary of identified POPCs is provided in Section 8.0. An introduction to the Tier 2 screening for the HHRA and ERA and the Tier 2 screening tables are provided in Section 9.0; however, details of the approach and Tier 2 screening results are detailed in the HHRA and ERA sections of the HHERA report.

2 PARAMETERS EXCLUDED FROM CONSIDERATION

Some metals and essential minerals are commonly analyzed in environmental samples (as part of the standard suite of metals included in the analytical methodology) but generally have low toxicity at concentrations that occur in the environment. Many of these parameters are mineralogical constituents of rock and soil materials and are present in a toxicologically inert form. Some of these parameters included in standard analytical chemical suites are essential micro- and macro-nutrients that are required for human and/or ecological health.

Although the following metals and essential minerals may be present in environmental media within the local study area (LSA) and regional study area (RSA), they were excluded from further consideration in the Tier 1 screening based on their expected low toxicological hazard:

- Essential minerals (calcium, magnesium, phosphorus [for human health only], potassium, sodium, and sulphur): essential minerals serve a variety of biochemical, intracellular, and ion balance purposes in human, plant and animal tissues. These parameters are naturally occurring substances that are included in routine laboratory analyses. These parameters are ubiquitous in the environment and have low toxicological hazard potential. As such, calcium, magnesium, potassium, sodium and sulphur were not retained as POPCs in the HHERA, even in instances where screening criteria were available and measured or predicted concentrations in environmental media were elevated above screening criteria. Similarly, phosphorus was considered to be an essential element of low toxicity to human health and was not retained as a POPC in the HHRA. Phosphorus was retained for further consideration in the ERA, however, due to its potential adverse effects in the aquatic environment through eutrophication.
- Trace elements (bismuth, silicon, thallium, thorium, tungsten, yttrium and zirconium): trace mineralogical parameters are not commonly assessed in risk assessment because human and animal toxicity data are lacking for these compounds. These parameters are naturally occurring substances that may be included in routine laboratory analyses. These parameters are ubiquitous in the environment and were assumed to have low toxicological hazard potential. As such, bismuth, silicon, thallium, thorium, tungsten, yttrium and zirconium were not retained as POPCs in the HHERA, even in instances where screening criteria were available or measured/ predicted concentrations in environmental media were elevated above screening criteria.

3 SOIL

Project activities may impact soil quality through the deposition of airborne emissions or dust. To identify POPCs in soil that have the potential to impact human or ecological health, baseline and predicted soil quality concentrations were compared to soil quality criteria, as presented in the following sections.

3.1 SCREENING CRITERIA FOR SOIL

Soil screening criteria considered for the HHERA are based on land use. The Project is located in a remote area of Ontario on the traditional territories of multiple communities of Indigenous people, and in proximity to the Municipality of Red Lake and the Township of Ear Falls within the District of Kenora. The region offers many opportunities for Indigenous traditional land use activities, as well as recreation (i.e., hiking, camping, fishing) for residents and visitors. Agricultural criteria as CCME (2006) recommends that agricultural land use are applicable to areas outside urban (residential/parkland), commercial, or industrial land use areas. The agricultural soil screening criteria were considered applicable as they are protective of edible plants in the LSA/RSA and take into account the protection of birds and mammals.

Generic screening criteria protective of both human health and ecological receptors are available from primary (i.e., CCME and Ontario) and secondary sources (other provincial or international jurisdictions).

The following sources were considered for the selection of soil screening criteria:

Primary Sources

- **CCME (1999a, current to 2025) Canadian Soil Quality Guidelines (SQG) for the Protection of Environmental and Human Health, Agricultural Land Use**— The CCME SQG for the protection of environmental and human health are divided into categories based on land use (agricultural, residential/parkland, commercial, and industrial). The guidelines for agricultural land use were considered applicable for the selection of Tier 1 screening criteria to be protective of residential exposure for humans as well as all ecological receptors including mammals and birds. CCME SQGs are selected as the lowest of the derived guidelines/check values for multiple human and ecological exposure pathways. For human health, the exposure pathways considered include soil ingestion, inhalation of indoor air (volatilization from soil), migration of soil off-site, drinking water (leaching of soil to groundwater), and produce, meat and milk ingestion (uptake from soil into food). For ecological health, the exposure pathways considered soil contact, soil and food ingestion, nutrient and energy cycling, migration of soil off-site, and soil leaching to groundwater and subsequent migration to surface water (protection of aquatic life). The lowest guideline/check value of all pathways considered is generally selected as the SQG for a given parameter. For the selection of human health screening criteria for carcinogenic compounds, guidelines derived based on an incremental lifetime cancer risk of 1×10^{-05} were selected if available.
 - For PAHs, CCME SQGs are provided in the Scientific Supporting Document (CCME 2010). Values derived based on an incremental lifetime cancer risk of 1×10^{-05} were selected.
- **MECP (MOE 2011a) Table 2 Full Depth Generic Site Condition Standards (SCS) in a Potable Ground Water Condition, Agricultural Land Use, Coarse-textured soil** — The MECP SCS are protective of both human and ecological receptors and are developed using a series of risk-based component values. Each component value is derived through risk assessment methods and is intended to protect a specific receptor, or group of receptors, from exposure to a parameter through a defined exposure pathway. SCS are categorized by land use (agricultural, parkland/residential/institutional, industrial/commercial/community), groundwater potability condition, soil texture and soil depth. For any given land use, potability condition and soil depth scenario, the lowest applicable component value is selected to establish the standard, ensuring protection of the most sensitive receptor or pathway. For example, a soil standard may be driven by the component value that protects the aquatic environment from parameters that leach through soil into groundwater and subsequently migrate to surface water. Standards are not permitted to be set below laboratory reporting limits or background concentrations, nor above thresholds associated with free-phase

product formation. The SCS for agricultural land use and coarse-grained soil were selected as soil screening criteria to be protective of potential exposure for humans as well as all ecological receptors including mammals and birds. It is noted that SCS for carcinogenic parameters are based on an incremental lifetime cancer risk of one in one million (1×10^{-06}), which is more conservative than the target risk of one in one hundred thousand (1×10^{-05}) recommended by Health Canada (2024).

Secondary Sources

- **British Columbia (2025) Contaminated Sites Regulation (BC CSR) Schedule 3.1 Numerical Soil Standards, Agricultural Land Use** —The CSR soil standards are divided into six categories and two sub-categories based on land use: wildlands (subdivided into natural and reverted), agricultural, urban park, residential (subdivided into low density and high density), commercial, and industrial. The agricultural land use was considered applicable for the selection of screening criteria to be protective of residential exposure for humans as well as all ecological receptors including mammals and birds. Pathway-specific criteria (e.g., intake of contaminated soil site-specific factor, toxicity to soil invertebrates and plants, and livestock ingesting soil and fodder site) from Schedule 3.1 – Part 1 Matrix Numerical Soil Standards for human health and ecological receptors protection were considered applicable for identifying POPCs in soil. Where pathway specific criteria were available, the lowest of the available criteria was selected for use in screening as it would be protective of both human and ecological health. In the absence of these pathway-specific criteria, the lower of the generic human and ecological receptors criteria from Schedule 3.1 – Part 2 Generic Numerical Soil Standards to Protect Human Health and Schedule 3.1 – Part 3 Generic Numerical Soil Standards to Protect Ecological Health were used. Where only human health generic soil criteria were available the Ontario Background was selected as the screening criterion for ecological receptors.
- **Alberta Environment and Protected Areas (AEPA 2024) Tier 1 Soil and Groundwater Remediation Guidelines, Agricultural Land Use, Coarse-textured soil** — The AEPA Tier 1 Soil and Groundwater Remediation Guidelines are generic guidelines for use in risk-based remediation of contaminated sites. Guidelines are categorized by land use: natural area, agricultural, residential/parkland, commercial and industrial. The agricultural land use was considered applicable for the selection of screening criteria to be protective of residential exposure for humans as well as all ecological receptors including mammals and birds. The generic guidelines are selected as the lowest of the derived guidelines for multiple human and ecological exposure pathways. For human health for agricultural land use, the exposure pathways considered direct soil contact, vapour inhalation (volatilization from soil) and protection of domestic use aquifer. For ecological health, the exposure pathways considered include direct soil contact, nutrient and energy cycling, wildlife/livestock soil and food ingestion, soil leaching to groundwater and subsequent migration to surface water (protection of aquatic life), and soil leaching to water used as drinking water/plant watering (protection of livestock water, protection of wildlife water, protection of irrigation water). The lowest guideline of all pathways considered is selected as the Tier 1 guideline for a given parameter.
- **United States Environmental Protection Agency (US EPA 2024) Regional Screening Level (RSL) for Resident Soil**— The US EPA RSLs are risk-based screening criteria for human health that are based on an acceptable hazard quotient of 1 for non-carcinogens and an acceptable incremental lifetime cancer risk of 1 in 1,000,000 for carcinogens. Health Canada (2024) considers a hazard quotient of 0.2 in order to account for background exposure. Therefore, for non-carcinogens, RSLs were adjusted by a factor of 0.2 to reflect an allocation of 20% of the tolerable daily intake from soil for the selection of screening criteria. Health Canada (2024) considers an incremental lifetime cancer risk of 1 in 100,000 to be acceptable. Therefore, for carcinogens, RSLs were adjusted to an incremental lifetime cancer risk of 1 in 100,000 for the selection of screening criteria. RSLs are developed for different scenarios (resident, composite worker, indoor worker, outdoor worker, construction worker, fish, soil to groundwater, and recreator). The RSLs for the resident scenario were considered applicable for the selection of screening criteria.

The soil screening criteria used to identify POPCs were selected according to the following hierarchy:

- The more conservative criterion (i.e., lower) available from the primary sources:
 - CCME SQGs.

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- MECP Table 2 SCS.
- In the absence of soil criteria for a POPC from primary sources, soil quality criteria from secondary sources were selected according to the following order of preference¹:
 - BC CSR Schedule 3.1 Numerical Soil Standards for intake of contaminated soil (human health), toxicity to soil invertebrates (ecological health), livestock ingesting soil and fodder (ecological health) pathway-specific or generic soil quality guideline.
 - AEPA Tier 1 Soil Guideline.
 - US EPA RSL for resident soil (applicable to human health only).

Background concentrations were also considered in the screening of soil quality. Ontario background concentrations are available for soil from MECP, Table 1 Full Depth Background SCS (MOE 2011a). In the absence of an available Table 1 SCS, Ontario Typical Range Soil Chemistry (OTR98) for Rural Parks (Region 6 - Northern Ontario, or All Regions, as available) were selected as background concentrations (MOE 2011b). In the absence of a soil screening criterion, the Ontario background was selected as the screening criterion (i.e., Table 1 SCS, or OTR98 in the absence of Table 1 SCS). If the Ontario background concentration was higher than the selected primary or secondary criterion, the Ontario background value was selected as the screening criterion.

For PAHs, benzo(a)pyrene total potency equivalents (B(a)P TPE) is the sum of estimated PAHs cancer potency relative to benzo(a)pyrene for carcinogenic unsubstituted PAHs. The baseline soil B(a)P TPE concentration and the predicted Project phase B(a)P TPE concentrations were calculated by multiplying the maximum (measured or predicted) concentration of each PAH by its B(a)P Potency Equivalence Factor (PEF) and summing the products for a target cancer risk of 1×10^{-05} . Potency Equivalence Factors are presented in Table C-1. The index of additive cancer risk (IACR) was also calculated for the PAH mixture to ensure that potable water resources are protected. It was calculated by dividing the maximum (measured or predicted) soil concentration of each carcinogenic PAH by its soil quality guideline for protection of potable water component value to calculate a hazard index for each PAH and then summing the hazard indices for the entire PAH mixture. Soil quality guideline for protection of potable water component values are presented in Table C-2. For both the calculation of B(a)P TPE and IACR, half the detection limit was used for non-detect concentrations (CCME 2010).

The soil quality criteria from the above agencies and the selected screening criteria are presented in Table C1-1. In general, the most conservative criterion for each parameter from each applicable source (i.e., primary source, and secondary source where required) was selected for use in the Tier 1 screening. This attachment should be reviewed in conjunction with Table C1-1 for a comprehensive understanding of the screening approach.

Table C-1: Potency Equivalency Factors (PEFs) for Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbon	B(a)P PEF
Benz(a)anthracene	0.1
Benzo(a)pyrene	1.0
Benzo(b+j+k)fluoranthene	0.1
Benzo(g,h,i)perylene	0.01
Chrysene	0.01
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-c,d)pyrene	0.1

Notes:

B(a)P PEF = benzo(a)pyrene potency equivalency factor

¹ BC CSR soil standards were preferentially selected as the standards are more current than AEPA soil guidelines. BC CSR and AEPA were both preferentially selected over US EPA RSL, which are applicable for human health only.

Table C-2: Soil Quality Guideline for Protection of Potable Water Component Value for Calculation IACR

Polycyclic Aromatic Hydrocarbon	SQG Protection of Potable Water (mg/kg)
Benz(a)anthracene	0.33
Benzo(b+j+k)fluoranthene	0.16
Benzo(g,h,i)perylene	6.8
Benzo(a)pyrene	0.37
Chrysene	2.1
Dibenz(a,h)anthracene	0.23
Indeno(1,2,3-c,d)pyrene	2.7

Notes:
mg/kg = milligrams per kilogram; SQG = soil quality guideline.

3.2 IDENTIFICATION OF POPCS IN SOIL

Baseline metal concentrations in soil were established as part of the soil and traditional food sampling program completed in support of the HHERA and are presented in Attachment A. Soil samples (co-located with vegetation samples) were collected and analyzed from 21 locations and were analyzed for metals and PAHs. Further details on measured baseline soil data can be found in Attachment A.

Predicted soil concentrations for the Project phases (i.e., construction, operations, closure) were calculated based on predicted deposition rates of airborne emissions from Project activities, which were generated through quantitative modeling by the Air Quality discipline (WSP 2025d). The calculation of incremental changes to soil quality as a result of dust deposition is presented in Attachment B. It was assumed that deposition would not occur under baseline conditions or post-closure, as there would be no Project activities contributing to dust generation, and notable sources of air emissions that would warrant an air quality assessment were not expected to occur (WSP 2025d). Therefore, soil quality predictions were not calculated for baseline and post-closure.

For PAHs, deposition rates were only provided by the Air Quality discipline for benzo(a)pyrene for the construction, operations and closure phases. As such, predicted soil concentrations for other carcinogenic PAHs considered as part of the B(a)P TPE calculation (see details in Section 3.1 above) were estimated based on the Project-related incremental change for benzo(a)pyrene. Benzo(a)pyrene TPE is the sum of all carcinogenic PAH concentrations estimated based on their PEF relative to benzo(a)pyrene. The CCME provides PEFs for the carcinogenic PAHs in the soil quality guidelines (CCME 2010) which are listed in Table C-1. It was assumed that the ratio of the predicted incremental change in the soil concentration of benzo(a)pyrene relative to its baseline concentration could be applied to all the other carcinogenic PAHs. The ratio of change in concentration for benzo(a)pyrene was multiplied by each carcinogenic PAH's respective baseline concentration to predict its respective Project-related incremental change. The predicted soil concentration for a given carcinogenic PAH was then calculated by adding the baseline soil concentration and the predicted incremental change. A sample calculation of the assumed concentrations of carcinogenic PAH depositions relative to benzo(a)pyrene, the resulting assumed B(a)P TPE and IACR concentrations, and the predicted maximum soil concentrations of the carcinogenic PAHs including B(a)P TPE and IACR, can be found below.

$$P_{B(a)P} = \frac{Dep_{B(a)P}}{C_{s-B(a)P}}$$

Where:

$P_{B(a)P}$ = Ratio of B(a)P concentration deposited by the Project relative to concentration in baseline (unitless)

$Dep_{B(a)P}$ = Concentration of B(a)P deposited by Project emissions (mg/kg)

$C_{s-B(a)P}$ = Concentration of B(a)P in baseline soil (mg/kg)

$$PAH_{dep} = C_{s-PAH} \times P_{B(a)P}$$

Where:

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PAH_{dep} = Assumed concentration of PAH deposited by Project emissions (mg/kg)

$P_{B(a)P}$ = Ratio of B(a)P concentration deposited by the Project relative to concentration in baseline (unitless)

C_{s-PAH} = Concentration of PAH in baseline soil (mg/kg)

$$B(a)P_{eqi-conc} = PAH_{dep} \times PEF$$

Where:

$B(a)P_{eqi-conc}$ = B(a)P equivalent dose of carcinogenic PAH (mg/kg)

PAH_{dep} = Assumed concentration of PAH deposited by Project emissions (mg/kg)

PEF = Potency equivalency factor (unitless)

$$B(a)P\ TPE = C_{s-B(a)P\ TPE} + \sum B(a)P_{eqi-conc}$$

Where:

$B(a)P\ TPE$ = B(a)P total potency equivalent (mg/kg)

$C_{s-B(a)P\ TPE}$ = Concentration of B(a)P TPE in baseline soil

$B(a)P_{eqi-conc}$ = B(a)P equivalent dose of carcinogenic PAH (mg/kg)

Example 3-1: B(a)P Deposition to Soil Concentration as a Proportion of Baseline Soil Concentration

$$P_{B(a)P} = \frac{2.35 \times 10^{-6} \text{ mg/kg}}{0.025 \text{ mg/kg}}$$

$$P_{B(a)P} = 0.0001$$

Example 3-2: Predicted Benz(a)anthracene Concentration as a Result of Project Related Deposition

$$PAH_{dep} = 0.010 \times 0.0001$$

$$PAH_{dep} = 1.01 \times 10^{-6} \text{ mg/kg}$$

Example 3-3: Predicted Benz(a)anthracene B(a)P Equivalent Concentration

$$B(a)P_{eqi-conc} = 1.01 \times 10^{-6} \text{ mg/kg} \times 0.1$$

$$B(a)P_{eqi-conc} = 1.01 \times 10^{-7} \text{ mg/kg}$$

Example 3-4: Predicted Maximum B(a)P TPE Concentration in Soil

$$B(a)P\ TPE = 0.037 \text{ mg/kg} + (1.01 \times 10^{-7} \text{ mg/kg} + 2.53 \times 10^{-6} \text{ mg/kg} + 7.17 \times 10^{-7} \text{ mg/kg} + 1.01 \times 10^{-8} \text{ mg/kg} + 5.25 \times 10^{-8} \text{ mg/kg} + 5.05 \times 10^{-7} \text{ mg/kg} + 1.01 \times 10^{-7} \text{ mg/kg})$$

$$B(a)P\ TPE = 0.037 \text{ mg/kg}$$

The total concentration in soil of each PAH from baseline and deposition was calculated as follows:

$$C_{s-PAHx} = PAH_{bkgx} + PAH_{dep\ x}$$

Where:

C_{s-PAHx} = Total soil concentration of PAH x (mg/kg)

PAH_{bkgx} = Baseline soil concentration of PAH x (mg/kg)

$PAH_{dep\ x}$ = Soil concentration related to Project deposition of PAH x (mg/kg)

Example 3-5: Total Concentration of Benz(a)anthracene in Soil

$$C_{s-Benz(a)anthracene} = 0.010 \text{ mg/kg} + 1.01 \times 10^{-6} \text{ mg/kg}$$

$$C_{s-Benz(a)anthracene} = 0.010 \text{ mg/kg}$$

The Index of Additive Cancer Risk was calculated for predicted soil concentrations as follows:

$$IACR = IACR_{baseline} + \sum \frac{C_{dep-PAH}}{SQGDW}$$

Where:

IACR = Index of additive cancer risk (unitless)

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IACR_{baseline} =Index of additive cancer risk estimated in baseline soil (unitless)

C_{dep-PAH} =Concentration of PAH from deposition of airborne particles related to the Project (mg/kg)

SQG_{dw} =Soil quality guideline for protection of potable water component value (mg/kg)**Example**

3-5: Estimated IACR in Soil

$$IACR = 0.68 + \frac{1.01 \times 10^{-6} \text{ mg/kg}}{0.33 \text{ mg/kg}} + \frac{7.17 \times 10^{-6} \text{ mg/kg}}{0.16 \text{ mg/kg}} + \frac{1.01 \times 10^{-6} \text{ mg/kg}}{6.8 \text{ mg/kg}} + \frac{2.53 \times 10^{-6} \text{ mg/kg}}{0.37 \text{ mg/kg}} \\ + \frac{5.25 \times 10^{-6} \text{ mg/kg}}{2.1 \text{ mg/kg}} + \frac{5.05 \times 10^{-7} \text{ mg/kg}}{0.23 \text{ mg/kg}} + \frac{1.01 \times 10^{-6} \text{ mg/kg}}{2.7 \text{ mg/kg}}$$

IACR = 0.68

For the purposes of screening, both the maximum measured baseline concentration and the maximum overall predicted soil concentration across all applicable Project phases (i.e., construction, operations, closure) for each parameter was selected for screening. The results of the Tier 1 screening for soil are presented in Table C1-1. A parameter was identified as a POPC if its maximum predicted concentration (Project + Baseline) was higher than the selected health-based soil quality criterion applicable for that parameter. The maximum predicted concentration in soil were higher than the soil criterion for arsenic; therefore, arsenic was retained as a POPC in soil for human and ecological health.

As noted in Section 1, Health Canada Impact Assessment Guidance (2023) identified arsenic, cadmium, chromium, cyanide, mercury and PAHs as parameters of potential concern related to gold mining (not including smelting). These parameters were specifically considered in the HHERA Tier 1 screening for soil. PAHs, cadmium, chromium and cyanide were below human health-based criteria in soil and, as such, they were not retained as POPCs for human health. As discussed above, arsenic was retained as a POPC based on soil measurements above human health-based criteria.

4 SEDIMENT

Baseline metal concentrations in sediment were measured as part of the sampling program completed in support of the Fisheries Resources Baseline Report (WSP 2025e). Surficial sediment samples were collected from sampling locations at Dixie Creek, Genessee Lake, Chukuni River, and nearby unnamed watercourses and waterbodies. Further details on the baseline sediment data can be found in the Fisheries Resources Baseline Report (WSP 2025e) and Attachment A.

Project activities which could potentially indirectly impact sediment quality include the discharge of mine contact water into the surrounding aquatic environments, or erosion of soil which has accumulated Project POPCs from deposition of airborne emissions. However, sediment concentrations are not anticipated to change substantially as a result of the Project. The majority of predicted surface water quality concentrations during construction and operations phases are within baseline ranges, with all predicted surface water quality concentrations within baseline ranges post-closure (details presented in the Receiver Water Quality report; WSP 2025a). Further, runoff is being controlled, collected and treated prior to release throughout the Project to mitigate changes to the surrounding aquatic environment. As such, sediment quality is not anticipated to be impacted by the Project and sediment predictions were not modelled (i.e., it was assumed that there would not be a material change in sediment quality and the incremental change from the Project was assumed to be zero). The assessment of potential Project impacts to soil and surface water are considered to be protective of Project-related changes to sediment quality.

Based on the recreational activities anticipated within the LSA and RSA (e.g., wading along the shoreline or swimming), sediment exposure is expected to be minimal because lakes or rivers in the region are generally deep, particularly in areas close to waterfront cabins, lodges or residences. While some small lakes and creeks located within the vicinity of the Project may be shallow enough or have near-shore areas where people could come into contact with sediment while wading, fishing or boating, any such contact during these activities is expected to be minimal and it is expected that people would be wearing footwear during these types of activities. Swimming may occur off docks at personal waterfront cabins, lodges or residences where limited sediment contact is expected due to water depths. Bathing within recreational waters is not expected within the LSA or RSA. If bathing were to occur in lakes in the region, sediment exposure is expected to be for small periods of time and limited to contact with the soles of the feet (i.e., standing for bathing). Therefore, dermal contact with and indirect ingestion of sediment is most likely to occur with suspended sediments in surface water or with intertidal sediment as people enter and leave the water for swimming and/or bathing. Dermal contact with sediment that is submerged under water is expected to result in lower exposure than a typical soil exposure scenario as overlying water causes removal of sediment from the exposed areas of the body when exiting the water. Potential sediment exposure from recreational activities at the shoreline (e.g., beach exposure at Pakwash Lake Provincial Park) were assessed through the soil exposure pathway. The assessment of potential human health risks from potential Project impacts to soil and surface water are considered to be protective of potential human exposure to sediment. Therefore, baseline sediment concentrations were not screened against human health-based guidelines and sediment contact/ ingestion was not assessed in the HHRA.

The ERA used baseline sediment quality concentrations, for POPCs identified in screening for other media, as an input for the ERA multi-media (food chain) model to account for total exposure by wildlife receptors. Baseline sediment quality used for the ERA is presented in Table A1-3, Attachment A. It was assumed that the Project will have no material effect on the POPC concentrations in sediment, however baseline sediment concentrations were included in the wildlife exposure model to characterize baseline exposures to wildlife receptors to be comprehensive (see Attachment E).

The ERA did not evaluate exposure to sediment by aquatic life because the Project will have no material effect on the POPC concentrations in sediment and predicted sediment quality changes were not modelled. Therefore, a Tier 1 screening of sediment quality was not completed for the ERA. The assessment of potential Project impacts to surface water and exposure by aquatic life was considered the primary and most relevant exposure pathway to be protective of Project-related changes to aquatic life.

5 SURFACE WATER

Project activities are anticipated to impact surface water quality through the discharge of mine contact water to the surrounding aquatic environment. To identify POPCs in surface water that have the potential to impact human or ecological health, surface water quality concentrations were compared to surface water quality criteria, as presented in the following sections.

Generic screening criteria for surface water protective of both human and ecological receptors were unavailable from primary or secondary sources. As such, separate screening criteria were selected for human health and ecological receptor screening, as presented in the following sections.

5.1 SCREENING CRITERIA FOR SURFACE WATER

Surface water quality screening criteria for human and ecological receptors were identified, where available. Health-based water quality criteria were selected preferentially over aesthetic objectives for human receptors. For some parameters, including chloride and sulphate, only aesthetic objectives were available, and were applied in the Tier 1 screening to be conservative.

For human health, surface water quality was screened for the protection of human health from exposure to surface water via ingestion as drinking water (see Attachment E for full details of applicable exposure pathways).

The following sources were considered for selecting surface water screening criteria for human health:

Primary Sources

- **Health Canada (Health Canada 2025) Guidelines for Canadian Drinking Water Quality (HC GCDWQ)**—Health Canada intended the GCDWQ to apply when groundwater or surface water may be used for drinking water purposes. Health Canada provides maximum allowable concentrations (MAC), which are drinking water guidelines established to be protective of health effects. Maximum acceptable concentrations were selected for surface water screening criteria unless otherwise indicated in Table C1-2.
- **MECP (MOECC 2016) Groundwater Components for Potable Water Scenario, GW1 Human Health Component Value**—The MECP GW1 component value is a risk-based value that is protective of human health exposure from groundwater ingested as drinking water. The MECP selected Ontario Drinking Water Quality Standards (ODWQS) as the GW1 component values as available. Where ODWQS were not available, drinking water values from other credible jurisdictions were selected as the GW1 component value. Jurisdictions considered, in priority sequence include Health Canada Canadian Drinking Water Guidelines, US EPA Maximum Contaminant Level (MCL), California Environmental Protection Agency (CalEPA), European Union (EU), and World Health Organization (WHO). Where no drinking water values were available from the listed jurisdictions, the GW1 components values were calculated by MECP using a drinking water exposure model and toxicity reference values. Where no health-based values were available, odour thresholds were applied. GW1 component values are independent of soil texture.

Secondary Sources

- **BC CSR (2025) Schedule 3.2 Generic Numerical Water Standards for Drinking Water**—The CSR water standards are divided into aquatic life (freshwater and marine), irrigation water, livestock water, and drinking water. The drinking water standards were considered applicable for human health and used for the selection of surface water screening criteria.
- **US EPA (2024) RSL for Resident Tap Water**—The tap water RSLs are risk-based criteria applicable to water at the point of exposure (e.g., from the tap, post-treatment). As discussed in Section 3.0 for soil, non-carcinogenic RSLs were adjusted to a hazard quotient of 0.2 and carcinogenic RSLs were adjusted to an incremental lifetime cancer risk of 1 in 100,000 for selection of screening criteria for surface water.

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The following hierarchy was used in the selection of drinking water quality criteria for the protection of human health:

- The more conservative criterion (i.e., lower) available from the primary sources:
 - MECP GW1 Human Health Component Value;
 - HC GCDWQ.
- In the absence of criteria from primary sources, surface water quality criteria from secondary sources were selected according to the following order of preference:
 - BC CSR Schedule 3.2 Generic Numerical Water Standards for Drinking Water;
 - US EPA RSL for Resident Tap Water.

For ecological receptors, surface water quality was screened for the protection of freshwater aquatic life exposed to surface water via direct contact. Surface water quality criteria protective of aquatic life are typically lower than criteria protective of drinking water consumed by wildlife and were considered conservative to use as Tier 1 screening criteria. The following sources were considered for selecting surface water screening criteria for ecological health:

Primary Sources

- **CCME (1999b, current to 2025) Canadian Water Quality Guideline (WQG) for the Protection of Aquatic Life, freshwater, long-term**—The CCME WQG are numerical guidelines derived for the protection of aquatic receptors (i.e., aquatic plants, invertebrates, fish, amphibians). The guidelines for freshwater and long-term exposures were applied. CCME WQGs for several parameters incorporate toxicity-modifying factors (e.g., hardness, pH, dissolved organic carbon).
- **Environment and Climate Change Canada (ECCC 2025) Federal Water Quality Guidelines (FWQG)**—The ECCC developed Federal Environmental Quality Guidelines (FEQGs) for parameters that do not have CCME guidelines or for parameters for which the CCME guidelines are not expected to be updated in the near future. The FEQGs for surface water (termed Federal Water Quality Guidelines or FWQGs) were derived based on more recent evaluations of the scientific literature and consider toxicity-modifying factors (e.g., hardness, pH, dissolved organic carbon). The approaches used in the FWQG derivation are consistent with the CCME WQG derivation protocol.
- **MECP (MOEE 1994) Provincial Water Quality Objective (PWQO)**—The PWQOs are risk-based objectives developed for the protection of aquatic life, and human health via pathways associated with recreational use of surface water.

Secondary Sources

- **British Columbia Ministry of Water Land and Resource Stewardship (BC MWLRS) (2025) Approved Water Quality Guideline for Freshwater Aquatic Life, long-term chronic**—Long-term chronic WQGs for freshwater aquatic life were developed by BC MWLRS to protect the most sensitive species and life stages against sub-lethal and lethal effects for indefinite exposure. WQGs for several parameters incorporate toxicity-modifying factors (e.g., hardness, pH, dissolved organic carbon) which are known to influence the health effects of parameters on aquatic receptors.

The following hierarchy was used in the selection of surface water quality criteria for the protection of ecological health:

- The more conservative criterion (i.e., lower) available from the primary sources:
 - CCME WQG for freshwater aquatic life, long-term;
 - ECCC FWQG;
 - MECP PWQO.
- In the absence of criteria from primary sources, surface water quality criteria from secondary sources were selected:

- BC MWLRS Approved Water Quality Guideline, freshwater aquatic life, long-term chronic.

The surface water quality criteria from the above agencies and the selected screening criteria are presented in Table C1-2. For parameters with criteria dependent on toxicity-modifying factors, the minimum predicted hardness (30 mg/L) and/or 25th percentile baseline temperature (0.1°C), field pH (6.4) and dissolved organic carbon concentrations (4.6 mg/L) were used as a conservative approach (details provided in Table C1-3). In general, the most conservative criteria for each parameter from each applicable source (i.e., primary source, and secondary source where required) was selected for use in the Tier 1 screening. This attachment should be reviewed in conjunction with Table C1-2 for a comprehensive understanding of the screening approach.

5.2 IDENTIFICATION OF POPCS IN SURFACE WATER

Existing conditions (i.e., baseline) for surface water quality for incorporation into the HHERA are based on a model baseline condition provided by the Water Quality discipline as presented in the Receiver Water Quality Modelling Report (WSP 2025a). Surface water concentrations were also predicted for each Project phase (i.e., construction, operations, closure) and post-closure, and provided by the Water Quality discipline. Details regarding surface water quality modelling is presented under separate cover in the Receiver Water Quality Modelling Report (WSP 2025a). The predicted concentrations for applicable water quality nodes used in the HHERA along with supporting details (e.g., selection of water modelled nodes included model description, and modelled results) are provided in Attachment B and WSP (2025a). The maximum monthly modelled concentrations across all applicable water quality nodes for baseline, construction, operations, closure and post-closure were conservatively selected as the EPC values for screening.

The selected screening criteria and screening results for surface water quality are presented in Table C1-2. A parameter was retained as a POPC in the HHRA or ERA if the maximum monthly predicted surface water concentration was greater than the selected screening criteria for human health or protection of ecological receptors, respectively.

Human Health

The maximum predicted concentration of arsenic was greater than its selected surface water criterion; therefore, arsenic was retained as a POPC in surface water for human health. While the maximum predicted mercury concentration was below its selected surface water screening criterion, mercury is considered a highly bioaccumulative substance, particularly in aquatic environments, and was identified as a parameter of concern by Indigenous communities for the Project. Therefore, mercury was carried forward to the multi-media assessment for the HHRA. Similarly, while the maximum predicted selenium concentration was below its selected surface water screening criterion, it is considered a bioaccumulative substance in the aquatic environment and can bioaccumulate in fish consumed by humans; therefore, selenium was carried forward to the multi-media assessment for the HHRA.

As discussed in Section 1.0, parameters associated with specific mining operations identified by Health Canada (2023) for gold mining (arsenic, cadmium, chromium, cyanide, mercury and PAHs) were specifically considered in the HHERA Tier 1 screening. Cadmium, chromium and cyanide was below human health-based criteria in surface water, as such they were not retained as POPCs for human health. Arsenic was retained as a POPC based on surface water measurements above guidelines of Tier 1 human health-based criteria. Surface water quality predictions did not include PAHs, therefore, PAHs were screened in soil via dust deposition only.

Ecological Receptors

The maximum predicted concentrations of total phosphorus, aluminum, arsenic, chromium, copper, iron and lead were above their respective selected surface water screening criteria and were retained as POPCs in surface water for ecological receptors. Additionally, as stated above for human health, while the maximum predicted concentrations of mercury and selenium were below their respective screening criteria, these parameters are considered to be potentially bioaccumulative in the aquatic ecosystem. The selected ecological screening criteria are protective of aquatic life (e.g., plants, invertebrates and

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fish) but not aquatic-feeding mammals and birds. As such, mercury and selenium were carried forward to the ERA Tier 2 Screening for surface water.

6 FISH, VEGETATION AND WILD GAME

Project activities are anticipated to impact soil and surface water quality through the deposition of airborne emissions and/or discharge of mine contact water into the surrounding aquatic environment. Vegetation may uptake parameters from soil or surface water. Wildlife may also uptake parameters directly from environmental media (e.g., soil, sediment, surface water) through ingestion or incidental ingestion, or through the ingestion of food items (i.e., vegetation, invertebrates, fish, other wildlife). Humans may be impacted from the subsequent consumption of vegetation and wild game.

Vegetation (traditional plants, berries), and wild game tissue were collected as part the Soil and Traditional Food sampling program completed in support of the HHERA and presented in Attachment A. Fish tissue sampling was conducted and described in the Fisheries Resources Baseline Report (WSP 2025e). Generic screening criteria protective of human and ecological receptors are generally not available for these media. As such, a Tier 1 screening was not completed for fish, vegetation or wild game tissue. However, these measured concentrations were incorporated into the multi-media assessments of both the HHRA and ERA components of the HHERA. Details regarding the application of fish, vegetation, and wild game tissue data in the HHERA are provided in Attachments E (Human Health Multi-Media Model) and F (Ecological Health Multi-Media Model).

7 AIR

Air quality concentrations from project activities were predicted based on an approved air dispersion model. To identify POPCs in air emitted by Project activities, in combination with ambient concentrations, that have the potential to impact human health, concentrations of the Project-related parameters, with background, were compared to air quality criteria as presented in the following sections.

Inhalation exposure is typically evaluated for acute (i.e., short-term) and chronic (i.e., long-term) exposures, where 1-hour and 24-hour averaging period represent acute exposures and annual averaging periods represent chronic exposures. Air quality concentrations and air quality criteria for 1-hour, 24-hour and annual averaging periods were therefore presented where available and evaluated accordingly.

7.1 SCREENING CRITERIA FOR AIR QUALITY

Air quality criteria were selected from various federal, provincial and state agencies. The health-based air criteria selected for screening were based on the following hierarchy:

The more conservative criterion (i.e., lower) of the criteria available from primary sources:

- MECP Ambient Air Quality Criteria (AAQCs) or Air Contaminants Benchmarks (ACBs);
- CCME Canadian Ambient Air Quality Standards (CAAQS) or National Ambient Air Quality Objectives (NAAQO).
- If multiple criteria were available for MECP or CCME, the available criteria were reviewed based on relevance to human health effects prior to selecting a screening criterion.
- It is noted that for the assessment of Diesel Particulate Matter (DPM), Health Canada (2016) reference values for 1-hour and 24-hour averaging periods were selected in the absence of MECP or CCME criteria.

In the absence of air quality criteria from primary sources, available criteria from secondary sources were reviewed. Criteria with supporting documentation available, and/or criteria based on more current studies, and/or criteria based on studies which are more relevant to human health (i.e., human studies) were preferentially selected. The hierarchy expands upon the hierarchy of the Air Quality Assessment (WSP, 2025d), which considered MECP and CCME air quality criteria in their assessment. Air quality criteria reviewed from secondary sources included:

- WHO Air Quality Guidelines (AQGs);
- US EPA National Ambient Air Quality Standards (NAAQS) or Regional Screening Levels (RSL);
- California Office of Environmental Health Hazard Assessment (Cal OEHHA) Reference Exposure Levels (RELs);
- British Columbia Ministry of the Environment and Climate Change (BC ENV) Ambient Air Quality Objectives (AAQOs);
- Texas Commission on Environmental Quality (TCEQ) Effect Screening Level (ESL)/Reference Value (ReV)/Air Monitoring Comparison Value (AMCV).

A summary of the available air quality criteria from each agency and the selected air quality criteria for the 1-hour, 24-hour and annual averaging periods is presented in Tables C1-3, C1-4, and C1-5, respectively, following this Attachment. It is noted that given 1-hour and 24-hour averaging periods represent acute inhalation exposure, in cases where air quality criteria for one of these averaging times were unavailable, the assessment applied the available air quality criteria from the alternative acute exposure scenario (i.e., if no 1-hour averaging time criteria was available, acute exposure was assessed with 24-hour averaging period criteria). In general, the most conservative criteria for each parameter from each applicable source (i.e., primary source, and secondary source where required) was selected for use in the Tier 1 screening.

This Attachment should be reviewed in conjunction with the Tier 1 screening tables for a comprehensive understanding of the screening approach.

7.1.1 PRIMARY SOURCES:

Ontario Ministry of the Environment, Conservation and Parks

The MECP has developed Ambient Air Quality Criteria (AAQC) to assess air quality (MECP 2020). The AAQC is a concentration in air that is protective against adverse effects on human health and/or the environment.

The AAQCs are provided for 1-hour, 24-hour, and annual average exposure periods. For this assessment, acute exposures are represented by 1-hour and 24-hour averaging periods. While criteria for 1-hour exposure periods were developed by the MECP to be protective against acute health effects, criteria for 24-hour exposure periods were developed by the MECP to be protective against chronic health effects. Therefore, for this assessment, the 24-hour criteria developed by the MECP were not preferentially selected for the assessment of acute exposures as they were derived by the MECP to be protective against chronic health effects.

In general, the chronic AAQCs for carcinogens are based on a risk level of 1 in 1,000,000 (1×10^{-6}). For the purpose of this assessment, the AAQCs based on carcinogenic effects were multiplied by a factor of 10 to adjust to a risk level of 1 in 100,000 (1×10^{-5}) to be consistent with the acceptable incremental lifetime cancer risk level as recommended by federal Health Canada guidance (Health Canada 2024). The air criteria for inhalation risks via non-carcinogens were set to a target hazard quotient (HQ) of 1.0.

Additionally, the HHRA considered Air Contaminants Benchmarks (ACB). In addition to AAQCs, the MECP provides Air Contaminants Benchmarks (ACB) which are a compilation of standards, guidelines, or screening levels which can be used to evaluate concentrations of parameters in air at points of impingement (MECP 2023). ACBs are available for the 24-hours and annual averaging period. For the selection of screening criteria for air quality, MECP AAQCs were preferentially selected over ACBs. Based on the availability of AAQCs, ACBs were selected as screening criteria for the 24-hours averaging period only.

Canadian Council of Ministers of the Environment

Air quality for criteria air parameters (CAPs) in Canada is regulated by standards set by the CCME, an inter-governmental body of federal, provincial, and territorial ministers responsible for the environment. In 2012, a Canada-wide Air Quality Management System was implemented as a national collaborative approach to reduce air pollution in Canada. As part of this initiative, the Canadian Ambient Air Quality Standards (CAAQS), which were originally established as National Ambient Air Quality Objectives (NAAQO) under the Canadian Environmental Protection Act (1999), were developed for the following criteria air parameters: particulate matter with nominal aerodynamic diameter of 2.5 microns or less (sometimes referred to as fine particulate matter; $PM_{2.5}$), sulphur dioxide, and nitrogen dioxide. Target levels for these parameters were set for the years 2015 ($PM_{2.5}$ and ozone only), 2020, and 2025 (ozone, sulphur dioxide, and nitrogen dioxide only) (CCME 2025).

7.1.2 SECONDARY SOURCES

World Health Organization

The WHO has developed air quality guidelines (AQG) for common air parameters. These global targets are intended to reduce human exposure to air pollutants and protect public health (WHO 2000, 2021). The guidelines are intended to provide background information and guidance to governments in making risk management decisions, particularly in setting standards. These guidelines may also be used in planning processes and various management decisions at a community or regional level. Supporting information on the derivation of the WHO guidelines is available. The air quality guidelines for non-carcinogens are based on an HQ of 1.0 and a cancer risk level of 1 in 100,000 for carcinogens.

United States Environmental Protection Agency

National Ambient Air Quality Standards

The US EPA has developed National Ambient Air Quality Standards (NAAQS) for criteria air parameters that are considered harmful to human health as part of the *Clean Air Act*. These six criteria air parameters are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter with nominal aerodynamic diameter of 10 microns or less (sometimes referred to as respirable particulate matter; PM₁₀), PM_{2.5}, and sulphur dioxide (US EPA 2025). A primary and/or secondary standard is set for each of the criteria air parameters. Primary standards are intended to protect public health, which include sensitive populations, such as children, the elderly, and those with pre-disposed respiratory illnesses (e.g., asthma). Secondary standards are intended to be protective of public welfare such as animals, crops, vegetation, and infrastructure.

Regional Screening Levels

The US EPA (2024) has developed RSLs for the protection of human health. The RSLs are risk-based concentrations derived from standardized equations that combine exposure assumptions with US EPA toxicity data. The US EPA has developed RSLs for different media (air, tap water, and soil) and different exposure scenarios (resident, indoor worker, and outdoor worker). For the purpose of the HHRA, the residential scenario was used. The RSLs are considered by the US EPA to be protective of human exposure (including sensitive groups) over a lifetime. Parameter concentrations above the RSL do not necessarily mean that a health effect will occur; however, concentrations above an RSL suggests that further evaluation of the potential risks may be needed. The US EPA RSLs for non-carcinogens are based on a HQ of 1.0, and RSLs for carcinogens are based on a cancer risk level of 1 in 1,000,000. For the purpose of this assessment, the carcinogenic RSLs were multiplied by a factor of 10 to adjust to a risk level of 1 in 100,000 with the acceptable incremental lifetime cancer risk level as recommended by Health Canada guidance (Health Canada 2024).

California Office of Environmental Health Hazard Assessment

The California Office of Environmental Health Hazard Assessment (Cal OEHHA 2025) has developed reference exposure levels (RELs), which are levels of a parameter at or below which adverse health effects are not expected to occur in a human population, including in sensitive populations such as children for a specific exposure period (Cal OEHHA 2008). The RELs are used in risk assessments to evaluate the potential for adverse health effects from exposure to air emissions from facilities or similar localized sources in the state's Air Toxics Hot Spots Program and from widespread exposures in the Toxic Air Contaminants Program. Supporting information is available for most RELs. The chronic RELs for non-carcinogens are based on an HQ of 1.0.

The California OEHHA does not develop RELs or air quality guidelines or objectives for carcinogens but has instead provided inhalation unit risks (IURs) for use in cancer risk assessments (Cal OEHHA 2009, 2025). California OEHHA was contacted regarding the use of their IUR factors for screening purposes and they indicated that IURs can be adjusted based on an applicable cancer risk level and used as air criteria (Halm 2010, pers. comm). The California OEHHA IURs are based on a cancer risk level of 1 in 1,000,000 which was divided by the IUR and multiplied by a factor of 10 to derive a risk specific concentration based on the acceptable incremental lifetime cancer risk level of 1 in 100,000 as recommended by Health Canada guidance (Health Canada 2024).

British Columbia Ministry of the Environment and Climate Change

In BC, ambient air quality objectives and standards (AAQO) are developed by the British Columbia Ministry of the Environment and Climate Change (BC ENV), under the authority of the *Environmental Management Act*. The AAQO are levels of a parameter that are considered to be acceptable in the air and protective of the environment and/or human health. BC ENV provides AAQO for time-weighted averages of 1-hour, 24-hour, and annual (BC ENV 2021). The AAQO were developed by BC ENV using air quality criteria from provincial and federal governing bodies. They are non-legally binding limits that help inform decisions with respect to the management of air quality, including guiding decisions on environmental impact assessments and informing regulatory development.

In addition, BC ENV has previously developed pollution control objectives for carbon monoxide (1-hour and 8-hour), which were adopted in the 1970s for industrial sectors such as for food-processing, agriculture, and other industries. The pollution control objectives have since been retracted but are kept by BC ENV for reference purposes.

Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) has developed acute (i.e., 1-hour) and chronic (i.e., annual) effects screening levels (ESLs) that are used in the air permitting process within Texas air sheds to evaluate emissions predicted by air dispersion modelling. The TCEQ has developed interim and final ESLs, where the approach and methods used to derive final ESLs are outlined by the TCEQ in publicly available supporting technical documents. The final ESLs are based on reference values (ReV), which are toxicological values derived for the protection of human health from a review of available scientific data and are based on an HQ of 1.0. The ESLs are then adjusted to an HQ of 0.3, which means that the ESL is calculated by multiplying the reference value by 0.3 (TCEQ 2015). The TCEQ has also developed air monitoring comparison values (AMCVs), which are based on reference values derived from toxicological data (i.e., lowest observed adverse effect level [LOAEL] and no observed adverse effect level [NOAEL]) (TCEQ 2015). The TCEQ have developed ACMVs for selected parameters for the 1-hour, 24-hour and annual exposure periods. The ACMVs are based on an HQ of 1.0.

For parameters where a final ESL (based on HQ of 0.3) is available, an AMCV and/or ReV (which is based on an HQ of 1.0) was selected as the TCEQ air criteria. For parameters with only interim values available, no adjustment to the value could be made as the TCEQ does not indicate whether interim ESL values are based on HQs of 0.3 or 1.0. Available ESLs, ReVs and ACMVs based on carcinogenic endpoints are based on a risk level of 1 in 100,000, which is consistent with benchmarks defined by Health Canada.

The TCEQ ESL and AMCV were retrieved from the Texas Air Monitoring Information System database (TCEQ 2025). The ESLs are not ambient air standards. The ESLs are used in the air permit review process, where emissions of one parameter from one site are evaluated at a time (emissions from multiple sites or multiple parameters are not evaluated). If predicted airborne levels of a parameter are below the screening level, adverse health effects are not expected. If predicted ambient levels of parameters in air are above the screening levels, it does not necessarily indicate a problem, but that a more detailed review is needed.

7.2 IDENTIFICATION OF POPCS IN AIR

Maximum predicted air concentrations were provided by the Air Quality discipline for each point of reception (POR) for each Project phase (construction/closure and operations) plus baseline, as presented in Attachment B, Table B1-1 and Table B1-2 and in the Air Quality Assessment report (WSP 2025d). Baseline (i.e., existing conditions) air quality data were collected from monitoring stations in the LSA, as reported by the Air Quality discipline in the Ambient Air Baseline Monitoring Report (WSP 2025f), and summarized in Attachment A. For the purposes of screening and POPC identification, the following air quality concentration statistics were compared to health-based air quality criteria:

- 1-hour averaging period: 90th percentile of measured (baseline) plus predicted (Project phases) 1-hour average concentrations
- 24-hours averaging period: 90th percentile of measured (baseline) plus predicted (Project phases) 24-hours average concentrations
- Annual averaging period: Average of maximum measured (baseline) plus predicted (Project phases) annual average concentrations

In terms of dust deposition, it was assumed that deposition rates from Project activities would be the same during construction and active closure phases, therefore the screening of the 'construction' phase, herein referred to as construction/closure in the context of air quality is representative of both construction

ATTACHMENT C: Identification of Parameters of Potential Concern

(3 years) and active closure (3 years) phases. It was assumed that no dust deposition occurred under baseline conditions and post-closure (WSP 2025d).

Additionally, total inhalation exposure (i.e., baseline + construction/closure and baseline + operations) was summed at each POR and compared to health-based air quality criteria for each averaging period to identify inhalation POPC. This screening was completed for all parameters for which both measured baseline and predicted Project concentrations were available.

It is noted that for carbon monoxide, an 8-hour averaging period was assessed rather than a 24-hour averaging period.

A parameter was identified as a POPC if its maximum predicted concentration for the construction phase, operations phase, baseline + construction phase, or baseline + operations phase were above the selected health-based air criterion applicable for that parameter. POPCs were individually screened and identified for each averaging period and assessment phase of the project.

The results of the air quality screening for the 1-hour, 24-hour and annual exposure periods are presented in Tables C1-6 (1-hour), C1-7 (24-hour) and C1-8 (annual). The following parameters were retained as POPCs in the Tier 1 screening:

- 1-hour: Nitrogen Dioxide (NO₂) and DPM
- 24-hour: No predicted Project phase concentrations, or baseline + predicted Project phase concentrations were above selected air quality screening criteria, therefore, no POPCs were identified for the 24-hour averaging period.
- Annual: DPM
 - Note that annual DPM predicted concentrations were above the carcinogenic criteria only at the maximum point of impingement (MPOI). No concentrations above guidelines were observed at PORs where human receptors are expected to spend significant time. No predicted Project phase concentrations, or baseline + predicted Project phase concentrations were above non-carcinogenic air quality criteria for DPM. DPM was retained as a POPC for the evaluation of potential carcinogenic risk at long-term exposure PORs in the HHRA.

In general, where no air quality criteria was available or where predicted air quality concentrations could not be estimated for a parameter for one of the acute averaging periods evaluated (i.e., 1-hour, 24-hours), screening of acute exposure for that parameter was evaluated solely based on the averaging period for which criteria/predicted concentrations were available. For example, if an air quality criterion and/or predicted concentrations of a parameter were unavailable for the 1-hour averaging period, acute exposure screening for the parameter was completed for 24-hours averaging period only. Where air quality criteria and/or predicted concentrations for a parameter were unavailable for the 24-hours averaging period, acute exposure screening for the parameter was completed for 1-hour averaging period only. Full details are provided in Table C1-6 and C1-7.

As presented in Table C1-8, health effects linked to carbon monoxide are associated with acute exposures (i.e., 1- or 8- hours), therefore carbon monoxide was not assessed for the annual averaging period. For chronic exposure to copper sulphate, the screening of copper for the annual averaging period was considered to be representative where predicted annual concentrations of copper sulphate were unavailable. Additionally, in the absence of annual air quality criteria for iron, the screening of particulate matter for the annual averaging period was considered to be representative of iron. Though TCEQ does not provide a specific value from iron, it is indicated that concentrations "Must Meet NAAQS", which means assessment of individual parameters is not required if a NAAQS analysis is completed for particulate matter of 2.5 and 10 microns or less, Therefore, the screening of particulate matter for the annual averaging period was considered to be representative of iron..

8 SUMMARY OF POPCS AFTER TIER 1 SCREENING

A summary of POPCs identified in soil, surface water and air through the Tier 1 screening and retained for further assessment in the HHERA is presented in Table C-3. As discussed in Section 4.0, a Tier 1 screening was not completed for sediment as the Project will have no material effect on the POPC concentrations in sediment and sediment quality predictions are not available for the Project. As discussed in Section 6.0, a Tier 1 screening was not completed for fish, vegetation or wild game tissue as generic screening criteria protective of human and ecological receptors are generally not available for these media.

While mercury was below its selected screening criteria in any media, mercury is considered a highly bioaccumulative substance and was identified as a parameter of concern by Indigenous communities in the area of the Project. Therefore, mercury was carried forward to the multi-media assessments in both the HHRA and ERA. Similarly, while selenium was below its selected soil screening criteria in any media, it is considered a bioaccumulative substance in the aquatic environment and can bioaccumulate in fish consumed by humans and ecological receptors. Therefore, selenium was carried forward to the multi-media assessments for the HHRA and ERA.

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Table C-3: Summary of POPCs Identified Following Tier 1 Screening

Media	Human Health		Ecological Health
Air	Averaging Period	1-Hour – Nitrogen Dioxide (NO ₂), Diesel Particulate Matter (DPM)	Not applicable
		24-Hours – None	
		Annual –DPM	
Soil	Arsenic Mercury ⁽¹⁾ Selenium ⁽²⁾		Arsenic Mercury ⁽¹⁾ Selenium ⁽²⁾
Surface Water	Arsenic Mercury ⁽¹⁾ Selenium ⁽²⁾		Total phosphorus Aluminum Arsenic Chromium Copper Iron Lead Mercury ⁽¹⁾ Selenium ⁽²⁾

Notes:

ERA = ecological risk assessment; HHRA = human health risk assessment; POPC = Parameter of Potential Concern.

- 1 Mercury concentrations were not above the selected screening criteria, but the parameter was retained as a POPC due to both community concerns and its bioaccumulation potential.
- 2 Selenium concentrations were not above the selected criteria, but the parameter was retained as a POPC due to its bioaccumulation potential in the aquatic ecosystem (applicable to the ERA) and that it can bioaccumulate in fish consumed by people (applicable to the HHRA).

9 TIER 2 SCREENING

The Tier 1 screening process, as described above, involves the comparison of analytical data to screening criteria protective of both human and ecological health. A secondary screening process (i.e., Tier 2 screening) is then required to identify specific human or ecological health POPCs in the HHRA or ERA based on respective human or ecological health-based screening criteria, and/or refinement of screening criteria to be specific for human or ecological health-based exposure pathways.

POPCs identified in the Tier 1 screening (Section 8.0) were further evaluated through Tier 2 screening for the HHRA and ERA. Tier 2 screening involves the comparison of maximum or statistical representative concentrations of POPCs identified through the Tier 1 screening against exposure pathway-specific health-based screening criteria. Details of the Tier 2 screening are provided in Section 4.1.1 of the HHRA and 5.2.1 of the ERA in the HHERA report.

The Tier 2 screening for the HHRA for surface water is presented in Tables C1-9 to C1-10. The Tier 2 screening for the ERA is presented in Table C1-11 for soil and C1-12 for surface water. Tier 2 screening for other media was not required, as discussed in Section 4.1.1 of the HHRA and 5.3.2 of the ERA in the HHERA report.

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Subattachment C1
**Tiered Screening of Parameters in Air,
Water, and Soil**



SUBATTACHMENT C1: TIERED SCREENING OF PARAMETERS IN AIR, WATER, AND SOIL

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Table C1-1: Tier 1 Screening of Soil Quality Parameters

Parameter	Units	Primary Source		Secondary Source		Ontario Background		Selected Screening Criteria ⁽⁸⁾	Source	Baseline Soil Maximum Concentration	Predicted Soil Maximum Concentration ⁽¹⁴⁾	POPC for Human Health ^{(15)?}	POPC for Ecological Health ^{(15)?}
		CCME SQG Agricultural ^(3,4)	MECP Table 2 SCS Agricultural, Coarse Soil ⁽¹⁾	OTHER (BC CSR > AEP > US EPA RSL) ^(5,6,7)	Source (if applicable)	MECP Table 1 SCS Agricultural ⁽¹⁾	MECP Rural Parks OTR ₉₈ ⁽²⁾						
Metals													
Aluminum	mg/kg	NV	NV	40000	BC CSR, G _{HH}	NV	30000	40000	BC CSR, G _{HH}	13800	14035	No	No ⁽¹⁷⁾
Antimony	mg/kg	20	7.5	-	-	1	0.45	7.5	MECP	1.4	1.4	No	No
Arsenic	mg/kg	31 ⁽¹³⁾	11	-	-	11	11	11	MECP	18	20	Yes	Yes
Barium	mg/kg	750	390	-	-	210	170	390	MECP	96	98	No	No
Beryllium	mg/kg	4	4	-	-	2.5	1.1	4	CCME & MECP	0.43	0.43	No	No
Bismuth	mg/kg	NV	NV	NV	NA	NV	NV	NA	NA	0.20	0.21	No ⁽¹⁸⁾	No ⁽¹⁸⁾
Boron	mg/kg	2	120	-	-	36	30	36	Table 1 SCS	5.3	5.3	No	No
Cadmium	mg/kg	1.4	1	-	-	1	0.7	1	MECP	0.68	0.71	No	No
Calcium	mg/kg	NV	NV	NV	NA	NV	54000	54000	MECP OTR ₉₈	4910	5080	No ⁽¹⁹⁾	No ⁽¹⁹⁾
Chromium (Total)	mg/kg	64	160	-	-	67	58	67	Table 1 SCS	27	28	No	No
Cobalt	mg/kg	40	22	-	-	19	16	22	MECP	12	12	No	No
Copper	mg/kg	63	140	-	-	62	46	63	CCME	22	22	No	No
Iron	mg/kg	NV	NV	35000	BC CSR, G _{HH}	NV	36000	36000	MECP OTR ₉₈	18100	18446	No	No
Lead	mg/kg	61 ⁽¹²⁾	45	-	-	45	38	45	MECP	17	18	No	No
Magnesium	mg/kg	NV	NV	NV	NA	NV	19000	19000	MECP OTR ₉₈	5510	5576	No ⁽¹⁹⁾	No ⁽¹⁹⁾
Manganese	mg/kg	NV	NV	2000	BC CSR	NV	1900	2000	BC CSR	1490	1497	No	No
Mercury	mg/kg	6.6	0.25	-	-	0.16	0.13	0.25	MECP	0.19	0.19	RET ⁽¹⁶⁾	RET ⁽²⁰⁾
Molybdenum	mg/kg	5	6.9	-	-	2	0.984	5	CCME	1.5	1.5	No	No
Nickel	mg/kg	45	100	-	-	37	34	45	CCME	17	17	No	No
Phosphorus	mg/kg	NV	NV	0.313	US EPA RSL _{HH}	NV	1100	1100	MECP OTR ₉₈	759	761	No ⁽¹⁹⁾	No ⁽¹⁹⁾
Potassium	mg/kg	NV	NV	NV	NA	NV	6500	6500	MECP OTR ₉₈	2140	2232	No ⁽¹⁹⁾	No ⁽¹⁹⁾
Selenium	mg/kg	1	2.4	-	-	1.2	0.91	1.2	Table 1 SCS	0.49	0.51	RET ⁽²¹⁾	RET ⁽²¹⁾
Silver	mg/kg	20	20	-	-	0.5	0.5	20	CCME & MECP	0.24	0.25	No	No
Strontium	mg/kg	NV	NV	9500	BC CSR, G _{HH}	NV	63	9500	BC CSR, G _{HH}	26	27	No	No ⁽¹⁷⁾
Sulphur	mg/kg	500	NV	-	-	NV	790	790	MECP OTR ₉₈	1200	1339	No ⁽¹⁹⁾	No ⁽¹⁹⁾
Thallium	mg/kg	1	1	-	-	1	NV	1	CCME & MECP	0.18	0.18	No ⁽¹⁸⁾	No ⁽¹⁸⁾
Thorium	mg/kg	NV	NV	NV	NA	NV	NV	NA	NA	NA	0.079	No ⁽¹⁸⁾	No ⁽¹⁸⁾
Tin	mg/kg	5	NV	-	-	NV	NV	5	CCME	2.0	2.0	No	No
Titanium	mg/kg	NV	NV	NV	NA	NV	4500	4500	MECP OTR ₉₈	953	970	No	No
Tungsten	mg/kg	NV	NV	15	BC CSR, G _{HH}	NV	NV	15	BC CSR, G _{HH}	1.1	1.1	No ⁽¹⁸⁾	No ⁽¹⁸⁾
Uranium	mg/kg	23	23	-	-	1.9	1.3	23	CCME & MECP	0.85	0.86	No	No
Vanadium	mg/kg	130	86	-	-	86	86	86	MECP	45	46	No	No
Yttrium	mg/kg	NV	NV	NV	NA	NV	NV	NA	NA	NV	0.057	No ⁽¹⁸⁾	No ⁽¹⁸⁾
Zinc	mg/kg	250	340	-	-	290	160	290	Table 1 SCS	59	65	No	No
Zirconium	mg/kg	NV	NV	1.25	US EPA RSL _{HH}	NV	NV	1.25	US EPA RSL _{HH}	3.2	4.0	No ⁽¹⁸⁾	No ⁽¹⁹⁾
Polycyclic Aromatic Hydrocarbons (PAHs)													
Benz(a)anthracene	mg/kg	See B(a)P TPE	0.5	-	-	0.095	-	0.5	MECP	0.010	0.010	No	No
Benzo(a)pyrene	mg/kg	See B(a)P TPE	0.078	-	-	0.05	-	0.078	MECP	0.025	0.025	No	No
Benzo(b+j)fluoranthene ^(9,22)	mg/kg	See B(a)P TPE	0.78	-	-	0.3	-	0.78	MECP	0.071	0.071	No	No
Benzo(b+j+k)fluoranthene ⁽⁹⁾	mg/kg	See B(a)P TPE	0.78	-	-	0.3	-	0.78	MECP	0.071	0.071	No	No
Benzo(g,h,i)perylene	mg/kg	See B(a)P TPE	6.6	-	-	0.2	-	6.6	MECP	0.010	0.010	No	No
Benzo(k)fluoranthene ⁽²²⁾	mg/kg	See B(a)P TPE	0.78	-	-	0.05	-	0.78	MECP	0.010	0.010	No	No
Chrysene	mg/kg	See B(a)P TPE	7	-	-	0.18	-	7	MECP	0.052	0.052	No	No
Dibenz(a,h)anthracene	mg/kg	See B(a)P TPE	0.1	-	-	0.1	-	0.1	MECP	0.0050	0.0050	No	No
Indeno(1,2,3-c,d)pyrene	mg/kg	See B(a)P TPE	0.38	-	-	0.11	-	0.38	MECP	0.010	0.010	No	No
B(a)P total potency equivalents [B(a)P TPE IACR ⁽¹¹⁾	mg/kg	5.3	NC	-	-	0.05	-	5.3	CCME	0.037	0.037	No	No
IACR ⁽¹¹⁾	unitless	1	-	-	-	NA	-	1	CCME	0.68	0.68	No	No

Notes:

AEPA = Alberta Environment and Protected Areas; B(a)P TPE= benzo(a)pyrene total potency equivalents; BC CSR= British Columbia Contaminated Sites Regulation; CCME = Canadian Council of Ministers of the Environment; ERA = ecological risk assessment; HHRA = human health risk assessment; HQ = hazard quotient; IACR = index of additive cancer risk; ILCR = incremental lifetime cancer risk; NA= not applicable; NV= no value available; MECP = Ontario Ministry of the Environment, Conservation and Parks; mg/kg= milligrams per kilogram; PAH= polycyclic aromatic hydrocarbon; POPC = parameter of potential concern; RSL= Regional Screening Level; SCS= site condition standard; SQG = soil quality guideline; US EPA= United States Environmental Protection Agency

“-“ = not applicable; screening criteria from a preferred source was available.

¹ MECP Table 1 Full Depth Background Site Condition Standards (considered as Ontario Background) and Table 2 Full Depth Generic Site Condition Standards in a Potable Ground Water Condition (considered a Primary Source), Agricultural Land Use, coarse-grained soil (MOE 2011a). Criteria for carcinogenic parameters are based on an incremental lifetime cancer risk of 1E⁻⁰⁶.

² Ontario Typical Range Soil Chemistry, Table 8.3: Soil - Rural Parks, OTR98. Where region specific criteria were available, Region 6 (Northern Ontario) criteria were selected (MOE 2011b).

³ CCME Soil Quality Guidelines for the Protection of Environmental and Human Health, Agricultural Land Use (CCME 1999, current to 2025).

⁴ CCME Soil Quality Guidelines for PAHs, Agricultural Land Use and ILCR of 10⁻⁵ (CCME 2010).

⁵ BC CSR Schedule 3.1 Numerical Soil Standards, Agricultural Land Use. Where pathway specific criteria were available, the lowest of the available criteria was selected as it would be protective of both human and ecological health. In the absence of these site-specific factors, the lower of the generic human and ecological health standards from Schedule 3.1 – Part 2 Generic Numerical Soil Standards to Protect Human Health and Schedule 3.1 – Part 3 Generic Numerical Soil Standards to Protect Ecological Health were used. For the applicable POPCs these criteria are only protective of human health (GHH = generic human health) (BC 2025)

⁶ AEPA Tier 1 Soil and Groundwater Remediation Guidelines, Coarse, Agricultural Land Use. (AEPA 2024)

⁷ US EPA RSLs, Resident Soil Ingestion. HQ = 0.2, ILCR = 1E-05 (US EPA 2024)

⁸ The lowest of the MECP and CCME criteria was preferentially selected as the screening criteria for soil. Where no MECP or CCME soil criteria was available, a soil quality criterion from other jurisdictions was selected according to order of preference BC>AEPA>US EPA. If the Ontario Background concentration (i.e., MECP Table 1 SCS, or MECP OTR98 in the absence of Table 1 SCS) was higher than any of these criteria, the Ontario Background was selected as the screening criterion. The Ontario Background was selected in the absence of screening criteria from primary and secondary sources.

⁹ Benzo(b)fluoranthene used as a surrogate for Benzo(b+j)fluoranthene and Benzo(b+j+k)fluoranthene

¹⁰ The B(a)P TPE is the sum of estimated cancer potency relative to B(a)P for carcinogenic unsubstituted PAHs. The B(a)P TPE for the baseline soil concentration and predicted Project phase concentration is calculated by multiplying the maximum (measured or predicted) concentration of each PAH by its B(a)P Potency Equivalence Factor (PEF), and summing the products. Potency Equivalence Factors are as follows: benzo(a)anthracene, 0.1; benzo(a)pyrene, 1; benzo(b+j+k)fluoranthene, 0.1; benzo(g,h,i)perylene, 0.01; chrysene, 0.01; dibenzo(a,h)anthracene 1; indeno(1,2,3-c,d)pyrene, 0.1. Incremental lifetime cancer risk of 1 in 10000 (1xE-05) . Where a concentration is non-detect, half the detection limit is applied (CCME 2010).

¹¹ The IACR is calculated to ensure that potable water resources are protected. It is calculated by dividing the soil concentration of each carcinogenic PAH by its soil quality guideline for protection of potable water component to calculate a hazard index for each PAH, and then summing the hazard indices for the entire PAH mixture. Soil quality guideline for protection of potable water component criteria are as follows: benz(a)anthracene, 0.33 mg/kg; benzo(b+j+k)fluoranthene, 0.16 mg/kg; benzo(g,h,i)perylene, 6.8 mg/kg; benzo(a)pyrene, 0.37 mg/kg; chrysene, 2.1 mg/kg; dibenz(a,h)anthracene, 0.23 mg/kg; indeno(1,2,3-c,d)pyrene, 2.7 mg/kg (CCME 2010)

¹² The selected CCME SQG for lead is based on 0.5 intelligence quotient (IQ) point decrement as a conservative approach and due to elevated lead concentrations in other media.

¹³ The criterion of 31 mg/kg was selected as it is based on an ILCR of 1xE-0⁵ (CCME 1999).

¹⁴ The predicted soil maximum concentration represents the highest overall soil concentrations predicted for Project phases (i.e. construction, operations and closure). It was assumed there would be no airborne emissions from Project activities, and therefore no soil deposition, in the post-closure phase.

¹⁵ A parameter is retained as a POPC if the predicted soil maximum concentration is greater than the selected screening criteria, unless otherwise noted.

¹⁶ This parameter was not identified as a POPC based on screening against soil criteria, however, it is carried forward to the multi-media assessment in the HHRA since it is considered a highly bioaccumulative substance, and was identified as a parameter of concern by Indigenous communities.

¹⁷ The selected screening criteria based on the hierarchy outlined in Note 8 is only protective of human health. In the absence of ecological screening criteria, the Ontario Background was selected as the screening criterion.

¹⁸ This parameter was not identified as a POPC because it is a trace mineralogical element not commonly assessed in risk assessment because human and animal toxicity data are lacking for these compounds. See text for further discussion.

¹⁹ This parameter was not identified as a POPC because it is an essential element, ubiquitous in the environment and generally non-toxic to human and ecological receptors in soil. See text for further discussion.

²⁰ This parameter was not identified as a POPC based on screening against soil criteria, however, it is carried forward to the multi-media assessment in the ERA since it is considered a highly bioaccumulative substance in the aquatic environment and was retained in surface water for the evaluation of aquatic-feeding wildlife.

²¹ This parameter was not identified as a POPC based on screening against soil criteria, however, it is carried forward to the multi-media assessment in the HHRA and ERA since it is considered a highly bioaccumulative substance in the aquatic environment.

²² This parameter is not included in the calculation of IACR or B(a)P TPE as it preresents a fraction of benzo(b+j+k)fluoranthene which is already accounted for in the calculations.

Bolded and shaded= Exceeds selected screening criteria.

RET (italicized) = Retained as a highly bioaccumulative substance. See Notes 16, 20 and 21.

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Table C1-2: Tier 1 Screening of Surface Water Quality Parameters

Parameter	Units	Human Health				Selected Human Health Screening Criteria ⁽⁵⁾	Source	Ecological Health				Selected Ecological Screening Criteria ⁽⁹⁾	Source	Maximum Predicted Water Quality Concentration ⁽¹⁰⁾					POPC for Human Health ^{(12,13)?}	POPC for Ecological Health ^{(12,13)?}
		Primary Source		Secondary Source				Primary Source		Secondary Source				Baseline (Existing Conditions) ⁽¹¹⁾	Construction	Operations	Closure	Post-Closure		
		Health Canada MAC ⁽¹⁾	MECP GW1 ⁽²⁾	OTHER (BC CSR>US EPA RSL) ^(3,4)	Source of Alternative Guideline (if applicable)			CCME WQG, Aquatic Life ⁽⁶⁾	ECCC FWQG ⁽⁷⁾	MECP PWQO ⁽⁸⁾	OTHER (BC MWLRS) ⁽¹⁷⁾									
Conventional Parameters																				
Hardness, as CaCO ₃	mg/L	NV	NV	NV	NA	NV	NA	NV	NV	NV	NV	NA	29.9	30.0	29.9	29.9	29.9	No ⁽¹⁴⁾	No ⁽¹⁴⁾	
Major Ions																				
Chloride	mg/L	250 ^(b)	250	-	-	250	Health Canada AO & MECP GW1	120	NV	NV	-	120	CCME WQG	5.2	4.6	4.8	4.9	4.6	No	No
Cyanide	mg/L	0.20	0.20	-	-	0.2	Health Canada MAC & MECP GW1	0.0050	NV	0.0050	-	0.0050	CCME WQG & MECP PWQO	0.0045	0.0045	0.0047	0.0047	0.0045	No	No
Magnesium	mg/L	NV	NV	NV	NA	NV	NA	NV	NV	NV	NV	NA	4.3	4.2	4.2	4.3	4.2	No ⁽¹⁵⁾	No ⁽¹⁵⁾	
Potassium	mg/L	NV	NV	NV	NA	NV	NA	NV	NV	NV	NV	NA	1.4	1.3	1.3	1.4	1.6	No ⁽¹⁵⁾	No ⁽¹⁵⁾	
Sulphate	mg/L	500 ^(b)	NV	-	-	500	Health Canada MAC	NV	NV	NV	128 ^(c)	128	BC MWLRS	6.1	6.4	9	6.9	6.1	No	No
Nutrients																				
Nitrate	mg-N/L	10	NV	-	-	10	Health Canada MAC	3.0	NV	NV	-	3.0	CCME WQG	0.20	0.20	0.30	0.20	0.20	No	No
Nitrite	mg-N/L	1.0	NV	-	-	1	Health Canada MAC	0.060	NV	NV	-	0.060	CCME WQG	0.015	0.015	0.018	0.018	0.014	No	No
Total ammonia	mg-N/L	NR ^(k)	NV	NV	NA	NR ^(k)	Health Canada MAC	80 ^(a)	NV	NV	-	80	CCME WQG	0.15	0.12	0.17	0.15	0.12	No	No
Total phosphorus	mg-P/L	NV	NV	NV	NA	NV	NA	NV	NV	0.010	-	0.010	MECP PWQO	0.057 ^(p)	0.057 ^(p)	0.057 ^(p)	0.057 ^(p)	0.057 ^(p)	No ⁽¹⁵⁾	Yes
Metals																				
Aluminum	mg/L	2.9	NV	-	-	2.9	Health Canada MAC	0.0050 ^(b)	0.20 ^(b,c,d)	NV ^(b,l)	-	0.005	CCME WQG	0.25 ^(Cc,Fc,P)	0.33 ^(Cc,Fc,P)	0.29 ^(Cc,Fc,P)	0.25 ^(Cc,Fc,P)	0.25 ^(Cc,Fc,P)	No	Yes
Antimony	mg/L	0.0060	0.0060	-	-	0.006	Health Canada MAC & MECP GW1	NV	NV	0.020	-	0.020	MECP PWQO	0.00045	0.00046	0.00057	0.00049	0.00050	No	No
Arsenic	mg/L	0.010	0.025	-	-	0.01	Health Canada MAC	0.0050	NV	0.0050	-	0.0050	CCME WQG & MECP PWQO	0.012 ^(Cc,H,P)	0.012 ^(Cc,H,P)	0.012 ^(Cc,H,P)	0.012 ^(Cc,H,P)	0.012 ^(Cc,H,P)	Yes	Yes
Beryllium	mg/L	NV	0.0040	-	-	0.004	MECP GW1	NV	NV	0.011 ^(c)	-	0.011	MECP PWQO	0.000032	0.000032	0.000034	0.000032	0.000032	No	No
Boron	mg/L	5.0	5.0	-	-	5	Health Canada MAC & MECP GW1	1.5	NV	0.20	-	0.20	MECP PWQO	0.0080	0.0080	0.0086	0.0080	0.0080	No	No
Cadmium	mg/L	0.0070	0.0050	-	-	0.005	MECP GW1	0.000058 ^(c)	NV	0.00010 ^(c)	-	0.000058	CCME WQG	0.000021	0.000035	0.000030	0.000021	0.000033	No	No
Calcium	mg/L	NV	NV	NV	NA	NV	NA	NV	NV	NV	NV	NA	15	15	15	16	16	No ⁽¹⁵⁾	No ⁽¹⁵⁾	
Chromium	mg/L	0.050 ^(e)	0.050	-	-	0.05	Health Canada MAC & MECP GW1	0.0010 ^(e)	0.0050 ^(e)	0.0089	-	0.0010	CCME WQG	0.0011 ^(Cc)	0.0011 ^(Cc)	0.0011 ^(Cc)	0.0011 ^(Cc)	0.0011 ^(Cc)	No	Yes
Cobalt	mg/L	NV	0.0030	-	-	0.003	MECP GW1	NV	0.00078 ^(c)	0.00090	-	0.00078	ECCC FWQG	0.00025	0.00033	0.00031	0.00024	0.00028	No	No
Copper	mg/L	2.0	1.0	-	-	1	MECP GW1	0.0020 ^(c)	0.00020 ^(f,g)	0.0050 ^(c)	-	0.0002	ECCC FWQG	0.0017 ^(Fc)	0.0017 ^(Fc)	0.0018 ^(Fc)	0.0017 ^(Fc)	0.0017 ^(Fc)	No	Yes
Iron	mg/L	0.10 ⁽ⁱ⁾	NV	2.8	US EPA RSL	2.8	US EPA RSL ⁽¹⁸⁾	0.30	0.42 ^(b,d)	0.30	-	0.30	CCME WQG & MECP PWQO	0.61 ^(Cc,Fc,P)	0.63 ^(Cc,Fc,P)	0.61 ^(Cc,Fc,P)	0.61 ^(Cc,Fc,P)	0.59 ^(Cc,Fc,P)	No	Yes
Lead	mg/L	0.0050	0.010	-	-	0.005	Health Canada MAC	0.0010 ^(c)	0.0069 ^(c,d)	0.0010-0.0030 ^(c)	-	0.001	CCME WQG	0.00021	0.0011 ^(Cc,P)	0.00095	0.00022	0.00021	No	Yes
Manganese	mg/L	0.12	NV	-	-	0.12	Health Canada MAC	0.31 ^(h)	NV	NV	-	0.28	CCME WQG	0.054	0.056	0.054	0.052	0.051	No	No
Mercury	mg/L	0.0010	0.0010	-	-	0.001	Health Canada MAC & MECP GW1	0.000026	NV	0.00020	-	0.000026	CCME WQG	0.0000034	0.0000038	0.0000037	0.0000034	0.0000033	RET ⁽¹⁶⁾	RET ⁽¹⁹⁾
Molybdenum	mg/L	NV	0.070	-	-	0.07	MECP GW1	0.073	NV	0.040	-	0.040	MECP PWQO	0.00033	0.00034	0.00043	0.00055	0.00059	No	No
Nickel	mg/L	NV	0.10	-	-	0.1	MECP GW1	0.025 ^(c)	NV	0.025	-	0.025	CCME WQG & MECP PWQO	0.0017	0.0017	0.0022	0.0017	0.0017	No	No
Selenium	mg/L	0.050	0.010	-	-	0.01	MECP GW1	0.0010	NV	0.10	-	0.001	CCME WQG	0.00023	0.00023	0.00024	0.00025	0.00027	RET ⁽¹⁶⁾	RET ⁽¹⁹⁾
Silver	mg/L	NV	0.10	-	-	0.1	MECP GW1	0.00025	NV	0.00010	-	0.00010	MECP PWQO	0.000027	0.000031	0.000030	0.000027	0.000027	No	No
Thallium	mg/L	NV	0.0020	-	-	0.002	MECP GW1	0.00080	NV	0.00030	-	0.00030	MECP PWQO	0.000007	0.000007	0.000017	0.000007	0.000007	No ⁽²⁰⁾	No ⁽²⁰⁾
Tungsten	mg/L	NV	NV	0.0030	BC CSR _{DW}	0.0030	BC CSR _{DW}	NV	NV	0.030	-	0.030	MECP PWQO	0.000054	0.00006	0.00014	0.00009	0.00012	No ⁽²⁰⁾	No ⁽²⁰⁾
Uranium	mg/L	0.020	0.020	-	-	0.02	Health Canada MAC & MECP GW1	0.015	NV	0.0050	-	0.0050	MECP PWQO	0.00029	0.00028	0.00029	0.00035	0.00035	No	No
Vanadium	mg/L	NV	0.0062	-	-	0.0062	MECP GW1	NV	0.12	0.0060	-	0.0060	MECP PWQO	0.0010	0.0010	0.0010	0.0011	0.0011	No	No
Zinc	mg/L	5.0 ⁽ⁱ⁾	5.0	-	-	5	Health Canada MAC & MECP GW1	0.023 ⁽ⁱ⁾	NV	0.020	-	0.020	MECP PWQO	0.0022	0.0070	0.0062	0.0024	0.0034	No	No
Zirconium	mg/L	NV	NV	0.00032	US EPA RSL	0.00032	US EPA RSL	NV	NV	0.0040	-	0.0040	MECP PWQO	0.0010 ^(Ho)	0.0014 ^(Ho)	0.0013 ^(Ho)	0.0010 ^(Ho)	0.0011 ^(Ho)	No ⁽²⁰⁾	No ⁽²⁰⁾

Notes:

AO = Aesthetic objective; BC CSR = British Columbia Contaminated Sites Regulation; BC CSRDW = BC CSR drinking water guideline; BC MWLRS = Ministry of Water, Land and Resource Stewardship; CaCO₃ = calcium carbonate; CCME = Canadian Council of Ministers of the Environment; DOC = dissolved organic carbon; ECCC = Environment and Climate Change Canada; ERA = ecological risk assessment; FWQG = Federal Water Quality Guideline; GW1 = groundwater component value protective of drinking water; HHRA = human health risk assessment; mg/L = milligrams per litre; mg-N/L = milligrams of nitrogen per litre; mg-P/L = milligrams of phosphorus per litre; MAC = maximum acceptable concentration; MECP = Ministry of the Environment, Conservation and Parks; MGRA = Modified Generic Risk Assessment; MOECC = Ontario Ministry of the Environment and Climate Change; NA = not applicable; NV = no value available; POPC = parameter of potential concern; PWQO = Provincial Water Quality Objective; RSL = regional screening level; US EPA = United States Environmental Protection Agency; WQG = water quality guideline.

“-“ = not applicable; guideline from a preferred source was available.

All concentrations presented are for total metals.

¹ Health Canada Guidelines for Canadian Drinking Water Quality. Maximum acceptable concentration (MAC), unless otherwise indicated (Health Canada 2025).

² MOECC MGRA Groundwater Components for Potable Water Scenario, coarse textured soil (GW1) (MOECC 2016).

³ BC CSR Schedule 3.2 Generic Numerical Water Standards, Drinking Water (BC 2025)

⁴ US EPA RSLs, Resident Tap Water. Hazard Quotient = 0.2, Incremental Lifetime Cancer Risk = 1E-05 (US EPA 2024)

⁵ Where no Health Canada or MECP drinking water guideline/standard was available, human health-based drinking water criteria from other jurisdictions were selected. Human-health based drinking water criteria from provincial jurisdictions (BC) were preferentially selected, followed by the US EPA, where no Canadian criteria were available (i.e., BC CSR> US EPA).

⁶ CCME WQG, freshwater aquatic life, long-term (CCME 1999, 2025)

⁷ ECCC FWQG (ECCC 2025)

⁸ MECP PWQO (MOEE 1994)

⁹ The lower of the available criteria from CCME WQG, ECCC FWQG and MECP PWQO was preferentially selected. Where no CCME, ECCC or MECP guideline/objective was available, ecological water criteria from provincial jurisdictions (BC) were selected.

¹⁰ Maximum predicted water quality concentrations by Project phase are based on the maximum monthly concentrations of all applicable water quality nodes. Full detailed provided in Attachment B.

¹¹ Existing conditions represent a modelled baseline condition. Full details provided in Attachment B.

¹² A parameter is retained as a POPC for human health or ecological health if the predicted surface water concentration is greater than the lowest screening criteria for human health or ecological health, respectively. In the absence of screening criteria, parameters with detected concentrations were retained for further consideration, unless otherwise noted.

¹³ Water quality data and screening criteria shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to screening criteria. Therefore, concentrations slightly above screening criteria may be displayed as being equal to the screening criteria and identified as exceedances. Concentrations equal to the screening criteria were not identified as exceedances.

¹⁴ Hardness is a water quality parameter and is not directly applicable to human health or ecological health screening. Rather it is considered in the calculation of certain water condition-specific ecological screening criteria.

¹⁵ This parameter was not identified as a POPC because it is an essential element, ubiquitous in the environment and generally non-toxic to human and ecological receptors. It is noted that phosphorus in surface water is considered to be generally non-toxic to humans, but can be a concern for ecological health due to eutrophication effects and therefore was retained as a POPC for ecological health. See text for further discussion.

¹⁶ This parameter was not identified as a POPC based on screening against surface water criteria, however, it is carried forward to the multi-media assessment in the HHRA since it is considered a bioaccumulative substance. Further, mercury was identified as a parameter of concern by Indigenous communities.

¹⁷ BC MWLRS Approved Water Quality Guideline (BC MWLRS 2025)

¹⁸ The US EPA RSL was selected as the human health screening criterion for iron as it is health-based, whereas the criterion available from Health Canada is based on an aesthetic objective.

¹⁹ This parameter was not identified as a POPC based on screening against surface water criteria, however, it is carried forward to the ERA since it is considered a bioaccumulative substance in the aquatic ecosystem and the selected ecological screening criteria is protective of aquatic life (e.g., plants, invertebrates and fish) but not protective of aquatic-feeding mammals and birds.

²⁰ This parameter was not identified as a POPC because it is a trace element, ubiquitous in the environment and generally non-toxic to human and ecological receptors. See text for further discussion.

(a) The ammonia guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (80 mg-N/L) is based on the combination of field pH (6.4) and water temperature (0.1 °C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the 25th percentile field pH and temperature measurements over all collected baseline samples.

(b) The guideline is pH dependent. The guideline shown is based on the 25th percentile pH observed in the baseline sample data (6.4). The 25th percentile pH was selected to provide a conservative guideline.

(c) The guideline is hardness dependent. The guideline shown is based on the minimum hardness calculated in the water quality predictions (30 mg/L). The minimum hardness was selected to provide the most conservative guideline.

(d) The guideline is DOC dependent. The guideline shown is based on the 25th percentile DOC concentration measured in the baseline dataset (4.6 mg/L). The 25th percentile DOC concentration was selected to provide a conservative guideline.

(e) The guideline is for chromium VI.

(f) The guideline is for dissolved copper, but comparison to total copper is appropriate when no dissolved copper concentrations are available as total copper concentrations are expected to be higher. The long-term dissolved copper guideline is pH, temperature, hardness and DOC dependent. The guideline that results in the minimum long-term copper guideline (0.2 µg/L) is based on the combination of field pH (6.4), temperature (0.1 °C), hardness (30 mg/L), and DOC (4.6 mg/L). Guidelines calculated with pH, temperature, hardness, and DOC values falling outside the defined range (i.e., pH 5.5 to 8.8, temperature 8.5 to 27 °C, hardness 7.9 to 525 mg/L, and DOC 0.2 to 33.4 mg/L) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH, temperature, hardness, and DOC extremes. The guideline is calculated based on the 25th percentile pH, temperature, and DOC measurements from the baseline dataset, and the minimum hardness calculated in the water quality predictions.

(g) The guideline was generated using a look-up table provided by ECCC; a biotic ligand model is available from ECCC, which can be used to increase the precision of the guideline if required.

(h) The guideline is for dissolved manganese, but comparison to total manganese is appropriate when no dissolved manganese concentrations are available as total manganese concentrations are expected to be higher. The chronic dissolved manganese guideline is pH and hardness dependent. The guideline that results in the minimum chronic manganese guideline (0.310 mg/L) is based on the combination of field pH (6.4) and hardness (30 mg/L). Guidelines calculated with pH and hardness values falling outside the defined range (i.e., pH 5.8 to 8.4 and hardness 25 to 670 mg/L) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and hardness extremes. The guideline is calculated based on the 25th percentile pH, temperature, and DOC measurements from the baseline dataset, and the minimum hardness calculated in the water quality predictions.

(i) The guideline is for dissolved zinc, but comparison to total zinc is appropriate when no dissolved zinc concentrations are available as total zinc concentrations are expected to be higher. The chronic dissolved zinc guideline is pH, hardness and DOC dependent. The guideline that results in the minimum chronic zinc guideline (0.0234 mg/L) is based on the combination of field pH (6.4), hardness (30 mg/L), and DOC (4.6 mg/L). Guidelines calculated with pH, hardness and DOC values falling outside the defined range (i.e., pH 6.5 to 8.13, hardness 23.4 to 399 mg/L, and DOC 0.3 to 22.9 mg/L) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH, hardness and DOC extremes. The guideline is calculated based on the 25th percentile pH, temperature, and DOC measurements from the baseline dataset, and the minimum hardness calculated in the water quality predictions.

(j) Health Canada Aesthetic Objective.

(k) Not Required (NR). Health Canada indicates that “[a] guideline value is not necessary as it is produced in the body and efficiently metabolized in healthy people; no adverse effects at levels found in drinking water.”

(l) At pH >5.5 to 6.5, no condition should be permitted which would increase the acid soluble inorganic aluminum concentration in clay-free samples to more than 10% above natural background concentrations for waters representative of that geological area of the Province that are unaffected by man-made inputs.

Bold and Shaded = Exceeds screening criteria as indicated by footnote below, or lacked screening criteria

RET (italicized) = Retained as a bioaccumulative substance. See Notes 16 and 19.

(Cc) = concentration is higher than the CCME WQG, aquatic life (long-term).

(Fc) = concentration is higher than the ECCC FWQG (chronic).

(H) = concentration is higher than the Health Canada MAC (or aesthetic objective as indicated).

(Ho) = concentration is higher than the Human Health Other guideline.

(M) = concentration is higher than the MECP GW1 (none meet this criterion).

(P) = concentration is higher than the MECP PWQO.

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Table C1-3: Available Inhalation Screening Criteria for the 1-Hour Averaging Period

Parameter	PRIMARY SOURCE			SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
	CAS	MECP (2020) AAQC	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQC	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV/ ReV (a)		
Criteria Air Parameters										
Particulate Matter ≤2.5 microns (PM _{2.5})	N/A	-	-	-	-	-	-	-	A 1-hour screening value is not available.	Acute inhalation exposure to particulate matter (PM _{2.5}) is assessed using the 24-hour exposure scenario.
Particulate Matter ≤10 microns (PM ₁₀)	N/A	-	-	-	-	-	-	-	A 1-hour screening value is not available.	Acute inhalation exposure to particulate matter (PM ₁₀) is assessed using the 24-hour exposure scenario.
Suspended Particulate Matter (SPM)	N/A	-	-	-	-	-	-	-	A 1-hour screening value is not available.	Acute inhalation exposure to SPM is assessed using the 24-hour exposure scenario.
Carbon monoxide (CO) (1-hour)	630-08-0	36200	Desirable NAAQO = 15,000 Acceptable NAAQO = 35,000	35000	40,100 (35,000 ppb)	23000	-	-	<p>MECP: Health-based screening value based on the CCME NAAQO of 30 ppm (MECP 1997). The MECP used a conversion factor of 1 ppm = 1.2055 mg CO/m³ to convert from the NAAQO of 30 ppm to a value of 36,200 mg CO/m³, while the CCME applied a conversion factor of 1 ppm = 1.146 mg CO/m³ in their conversion of the NAAQO. The different conversion factors relate to the assumed ambient temperature.</p> <p>CCME (NAAQO): Screening value was derived by the CCME (Health Canada 1994) and is based on cardiorespiratory effects in people with exercise-induced myocardial ischemia. The CCME derived a 1-hour average maximum acceptable level (35,000 µg/m³) which is based on the maintenance of blood carboxyhemoglobin concentrations below the lowest-observed effect level (LOEL) of 2% (Allred et al. 1989; as cited in Health Canada 1994). A PBPK model developed by Coburn, Foster, and Kane was used to extrapolate a 2% blood carboxyhemoglobin concentration to an ambient carbon monoxide concentration in the air. The maximum desirable level (15,000 µg/m³) was derived based on 1% blood carboxyhemoglobin concentration. The maximum acceptable level is an air quality concentration that is protective of the general population against health effects, while the maximum desirable level is the long term objective for air quality.</p> <p>WHO: Screening value based on a maximum concentration of 2.5% carboxyhemoglobin in blood which is intended to be protective of non-smoking, middle-aged and elderly population groups with coronary artery disease, and fetuses of non-smoking pregnant women. The guideline is calculated using an equation that takes into account the physiological variables that have an impact on the uptake of carbon monoxide and determines the guideline that will keep carboxyhemoglobin levels below 2.5%.</p> <p>US EPA: Screening value based on clinical evidence relating carboxyhemoglobin (carbon monoxide bound to blood hemoglobin) levels to various adverse health endpoints. The NAAQS of 35 ppm was converted to 40,100 µg/m³ for this assessment using a molecular weight of 28.01 g/mol (values were rounded up). US EPA indicates that the NAAQS is not to be exceeded more than once per year.</p> <p>Cal OEHHA: Screening value based on an inhalation study in humans examining the aggravation of existing angina and other cardiovascular diseases when subjects are exercising heavily (Allred et al. 1989 and Kleinman et al., 1989; as cited in Cal OEHHA 2008b). The screening value is based on a NOAEL of 1.1 to 1.3 % carboxyhemoglobin level in blood which corresponds to 23,000 µg/m³.</p> <p>BC ENV [Reference only]: Pollution control objective for food-processing, agriculturally oriented, and other industries. The pollution control objective was developed in the 1975. This pollution control objective was rescinded in 2006 but is used by BC ENV for reference purposes (supporting documentation not available).</p>	CCME- Acceptable NAAQO (35,000 µg/m ³) was selected because it is based on health effects and is the most conservative of the primary sources. Supporting information on criterion derivation is also available.
Carbon monoxide (CO) (8 hour)	630-08-0	15700	Desirable NAAQO = 6,000 Acceptable NAAQO = 15,000 Tolerable NAAQO = 20,000	10,000	10,300 (9000 ppb)	-	-	-	<p>MECP: Health-based 24-hour screening value. CO is a criteria air pollutant and for this reason Ontario has adopted the Federal-provincial NAAQO for CO (described above). The MECP 24-hour AAQC uses a conversion factor of 1 ppm = 1.2055 to convert from ppm to mg/m³, while a conversion factor of 1 ppm = 1.146 mg CO/m³ was applied in the conversion of the NAAQO.</p> <p>CCME NAAQO (1994): Screening value is based on cardiorespiratory effects in people with exercise-induced myocardial ischemia. The maximum acceptable level (15,000 µg/m³) over an 8 hour rolling average was established based on the maintenance of blood carboxyhemoglobin concentrations below the LOEL of 2% (Allred et al. 1989; as cited in Health Canada 1994). The maximum acceptable level is an air quality concentration that is protective against effects on the environment, visibility, personal comfort, and well-being, but provides only a small margin of safety. The PBPK model developed by Coburn, Foster, and Kane was used to extrapolate an ambient carbon monoxide concentration in the air from a blood carboxyhemoglobin concentration. The maximum desirable level is based on 1% blood carboxyhemoglobin concentration, and the maximum tolerable level is based on a LOAEL of 2.9% carboxyhemoglobin. The maximum desirable level (6,000 µg/m³) is the long term goal for air quality for protection of public health.</p> <p>WHO: Screening value is a time-weighted average 8 hour exposure derived so that the carboxyhemoglobin (carbon monoxide bound to blood hemoglobin) level of 2.5% is not exceeded (screening value for human health effect).</p> <p>US EPA: Screening value based on clinical evidence relating carboxyhemoglobin (carbon monoxide bound to blood hemoglobin) levels to various adverse health endpoints including hypoxia, cardiovascular effects, reproductive effects, central nervous system effects, respiratory effects and impairment of prenatal development. For this assessment, the NAAQS of 9 ppm was converted to 10,300 µg/m³ using a molecular weight of 28.01 g/mol. US EPA indicates that this value is not to be exceeded more than once per year.</p> <p>BC ENV [Reference only]: Pollution control objective for food-processing, agriculturally oriented, and other industries. Rescinded in 2006, used for reference purposes. Supporting documentation not available.</p>	CCME- Acceptable NAAQO (15,000 µg/m ³) was selected because it provides adequate protection against effects on soil, water, vegetation, materials, animals, visibility, and personal comfort and well-being. Supporting information on criterion derivation is also available.

Table C1-3: Available Inhalation Screening Criteria for the 1-Hour Averaging Period

Parameter	PRIMARY SOURCE			SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
	CAS	MECP (2020) AAQC	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV/ ReV ^(a)		
Nitrogen dioxide (NO ₂)	10102-44-0	400	CAAQS (2025) = 79 (42 ppb)	200	188 (100 ppb)	470	Provincial AQO = 113 (60 ppb) CAAQS (2025) = 79 (42 ppb)	-	<p>MECP: Health-based 1-hour screening value; however, the specific health endpoint is not indicated by MECP. The 1-hour screening value is considered to be below any adverse effects level.</p> <p>CCME CAAQS: The CAAQS is a three-year average of the annual 98th percentile of the daily maximum 1-hour average nitrogen dioxide concentrations. The CAAQS of 60 and 42 ppb were converted to 113 and 79 µg/m³, respectively using a molecular weight of 46.01 g/mol.</p> <p>WHO: Screening value based on studies of bronchial responsiveness among asthmatics (WHO 2021). This value is based on short-term animal and human experimental toxicology studies which associate significant health effects (including adverse respiratory effects) with exposure to NO₂ levels greater than 200 µg/m³. In a 1992 meta-analysis which assessed 20 respiratory studies of asthmatics and 5 studies of health subjects, there was a significant increase in airway responsiveness associated with a range of constrictor stimuli in asthmatic subjects exposed to NO₂ concentrations ≥200 µg/m³ (Folinsbee 1992, as cited in WHO 2005). WHO (2021) has specified that this short-term guideline of 200 µg/m³, originally reported in 2005 (WHO 2005), remains valid.</p> <p>US EPA: Screening value based on the 98th percentile of maximum 1-hour daily concentrations, averaged over a three-year period. The NAAQS is protective of a broad range of respiratory effects in sensitive populations, such as those with asthma and those who spend time near major roadways. The NAAQS of 100 ppb was converted to 188 µg/m³ for this assessment using a molecular weight of 46.01 g/mol.</p> <p>Cal OEHHA: Screening value is based on a study where sensitive humans (asthmatics) were exposed to 0.25 ppm (470 µg/m³) of NO₂ for 1-hour (Mohsenin 1987; as cited in Cal OEHHA 2008b). The critical effect was an increase in airway reactivity. No uncertainty factors were applied to the NOAEL of 0.25 ppm (470 µg/m³), which was adopted as the reference exposure level (REL) and California ambient air quality standard to protect against mild adverse effects.</p> <p>BC ENV: BC adopted the 2020 CAAQS of 113 µg/m³ as the new Provincial Air Quality Objective which took effect on 1 January 2020 (BC ENV 2025). A value of 42 ppb (79 µg/m³) is proposed as the CAAQS for the year 2025, however, BC ENV has not yet updated their provincial AQO to align with the 2025 CAAQS. The CAAQS is a three-year average of the annual 98th percentile of the daily maximum 1-hour average nitrogen dioxide concentrations.</p>	CCME- The 2025 CAAQS (79 ug/m ³) from CCME was selected because it is the most conservative of the primary sources.
Sulfur dioxide (SO ₂)	7446-09-05	100 (40 ppb)	CAAQS (2025) = 170 (65 ppb)	-	197 (75 ppb)	660	170	-	<p>MECP: MECP used a conversion factor of 0.6 to convert the AAQC for the 10-minute averaging time (67 ppb; 176 µg/m³) to a 1-hour averaging time (40 ppb; 100 µg/m³). The 10-minute value was derived based bronchoconstriction in US EPA and Health Canada meta-analyses of chamber studies of exercising asthmatics. For this assessment, the units were converted from ppb to µg/m³ using the conversion rate of 1 ppb = 2.66 µg/m³ provided by the MECP (under the assumption of 20°C and 1 atmosphere, rounded) (MECP 2017).</p> <p>CCME CAAQS: Screening value was developed based on respiratory health problems, focused on susceptible populations (e.g. asthmatic children and adults), and environmental impacts such as acid rain and smog (CCME 2025). The metric is the 3-year average of the 99th percentile of the sulphur dioxide daily maximum 1-hour average concentration. The CAAQS of 70 and 65 ppb were converted to 183 and 170 µg/m³, respectively, using a molecular weight of 64.07 g/mol.</p> <p>US EPA: The 2024 screening value based on epidemiological evidence of increased emergency department visits and hospitalizations associated with sulphur dioxide concentrations in the range of 75 to 150 ppb (197 to 393 µg/m³). The previous SO₂ standards (0.14 ppm 24-hour and 0.03 ppm annual) will remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which an implementation plan providing for attainment of the current (2010) standard has not been submitted and approved and which is designated nonattainment under the previous SO₂ standards or is not meeting the requirements of a SIP call under the previous SO₂ standards (40 CFR 50.4(3)). A SIP call is an EPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the required NAAQS. For the purpose of this assessment, the NAAQS of 75 ppb was converted to 197 µg/m³ using a molecular weight of 64.07 g/mol.</p> <p>BC ENV: The provincial AAQO of 170 µg/m³ is based on the 2025 CAAQS. The CAAQS is based on the annual 99th percentile of daily 1-hour maximum (D1HM), averaged over three consecutive years and is described below. The CAAQS of 65 ppb was converted to 170 µg/m³ using a molecular weight of 64.07.</p> <p>Cal OEHHA: Screening value based on impairment of airway function (bronchoconstriction) especially in asthmatics (Linn et al. 1987; as cited in Cal OEHHA 2008b). After reviewing human several studies on acute exposures of normal, asthmatic, and atopic (susceptible to hypersensitive allergic reactions) individuals to low concentrations of SO₂ (0.25 to 2.0 ppm; 660 to 5240 µg/m³), Cal OEHHA staff concluded that exposure to 0.25 ppm (660 µg/m³), the California Ambient Air Quality Standard (Cal AAQS) for SO₂, would not result in respiratory effects causing discomfort in sensitive individuals exposed for one hour. The Cal AAQS for SO₂ is intended to protect sensitive individuals (i.e., exercising asthmatics) from lower respiratory effects of acute exposure. Cal OEHHA concluded that an exposure concentration of 0.25 ppm (660 µg/m³) SO₂ for 1-hour is comparable to a NOAEL in sensitive individuals. It was determined by Cal OEHHA that the NOAEL would be protective of asthmatic individuals because adverse effects are consistently observed only at higher concentrations with participants undertaking moderate exercise and there is also an inconsistency in response to SO₂ exposure at lower concentrations.</p>	MECP - MECP was selected because it is the lowest criterion of the primary sources.
Diesel particulate matter (DPM)	N/A	-	10 (Health Canada 2016) ^(b)	-	-	-	-	63	<p>Health Canada: Screening value based on a LOAEL of 100 µg/m³ for respiratory effects (increased airway resistance and respiratory inflammation) in healthy and/or mildly asthmatic subjects exposed to DPM for 2 hours in human exposure studies under controlled conditions (Mudway et al. 2004; Riedl et al. 2012; Stenfors et al. 2004; Behndig et al., 2006, as cited in Health Canada 2016). Respiratory endpoints were the most sensitive endpoints documented in these controlled human exposure studies. The LOAEL of 100 µg/m³ for respiratory effects was selected as the POD and an uncertainty factor of 10 was applied by Health Canada to determine the short-term exposure screening value of 10 µg/m³.</p> <p>TCEQ: Interim screening value based on 2-hour human inhalation studies (Mudway et al. 2004, Behndig et al. 2006, and Nightingale et al. 2000; Holgate et al. 2003; as cited in TCEQ 2015c) in which a minimal LOAEL of 100 µg/m³ was selected as the POD based on mild pulmonary inflammation. It is noted that this level was identified as a free-standing NOAEL in a study with asthmatic subjects (Riedl et al. 2012; as cited in TCEQ 2015q). The LOAEL of 100 µg/m³ was adjusted to a 1-hour exposure and an uncertainty factor of 2 was applied for the use of a LOAEL that showed minimal effects. A reference value ReV of 63 µg/m³ as particulate matter, based on a target HQ=1, was established.</p>	Health Canada- Health Canada value was selected because it is the only available criterion from primary sources.

Table C1-3: Available Inhalation Screening Criteria for the 1-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE			SECONDARY SOURCE				TCEQ (2025) ESL/AMCV/ ReV (a)	Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
		MECP (2020) AAQC	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO				
Metals											
Aluminum	7429-90-5	-	-	-	-	-	-	-	50	TCEQ: Screening value based on a study of male rats exposed to aluminum at concentrations of 10, 50, 100, 200 and 1000 mg/m ³ for 4 hours, in which a NOAEL and LOAEL for increased enzymatic alkaline phosphatase activities of 10 and 50 mg/m ³ was observed, respectively (Thompson et al. 1986; as cited in TCEQ, 2021a). The NOAEL of 10 mg/m ³ was selected by TCEQ as the POD to derive the 1-hour screening value. This POD was then adjusted to 15.874 mg/m ³ to account for exposure duration and animal-to-human concentration. Uncertainty factors were applied for interspecies variability (3), intraspecies variability (10) and database uncertainties (6), to derive a reference value of 0.04975 mg/m ³ or 50 µg/m ³ , based on a target HQ=1, which was selected by the TCEQ as the 1-hour AMCV.	TCEQ- TCEQ value selected as it is the only available criterion and supporting documentation on the derivation of the 1-hour criterion is available.
Antimony	7440-36-0	-	-	-	-	-	-	-	5	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL and AMCV.	TCEQ- TCEQ value selected as it is the only available criterion.
Arsenic	7440-38-2	-	-	-	-	0.2	-	-	9.9	Cal OEHHA: Screening value based on a study by Nagymajtenyi et. al. (1985; as cited in Cal OEHHA 2014) which found decreased fetal weight in mice following maternal inhalation of As ₂ O ₃ for 4 hours/day during gestation days 9 to 12. A statistically significant decrease in the weight of fetuses was observed in all concentrations used in the study; therefore, a NOAEL was not available. A LOAEL of 0.26 mg/m ³ and an uncertainty factor of 1,000 (10 for a lack of a NOAEL value, 10 for interspecies differences between mice and humans, and 10 for human interindividual differences) was used to derive the screening value. TCEQ: Screening value based on a study where female rats were exposed to 0, 0.3, 3, and 10 mg/m ³ arsenic trioxide for 6 hours/day for multiple days (Holson et al. 1999; as cited in TCEQ 2012). The NOAEL and LOAEL for maternal effects (i.e., rates) were 3,000 and 10,000 µg/m ³ , respectively. The TCEQ chose the NOAEL of 3,000 µg/m ³ as the POD. The NOAEL was adjusted for exposure duration (5,451 µg/m ³) and a HEC of 0.714 (3,891.3 µg/m ³). Uncertainty factors were applied for interspecies variability (3), intraspecies variability (10) and database uncertainties (10) to derive a reference value 13 µg/m ³ for arsenic trioxide. This reference value for arsenic trioxide was adjusted for arsenic (arsenic trioxide is 76% arsenic by weight), resulting in an arsenic reference value of 9.9 µg/m ³ based on a target HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV.	TCEQ- The TCEQ value was selected because it is based on a recent study and is derived from a more study where a NOAEL was identified (more robust than selection by CalOEHHA). This is also reflected in the magnitude of the uncertainty factors chosen by the respective agencies in deriving the screening criteria.
Barium	7440-39-3	-	-	-	-	-	-	-	5	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), barium soluble compounds as particulate matter, and selected as the ESL and AMCV.	TCEQ- TCEQ value selected as it is the only available criterion.
Beryllium	7440-41-7	-	-	-	-	-	-	-	0.02	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available criterion.
Bismuth	7440-69-9	-	-	-	-	-	-	-	50	TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), bismuth telluride as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available criterion.
Boron	7440-42-8	-	-	-	-	-	-	-	50	TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available criterion. Noted that in the absence of 1-hour projected air concentrations, acute inhalation exposure to boron is assessed utilizing the 24-hour exposure scenario.
Cadmium	7440-43-9	-	-	-	-	-	-	-	18	TCEQ: Screening value based on immunotoxicity in Swiss albino mice exposed to cadmium chloride as an aerosol for 2 hours (Graham et al. 1978, as cited in TCEQ 2016). A NOAEL of 110 µg/m ³ was identified from the study. The NOAEL was adjusted to a 1-hour exposure (138.6 µg/m ³). A point of departure human equivalency concentration (POD _{HEC}) of 554 µg cadmium/m ³ was derived from the study and an uncertainty factor of 30 was applied (3 for extrapolation from animals to humans and 10 to account for intraspecies variability) to derive a reference value of 18 µg/m ³ , based on HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV.	TCEQ- TCEQ value selected as it is the only available criterion.
Calcium	7440-70-2	-	-	-	-	-	-	-	-	A 1-hour screening value is not available for calcium.	Parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. Not further evaluated for the 1-hour averaging period.
Calcium Oxide	1305-78-8	-	-	-	-	-	-	-	20	TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available criterion. Noted that in the absence of 1-hour projected air concentrations, acute inhalation exposure to calcium oxide is assessed utilizing the 24-hour exposure scenario.
Chromium (total)	7440-47-3	-	-	-	-	-	-	-	12	TCEQ: Screening value for lung effects in hamsters exposed to chromium chloride (via inhalation) for 30 minutes (Henderson et al. 1979; as cited in TCEQ 2013a). The NOAEL was 77 mg/m ³ and extrapolated to a 1-hour exposure (38.5 mg/m ³). The HEC was 10.82 mg/m ³ and an uncertainty factor of 300 (3 for interspecies variability, 10 for intraspecies variability and 10 for database limitations) was applied to derive an acute ReV of 12 µg/m ³ , based on HQ=1.	TCEQ- TCEQ value selected as it is the only available criterion. Noted that in the absence of 1-hour projected air concentrations, acute inhalation exposure to chromium is assessed utilizing the 24-hour exposure scenario.
Cobalt	7440-48-4	-	-	-	-	-	-	-	0.69	TCEQ: Screening value based on the critical effect of respiratory irritation (coughing, sore throat and changes to forced expiratory volume) after exposure of 15 healthy male workers to hard metal dust containing 38 µg cobalt/m ³ for 6 hours (Kusaka et al. 1986; as cited in TCEQ 2017a). The LOAEL of 38 µg cobalt/m ³ is used as the POD for derivation of the 1-hour reference concentration and is adjusted to a 1-hour value of 69.05 µg cobalt/m ³ . A total uncertainty factor of 100 was applied (10 for intrahuman variability and 10 to extrapolate from a LOAEL to NOAEL) to derive a reference value of 0.69 µg/m ³ based on HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV.	TCEQ- TCEQ value selected as it is the only available criterion.
Copper	7440-50-8	-	-	-	-	100	-	-	10	Cal OEHHA: Screening value based on a NOAEL of 1 mg copper/m ³ from a study where workers were exposed to 1 to 3 mg/m ³ copper for an unspecified amount of time (Whitman 1957; as cited in Cal OEHHA 2008b). No extrapolation for continuous exposure was applied because the exposure duration was not clearly specified in the reports. An uncertainty factor for intraspecies variability (10) was applied. TCEQ: Screening value based on a health endpoint (supporting documentation not available), as particulate matter, and selected as the ESL and AMCV.	Cal OEHHA- The Cal OEHHA value was selected because supporting documentation on the derivation of the 1-hour criterion is available.

Table C1-3: Available Inhalation Screening Criteria for the 1-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE			SECONDARY SOURCE				Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
		MECP (2020) AAQC	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV/ ReV (a)		
Copper Sulphate	7758-98-7	-	-	-	-	-	-	-	A 1-hour screening value is not available for copper sulphate.	Acute inhalation exposure to copper sulfate is assessed utilizing the 24-hour exposure scenario.
Iron	7439-89-6	-	-	-	-	-	-	-	A 1-hour screening value is not available for iron.	Acute inhalation exposure to iron is assessed utilizing the 24-hour exposure scenario.
Lead	7439-92-1	-	-	-	-	-	-	-	A 1-hour screening value is not available for lead.	Acute inhalation exposure to lead is assessed utilizing the 24-hour exposure scenario.
Magnesium	7439-95-4	-	-	-	-	-	-	40	Magnesium oxide used as a surrogate in the absence of inhalation screening criteria for magnesium. TCEQ: Screening value for magnesium oxide based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value for magnesium oxide selected as a surrogate criterion for magnesium because it is the only 1-hour criterion available.
Manganese	7439-96-5	-	-	-	-	-	-	9.1	TCEQ: Screening value based on an inhalation study where rhesus monkeys were exposed to manganese sulphate for 6 hours per day, 5 days per week for 3 weeks (total of 90 hours of exposure) (Dorman et al. 2005; as cited in TCEQ 2017b). The critical effect was mild inflammatory changes to the airway with a POD LOAEL for 6 hours of exposure of 1.5 mg manganese/m ³ . The LOAEL was extrapolated from a 6 hour exposure over a single day to a 1-hour value of 2.72 mg manganese/m ³ . An uncertainty factor of 360 was calculated (2 for extrapolation from a LOAEL to a NOAEL, 10 for intrahuman variability, 3 for potential toxicodynamic differences between rhesus monkeys and humans and 6 to account for limitations and uncertainty in the database); however, a maximum uncertainty factor of 300 was applied to derive a reference value of 9.1 µg/m ³ , based on HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV.	TCEQ- TCEQ value selected as it is the only available criterion.
Mercury	7439-97-6	-	-	-	-	0.6	-	0.25	Cal OEHHA: Screening value based on central nervous system disturbances in rat offspring where maternal rats were exposed to metallic mercury vapour (1.8 mg/m ³) for 1 or 3 hours/day during gestation (Danielsson et al. 1993; as cited in Cal OEHHA 2014). Significant dose-dependent behavioural deficits (e.g., spontaneous motor activity, performance of a spatial learning task, and habituation to an automated test chamber) were observed in offspring subjects 3 to 7 months post-birth as compared to controls, in which a LOAEL of 1,800 µg/m ³ (1.8 mg/m ³) was derived. The LOAEL was selected to derive the REL, as no NOAEL was available, and an uncertainty factor of 3,000 (10 for using LOAEL for moderate to severe effects in the absence of a NOAEL, 3 for interspecies toxicokinetic differences, 10 for interspecies toxicodynamic differences, 3 for individual variability, and 3 for intraspecies differences in age differences) was applied to derive a REL of 0.6 µg/m ³ (0.0006 mg/m ³). TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), mercury inorganic compounds as particulate matter, and selected as the ESL.	Cal OEHHA- The Cal OEHHA value was selected because supporting documentation on the derivation of the 1-hour criterion is available.
Molybdenum	7439-98-7	-	-	-	-	-	-	150	TCEQ: Screening value based on an inhalation study where rats were exposed to molybdenum trioxide for 6 hours per day, 5 days per week for 2 weeks (National Toxicological Program 1997, as cited in TCEQ 2021c). The critical effect was decreased body weight with a POD NOAEL of 30 mg/m ³ . The LOAEL was adjusted to a 1-hour exposure duration and a HEC for a POD of 41.8 mg/m ³ . Uncertainty factors for intrahuman variability (10), 3 to account for potential toxicodynamic differences between rats and humans and 6 for a limited database were applied to derive a reference value of 230 µg/m ³ molybdenum trioxide or 150 µg/m ³ for molybdenum, based on a HQ=1, which was selected by the TCEQ as the 1-hour AMCV.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Nickel	7440-02-0	-	-	-	-	0.2	-	1.1	Cal OEHHA: Screening value based on a mild reduction in antibody response in mice exposed for 2 hours to nickel and nickel compounds (Graham et al. 1978; as cited by Cal OEHHA 2012). The 2 hour benchmark dose level (BMDL) was 165 µg/m ³ and was extrapolated to a 1-hour concentration of 233 µg/m ³ . An uncertainty factor of 1000 (3 for benchmark response uncertainty, 10 for interspecies differences, and 30 for intraspecies differences) was applied. TCEQ: Screening value is based on an exposure study in which significant bronchial constriction was observed in 12 metal plating factory workers with recurring occupationally-related respiratory problems (Cirla et al. 1985, as cited by TCEQ 2017c). The subjects of the study were exposed to an aerosol of 0.3 mg/m ³ of nickel sulphate (67 µg nickel/m ³) in an exposure chamber for 30 minutes in which respiratory effects were significant at this level of exposure (LOAEL of 67 µg/m ³) and therefore a NOAEL was not available. The exposure concentration was extrapolated to 1-hour (33.5 µg nickel/m ³) and an uncertainty factor of 30 (10 for using a LOAEL and 3 for an incomplete database) was applied by TCEQ to derive an acute reference value of 1.1 µg/m ³ , based on a HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV.	TCEQ- TCEQ value selected as it is based on a human study and the evaluation was conducted more recently.
Phosphorus	7439-95-4	-	-	-	-	-	-	1	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter applicable to red and white phosphorus, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Potassium	7440-09-07	-	-	-	-	-	-	20	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Selenium	7782-49-2	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL and AMCV.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Silver	7440-22-4	-	-	-	-	-	-	0.1	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Strontium	7440-24-6	-	-	-	-	-	-	20	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Sulphur	9305-99-8	-	-	-	-	-	-	50	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.

Table C1-3: Available Inhalation Screening Criteria for the 1-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE			SECONDARY SOURCE				Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion	
		MECP (2020) AAQC	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV/ ReV (a)			
Thallium	7440-28-0	-	-	-	-	-	-	-	1	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Thorium	7440-29-1	-	-	-	-	-	-	-	-	A 1-hour screening value is not available for thorium.	Parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. Not further evaluated for the 1-hour averaging period.
Tin	7440-31-5	-	-	-	-	-	-	-	20	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), tin inorganic compounds as particulate matter, and selected as the ESL and AMCV.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Titanium	7440-32-6	-	-	-	-	-	-	-	50	TCEQ: Screening value based on a health endpoint (interim, supporting documentation not available), titanium (IV) dioxide as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Tungsten	7440-33-7	-	-	-	-	-	-	-	50	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), tungsten insoluble compounds as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Uranium	7440-61-1	-	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value selected as it is the only available screening criterion.
Vanadium	7440-62-2	-	-	-	-	30	-	-	2.2	Cal OEHHA: Screening value based on respiratory effects (increased respiratory mucus production that was cleared by coughing) in humans exposed to vanadium pentoxide for 8 hours (Zenz & Berg 1967, as cited in Cal OEHHA 2008b). The LOAEL was 0.25 mg/m ³ and the NOAEL was 0.1 mg/m ³ . The equivalent 1-hour LOAEL concentration was determined to be 0.3 mg/m ³ using the following equation: C2 = [0.1 mg/m ³] ² x 8 hours/1-hour). An uncertainty factor of 10 was applied (1 for use of a LOAEL, 1 for interspecies variation, and 10 for intraspecies variation). TCEQ: Interim screening value based on an inhalation study where human subjects (n=9) were exposed to vanadium pentoxide dust for 8 hours (Zenz & Berg 1967, as cited in TCEQ 2021e). A NOAEL of 0.1 mg/m ³ for respiratory irritation was observed, which was adjusted to a 1-hour exposure duration by TCEQ to derive a PODADJ of 0.2 mg/m ³ . Uncertainty factors for intrahuman variability (10) and database uncertainty (6) were then applied to derive a reference value of 3.3 µg/m ³ for vanadium pentoxide or 2.2 µg/m ³ for vanadium, based on HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV.	TCEQ- TCEQ value was selected as it is based on a more recent evaluation and is the most conservative criterion from the secondary sources.
Yttrium	7440-65-5	-	-	-	-	-	-	-	10	TCEQ: Screening value based on Occupational Exposure Limits (OEL) from NIOSH, OSHA. The selected OEL of 1000 µg/m ³ , as particulate matter, was modified by an uncertainty factor of 100x and selected as the ESL (interim, supporting documentation is not available, based on email communication with TCEQ).	TCEQ- TCEQ value selected as it is the only available screening criterion.
Zinc	7440-66-6	-	-	-	-	-	-	-	20	TCEQ: Screening value based on a health endpoint, selected as ESL and AMCV (interim, supporting documentation not available).	TCEQ- TCEQ value selected as it is the only available screening criterion.
Zirconium	7440-67-7	-	-	-	-	-	-	-	50	TCEQ: Screening value based on Occupational Exposure Limits (OEL) from NIOSH, OSHA. The selected OEL of 5000 µg/m ³ , as particulate matter, was modified by an uncertainty factor of 100x and selected as the ESL (interim, supporting documentation is not available, based on email communication with TCEQ).	TCEQ- TCEQ value selected as it is the only available screening criterion.

Table C1-3: Available Inhalation Screening Criteria for the 1-Hour Averaging Period

Parameter	PRIMARY SOURCE			SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
	CAS	MECP (2020) AAQC	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQC	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV/ ReV ^(a)		
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	50-32-8	-	-	-	-	-	-	-	A 1-hour screening value is not available for benzo(a)pyrene.	Acute inhalation exposure to benzo(a)pyrene is assessed utilizing the 24-hour exposure scenario.
Volatile Organic Compounds (VOCs)										
1,3-Butadiene	106-99-0	-	-	-	-	660	-	3,700	Cal OEHHA: Screening value based on reduced weight gain in male fetal mice at gestation day 18 when pregnant mice were exposed to 1,3-butadiene during gestation days 6 to 15 (Hackett et al. 1987 and Green (2003); as cited in Cal OEHHA (2014). The NOAEL was 40 ppm (88.5 mg/m ³) and the BMCL ₀₅ (benchmark concentration level lower confidence limit corresponding to 5% incidence of effect in male pups) was 17.7 ppm (39.2 mg/m ³). A HEC was calculated to be 29.7 ppm (65.7 mg/m ³). A cumulative uncertainty factor of 100 (3 for uncertainty in interspecies toxicodynamics, 10 for uncertainty in intraspecies toxicokinetics and 3 for uncertainty in intraspecies toxicodynamics) was applied to the HEC to derive the inhalation reference exposure level. TCEQ: Screening value is based on the same studies as that for which the Cal OEHHA derived a minimal risk level (Hackett et al. 1987; Green 2003; as cited in TCEQ 2015a); however, the TCEQ screening value was derived using a different benchmark concentration model and a POD of BMCL ₀₅ = 54.7 ppm (121 mg/m ³). A total uncertainty factor of 30 was applied (3 for interspecies extrapolation and 10 for intraspecies variability). TCEQ applies this concentration as a 6-hour reference value, based on a target HQ = 1, selected as the ReV and AMCV.	Cal OEHHA - Cal OEHHA value was selected as it is based on a more recent study and is a more conservative criterion
Benzene	71-43-2	-	-	-	-	-	-	580	TCEQ: Screening value based on effects to white blood cells in mice exposed to benzene for 6 hours/day for 6 days via inhalation (Rozen et al. 1984, Dempster and Snyder 1991, and Corti and Snyder 1996, as cited in TCEQ, 2015b). Critical effects were documented for all exposure concentrations in this study; therefore, a NOAEL was not available. The LOAEL was 10.2 ppm (32.6 mg/m ³) and adjusted for a 1-hour exposure (18.5 ppm or 59.1 mg/m ³). The HEC was 18.5 ppm (59.1 mg/m ³) and an uncertainty factor of 100 (3 for interspecies extrapolation, 10 for intraspecies variation and 3 for using a LOAEL) was applied, resulting in an acute reference value of 180 ppb or 580 µg/m ³ , based on a HQ=1, which was selected by the TCEQ as the AMCV and ReV.	TCEQ- TCEQ value selected as it is the only available criterion and supporting documentation is available.
Hydrogen Cyanide	74-90-8	-	-	-	-	340	-	20	Cal OEHHA: Screening value based on nervous system effects (loss of coordination and consciousness as a result of cellular hypoxia) in four cynomolgus monkeys exposed to hydrogen cyanide at concentrations of 60 ppm (68 mg/m ³) and 80 ppm (and above, doses not specified) for 30 minutes (Purser et al. (1984); as cited in Cal OEHHA 2008a). The NOAEL was 60 ppm (68 mg/m ³). A 1 hour concentration of 30 ppm was extrapolated by multiplying the NOAEL by 0.5. A cumulative uncertainty factor of 100 (10 for interspecies uncertainty, 10 intraspecies uncertainty) was applied to the 1 hour concentration (30 ppm) derive the inhalation reference exposure level of 0.3 ppm (340 µg/m ³). TCEQ: Screening value based on a health endpoint (interim, supporting documentation not available).	Cal OEHHA - CalOEHHA value was selected as supporting documentation is available.
Other										
Silica, crystalline	7631-86-9	-	-	-	-	-	-	47	TCEQ: The screening value is an ReV based on a study that exposed rats to 10, 50, or 100 mg/m ³ quartz or carbonyl iron particles. The exposure period was over 6 h or for 6 h/d for 3 days. Animals were evaluated at 0, 24, and 48 h post-exposure as well as 1, 2, and 3 months post-exposure (Warheit et al. 1991; as cited in TCEQ 2013b). Delayed increases in inflammation and cytotoxicity and the potential for the development of pulmonary lesions within 6 hours determined 10 mg/m ³ to be the LOAEL and the relevant POD. Dosimetry adjustments for a 1 hour exposure duration was performed to determine a PODADJ of 18.2 mg/m ³ . A dosimetry adjustment for human exposure scenarios was performed to determine a PODHEC of 14.1 mg/m ³ . An uncertainty factor of 300 (3 for extrapolation from a LOAEL to a NOAEL, 3 for interspecies extrapolation, 10 for intraspecies variability, and 3 for database uncertainty) was applied. This determined the acute ReV of 47 µg/m ³ .	TCEQ- TCEQ value selected as it is the only available criterion.

Notes:
µg/m³ = Microgram per cubic metre; AAQC = Ambient Air Quality Criteria; AAQO = Ambient Air Quality Objective; AMCV = Air Monitoring Comparison Value; AQC = Air Quality Guideline; BC ENV = British Columbia Ministry of the Environment and Climate Change Strategy; BMCL₀₅ = benchmark concentration level lower confidence limit corresponding to 5% incidence of effect; BMDL = benchmark dose level; CAAQS = Canadian Ambient Air Quality Standard; Cal OEHHA = California Office of Environmental Health Hazard Assessment; CAS = Chemical abstract service; CCME = Canadian Council of Ministers of the Environment; CFR = Code of Federal Regulations; CO = Carbon monoxide; DPM = Diesel Particulate Matter; ESL = Effects screening level; g/mol = grams per mol; HEC = Human equivalent concentration; HQ = Hazard Quotient; LOAEL = Lowest observed adverse effect level; LOEL = Lowest observed effect level; m³ = cubic meters; MECP = Ministry of the Environment, Conservation and Parks; mg/m³ = milligrams per cubic metre; mm Hg = millimeters of mercury; NAAQO = National Ambient Air Quality Objective; NAAQS = National Ambient Air Quality Standard; NIOSH = National Institute for Occupational Safety and Health; NO₂ = nitrogen dioxide; NOAEL = No observed adverse effect level; OEL = Occupational Exposure Limit; OSHA = Occupational Safety and Health Administration; PAH = polycyclic aromatic hydrocarbon; PBPK = physiologically based pharmacokinetic modelling; PM_{2.5} = Particulate matter ≤2.5 microns; PM₁₀ = Particulate matter ≤10 microns; POD = Point of departure; PODADJ = Point of departure adjust to account for discontinuous exposure; PODHEC = Point of departure adjust to human equivalent concentration; ppb = parts per billion; ppm = parts per million; REL = Reference exposure level; ReV = Reference value; SIP = State Implementation Plan; SPM = Suspended particulate matter; TCEQ = Texas Commission on Environmental Quality; µg/m³ = micrograms per cubic metre; US EPA = United States Environmental Protection Agency; SO₂ = Sulfur dioxide; VOC = volatile organic compound; WHO = World Health Organization.

- = Guideline not available
Concentrations are in microgram per cubic metre (µg/m³), unless otherwise noted.
Concentrations in parts per billion (ppb), provided in brackets, were converted to µg/m³ by applying the formula: molecular weight (grams per mol) x ppb / 24.45. The conversion is based on the assumption of 25 °C and an atmospheric pressure of 1.
The MECP has converted values in ppb/ppm to µg/m³ assuming 10 °C and 760 mm Hg pressure, unless specified otherwise.
The US EPA values recorded as ppm or ppb have been converted from µg/m³ assuming 25 °C and an atmospheric pressure of 1.

^(a) For parameters where a final ESL is available, the AMCV and/or ReV (derived based on a HQ of 1) were selected as the TCEQ air criteria because final ESLs were derived based on an HQ of 0.3. For parameters with interim values, an adjustment to the screening value was not made for parameters where supporting documentation for these interim values is not available.
^(b) In the absence of guidance from the MECP and CCME, available 1 hour screening criteria from Health Canada was selected.

For the selection of a screening criterion, the following hierarchy was applied: The lower of the values available from the MECP AAQC and CCME CAAQS/NAAQO was preferentially selected. If multiple criteria were available for MECP or CCME, the available criteria were reviewed based on relevance to human health effects prior to selecting a screening criterion. In the absence of MECP and CCME values, available values from WHO AQC, US EPA NAAQS, Cal OEHHA REL, BC ENV AAQO and TCEQ ESL/AMCV/ReV were reviewed. Values with supporting documentation available, values based on more current studies, or values based on studies which are more relevant to human health (i.e., human studies) were preferentially selected.

Bold and highlighted = Selected air screening criterion

Table C1-4: Available Inhalation Screening Criteria for the 24-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
		MECP (2020, 2023) AAQC ⁽⁹⁾ /ACB	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) AMCV		
Criteria Air Parameters										
Particulate Matter ≤2.5 microns (PM _{2.5})	N/A	27	27	15	35	-	Provincial AAQO= 25 CAAQS= 27	-	MECP: The 24-hour screening value is based on the protection of chronic health effects and is adapted from CCME CAAQS, which reflects a 3-year average of the annual 98th percentile of the daily 24-hour average concentrations. No additional supporting information is available. CCME: The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations. WHO: Based on non-accidental and cause-specific mortality (e.g., cardiovascular, non-malignant respiratory and cerebrovascular mortality). The guideline is derived from the 99th percentile of common distributions of daily air pollution concentrations corresponding to an average long-term concentration equivalent to the annual AQG level. US EPA: Standard based on the 98th percentile of daily 24-hour concentrations averaged over 3 years and is protective of increased health effects associated with short-term PM _{2.5} exposure, including premature mortality and increased hospital admissions and emergency department visits. 98th percentile, averaged over 3 years. BC ENV: The provincial air quality objective is based on the annual 98th percentile of daily average (block average), over one year. The objective is the primary air management tool that is used to guide decisions on environmental impact assessments and authorizations, airshed planning efforts, and regulatory development. The objective is also used to guide decisions on whether or not to issue an air quality advisory. The CAAQS is based on the annual 98th percentile of daily average, averaged over three consecutive years.	MECP- MECP value was selected as it the same criterion as CCME and is a primary source.
Particulate Matter ≤10 microns (PM ₁₀)	N/A	50	-	45	150	-	50	-	MECP: The 24-hour AAQC is based on the protection of chronic health effects. While the MECP indicated that this Interim AAQC is based on health endpoints, there were no available technical supporting documents that provide rationale supporting the derivation of this AAQC. WHO: Based on non-accidental and cause-specific mortality (e.g., cardiovascular, non-malignant respiratory and cerebrovascular mortality). The guideline is derived from the 99th percentile of common distributions of daily air pollution concentrations corresponding to an average long-term concentration equivalent to the annual AQG level. US EPA: Air screening level to protect against adverse health effects of inhalable airborne particles that can be deposited in the lower (thoracic) regions of the human respiratory tract. The standard is met when a 24-hour average PM ₁₀ concentration of 150 mg/m ³ is not exceeded more than one day per year, on average over a three-year period. BC ENV: Supporting documentation not available.	MECP- MECP value was selected as it the only criterion available from the primary sources.
Suspended Particulate Matter (SPM)	N/A	120	-	-	-	-	-	-	MECP: Supporting information for the 24-hour AAQC was not available, however MECP noted that the screening value is based on decreased visibility and is not health-based.	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Carbon Monoxide	630-08-0	-	-	-	-	-	-	-	A 24-hour screening value is not available for carbon monoxide.	A 24-hour screening value is not available for carbon monoxide. Acute exposure is assessed using the 1-hour air criterion.
Nitrogen dioxide (NO ₂)	10102-44-0	200 (100 ppb)	-	25	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available). WHO: Screening value based on studies of bronchial responsiveness among asthmatics. 24-hour screening value is based on the 99th percentile of common distributions of daily air pollution concentrations corresponding to an average long-term concentration equivalent to the annual air quality guideline. Data from Liu et al. (2019; as cited in WHO 2021) suggest that the 99th percentile of daily concentrations are about 2.5 times higher than the annual mean nitrogen dioxide concentration. It is expected that the daily means will be higher than the short-term air quality guideline not more than three to four times per year once air quality complies with the proposed annual mean air quality guideline. The effect estimates obtained from a systemic review on nitrogen dioxide and daily hospital admissions for asthma supported the calculation of the short-term air quality guideline.	MECP- MECP value was selected as it is the only available criterion from the primary sources.
Sulfur dioxide (SO ₂)	7446-09-05	-	-	40	-	-	-	-	WHO: 24-hour screening value is based on the 99th percentile (equivalent to three to four exceedance days per year) of the annual distribution of 24-hour average concentrations. The epidemiological evidence underpinning the AQG level is discussed in a systematic review commissioned by WHO on asthma hospital admissions and emergency room visits (Zheng et al., 2021; as cited in WHO 2021) and another on daily sulfur dioxide mortality (Orellano, Reynoso & Quaranta, 2021; as cited in WHO 2021). Air projections for SO ₂ were provided by the Air Discipline for the 1-hour averaging period. Acute exposure to SO ₂ was therefore assessed using 1-hour air criteria.	WHO- WHO value selected as it is the only available criterion and supporting documentation is available.
Diesel particulate matter (DPM)	N/A	-	-	-	-	-	-	-	A 24-hour screening value is not available for DPM.	A 24-hour screening value is not available for DPM. Acute exposure is assessed using the 1-hour air criterion.

Table C1-4: Available Inhalation Screening Criteria for the 24-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion	
		MECP (2020, 2023) AAQC ^(a) /ACB	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) AMCV			
Metals											
Aluminum	7429-90-5	12 ^(c)	-	-	-	-	-	-	8.9	MECP: Screening value based on the lower annual screening criteria from the New York State Department of Environmental Conservation (2.4 µg/m ³) and TCEQ (5 µg/m ³). The MECP converted the annual New York guideline to a 24-hour averaging period using a conversion factor of 5. Screening criteria based on a health endpoint (supporting documentation for the annual screening criteria from New York not available). TCEQ: Screening value based on 4 hours per day for 3 days (total exposure of 12 hours) acute study that identified a NOAEL and a LOAEL of 3.2 and 7 mg/m ³ , respectively, for increased lung weight in male hamsters (Drew 1974 as cited in TCEQ, 2021b). The NOAEL was adjusted for a 24-hour exposure duration. Uncertainty factor of 180 (3 for interspecies variability, 10 for intraspecies variability, and 6 for database uncertainties) was applied to derive a reference criteria 8.9 µg/m ³ for aluminum, based on a target HQ=1, which was selected by the TCEQ as the interim 24-hour AMCV for aluminum.	MECP- MECP value was selected as it is the only available criterion from the primary sources.
Antimony	7440-36-0	25	-	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Arsenic	7440-38-2	0.3	-	-	-	-	-	-	5.4	MECP: Screening value based on an occupational exposure study conducted on retired copper smelter employees, who had worked in copper smelters for 28 years (Pinto et al. 1978; as cited in MECP 1981). The study examined urinary arsenic biomarkers and found an increased risk of mortality due to lung cancer associated with duration and degree of exposure to arsenic trioxide. TCEQ: Screening value based on a study where female rats were exposed to 0, 0.3, 3, and 10 mg/m ³ arsenic trioxide for 6 hours/day for multiple days (Holson et al. 1999; as cited in TCEQ 2012) A NOAEL of 3000 µg/m ³ and a LOAEL 10,000 µg/m ³ , respectively, were observed for maternal effects (i.e., decreased maternal weight gain and rates), where the NOAEL was selected as the point of departure. The NOAEL of 3000 µg/m ³ was then adjusted using a HEC of 0.714 (2142 µg/m ³). A total uncertainty factor of 300 were applied for interspecies variability (3), intraspecies variability (10) and database uncertainties (10), to derive a threshold of 7.14 µg/m ³ for arsenic trioxide. The threshold for arsenic trioxide was adjusted for arsenic (arsenic trioxide is 76% arsenic by weight), resulting in a reference value of 5.4 µg/m ³ which was selected by the TCEQ as the interim 24-hour AMCV for arsenic.	MECP- MECP value was selected as it is the only available criterion from the primary sources.
Barium	7440-39-3	10	-	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available), for total water soluble barium.	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Beryllium	7440-41-7	0.01	-	-	-	-	-	-	-	MECP: Screening value based on lung disease, tracheobronchitis, and dermatitis in people (MECP 2005a). The screening value was set at 1/200 of the threshold limit value of 2 µg/m ³ because lung disease is potentially fatal.	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Bismuth	7440-69-9	2.5 ^(c)	-	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Boron	7440-42-8	120	-	-	-	-	-	-	-	MECP: Screening value based on particulates (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Cadmium	7440-43-9	0.025	-	-	-	-	-	-	0.55	MECP: Screening values calculated by using a conversion factor of 5 to convert from the annual-averaging value (0.005 µg/m ³) to the 24-hour averaging-value. Screening value is based on the annual MECP screening value, which is based on kidney effects associated with exposure to cadmium compounds (MECP 2006). TCEQ: Screening value based on the same study used to derive the ATSDR MRL. The LOAEL was 0.088 mg/m ³ (total of 62 hours of exposure) (National Toxicological Program 1995, as cited in TCEQ 2016). The LOAEL was not extrapolated to a 24-hour exposure. The LOAEL was adjusted for a regional deposited dose ratio (1.87), resulting in a POD _{HEC} of 165 µg/m ³ . An uncertainty factor of 300 was applied (3 for interspecies variability, 10 for intraspecies variability and 10 for use of a LOAEL) to derive a reference value of 0.55 µg/m ³ based on an HQ=1, which was selected by the TCEQ as the 24-hour AMCV.	MECP- MECP value was selected as it is the only available criterion from primary sources.
Calcium	7440-70-2	-	-	-	-	-	-	-	-	A 24-hour screening value is not available for calcium.	Parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. Not further evaluated for the 24-hour averaging period.
Calcium Oxide	1305-78-8	10	-	-	-	-	-	-	-	MECP: Screening value based on a corrosion endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Chromium (total)	7440-47-3	0.5	-	-	-	-	-	-	-	MECP: Screening value for chromium (metallic, divalent and trivalent forms) based on a subchronic inhalation study where rats were exposed to various forms of trivalent chromium at 3, 10, and 30 mg/m ³ for 6 hours/day, 5 days/week for 13 weeks (Derelanko et al. 1999, as cited in MECP 2011d). MECP derived a BMCL10 value of 3.45 mg/m ³ chromium sulphate for increases in total lung and trachea weights (relative to body weight) in rats. The BMCL10 was adjusted for continuous exposure (3.45 mg/m ³ x 6/24-hours x 5/7 days = 0.616 mg/m ³) and converted to a HEC using a Regional Deposited Dose Ratio value of 1.31. The fraction of trivalent chromium in chromium sulfate was accounted for (17%), resulting in an adjusted concentration of 0.138 mg/m ³ . Uncertainty factors of 10 (intraspecies variability), 3 (interspecies extrapolation), and 10 (use of a subchronic (13-weeks) study) were applied.	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Cobalt	7440-48-4	0.1	-	-	-	-	-	-	0.095	MECP: Screening value based on a health endpoint (supporting documentation not available). TCEQ: Screening value based on respiratory irritation (coughing, sore throat and changes to forced expiratory volume) in occupationally-exposed people (TCEQ 2017a). The 6 hour LOAEL of 38 µg/m ³ was adjusted to 24-hours using the following equation: C2 = C1 * (T1/T2), where C1 = 38 µg/m ³ , T1 = 6 hours and T2 = 24-hours. An uncertainty factor of 100 was applied (10 for interspecies variability, 10 for use of a LOAEL) to derive a reference value of 0.095 µg/m ³ , based on a target HQ=1, which was selected by the TCEQ as the 24-hour AMCV.	MECP- MECP value was selected as it is the only available criterion from primary sources.
Copper	7440-50-8	50	-	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.

Table C1-4: Available Inhalation Screening Criteria for the 24-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
		MECP (2020, 2023) AAQC ⁽⁹⁾ /ACB	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) AMCV		
Copper Sulphate	7758-98-7	-	-	-	-	-	-	-	A 24-hour screening value is not available for copper sulphate.	Screening value for copper selected as surrogate for screening purposes.
Iron	7439-89-6	4	-	-	-	-	-	"Must Meet NAAQS"	MECP: Screening value from a 1/2 hour value (10 µg/m ³) using a conversion factor of 2.5. The conversion factor of 2.5 accounts for differences in sampling time and the potential for multiple iron sources (MECP 2005b). The 1/2 hour standard of 10 µg/m ³ for metallic iron, derived in 1968, was established as an upper limit concentration that would not result in rust spotting on vehicles. Instances of car spotting were reported by Fochtman and Langer (1957; as cited in MECP 2005b) when this 1/2 limit was exceeded. In a subsequent review which focused on the health effects of iron, the established AAQC of 4 µg/m ³ (24-hours) was determined to be health-protective for the general population (reported health effect: pulmonary siderosis, a form of pneumoconiosis due to inhalation of iron particles - a chronic endpoint), but conservatively so. For comparison, the health-based threshold limit value of 5,000 µg/m ³ (measured as iron) from an occupational study suggests that iron spotting on vehicles occurs at a much lower concentration than health-effects. TCEQ: No value specific to iron. "Must Meet NAAQS" indicates that, for species of limited concern, the determination of the individual species impacts are not required if a National Ambient Air Quality Standards (NAAQS) analysis is completed for particulate matter of 2.5 and 10 microns or less (PM _{2.5} and PM ₁₀).	MECP- MECP value was selected as it is the only available criterion from primary sources.
Lead	7439-92-1	0.5	-	-	-	-	-	-	MECP: Screening value based on neurological effects in children. The screening value is based on Cal EPA (2001; as cited in MECP 2007) approach where the airborne lead concentration is based on a 5% probability of children in a reference population exceeding the LOAEL. The study that formed the basis of the Cal EPA derivation (Lanphear et al. 2005 as cited in CalEPA 2001) evaluated the epidemiologic incidence of increased blood lead levels and decreased intelligence quotients (IQ), in several cohorts of children. The LOAEL blood level lead was determined to be 10 µg/dL. An uncertainty factor of 2 to account for other study results that showed blood levels below the LOAEL associated lower IQ and other adverse neurobehavioural effects.	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Magnesium	7439-95-4	120	-	-	-	-	-	-	Magnesium oxide used as a surrogate in the absence of inhalation screening criteria for magnesium. MECP: Screening value for magnesium oxide based on a health endpoint (supporting documentation not available) for particulate matter.	MECP- MECP for magnesium oxide selected as a surrogate for magnesium because it is the only 24-hour criterion available.
Manganese	7439-96-5	0.1 (PM2.5) 0.2 (PM10) 0.4 (suspended particulate matter)	-	-	-	-	-	5	MECP: Screening value based on the occupational exposure to manganese. A BMCL ₀₅ of 84 µg/m ³ for neurological effects (eye-hand coordination impairment) was identified (Roels et al. 1992 as cited in MECP 2011e). The BMCL ₀₅ was adjusted for continuous exposure (84 µg/m ³ x 5/7 days x 10m ³ /20m ³ = 30 µg/m ³). Uncertainty factors of 10 (intraspecies variability), 3 (database limitations), 3 (subchronic to chronic extrapolation) were applied, resulting in a screening value of 0.1 µg/m ³ for manganese in PM _{2.5} . This was converted to a manganese concentration in PM ₁₀ and then TSP (0.4 µg/m ³) on the basis that approximately 50% of ambient PM ₁₀ is made up of PM _{2.5} and approximately 50% of ambient TSP is made up of PM ₁₀ . TCEQ: Screening value based on an inhalation study where rhesus monkeys were exposed to manganese sulphate for 6 hours per day, 5 days per week for 3 weeks (total of 90 hours of exposure) (Dorman et al. 2005, as cited in TCEQ 2017b). The critical effect was mild inflammatory changes to the airway with a point of departure LOAEL (6 hours of exposure) of 1.5 mg/m ³ . The LOAEL did not require adjustment to a HEC because the particulate deposition efficiency is the same in rhesus monkeys and humans. Uncertainty factors for extrapolation from a LOAEL to a NOAEL (2), intrahuman variability (10), 3 to account for potential toxicodynamic differences between rhesus monkeys and humans and 6 for a limited database were applied; however, a maximum uncertainty factor of 300 is used to derive an acute reference value of 5 µg/m ³ which was selected as the AMCV.	MECP- MECP values were selected as they are the only available criteria from primary sources.
Mercury	7439-97-6	2	-	-	-	-	-	-	MECP: Screening value based on the NIOSH occupational limit of 50 µg/m ³ for mercury compounds (MECP 2020). The MECP divided the NIOSH occupational limit (50 µg/m ³) by a factor of 25 to obtain the 24-hour screening value (MECP 2020) (MECP, email correspondence).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Molybdenum	7439-98-7	120	-	-	-	-	-	21	MECP: Screening value based on a particulate endpoint (supporting documentation not available). TCEQ: Screening value based on an inhalation study where rats were exposed to molybdenum trioxide for 6 hours per day, 5 days per week for 2 weeks (National Toxicological Program 1997, as cited in TCEQ 2021d). The critical effect was decreased body weight with a point of departure NOAEL of 30 mg/m ³ . The LOAEL was adjusted to a 24 h exposure duration and a HEC for a POD of 5.75 mg/m ³ . Uncertainty factors for intrahuman variability (10), 3 to account for potential toxicodynamic differences between rats and humans and 6 for a limited database were applied to derive a reference value of 32 µg/m ³ for molybdenum trioxide or 21 µg/m ³ molybdenum.	MECP- MECP value was selected as it is the only available criterion from primary sources.
Nickel	7440-02-0	0.1 (PM10) 0.2 (suspended particulate matter)	-	-	-	-	-	1.1	MECP: Screening value is for nickel as a metal in PM ₁₀ . Screening value based on the annual MECP screening value which is based on carcinogenic and non-carcinogenic effects (MECP 2011f). MECP used a conversion factor of 5 to convert from the annual-averaging value (0.02 µg/m ³). The MECP screening value of 0.2 µg/m ³ is based on nickel in TSP assuming that approximately 50% of ambient TSP is made up of PM ₁₀ . TCEQ: Screening value as PM ₁₀ based on an inhalation study where rats were exposed to nickel for 72 hours over 12 exposure days (National Toxicological Program 1996, as cited in TCEQ 2017e). The critical effect was lung inflammation and increased relative lung weight with a point of departure LOAEL of 0.7 mg/m ³ . The LOAEL was adjusted to a HEC for a POD of 0.9191 mg/m ³ . Uncertainty factors for extrapolation of LOAEL to NOAEL (10), intrahuman variability (10), and potential toxicodynamic differences between rats and humans (3) were applied to derive a final acute reference value of 3.1 µg/m ³ . The candidate interim 24-ReV of 3.1 µg/m ³ is higher than the 1-hour ReV of 1.1 µg/m ³ (based on bronchial constriction in human volunteers with occupational asthma). While associated with uncertainty that is an order of magnitude higher, the candidate interim 24-ReV supports use of the 1-hour ReV (1.1 µg/m ³) as the interim 24-hour ReV and the AMCV.	MECP- MECP values were selected as they are the only available criteria from primary sources.

Table C1-4: Available Inhalation Screening Criteria for the 24-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
		MECP (2020, 2023) AAQC ^(a) /ACB	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) AMCV		
Phosphorus	7439-95-4	0.5 ^(c)	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Potassium	7440-09-07	10 ^(c)	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Selenium	7782-49-2	10	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Silver	7440-22-4	1	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Strontium	7440-24-6	120	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Sulphur	9305-99-8	-	-	-	-	-	-	-	A 24-hour screening value is not available for sulphur.	A 24-hour screening value is not available for sulphur. Acute exposure is assessed using the 1-hour air criterion.
Thallium	7440-28-0	0.5 ^(c)	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Thorium	7440-29-1	-	-	-	-	-	-	-	A 24-hour screening value is not available for thorium.	Parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. Not further evaluated for the 24-hour averaging period.
Tin	7440-31-5	10 ^(c)	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Titanium	7440-32-6	120	-	-	-	-	-	-	MECP: Screening value based on a health endpoint for chemical sorbed to particulates (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Tungsten	7440-33-7	5 ^(c)	-	-	-	-	-	-	MECP: 24- hour ACB based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Uranium	7440-61-1	-	-	-	-	-	-	-	A 24-hour screening value is not available for uranium.	A 24-hour screening value is not available for uranium. Acute exposure is assessed using the 1-hour air criterion.
Vanadium	7440-62-2	2	-	1	-	-	-	0.31	MECP: Screening value based on a health endpoint (supporting documentation not available). WHO: Screening value based on human occupational studies identified a LOAEL for vanadium of 20 µg/m ³ , based on chronic upper respiratory tract symptoms. The observed effects, including irritation, coughing, and effects on the pharynx, were considered to be minimal at 20 µg/m ³ relative to the higher exposures of 1 mg/m ³ where more serious effects such as chronic bronchitis and pneumonia were observed. A susceptible subpopulation was not identified and an uncertainty factor of 20 (to account for use of a concentration where only minimal effects to the respiratory tract were seen and for lack of identification of a susceptible subpopulation) was selected (WHO, 2000). TCEQ: Screening value as particulate matter based on an inhalation study where human subjects were exposed to vanadium (IV) oxide for 8 hours through inhalation (Zenz & Berg 1967; as cited in TCEQ 2021). The critical effect was respiratory irritation with a point of departure NOAEL of 0.1 mg/m ³ . The NOAEL was adjusted to a 24-hour exposure duration for a POD of 0.033 mg/m ³ . Uncertainty factors for intrahuman variability (10) and database uncertainty (6) were applied to derive a reference value of 0.55 µg/m ³ for vanadium (IV) oxide or 0.31 µm ³ for vanadium, based on an HQ=1, which was selected by the TCEQ as the interim 24-hour AMCV.	MECP- MECP value was selected as it is the only available criterion from primary sources.
Yttrium	7440-65-5	5 ^(c)	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Zinc	7440-66-6	120	-	-	-	-	-	-	MECP: Screening value based on a health endpoint for chemical sorbed to particulates (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Zirconium	7440-67-7	25 ^(c)	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.

Table C1-4: Available Inhalation Screening Criteria for the 24-Hour Averaging Period

Parameter	CAS	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
		MECP (2020, 2023) AAQC ^(a) /ACB	CCME (1999, 2025) CAAQS and NAAQO	WHO (2000, 2021) AQG	US EPA (2025) NAAQS	Cal OEHHA (2025) REL	BC ENV (2025) AAQO	TCEQ (2025) AMCV		
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)pyrene	50-32-8	0.0005 (0.00005)	-	-	-	-	-	-	MECP: Health-based annual-averaging value (0.00001 µg/m ³) was converted to the 24-hour AAQC using a conversion factor of 5. The AAQC is based on an increased risk of developing lung cancer from a lifetime exposure to PAHs in ambient air (benzo(a)pyrene used as a surrogate for the total carcinogenicity of PAHs) (MECP 2011). The annual MECP screening value is based on a cancer risk of 1 in 1,000,000 and was adjusted for this assessment to a cancer risk of 1 in 100,000; therefore, the 24-hour value was also adjusted by 10. The unadjusted AAQC of 0.00005 µg/m ³ is provided in brackets.	MECP- MECP value was selected as it is the only available criterion and it is from a primary source.
Volatile Organic Compounds (VOCs)										
1,3-Butadiene	106-99-0	100 (10)	-	-	-	-	-	950	MECP: Health-based annual-averaging value (2 µg/m ³) was converted to the 24-hour AAQC using a conversion factor of 5. The AAQC is based on an increased risk of developing cancer (lymphosarcoma or leukaemia; MECP 2011). The annual MECP screening value is based on a cancer risk of 1 in 1,000,000 and was adjusted for this assessment to a cancer risk of 1 in 100,000; therefore, the 24-hour value was also adjusted by 10. The unadjusted AAQC of 10 µg/m ³ is provided in brackets. TCEQ: Screening value based on a study where reduction in extragastrational weight gain and fetal body weight, and developmental toxicity (abnormal sternbrae, reduced ossification for all sites and increased incidence of supernumerary (additional ribs) were observed in mice exposed to 1,3-butadiene for 6 hours/day on gestational days 6 to 15 (Hackett et al. 1987, as cited in TCEQ 2015a). A benchmark concentration level corresponding to the lower confidence limit (one standard deviation) (BMCL _{1SD}) of 51.3 ppm (113 mg/m ³) was calculated based on this study. The BMCL _{1SD} was extrapolated to 24-hours (12.8 ppm; 28.3 mg/m ³) and adjusted to a HEC (12.8 ppm). Uncertainty factors for interspecies variation (3) and intraspecies variation (10) were applied, resulting in a value of 0.43 ppm (0.95 mg/m ³). Based on AMCV value where target HQ=1.	MECP- MECP value was selected as it is the only available criterion from primary sources.
Benzene	71-43-2	23 (2.3)	-	-	-	27	-	320	MECP: Health-based 24-hour screening value (AAQC) was converted from the annual-averaging value (0.45 µg/m ³) to the 24-hour AAQC using a conversion factor of 5. The 24-hour screening value is based on mortality caused by acute myeloid leukemia due to occupational exposure (MECP 2011c). The annual MECP screening value is based on a cancer risk of 1 in 1,000,000 and was adjusted for this assessment to a cancer risk of 1 in 100,000; therefore, the 24-hour value was also adjusted by 10. The unadjusted AAQC of 2.3 µg/m ³ is provided in brackets. Cal OEHHA: Screening value based on decreased early nucleated red cell counts in pregnant female mice exposed to benzene via inhalation for 6 hours/day for 10 days during days 6-15 of gestation (Keller and Snyder 1988; as cited in Cal OEHHA 2014). Critical effects were documented for all exposure concentrations in this study; therefore, a NOAEL was not available. The LOAEL was 16 mg/m ³ (5 ppm) and an uncertainty factor of 600 (√10 for use of a LOAEL, 2 and √10 for interspecies differences, 10 and √10 for intraspecies differences) was applied. TCEQ: Screening value based on a LOAEL of 10.2 ppm (32.59 mg/m ³) for depressive effects to white blood cells, resulting from exposures of up to 301 ppm (961 mg/m ³) benzene for 6 hours/day for 6 days (Rozen et al. 1984, as cited in TCEQ 2015). A NOAEL was not available because all exposure concentrations used in the study resulted in significant effects. The study TCEQ used to derive a reference value is the same as that used by ATSDR to derive a minimal risk level. The TCEQ did not adjust the LOAEL for duration, (i.e., it was not extrapolated to 24-hours as it was not considered applicable based on consideration of toxicokinetics). The TCEQ determined there to be inadequate clearance following each day of exposure, and considered the multiple day exposure as a continuous exposure in order to derive a 24-hour reference value. The LOAEL was adjusted to a HEC (10.2 ppm; 32.59 mg/m ³). Uncertainty factors of 100 (3 for interspecies variation, 10 for intraspecies variation, and 3 for use of a LOAEL) were applied to derive an acute reference value of 320 µg/m ³ . TCEQ applied an uncertainty factor of 3 for use of a LOAEL, instead of an uncertainty factor of 10 used by ATSDR, because the selected LOAEL is comparatively lower than other LOAELs observed in similar studies and similar to the NOAEL calculated based on weight-of-evidence in evaluated mouse studies. Furthermore, a lower confidence benchmark dose calculated using data from Rozen et al. (1984) supports the use of a conservative uncertainty factor of 3. Based on AMCV value where target HQ=1.	MECP- MECP value was selected as it is the only available criterion from the primary sources.
Hydrogen Cyanide	74-90-8	8	-	-	-	-	-	-	MECP: Screening value based on a health endpoint (supporting documentation not available).	MECP- MECP value was selected as it is the only available criterion from the primary sources.
Other										
Silica, crystalline	7631-86-9	5	-	-	-	-	-	24	MECP: Screening value based on a health endpoint (supporting documentation not available). Applicable for respirable (<10 µm diameter), cristobalite, quartz and tridymite.	MECP- MECP value was selected as it is the only available criterion from the primary sources.

Notes:

µg/m³ = micrograms per cubic metre; µm = micrometre; AAQC = Ambient Air Quality Criteria; AAQO = Ambient Air Quality Objective; ACB = air contaminant benchmark; AMCV = Air Monitoring Comparison Value; AQG = Air Quality Guideline; ATSDR = Agency for Toxic Substances and Disease Registry; BC ENV = British Columbia Ministry of the Environment and Climate Change Strategy; BMCL_{1SD} = benchmark concentration lower confidence limit of x% effect level; CAAQS = Canadian Ambient Air Quality Standard; Cal EPA = California Environmental Protection Agency; Cal OEHHA = California Office of Environmental Health Hazard Assessment; CAS = Chemical abstract service; CCME = Canadian Council of Ministers of the Environment; DPM= diesel particulate matter; HEC= human equivalent concentration; HQ = hazard quotient; LOAEL= lowest observed adverse effect level; MECP = Ministry of the Environment, Conservation and Parks; mg/m³ = milligrams per cubic metre; MRL= minimum risk level; NAAQO= National Ambient Air Quality Objective; NAAQS = National Ambient Air Quality Standard; NIOSH= National Institute for Occupational Safety and Health; NO₂= nitrogen dioxide; NOAEL = No observed adverse effect level; PAH = polycyclic aromatic hydrocarbon; PM_{2.5} = particulate matter equal to or less than 2.5 microns in diameter; PM₁₀ = particulate matter equal to or less than 10 microns in diameter; ppb = parts per billion; ppm= parts per million; POD= point of departure; REL= Reference exposure level; ReV=Reference value; SD = standard deviation; SO₂= sulfur dioxide; SPM = suspended particulate matter; TCEQ = Texas Commission on Environmental Quality; TSP = total suspended particulates; US EPA = United States Environmental Protection Agency; VOC = volatile organic compound; WHO = World Health Organization.

- = Guideline not available

Concentrations are in microgram per cubic metre (µg/m³), unless otherwise noted.

Concentrations in parts per billion (ppb), provided in brackets, were converted to µg/m³ by applying the formula: molecular weight (grams per mol) x ppb / 24.45. The conversion is based on the assumption of 25 °C and an atmospheric pressure of 1.

The MECP has converted values in ppb/ppm to µg/m³ assuming 10 °C and 760 mm Hg pressure, unless specified otherwise.

^(a) MECP AAQC based on 24-hour averaging times are based on the protection against chronic effects.

^(c) MECP (2023) Air Contaminant Benchmark (ACB) was summarized because MECP (2020) Ambient Air Quality Criteria (AAQC) were unavailable. The ACBs are standards, guidelines and screening levels for assessing point of impingement concentrations.

For the selection of a screening criterion, the following hierarchy was applied: The lower of the values available from the MECP AAQC and CCME CAAQS/NAAQO was generally preferentially selected. In the absence of MECP and CCME values, available values from WHO AQG, US EPA NAAQS, Cal OEHHA REL, BC ENV AAQO and TCEQ ESL/AMCV/ReV were reviewed. Values with supporting documentation available, values based on more current studies, or values based on studies which are more relevant to human health (i.e., human studies) were preferentially selected.

Bold and highlighted = Selected air screening criterion

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
			MECP (2020, 2023) AAQC/ACB ^(d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS ^{(a), (b)}	CalOEHHA (2025) REL ^(c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV ^(e)		
Criteria Air Parameters											
Particulate Matter ≤2.5 microns (PM _{2.5})	N/A	NC	8.8	CAAQS = 8.8	5	9	-	Provincial AQO= 8 CAAQS = 8.8	-	MECP: MECP has adopted the CAAQS (described above). It reflects a 3-year average of the annual average of the daily 24-hour average concentrations. CCME: CAAQS protective of human health and the environment. The standard represents a balance between achieving the best health and environmental protection possible and the feasibility and costs of reducing pollutant emissions; a value of 8.8 µg/m ³ is proposed for the year 2020. Based on the 3-year average of the annual average of daily 24-hour average concentrations. US EPA: The NAAQS is protective of adverse health effects associated with long-term PM _{2.5} exposure, including premature mortality, asthmatic symptoms, heart attacks, emergency room visits, and lost work/school days. Achievement is based on the annual mean, averaged over 3 years. In February 2024, US EPA announced its decision to lower the primary health-based annual standard from its current level of 12 µg/m ³ to 9.0 µg/m ³ . This decision is based on review of the more recent scientific evidence on adverse effects caused by particle pollution. WHO: A long-term air quality guideline of 5 µg/m ³ was established to protect against non-accidental and cause-specific mortality (e.g., circulatory, lung cancer, and non-malignant respiratory mortality). This guideline is derived from the average of the five lowest 5th percentile levels from five studies assessed in a meta-analysis of PM _{2.5} and non-accidental mortality (Chen & Hoek 2020; as cited in WHO 2021). BC ENV: The provincial AQO of 8 µg/m ³ is an air management tool used to guide decisions on environmental impact assessments and authorizations, airshed planning efforts and regulatory development (BC ENV 2025). No additional supporting information on the derivation of the AAQO is available. The provincial AAQO is based on an annual average, over one year. BC has also adopted the CAAQS of 8.8 µg/m ³ , which is measured against the annual average, averaged over three consecutive years.	MECP- MECP value was selected as it the same as the CCME criterion and is from a primary source.
Particulate Matter ≤10 microns (PM ₁₀)	N/A	NC	-	-	15	-	-	-	-	WHO: The PM ₁₀ annual air quality guideline reduced from 20 µg/m ³ to 15 µg/m ³ . This reflects the new evidence of effects on mortality occurring at concentrations below 20 µg/m ³ . In this update of the air quality guidelines, an analysis was introduced to identify the most appropriate level of the long-term air quality guidelines that is more formalized than what was used in 2005. However, the change from 20 µg/m ³ to 15 µg/m ³ primarily reflects the new evidence about effects occurring at low levels. It is important to note that the assessment of PM ₁₀ was based on studies that had actually measured PM ₁₀ , without taking into consideration the ratios between PM ₁₀ and PM _{2.5} . In 2005 based on empirical data, a PM ₁₀ /PM _{2.5} ratio of 2 was used to establish the PM ₁₀ air quality guideline.	WHO- WHO value selected as it is the only available criterion and supporting documentation is available.
Suspended Particulate Matter (SPM)	N/A	NC	60	-	-	-	-	60	-	MECP: Value for "Suspended particulate matter (< 44 µm diameter)", geometric mean. Based on visibility, not health based. Supporting documentation not available. CCME: National Ambient Air Quality Objective (1974) based on geometric mean, supporting documentation not available. BC ENV: Supporting documentation not available. Based on the CCME NAAQO from 1974 (BC ENV 2025). Achievement is based on the geometric mean of annual concentrations.	MECP- MECP value was selected as it the same as the CCME criterion and is from a primary source.
Carbon monoxide (CO)	630-08-0	NC	-	-	-	-	-	-	-	Chronic screening values not available because health effects linked to carbon monoxide are associated with shorter term exposures (i.e., 1- or 8- hours).	Health effects linked to carbon monoxide are associated with shorter term exposures (i.e., 1- or 8- hours), therefore carbon monoxide was not assessed for a chronic exposure averaging period.
Nitrogen dioxide (NO ₂)	10102-44-0	NC	-	CAAQS (2025) = 23 (12 ppb)	10	100 (53 ppb)	-	Provincial AQO = 32 CAAQS (2025) = 23	-	CCME CAAQS: Supporting documentation not available. The metric is the average over a single calendar year of all 1-hour average concentrations. The CAAQS of 12 ppb was converted to µg/m ³ using a molecular weight of 46.01 g/mol. WHO: Based on non-accidental and cause-specific, respiratory mortality (e.g., Chronic obstructive pulmonary disease, respiratory and acute lower respiratory infection mortality). This screening level is derived from average of the five lowest 5th percentile levels from five studies with the five lowest reported or estimated levels in a meta-analysis of non-accidental mortality (Chen & Hoek 2020; as cited in WHO 2021). US EPA: NAAQS based on a large body of evidence for respiratory effects from exposure to nitrogen oxides. The key clinical studies on human health effects are based on shorter exposure durations (0.5 to 3 hours). The health effects reported include increased airway responsiveness in asthmatics, small decreases in forced vital capacity and forced expiratory volume in one second (FEV1) with mild exercise in patients with chronic obstructive pulmonary disease, increased airway responsiveness to bronchoconstrictors in healthy adults, and changes in lung function in healthy adults (US EPA 1993). The key epidemiological studies on human health effects indicated increased risk of lower respiratory symptoms/disease in children (aged 5 to 12 years). Exposure to NO ₂ in occupational settings was associated with bronchial pneumonia and bronchitis (25 to 100 ppm). In high occupational exposure cases (>200 ppm), effects ranged from hypoxemia/transient airway obstruction to death (US EPA 1993). The NAAQS is a primary and secondary value, which is protective of "sensitive" populations such as asthmatics, children, and the elderly. The NAAQS of 53 ppb was converted to µg/m ³ for this assessment using a molecular weight of 46.01 g/mol. BC ENV: In November 2021, B.C. adopted the 2020 Canadian Ambient Air Quality Standard (CAAQS) of 32 µg/m ³ of as the new Provincial Air Quality Objective for for NO ₂ . A CAAQS value of 23 µg/m ³ is proposed for the year 2025, however, BC ENV has not yet updated their provincial AQO to align with the 2025 CAAQS. The CAAQS is the annual average of 1-hour average concentrations over one year. The CAAQS of 12 ppb was converted to µg/m ³ using a molecular weight of 46.01 g/mol. Supporting documentation not available for screening value.	CCME- The 2025 CAAQS (23 µg/m ³) was selected as it is the only available criterion from the primary sources.
Sulphur dioxide (SO ₂)	7446-09-05	NC	10 ^(f)	CAAQS (2025) = 10 (4 ppb)	-	-	-	10.5 (4 ppb)	-	MECP: Screening value based on a health endpoint (supporting documentation not available). CCME CAAQS: The annual screening value of 10 µg/m ³ (4.0 ppb) is intended to be applied to the average over a single calendar year of all the 1-hour average SO ₂ concentrations. The CAAQS of 4 ppb was converted to µg/m ³ using a molecular weight of 64.07 g/mol. BC ENV: The provincial AAQO of 10.5 µg/m ³ is based on the 2025 CAAQS. The CAAQS is the average over a single calendar year of all the 1-hour average concentrations. Supporting documentation not available.	CCME- The 2025 CAAQS (10 µg/m ³) was selected as it is the only available criterion from the primary sources.

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
			MECP (2020, 2023) AAQC/ACB (d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS (e), (f)	CalOEHHA (2025) REL (c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV (g)		
Diesel particulate matter (DPM)	N/A	NC	-	5 (Health Canada, 2016) (h)	-	5.2	5	-	5	Health Canada: Screening value based on a NOAEL of 0.46 mg/m ³ for effects on the respiratory tract (inflammation, histopathological and/or functional changes) in rats (Ishinishi et al. 1988; as cited in Health Canada 2016), which is the same primary study selected for the derivation of the US EPA RfC. The NOAEL was adjusted to a human equivalent concentration of 0.12 mg/m ³ . An uncertainty factor of 25 was applied (10 ^{0.4} for toxicodynamic differences in animal to human extrapolation and 10 for sensitive individuals in the human population) to derive a guidance value of 5 µg/m ³ .	Health Canada- Health Canada value was selected as it is the only criterion available from the primary sources.
										US EPA: Screening level based on RfC of 5 µg/m ³ , which is derived from a NOAEL of 0.46 mg/m ³ for pulmonary inflammation and histopathology in rats exposed to DPM for 16 hours/day, 6 days/week for 30 months (Ishinishi et al. 1988; as cited in US EPA 2003a). The NOAEL was adjusted to a human equivalent concentration of 0.144 µg/m ³ and an uncertainty factor of 30 was applied (3 for interspecies variability and 10 for intraspecies variability) to derive an RfC of 5 mg/m ³ . The US EPA then applies a residential scenario exposure factor to derive the RSL.	
										Cal OEHHA: Reference exposure level based on same study as US EPA described above (Ishinishi et al. 1988; as cited in Cal OEHHA 1998).	
		TCEQ: Screening value based on an inhalation RfC of 5 µg/m ³ derived by the US EPA IRIS (US EPA 2003a). The US EPA RfC was based the chronic inhalation study in which rats (120 male and 95 female per group) were exposed to DPM concentrations (0.46, 0.96, 1.84, or 3.72 mg/m ³) from a heavy-duty engine for 16 hours/day, 6 days/week for 30 months (Ishinishi et al. 1988, as cited in US EPA 2003a). The study derived a NOAEL and LOAEL of 0.46 and 0.96 mg/m ³ , respectively, based on inflammatory and histopathological changes in the lungs. The NOAEL was used by US EPA as the POD to derive its RfC for DPM. The corresponding interim long-term TCEQ ESL is 1.5 µg/m ³ (5 µg/m ³ (ReV) x 0.3) for non-cancer effects, which is based on HQ=0.3 and not used for this assessment (TCEQ 2015c). The unadjusted ReV (5 µg/m ³ , HQ=1) is presented.									
C	-	-	-	0.094 (0.0094)	0.033	-	0.15	US EPA: Screening level based on Cal OEHHA IUR of 3x10 ⁻⁴ per µg/m ³ (Cal OEHHA 1998). An incremental lifetime cancer risk of 1 in 100,000 was used to convert the IUR to a risk-based concentration of 0.033 µg/m ³ . The US EPA applies a residential scenario exposure factor to derive the screening level.	CAL OEHHA- CalOEHHA value selected. Based on Health Canada (2016) human health risk assessment for DPM, there are uncertainties with quantifying unit risks based on rat bioassays of lung tumour induction and Health Canada has not derived guidance value based on cancer effects. Despite the uncertainties, the Cal OEHHA value was used in this assessment based on previous direction from Health Canada on other Canadian Impact Assessments and it is the lowest criteria available from the secondary sources. Criteria from primary sources were unavailable.		
								Cal OEHHA: Screening value based on IUR of 3x10 ⁻⁴ per µg/m ³ based on an epidemiological data of occupationally-exposed individuals with elevated risks of developing lung cancer (Cal OEHHA 1998). Since the available data were from an occupational setting, a factor of 0.33 was applied to account for the non-continuous exposure duration. An incremental lifetime cancer risk of 1 in 100,000 was used to convert the IUR to a screening value by dividing 10 ⁻⁶ by the IUR.			
								TCEQ: Screening value is based on lung tumorigenicity data from five rat studies, from which Cal OEHHA derived a cancer URF range of 1 x 10 ⁻⁵ to 3 x 10 ⁻⁴ (µg/m ³) ⁻¹ and a geometric mean of 6 x 10 ⁻⁵ (µg/m ³) ⁻¹ for diesel exhaust/DPM (Cal OEHHA 1998). The California Air Resources Board listed DPM as a toxic air contaminant, with a cancer URF of 3 x 10 ⁻⁴ (µg/m ³) ⁻¹ . Based on the URF ranges of 1 x 10 ⁻⁵ to 3 x 10 ⁻⁴ (µg/m ³) ⁻¹ and a cancer risk level of 1 in 100,000 (i.e., 10 ⁻⁵), the chronic ESL for carcinogenic effects ranges from 0.03 to 1 µg/m ³ . The chronic ESL, if based on the geometric mean of 6 x 10 ⁻⁵ (µg/m ³) ⁻¹ , would be 0.17 µg/m ³ . The previous interim long-term ESL of 0.15 µg/m ³ is within the estimated ESLs (0.03 to 1 µg/m ³) and thus, was kept and not changed by the TCEQ (TCEQ 2015c).			
Metals											
Aluminum	7429-90-5	NC	-	-	-	5.2	-	-	1.5	US EPA: Screening value based on a provisional RfC of 0.005 mg/m ³ for neurotoxic effects (psychomotor and cognitive impairment) in occupationally exposed workers (Hosovski et al. 1990; as cited in US EPA 2006). Workers were exposed to a time-weighted average concentration of 4.6 to 11.5 mg/m ³ for an average of 12 years. The LOAEL of 4.6 mg/m ³ based on an 8 hour exposure was adjusted for continuous exposure and corrected for a HEC. The LOAEL _{HEC} is 1.64 mg/m ³ . An uncertainty factor of 300 (10 for intrahuman variability, 10 for using a LOAEL and 3 for database limitations) was applied. A residential scenario exposure factor was applied to the RfC to derive the screening level.	US EPA- The US EPA value was selected because supporting documentation is available. The RSL derivation which is based on occupationally exposed workers also accounts for continuous exposure to sensitive subpopulations, while the TCEQ value is derived from the OSHA occupational exposure limit.
										TCEQ: Screening value based on a health endpoint (interim, adopted from OSHA, supporting documentation not available). TCEQ applied a safety factor of 100 to the 8-hour TWA of 15 000 µg/m ³ for total aluminum dust. The adjusted value of 1.5 µg/m ³ was selected as the ESL and AMCV.	
Antimony	7440-36-0	NC	-	-	-	0.31	-	-	0.5	US EPA: Screening value is based on the chronic ATSDR minimal risk level of 0.0003 mg/m ³ (0.3 µg/m ³). ATSDR screening value is based on lung inflammation in Fischer rats exposed to 0, 0.06, 0.51 or 4.5 mg/m ³ antimony trioxide dust for 6 hours/day, 5 days/week for 12 months followed by a 12-month observation period (Newton et al. 1994; ATSDR 2019). The minimum risk level was derived from a BMCL10 of 0.10 mg/m ³ (human equivalent BMCL of 0.008 mg/m ³). The BMCL10 was adjusted for intermittent exposure (PODADJ) followed by an adjustment to a human-equivalent concentration by multiplying the PODADJ by a regional deposited dose ratio. A total uncertainty factor of 30 was then applied (3 for intraspecies variability and 10 for human variability) to calculate the minimum risk level of 0.0003 mg/m ³ (0.3 µg/m ³) (ATSDR 2019). The US EPA applies a residential scenario exposure factor to derive the screening level.	US EPA- US EPA value was selected as it is the most conservative criterion from the secondary sources that have available supporting documentation.
Arsenic	7440-38-2	NC	-	-	-	0.016	0.015	-	-	US EPA: Screening value based on a Cal OEHHA chronic REL of 1.5E-02 (based on study by Wasserman et al. 2004; as cited in Cal OEHHA 2014), and a residential scenario exposure factor was applied to the REL to derive the screening level.	US EPA- US EPA value selected as the US EPA used the CalOEHHA chronic REL to derive its RSL. The US EPA and CalOEHHA criteria are similar and supporting documentation is available.
										Cal OEHHA: Screening value based on decrease in intellectual function and adverse effects on neurobehavioural development in humans (Wasserman et al. 2004; as cited in Cal OEHHA 2014). An inhalation dose was estimated from an oral dose (drinking water) to give a value of 0.46 µg/m ³ . An uncertainty factor of 30 (3 for estimating a LOAEL based on quantitative dose-response analysis and 10 for inter-individual variation) was used.	
		C	-	-	0.0066	0.0065 (0.0065)	0.003	-	0.067	WHO: Screening value based on an estimated incremental lifetime cancer risk of 1 in 100,000 and an IUR of 0.0015 per µg/m ³ , derived from lung cancer incidences in exposed workers at metal smelters (Viren and Silvers, 1994; as cited in WHO 2000).	US EPA- US EPA RSL and WHO have derived very similar screening values based on occupationally exposed workers. The US EPA value was selected as it is slightly more conservative (i.e., lower screening value).
										US EPA: Screening value based on an IUR of 0.00429 per µg/m ³ based on lung cancer in occupationally-exposed male workers (Brown and Chu 1983a, b; as cited in US EPA 1988a). The risk-based concentration for a cancer risk of 1 in 100,000 is 0.002 µg/m ³ . A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level of 0.0065 for a risk level of 1 in 100,000 and 0.00065 for a cancer risk of 1 in 1,000,000.	
Cal OEHHA: Screening value based on an IUR of 0.0033 per µg/m ³ based on lung tumour incidence in occupationally-exposed workers and an incremental lifetime cancer risk of 1 in 100,000 (Tseng et al. 1968, 1977; as cited in Cal OEHHA 2011).											
TCEQ: Screening value based on respiratory and lung cancer in occupational workers. The screening value is based on an IUR of 0.00015 per µg/m ³ and an incremental lifetime cancer risk of 1 in 100,000 (Enterline et al., 1987; Lubin et al., 2000; Jarup et al., 1988, Viren and Silvers 1994; as cited in TCEQ 2012), selected as the ESL and AMCV.											

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Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion	
			MECP (2020, 2023) AAQC/ACB ^(d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS ^{(a), (b)}	CalOEHHA (2025) REL ^(c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV ^(e)			
Barium	7440-39-3	NC	-	-	-	0.52	-	-	-	0.5	US EPA: Screening value based a RfC of 0.5 µg/m ³ based on a reproductive study in rats exposed for four months via inhalation (Tarasenko et al. 1977, as cited in US EPA 1997). The NOAEL was 0.8 mg/m ³ , adjusted for continuous exposure, and an uncertainty factor of 1000 was applied (to derive an RfC of 0.5 µg/m ³). A residential scenario exposure factor was applied to the RfC to derive the screening level. TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), barium soluble compounds as particulate matter, and selected as the ESL and AMCV.	US EPA- US EPA value was selected because supporting documentation is available.
Beryllium	7440-41-7	NC	-	-	-	0.021	0.007	-	-	0.002	US EPA: Screening value based on beryllium sensitization and progressing to chronic beryllium disease in an occupational study of beryllium and compounds (US EPA 1998b). The HEC of the lowest observed adverse effect level (LOAEL _{HEC}) was 0.2 µg/m ³ and an uncertainty factor of 10 (1 for sensitive individuals in the population, 1 for less than chronic exposure duration, 3 for the sensitive nature of a subclinical endpoint and 3 for database uncertainty to account for the poor quality of exposure monitoring) was applied to derive the RfC of 0.02 µg/m ³ . A NOAEL was not identified in the key study given that exposures for the workers that developed chronic beryllium disease were not statistically different from the workers that did not develop the disease. However, a community exposure study evaluating 11 cases of chronic beryllium disease identified a NOAEL ranging from 0.01 to 0.1 µg/m ³ (US EPA 1998b). The study identifying the LOAEL was used as the basis of the RfC given that the screening method used in that study was more sensitive than that used in the study identifying the NOAEL. A residential scenario exposure factor was applied to the RfC of 0.02 µg/m ³ to derive the screening level. Cal OEHHA: Screening value based on beryllium-sensitized (chronic beryllium disease) workers in a ceramics plant, which was the same key study used in the US EPA RfC (Kreiss et al. 1966; as cited in Cal OEHHA 2008b). However, Cal OEHHA identified the LOAEL as the median exposure concentration of the sensitized workers of 0.55 µg/m ³ . Cal OEHHA did not identify a NOAEL. The LOAEL was adjusted by the average experimental exposure to a human equivalent concentration (HEC) of 0.2 µg/m ³ . An uncertainty factor of 30 (10 for use of a LOAEL and 3 for intraspecies differences) was applied to 0.2 µg/m ³ . Cal OEHHA typically uses an uncertainty factor of 3 to account for use of a LOAEL instead of a NOAEL. However, because chronic beryllium disease is serious, chronic, disabling, usually irreversible, and often fatal (Newman et al. 1997; as cited in Cal OEHHA 2008b), Cal OEHHA has applied a higher uncertainty factor to account for the use of a LOAEL. TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), as particulate matter, and selected as the ESL.	Cal OEHHA- Cal OEHHA value was selected as it is the most conservative criterion of the secondary sources with supporting documentation.
		C	-	-	-	0.012 (0.0012)	0.0042	-	-	-	-	US EPA: Screening value based on an IUR of 0.0024 per µg/m ³ related to an increased incidence of lung cancer in workers (Wagoner et al. 1980; as cited in US EPA 1998b). This IUR represents the geometric mean of eight potency estimates calculated to account for various uncertainties in the Wagoner et al. study. The risk-based concentration for a cancer risk of 1 in 100,000 is 0.0042 µg/m ³ . A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. Cal OEHHA: Screening value based on an IUR of 0.0024 per µg/m ³ , based on lung cancer in beryllium processing workers (US EPA 1992, Wagoner et al. 1980; as cited in Cal OEHHA 2011). The risk-based concentration for a cancer risk of 1 in 100,000 is 0.0042 µg/m ³ .
Bismuth	7440-69-9	NC	-	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), bismuth telluride as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only available criterion.
Boron	7440-42-8	NC	-	-	-	20.9	-	-	-	5	US EPA: Screening value is based on an inhalation unit risk of 0.02 µg/m ³ . The US EPA inhalation RSL is based on information previously available from the US EPA IRIS. US EPA IRIS no longer recommends the evaluation of boron via inhalation, and does not provide the supporting derivation documents associated with its previously recommended value. However, the US EPA continues to recommend an inhalation RSL for boron. TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), as particulate matter, and selected as the ESL.	US EPA- US EPA value was selected because supporting documentation is available.
Cadmium	7440-43-9	NC	0.005	-	0.005	0.01	0.02	-	-	0.011	MECP: Screening value based on renal effects in humans associated with exposure to cadmium compounds (Friberg et al., 1974, Kjellstrom et al., 1978; as cited in MECP 2006). A LOAEL OF 100 µg/m ³ -years was identified from the study. A continuous lifetime exposure of 270 ng/m ³ for the general population was derived from the cumulative occupational exposure of 100 µg/m ³ -years. The occupational exposure level was converted into an equivalent continuous lifetime exposure by extrapolating the occupational LOAEL from 8 hours to 24-hours, from 225 working days to 365 days and distributed over an average human lifetime of 75 years (100 µg/m ³ -years x 8/24-hours x 225/365 days x 1/75 years = 270 ng/m ³), resulting in an adjusted LOAEL of 0.27 µg/m ³ . An uncertainty factor of 10 for intraspecies variability and an uncertainty factor of 5 for use of a LOAEL were applied. WHO: Screening value based on data collected in industrial workers with lung cancer and renal effects (elevated levels of biomarkers of renal function). Cadmium exposure may result in various renal alterations, whether it is absorbed via inhalation or contaminated food. WHO (Thun et al. 1991, Kjellstrom 1986; as cited in WHO 2000) indicated that the lowest estimate of the cumulative exposure to airborne cadmium in industrial workers leading to an increased risk of renal dysfunction (low-molecular-weight proteinuria) or lung cancer was 100 µg/m ³ -year for an 8 hour exposure, and this was extrapolated to a continuous lifetime exposure estimate of 0.3 µg/m ³ . WHO (2000) indicated that existing levels of cadmium in the air of most urban or industrial areas are around one-fiftieth of this value. The screening value was derived to prevent a further increase of cadmium in agricultural soils, which is likely to increase exposure to future generations through dietary intake. US EPA: Screening value derived from a Cal OEHHA REL. The US EPA applies a residential scenario exposure factor to derive the screening level. Cal OEHHA: Screening value based on kidney and respiratory system effects in an occupational study (Lauwerys et al., 1974; as cited in Cal OEHHA 2008b). A LOAEL of 21 µg/m ³ and a NOAEL of 1.4 µg/m ³ were identified. Cal OEHHA derived an average occupational exposure concentration of 0.5 µg/m ³ and assumed exposure occurred 5 days per week, 8 hours per day with an average exposure duration of 4.1 years. The NOAEL was converted to an average occupational exposure of 0.5 µg/m ³ and an uncertainty factor of 30 (3 for use of a subchronic study and 10 for intraspecies uncertainty) was applied. TCEQ: Screening value based on kidney effects in humans (TCEQ 2016). A meta-analysis of multiple studies in humans identified beta2-microglobulin proteinuria as a critical effect. A PODHEC for urine of 0.5 µg cadmium/g creatinine based upon a 10% increase in the critical effect was adjusted to a POD _{HEC} for air of 0.1 µg cadmium/m ³ using a pharmacokinetic model (ATSDR 2012; as cited in TCEQ 2016). A total uncertainty factor of 9 was used which was comprised of 3 for interspecies sensitivity (i.e., protection of diabetics) and 3 for database uncertainty to derive an AMCV value of 0.011 µg/m ³ based on HQ=1, which is also selected as the ReV.	MECP- MECP value was selected as it is the only available criterion.
		C	-	-	-	0.016 (0.0016)	0.0024	-	-	-	0.02	US EPA: Screening value based on an IUR of 0.0018 per µg/m ³ for lung, trachea and bronchial cancer deaths in occupational exposure studies (Thun et al. 1985; as cited in US EPA 1987b). An incremental lifetime cancer risk of 1 in 100,000 was used to convert the IUR to a risk-based concentration of 0.0056 µg/m ³ . The US EPA applies a residential scenario exposure factor to derive the screening level. Cal OEHHA: Screening value based on human occupational exposure lung cancer data; an IUR of 0.0042 per µg/m ³ was derived and an incremental lifetime cancer risk of 1 in 100,000 was used to convert the IUR to a screening value (Charest-Tardif et al. 2006; as cited in Cal OEHHA 2009). TCEQ: The screening value is based upon an IUR of 0.000487 per µg/m ³ considering background lung cancer mortality rates in cadmium smelter workers adjusted for co-exposure to arsenic, worker health and ethnicity (Park et al., 2012; as cited in TCEQ 2016). The screening value was derived using an incremental lifetime cancer risk of 1 in 100,000 to adjust the IUR, and selected as the ESL.

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion	
			MECP (2020, 2023) AAQC/ACB ^(d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS ^{(a), (b)}	CalOEHHA (2025) REL ^(c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV ^(e)			
Calcium	7440-70-2	NC	-	-	-	-	-	-	-	-	An annual screening value is not available for calcium.	Parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. Not further evaluated for the 24-hour averaging period.
Calcium Oxide	1305-78-8	NC	-	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim ESL, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only available criterion. Note that in the absence of annual predicted air concentrations, chronic inhalation exposure to copper sulphate is assessed via copper.
Chromium (total)	7440-47-3	NC	-	-	-	-	-	-	-	0.14	TCEQ: Screening value based on a study where rats were exposed to 0, 17, 54, or 168 mg/m ³ chronic sulphate particulate for 6 hours/day, 5 days/week for 13 weeks (Derelanko et al. 1999; as cited in TCEQ 2013a). The critical effects were increased total lung and trachea weight relative to body weight in male and female rats. The benchmark concentration lower confidence limit corresponding to a 10% increase in effect (BMCL10) was 3.45 mg/m ³ . The BMCL10 was adjusted for continuous exposure (6 hours/24-hours and 5 days/7 days) and a regional deposition dose ratio (of 1.31, resulting in a point of departure [human equivalent concentration]) (PODHEC) of 0.81 mg/m ³ . An uncertainty factor of 1000 for interspecies variability (3), intraspecies variability (10), subchronic duration (10), and database limitations (3) was applied. The value was adjusted for the proportion of trivalent chromium in chromium sulphate (0.171) to derive a chronic ReV value of 0.14 µg/m ³ based on HQ=1.	TCEQ- TCEQ value was selected as it is the only available criterion.
Cobalt	7440-48-4	NC	-	-	-	0.0063	-	-	-	0.063	US EPA: Screening value based on a provisional RfC of 0.006 mg/m ³ based on decreased pulmonary function and respiratory tract irritation in occupationally-exposed workers (Nemery et al., 1992; as cited in US EPA 2008). A NOAEL of 5.3 µg/m ³ was identified and adjusted for continuous exposure (1.9 µg/m ³). An uncertainty factor of 300 (3 for extrapolating from a subchronic to chronic exposure duration, 10 for database insufficiencies and 10 for human variability) was applied to derive a provisional RfC of 0.006 µg/m ³ . The US EPA applies a residential scenario exposure factor to derive the screening level. TCEQ: Screening value based on respiratory irritation and reduced lung function in humans (Nemery et al., 1992; as cited in TCEQ 2017a). A NOAEL of 5.3 µg/m ³ was derived from an occupational study in which exposed workers experienced eye, nose, and throat irritation, cough, and reduced lung function. A dosimetric adjustment for the ventilation rate during an 8 hour day was made to reflect continuous exposure, resulting in a human equivalent concentration point of departure (PODHEC) of 1.89 µg/m ³ . The PODHEC was then adjusted using a total uncertainty factor of 30 (10 for intrahuman variability, 3 for extrapolation from subchronic to chronic exposure duration, and 1 for database uncertainties) to derive the chronic ReV. It is noted that the screening value is also considered to be protective of developmental endpoints.	US EPA- The US EPA and TCEQ derived screening values based on the same principle study; however, US EPA value was selected as the criterion because it is the most conservative (i.e. lowest) value of the two agencies.
		C	-	-	-	0.0031 (0.00031)	-	-	-	0.0017	US EPA: Screening value based on a 2 year rat study where adenoma and carcinoma of the lung was observed. Benchmark dose modelling was used to derive an IUR of 9 per mg/m ³ . The IUR was then used to derive a risk-based concentration of 0.0011 µg/m ³ , based on an incremental lifetime cancer risk of 1 in 100,000 (NTP 1998, Bucher et al. 1999 as cited in US EPA 2008). The US EPA applies a residential scenario exposure factor to derive the screening level. TCEQ: Screening value based on two key studies by the National Toxicology Program (NTP 1998; as cited in TCEQ 2017a). The key studies identified IURs of 0.0091 per µg cobalt/m ³ and 0.003 per µg/m ³ and were associated with an increased incidence of lung adenomas and carcinomas in female rats. The mid-point of the two IURs (i.e., 0.006 per µg/m ³) was selected as the final IUR, and was adjusted to the AMCV and ESL using an incremental lifetime cancer risk level of 1 in 100,000.	US EPA- US EPA value was selected as the screening criterion.
Copper	7440-50-8	NC	-	-	-	-	-	-	-	1	TCEQ: Screening value based on a health endpoint (supporting documentation not available), as particulate matter, and selected as the ESL and AMCV.	TCEQ- TCEQ value selected as it is the only criterion available.
Copper Sulphate	7758-98-7	NC	-	-	-	-	-	-	-	2.5	TCEQ: Screening value based on a health endpoint (supporting documentation not available), as particulate matter, selected as the ESL and AMCV.	TCEQ- TCEQ value selected as it is the only criterion available.
Iron	7439-89-6	NC	-	-	-	-	-	-	-	"Must Meet NAAQS"	TCEQ: No value specific to iron. "Must Meet NAAQS" indicates that, for species of limited concern, the determination of the individual species impacts are not required if a NAAQS analysis is completed for particulate matter of 2.5 and 10 microns or less (PM _{2.5} and PM ₁₀).	Iron is assessed indirectly using particulate matter as a surrogate.
Lead	7439-92-1	NC	-	-	0.5	0.15	-	-	-	"Must Meet NAAQS"	WHO: Screening value based on preventing blood lead levels exceeding 100 µg/L in order to protect 98% of the population including children (WHO 2000). Various international expert groups have determined that the earliest signs of adverse effects of lead in young children begin at 100 to 150 µg/L in blood. It also appears that 1 µg/m ³ of lead in air directly contributes approximately 19 µg/L of lead in blood in children and 16 µg/L in adults. US NAAQS: Screening value is a rolling 3-month average based on neurological effects (decrease of less than 2 IQ points) in children, and the potential for cardiovascular and renal effects in adults (US EPA 2016). An air concentration of less than 0.15 µg/m ³ of lead would correspond to a blood lead concentration of approximately 1 µg/dL which leads to less than a 2 IQ point decrease in American children based on an air-to-blood ratio of 1:7. TCEQ: No value specific to lead. "Must Meet NAAQS" indicates that, for species of limited concern, the determination of the individual species impacts are not required if a NAAQS analysis is completed for particulate matter of 2.5 and 10 microns or less (PM _{2.5} and PM ₁₀).	US EPA- US EPA value was selected is the most recent study and the most conservative criterion.
Magnesium	7439-95-4	NC	-	-	-	-	-	-	-	4	Magnesium oxide used as a surrogate in the absence of inhalation screening criteria for magnesium. TCEQ: Screening value for magnesium oxide based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value for magnesium oxide selected as a surrogate criterion for magnesium because it is the only annual criterion available.

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
			MECP (2020, 2023) AAQC/ACB (d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS (a), (b)	CalOEHHA (2025) REL (c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV (e)		
Manganese	7439-96-5	NC	-	-	0.15	0.052	0.09	-	0.84	<p>WHO: Screening value based on neurotoxic effects observed in occupationally-exposed workers and the BMCL corresponding to a 5% incidence of effect (BMCL₅) of 30 µg/m³ was selected as the NOAEL (Roels et al. 1992; as cited in WHO 2000). The screening value was derived using a benchmark approach and by dividing by the NOAEL a factor of 4.2 for continuous exposure and an uncertainty factor of 50 (10 for interindividual variation and 5 for developmental effects in younger children).</p> <p>US EPA: Screening value based on a RfC of 0.05 µg/m³ for impairment of neurobehavioural function in occupationally-exposed workers (Roels et al. 1987; as cited in US EPA 1988). A NOAEL was not available because a single geometric mean exposure concentration was calculated for this cross-sectional study and effects were observed in workers who had been exposed. The LOAEL was 150 µg/m³ and the LOAEL adjusted for a human equivalent concentration (LOAEL_{HEC}) was 50 µg/m³. An uncertainty factor of 1,000 (10 to protect sensitive individuals, 10 for using a LOAEL and 10 for database limitations) was applied. The US EPA applies a residential scenario exposure factor to derive the screening level.</p> <p>Cal OEHHA: Screening value based on impairment of neurobehavioral function in humans (occupational study) for manganese and compounds. A benchmark concentration lower confidence limit corresponding to a 5% response (BMCL05) of 72 µg/m³ was obtained and adjusted for continuous exposure, resulting in a value of 26 µg/m³ (Roels et al. 1992; as cited in Cal OEHHA 2014). An uncertainty factor of 300 (3 for extrapolation from subchronic to chronic exposure duration, 100 for intraspecies differences [10 for adults to children and 10 for the more sensitive developing brains of newborns and infant children]) was used to derive the REL.</p> <p>TCEQ: Screening value based on the same key study as ATSDR, using the same point of departure of 142 µg/m³, an uncertainty factor of 60 was applied (10 for intrahuman variability and 6 for database uncertainties) to derive the AMCV, based on an HQ=1. ATSDR study details: Screening value for respirable manganese based on abnormal performances in eye-hand coordination in an occupational study (Roels et al. 1992; as cited in ATSDR 2012a). The exposure was determined for each employee based on their jobs and the length of time they had worked at the factory. On average, workers were exposed for an average of 5.3 years to an average concentration of respirable manganese of 0.25 mg/m³. The benchmark concentration lower confidence limit corresponding to a 10% incidence of effect (BMCL10) of 142 µg/m³ derived from a logistic model was adjusted for continuous exposure and then an uncertainty factor of 100 was applied (10 for human variability and 10 for database limitations), with the adjusted value selected as the ESL and AMCV.</p>	CalOEHHA- The CalOEHHA value was selected as it is based on a more recent evaluation and is the lower criterion from the secondary sources that use a benchmark approach.
Mercury	7439-97-6	NC	-	-	1	0.31	0.03	-	0.025	<p>WHO: Screening value based on the LOAELs for mercury vapour (15 to 30 µg/m³, tremors, renal tubular effects, and changes in plasma enzymes) and applying an uncertainty factor of 20 (10 for uncertainty in variable sensitivities in higher risk populations and 2 for extrapolating from LOAEL to NOAEL).</p> <p>US EPA: Screening value based on a RfC of 0.0003 mg/m³ for hand tremors, increases in memory disturbance and central nervous system effects in occupational workers (Fawer et al. 1983; as cited in US EPA 1995). A NOAEL was not observed in this study as a single mean concentration was calculated from personal air monitors of workers and effects were identified in workers. A LOAEL of 0.025 mg/m³ was calculated as a time weighted average and adjusted using occupational ventilation rates and workweek hours to a LOAEL of 0.009 mg/m³. An uncertainty factor of 30 (10 to protect sensitive individuals and 3 for a lack of a database) was used. The US EPA applies a residential scenario exposure factor to derive the screening level.</p> <p>Cal OEHHA: Screening value based on neurotoxicity as measured by tremor, memory and sleep disturbances, decreased performance on neurobehavioural tests and decreased electroencephalography activity in occupational studies (Piihvi and Hanninen 1989; as cited in Cal OEHHA 2014). Humans were exposed to mercury for 8 hours/day, 5 days/week for 13.7 to 15.6 years. A NOAEL was not observed as only a single exposure concentration was assessed and effects were seen at this level. A LOAEL of 0.025 mg/m³ was adjusted for continuous exposure (0.009 mg/m³) and an uncertainty factor of 300 (10 for neurotoxicity being a moderate to severe effect, 3 to reflect interindividual variability and 10 for the higher susceptibility of the developing nervous system) was applied to derive the screening value.</p> <p>TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), mercury inorganic compounds as particulate matter, and selected as the ESL.</p>	CalOEHHA- CalOEHHA value was selected as it is the lower criterion from secondary sources with supporting information.
Molybdenum	7439-98-7	NC	-	-	-	2.1	-	-	4.5	<p>US EPA: Screening value based on the chronic RfC of 0.002 mg/m³ based on respiratory effects, and squamous metaplasia of epiglottis in female rates (NTP 1997; as cited in ATSDR 2020). The US EPA applies a residential scenario exposure factor to derive the screening level.</p> <p>TCEQ: Screening value based on an inhalation study where rats were exposed to molybdenum trioxide for 6 hours per day, 5 days per week for 2 weeks (National Toxicological Program 1997, as cited in TCEQ 2021c). The critical effect was decreased body weight with a POD NOAEL of 30 mg/m³. The LOAEL was adjusted to a 1-hour exposure duration and a HEC for a POD of 41.8 mg/m³. Uncertainty factors for intrahuman variability (10), 3 to account for potential toxicodynamic differences between rats and humans and 6 for a limited database were applied to derive a reference value of 230 µg/m³ molybdenum trioxide or 150 µg/m³ for molybdenum, based on a HQ=1, selected as the 1-hour ReV. The chronic ReV and AMCV values were selected as 10% of the 1-hour ReV.</p>	US EPA- The US EPA value was selected as it is the lower criterion from secondary sources with supporting information
Nickel	7440-02-0	NC	0.02 (PM ₁₀) 0.04 (SPM)	-	-	0.015, 0.094, 0.021	0.014	-	0.23	<p>MECP: Screening values are based on health effects and were calculated using an annual averaging period. The screening value of 0.04 µg/m³ is based on nickel in TSP assuming that approximately 50% of ambient TSP is made up of PM₁₀ and is considered protective of both carcinogenic and non-carcinogenic effects of nickel and nickel compounds (MECP 2011a,f). The screening value of 0.02 µg/m³ is based on nickel in the PM₁₀ size fraction and is considered protective of both carcinogenic and non-carcinogenic effects of nickel and nickel compounds (MECP 2011a,f). The MECP considers that the carcinogenic effects are of a greater potency than non-carcinogenic effects. Although the non-carcinogenic critical effects of the various nickel compounds were reviewed by the MECP, their potencies were not discussed in detail.</p> <p>US EPA: For nickel refinery dust and nickel subsulphide (RSL of 0.015 µg/m³), the screening value is based on a Cal OEHHA REL of 0.014 µg/m³ (see below). A residential scenario exposure factor was applied by US EPA to derive a screening level. For nickel soluble salts (RSL of 0.094 µg/m³), the screening value is based on a chronic ATSDR minimal risk level of 0.09 µg/m³. Supporting documentation for the ATSDR study are temporarily unavailable, with the ATSDR indicating "Disclaimer: ATSDR has temporarily removed the Nickel Tox Profile and associated documents while we evaluate some calculations. We apologize for any inconvenience." US EPA applied a residential scenario exposure factor to the ATSDR minimal risk level to derive a screening level.</p> <p>For nickel oxide (RSL of 0.021 µg/m³), the screening value is based on a Cal OEHHA REL derivation for nickel oxide (see below). Health effects (active pulmonary inflammation and alveolar proteinosis) were observed in mice following exposure to nickel oxide for 6 hours/day, 5 days/week for 104 weeks. A BMCL05 of 117 µg/m³ was obtained and adjusted for continuous exposure, resulting in a value of 20.9 µg/m³. This value was then adjusted to a HEC of 2.0 µg/m³. An uncertainty factor of 100 (3 for interspecies variability and 30 for intraspecies variability) was applied to derive an inhalation REL of 0.02 µg/m³. A residential scenario exposure factor was applied by US EPA to derive a screening level.</p> <p>Cal OEHHA: Screening value based on pathological changes in lung, lymph nodes and nasal epithelium in rats exposed to nickel and nickel compounds (except nickel oxide) for 6 hours/day, 5 days/week for 104 weeks (Benson et al. 1987; as cited in Cal OEHHA 2012). The benchmark dose level corresponding to a 5% response level (BMDL05) was 30.5 µg/m³ and the human equivalent concentration (BMDLHEC05) was 1.4 µg/m³. An uncertainty factor of 100 (3 for interspecies differences and 30 for intraspecies differences) was applied.</p> <p>TCEQ: Screening value based on chronic active lung inflammation and associated lesions in rats exposed to nickel sulphate hexahydrate for 6 hours/day, 5 days/week for 2 years (NTP 1996c; as cited in TCEQ 2017c). The NOAEL/POD was 0.03 mg nickel/m³, the POD adjusted for continuous exposure was 5.357 µg/m³ and the HEC was 7.034 µg/m³. An uncertainty factor of 30 (3 for interspecies variability and 10 for intraspecies variability) was applied to derive the ReV, based on HQ=1.</p>	MECP- MECP values were selected as they are the only

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Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
			MECP (2020, 2023) AAQC/ACB ^(d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS ^{(a), (b)}	CalOEHHA (2025) REL ^(c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV ^(e)		
Nickel	7440-02-0	C	0.02 (PM10) 0.04 (Total Suspended Particulate)	-	0.025	0.12, 0.11, 0.058	0.038	-	0.059	MECP: Screening values are based on health effects and were calculated using an annual averaging period. The screening value of 0.04 µg/m ³ is based on nickel in TSP assuming that approximately 50% of ambient TSP is made up of PM10 and is considered protective of both carcinogenic and non-carcinogenic effects of nickel and nickel compounds (MECP 2011a). The screening value of 0.02 µg/m ³ is based on nickel in the PM ₁₀ size fraction and is considered protective of both carcinogenic and non-carcinogenic effects of nickel and nickel compounds (MECP 2011a). The MECP considers that the carcinogenic effects are of a greater potency than non-carcinogenic effects. Although the non-carcinogenic critical effects of the various nickel compounds were reviewed by the MECP, their potencies were not discussed in detail.	MECP- MECP criteria selected as they are the only available.
										US EPA: Screening value for nickel refinery dust (RSL of 0.12 µg/m ³) is based on an IUR of 0.00024 per µg/m ³ which was derived from several epidemiological studies (excess lung cancer mortality in four studies of nickel refinery workers) (Enterline and Marsh 1982, Chovil et al. 1981, Peto et al. 1984, Magnus et al. 1982; as cited in US EPA 1987a). The risk-based concentration for a cancer risk of 1 in 100,000 is 0.042 µg/m ³ . A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. Screening value for nickel soluble salts (RSL of 0.11 µg/m ³) is based on an IUR of 0.00026 per µg/m ³ from Cal OEHHA (see below). A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level. Screening value for nickel subsulphide (RSL of 0.058 µg/m ³) is based on an IUR of 0.00048 per µg/m ³ , which was based on excess lung cancer mortality observed in four (4) studies of workers exposed to nickel compounds (Enterline and Marsh 1982, Chovil et al. 1981, Peto et al. 1984, Magnus et al. 1982; as cited in US EPA 1987a). The IUR was the incremental unit risk estimate of nickel refinery dust (2.4 x 10 ⁴ per µg/m ³) used with a multiplication factor of 2.0 to account for a nickel subsulphide composition of about 50% in the refinery dust. The risk-based concentration for a cancer risk of 1 in 100,000 is 0.021 µg/m ³ . A residential scenario exposure factor was applied to the risk-based concentration to derive the screening level.	
										WHO: Screening value based on an IUR of 0.00038 µg/m ³ for 1 µg/m ³ of nickel in the air, based on lung cancer incidences in exposed human workers. The concentration corresponding to an incremental lifetime risk of 1 in 100,000 is 0.025 µg/m ³ (Andersen 1992, Andersen et al. 1996; as cited in WHO 2000).	
										Cal OEHHA: Screening value based on an inhalation unit risk (IUR) of 0.00026 per µg/m ³ and an incremental lifetime cancer risk of 1 in 100,000 (Chovil et al. 1981, Roberts et al. 1984, Muir et al. 1985; as cited in Cal OEHHA 2011). The IUR is calculated from Ontario nickel refinery worker lung cancer mortality data.	
										TCEQ: Screening level based on lung cancer in workers exposed to various forms of nickel in air (Grimsrud et al. 2003; and Enterline and Marsh 1983; as cited in TCEQ 2017c). An IUR of 0.00017 per µg/m ³ was used to derive the AMCV, based on an incremental lifetime risk of 1 in 100,000. This value was adopted as the chronic ESL and AMCV.	
Phosphorus	7223-14-0	NC	-	-	-	-	-	-	0.1	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter applicable to red and white phosphorus, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Potassium	7440-09-07	NC	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Selenium	7782-49-2	NC	-	-	-	21	20	-	0.2	US EPA: Screening value based on the REL from Cal OEHHA (see below). The US EPA applies a residential scenario exposure factor to derive the screening level.	CalOEHHA- CalOEHHA value was selected as it is the lower criterion available from secondary sources with supporting information.
										Cal OEHHA: Screening value based on environmental exposure of selenium (in soil and food supplies) to people in China over a lifetime in their diets (as selenium subsulphide) (Kuper et al. 1988; as cited in Cal OEHHA 2008c). Health effects were clinical selenosis (liver, blood, skin and central nervous system). The LOAEL was 0.023 mg/kg/day and the NOAEL was 0.015 mg/kg/day. The inhalation chronic REL is based on the oral chronic REL and an inhalation extrapolation factor of 3,500 µg/m ³ per mg/kg/day. An uncertainty factor of 3 to account for intraspecies differences was applied. One of the assumptions of route-to-route extrapolation assumes that a parameter is equally absorbed by both oral and inhalation routes; Cal OEHHA indicated that the available data are not adequate to depart from the default assumption of equal absorption across the lungs and gastrointestinal tract.	
										TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL and AMCV.	
Silver	7440-22-4	NC	-	-	-	-	-	-	0.01	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected to the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Strontium	7440-24-6	NC	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Sulphur	7704-34-9	NC	-	-	-	-	-	-	5	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Thallium	7440-28-0	NC	-	-	-	-	-	-	0.1	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Thorium	7440-29-1	NC	-	-	-	-	-	-	-	An annual screening value is not available for thorium.	Parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. Not further evaluated for the annual averaging period.
Tin	7440-31-5	NC	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), tin inorganic compounds as particulate matter, and selected as the ESL and AMCV.	TCEQ- TCEQ value was selected as it is the only criterion available.
Titanium	7440-32-6	NC	-	-	-	-	-	-	5	TCEQ: Screening value based on a health endpoint (interim, supporting documentation not available), titanium (IV) dioxide as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.
Tungsten	7440-33-7	NC	-	-	-	-	-	-	5	TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), tungsten insoluble compounds as particulate matter, and selected as the ESL.	TCEQ- TCEQ value was selected as it is the only criterion available.

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion	
			MECP (2020, 2023) AAQC/ACB ^(d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS ^{(a), (b)}	CalOEHHA (2025) REL ^(c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV ^(e)			
Uranium	7440-61-1	NC	0.03 (PM ₁₀) 0.06 (Total Suspended Particulate)	-	-	-	0.042	-	-	0.2	MECP: Screening value based on kidney effects in an epidemiological study of uranium exposure in drinking water. The MECP selected the kidney uranium reference concentration 0.1 µg/g kidney, which was derived using a biokinetic model (United Kingdom's Royal Society 2001a; Zamora et al. 1988; as cited in MECP 2011g). The MECP allocated 10% of the kidney reference concentration to inhalation exposure for a typical Ontario resident and accounted for the solubility and absorption rates of three major classes of uranium compounds (slow, medium, and fast-absorbing uranium forms). The MECP calculated the daily inhalation intake of uranium that would remain below 10% of the kidney reference concentration, and then converted the daily inhalation intake to an air concentration assuming that an adult inhales approximately 20 m ³ of air per day. The MECP set the annual criteria based on a 50:50 ratio of Type-F (fast-absorbing uranium) and Type M (medium-absorbing uranium) compounds in ambient air. The MECP annual-averaging value is also based on the PM ₁₀ fraction, which is conservative because particle sizes greater than 10 µm are not readily inhaled (MECP 2011g).	MECP- MECP values were selected as they are the only available criteria from primary sources.
											US EPA: Screening value based on ATSDR minimal risk level. Screening value for soluble forms of uranium (0.04 µg/m ³) is based on renal tubular atrophy in dogs exposed to uranium tetrachloride for 33 hours/week for 1 year (Stokinger et al., 1953; as cited in ATSDR 2013). The BMCL10 was 0.019 mg/m ³ and adjusted for continuous exposure (multiplied by 33/168 hours = 0.0037 mg/m ³) and an uncertainty factor of 100 (10 for extrapolating from animals to humans and 10 for human variability) was applied to give 0.04 µg/m ³ as the screening value for soluble uranium. Screening value for insoluble uranium (0.8 µg/m ³) based on fibrosis in the lungs and tracheobronchial lymph nodes in monkeys exposed to insoluble forms of uranium for 5.4 hours/day, 5 days/week for 5 years (ATSDR 2013). The LOAEL (5.1 mg/m ³) was adjusted for intermittent exposure (5.1 mg/m ³ x 5.4 hours/24-hour x 5 days/7 days) and an uncertainty factor of 1,000 (10 for using a LOAEL, 10 for extrapolating from animals to humans and 10 for human variability) was applied to give 0.8 µg/m ³ as the screening value for insoluble uranium. The US EPA applies a residential scenario exposure factor to derive the screening level.	
											TCEQ: Screening value based on a health endpoint (interim value, supporting documentation not available), as particulate matter, and selected as the ESL.	
Vanadium	7440-62-2	NC	-	-	-	-	0.1	-	-	0.066	US EPA: Screening value based on degeneration of respiratory epithelium of the epiglottis in mice exposed to vanadium pentoxide for 6 hours/day, 5 days/week for 104 weeks (NTP 2002; as cited in ATSDR 2012b). The BMCL10[HEC] of 0.003 mg/m ³ was used and an uncertainty factor of 30 (3 for extrapolating from animals to humans and 10 for human variability) was applied to calculate 0.1 µg/m ³ as the screening value for vanadium pentoxide.	US EPA- US EPA value based on vanadium pentoxide is selected as it is based on a more recent study with supporting documentation.
											TCEQ: Interim screening value based on an inhalation study where human subjects (n=9) were exposed to vanadium pentoxide dust for 8 hours (Zenz & Berg 1967, as cited in TCEQ 2021e). A NOAEL of 0.1 mg/m ³ for respiratory irritation was observed, which was adjusted to a 1-hour exposure duration by TCEQ to derive a PODADJ of 0.2 mg/m ³ . Uncertainty factors for intrahuman variability (10) and database uncertainty (6) were then applied to derive a reference value of 3.3 µg/m ³ for vanadium pentoxide or 2.2 µg/m ³ for vanadium, based on HQ=1, which was selected by the TCEQ as the 1-hour ReV and AMCV. The 1-hour ReV was multiplied by an HQ of 0.3 to derive a 1-hour ESL of 0.66 µg/m ³ for vanadium, which was multiplied by 10% to derive a long-term ESL and AMCV of 0.066 µg/m ³ for vanadium.	
Yttrium	7440-65-5	NC	-	-	-	-	-	-	-	1	TCEQ: Screening value based on OELs from NIOSH, OSHA (TLVs). The selected OEL of 1000 µg/m ³ , as particulate matter, was modified by an uncertainty factor of 1000x and selected as the ESL (interim, supporting documentation is not available, based on email communication with TCEQ).	TCEQ- TCEQ value was selected as it is the only criterion available.
Zinc	7440-66-6	NC	-	-	-	-	-	-	-	2	TCEQ: Screening value based on a health endpoint, selected as ESL and AMCV (interim, supporting documentation not available).	TCEQ- TCEQ value was selected as it is the only criterion available.
Zirconium	7440-67-7	NC	-	-	-	-	-	-	-	5	TCEQ: Screening value based on OELs from NIOSH, OSHA (TLVs). The selected OEL of 5000 µg/m ³ , as particulate matter, was modified by an uncertainty factor of 1000x and selected as the ESL (interim, supporting documentation is not available, based on email communication with TCEQ).	TCEQ- TCEQ value was selected as it is the only criterion available.
Polycyclic Aromatic Hydrocarbons (PAHs)												
Benzo(a)pyrene	50-32-8	NC	-	-	-	-	0.0021	-	-	-	US EPA: Screening value was calculated from a RfC of 0.000002 mg/m ³ based on developmental toxicity in rats exposed to 25, 75 and 100 µg/m ³ of benzo(a)pyrene for 4 hours daily for 10 days. A LOAEL of 25 µg/m ³ for decreased embryo/fetal survival was selected as the POD and adjusted to account for discontinuous exposure (PODADJ) and then adjusted to HEC resulting in a PODHEC of 4.6 µg/m ³ . An uncertainty factor of 3000 (3 for extrapolating from animals to humans, 10 for interindividual variability, 10 for extrapolating from subchronic to chronic exposure, and 10 for database limitations) was applied (US EPA, 2017). The US EPA applies a residential scenario exposure factor to derive the screening level.	US EPA- US EPA value selected as it is the only available criterion.
											MECP: Annual AAQC based on carcinogenic potential endpoint from an evaluation of coke-oven worker epidemiological studies by the WHO which derived an IUR value of 8.7x10 ⁻⁵ per ng/m ³ for benzo(a)pyrene, equivalent to 0.1 ng/m ³ of benzo(a)pyrene at a risk level of 1 in 100,000. Screening value for benzo(a)pyrene as a surrogate for total PAHs (Mazumdar et al., 1975; as cited in MECP, 2011h).	
											WHO: Based on epidemiological data from studies on coke-oven workers exposed to a mixture of PAHs, an IUR for benzo(a)pyrene as an indicator in air constituent was determined to be 8.7 x 10 ⁻⁵ per ng/m ³ . The corresponding concentrations of benzo(a)pyrene producing an incremental lifetime cancer risk of 1 in 100,000 is 0.12 ng/m ³ (WHO 2000).	
											US EPA: Screening value based on incidence of upper respiratory tract and upper digestive tract tumors in male hamsters exposed to benzo(a)pyrene for a lifetime (Thyssen et al. 1981; as cited in US EPA 2017). The inhalation unit risk was derived using linear extrapolation from a benchmark concentration level of 0.16 mg/m ³ . The screening level of 0.0017 µg/m ³ is based on a target ILCR of 1E-06. This value was multiplied by 10 to align with the target ILCR of 1E-05 for this assessment (0.017 µg/m ³).	
											Cal OEHHA: Screening level based on respiratory tract tumors in hamsters. A linearized multistage model was fit to the respiratory tract tumor data resulting from inhalation exposure of hamsters to benzo(a)pyrene (Thyssen et al. 1981; as cited in Cal OEHHA 2009). A human equivalent IUR of 0.0011 per µg/m ³ based on a risk level of 1 in 100,000 was derived by dividing 1 x 10 ⁻⁶ by the IUR, then multiplying by 10 (US EPA/IRIS 1996; as cited in Cal OEHHA 2009).	
TCEQ: Screening value based on a health endpoint (interim, limited supporting documentation available), as particulate matter. Derived from US EPA IRIS IUR of 6 x10 ⁻⁴ per µg/m ³ and a 1 in 100,000 ILCR (TCEQ 2017b), selected as the ESL.												

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
			MECP (2020, 2023) AAQC/ACB (d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS (a), (b)	CalOEHHA (2025) REL (c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV (e)		
Volatile Organic Compounds (VOCs)											
1,3-Butadiene	106-99-0	NC	-	-	-	2.1	2	-	33	<p>US EPA: Screening value based on a RfC of 0.002 mg/m³ based on ovarian atrophy in a 2-year mouse inhalation study (NTP 1993; as cited in US EPA 2002). Mice were exposed to 0, 14, 44, 138, 442 or 1383 mg/m³ 1,3-butadiene for 6 hours/day, 5 days/week up to 103 weeks. The exposure concentrations were adjusted for continuous exposure (6 hours/24-hours and 5 days/7 days). The BMCL10 was determined to be 1.98 mg/m³ (0.88 ppm). The 1,383 mg/m³ group was not considered in the derivation of the BMCL10 due to high incidence of early mortality. An uncertainty factor of 1,000 (3 for interspecies extrapolation, 10 for intraspecies variability, 3 for database limitations and 10 for extrapolation to a level below the 10% effect level [analogous to the LOAEL to NOAEL extrapolation]) was applied to derive an RfC of 0.002 mg/m³. The US EPA applies a residential scenario exposure factor to derive the screening level.</p> <p>Cal OEHHA: Screening value based on an increased incidence of ovarian atrophy in mice exposed through inhalation for 6 hours/day, 5 days/week for 9 to 24 months (NTP 1993; as cited in Cal OEHHA 2014). The BMCL05 was 1.01 ppm (2.23 mg/m³) and adjusted for continuous exposure and to a HEC (0.302 ppm or 0.67 mg/m³). An uncertainty factor of 300 (10 for interspecies toxicodynamic differences, 10 for intraspecies toxicokinetic differences and 3 for intraspecies toxicodynamic differences) was applied to derive a chronic REL of 0.002 mg/m³.</p> <p>TCEQ: Screening value based on ovarian atrophy in female mice exposed for 6 hours/day, 5 days/week for 2 years (NTP 1993; as cited in TCEQ 2015a). The BMCL05 was 0.462 ppm (1.02 mg/m³) and was not adjusted for a HEC. An uncertainty factor of 30 (10 for intraspecies variability and 3 for database uncertainty) was applied. Selected as a chronic ReV where target HQ=1.</p>	<p>US EPA- The US EPA and CalOEHHA derived screening values based on the same principle study. The US EPA value was selected as the screening criterion as it is a similar value to CalOEHHA.</p>
		C	20 (2)	-	-	0.94 (0.094)	0.059	-	20	<p>MECP: Screening value based on carcinogenic effects. Screening value based on an IUR estimate from TCEQ that was based on a cancer studies in occupationally exposed workers (Delzell et al. 1995; Macaluso et al. 2004, Sathikumar et al. 2005, Graff et al. 2005, HEI 2006; as cited in MECP 2011b). The screening value of 2 µg/m³ was derived using the TCEQ IUR of 5 x 10⁻⁷ per µg/m³ and an incremental lifetime cancer risk level of 1 in 1,000,000. The screening value was adjusted for this assessment by 10 to account for a cancer risk of 1 in 100,000.</p> <p>US EPA: Screening value based on an IUR of 3 x 10⁻⁵ per µg/m³ based on leukemia incidence in occupationally exposed workers (Delzell et al. 1995, 1996; as cited in US EPA 2002). An air concentration of 0.3 µg/m³ was determined for a risk level of 1 in 100,000. The US EPA applies a residential scenario exposure factor to derive the screening level.</p> <p>Cal OEHHA: Screening level based on an IUR of 1.7 x 10⁻⁴ per µg/m³ calculated from lung alveolar and bronchiolar neoplasms in female mice using a linearized multistage procedure (Melnick et al. 1990; as cited in Cal OEHHA 2011). Mice were exposed to a concentration of 0, 6.25, 20, 62.5, 200 or 625 ppm 1,3-butadiene for 6 hours/day, 5 days/week for 40 or 65 weeks. An incremental lifetime cancer risk of 1 in 100,000 was used to calculate the screening value.</p> <p>TCEQ: Screening value based on incidence of leukemia in an occupational study (Delzell et al. 1995; Macaluso et al. 2004, Sathikumar et al. 2005, Graff et al. 2005, HEI 2006; as cited in TCEQ 2015a). An IUR of 5 x 10⁻⁷ per µg/m³ and an incremental lifetime cancer risk of 1 in 100,000 were used to derive the screening value, selected as the ESL and AMCV.</p>	
Benzene	71-43-2	NC	-	-	-	31.3	3	-	280	<p>US EPA: Screening values is based on based on benchmark dose modeling of the absolute lymphocyte count data from an epidemiological occupational study of workers exposed to benzene through inhalation (Rothman et al. 1996; as cited in US EPA 2003c). Included a cross-sectional study of 44 workers exposed to a range of benzene concentrations and 44 age- and gender- matched unexposed controls. Mean occupational exposure to benzene was 6.3 with a range of 0.7-16 years. The BMCL was 8.2 mg/m³ based on decreased lymphocyte count and an uncertainty factor of 300 was applied (3 for effect-level extrapolation, 10 for intraspecies differences (human variability), 3 for subchronic-to-chronic extrapolation, and 3 for database deficiencies).</p> <p>Cal OEHHA: Screening value based on occupational exposure study with male and female workers exposed for an average of 8 hr/day, 6 days/week, for 6.1 ± 2.1 years (Lan et al. 2004; as cited in Cal OEHHA 2008a). A BMCL of 0.476 ppm was derived based on decreased peripheral blood cell counts. The BMCL was adjusted for continuous exposure and an uncertainty factor of 200 was applied (3 for subchronic to chronic extrapolation and 60 for intraspecies variability).</p> <p>TCEQ: Screening value based on decreased lymphocyte count in 44 benzene-exposed workers exposed for 5 days/week for a mean of 6.3 years (Rothman et al. 1996; as cited in TCEQ 2015b). The BMCL was 7.2 ppm (23 mg/m³) and extrapolated to continuous exposure (2.6 ppm or 8.3 mg/m³). An uncertainty factor of 30 (10 for intraspecies variability and 3 for database limitations) was applied. Selected as a chronic ReV where target HQ=1.</p>	<p>Cal OEHHA - The Cal OEHHA value was selected as it was more current study and is the lowest criterion available.</p>
	71-43-2	C	4.5 (0.45)	-	1.7	3.6 (0.36)	0.34	-	4.5	<p>MECP: Screening value based on increased incidence of cancer death in occupationally exposed male workers exposed for 8 hours/day, 250 days/year in a Pliofilm plant. An IUR of 2.2x10⁻⁶ per µg/m³ was determined. MECP reviewed the US EPA proposed a range of IURs from 2.2x10⁻⁶ to 7.8x10⁻⁶ per µg/m³. The lower end of this range was based on the Paustenbach et al. (1992; as cited in MECP 2011c) exposure estimates and the higher end was based on the Crump (1994; as cited in MECP 2011c) exposure estimates. Both approaches are based on the Pliofilm study but MECP preferred the Paustenbach exposure matrix because it includes additional observations. Hence, the lower unit risk of 2.2x10⁻⁶ per µg/m³ was selected which corresponds to a concentration of 0.45 µg/m³. The screening value was adjusted for this assessment by 10 to account for a cancer risk of 1 in 100,000.</p> <p>US EPA: Screening value based on an IUR of 7.8 x 10⁻⁶ per µg/m³ for an increased incidence of leukemia in occupationally exposed workers (Crump 1994; as cited in US EPA 2003c). The US EPA applies a residential scenario exposure factor to derive the screening level. Screening level of 0.36 µg/m³ is based on a target ILCR of 1 in 1,000,000 which was adjusted for this assessment to 3.6 based on a target ILCR of 1 in 100,000.</p> <p>WHO: Screening value based on an increase of mortality from leukemia in workers who were occupationally exposed. Screening value based on the geometric mean of the range of estimates of the incremental lifetime cancer risk (IUR = 6 x 10⁻⁶ per µg/m³) of leukemia from the Pliofilm cohort study (Paustenbach et al. 1992; as cited in WHO 2000). The guideline is based on an incremental lifetime cancer risk of 1 in 100,000 (WHO 2000).</p> <p>Cal OEHHA: Screening value based on IUR of 2.9 x 10⁻⁵ per µg/m³, which is based on a risk level of 1 in 1,000,000 and corresponds to the upper 95% confidence bound derived by US EPA for human leukemia incidence data from two occupational studies (Rinsky et al. 1981; as cited in Cal OEHHA 2009). A carcinogenic REL based on a 1 in 100,000 risk levels was calculated by dividing 1 x 10⁻⁶ by the IUR, then multiplying by 10.</p> <p>TCEQ: Screening value based on acute myelogenous and acute monocytic leukemia in occupationally exposed workers and an unite risk factor of is 2.2 x 10⁻⁶ per µg/m³; based on an incremental lifetime cancer risk of 1 in 100,000 (Crump 1994; as cited in TCEQ 2015b). Selected as the ESL and AMCV.</p>	<p>MECP- MECP value was selected as it is the only criterion available.</p>

Table C1-5: Available Inhalation Screening Criteria for the Annual Averaging Period

Parameter	CAS	Carcinogenic Classification	PRIMARY SOURCE		SECONDARY SOURCE					Toxicological Endpoints and Derivations	Rationale for Selected Screening Criterion
			MECP (2020, 2023) AAQC/ACB ^(d)	CCME (2025) CAAQS/ NAAQO	WHO (2000, 2021) AQG	US EPA (2024, 2025) RSL/NAAQS ^{(a), (b)}	CalOEHHA (2025) REL ^(c)	BC ENV (2025) AAQO	TCEQ (2025) ESL/AMCV ^(e)		
Hydrogen Cyanide	74-90-8	NC	-	-	-	0.83	9	-	2	US EPA: Screening value is based on a study by El Ghawabi et al. (1975; as cited in US EPA 2010) which observed workers that were exposed to hydrogen cyanide in the workplace from 5-15 years in an electroplating facility. An occupational exposure of 8 hours per day, 5 days a week was assumed. A LOAEL for thyroid enlargement and altered iodide uptake was observed at 7.07 mg/m ³ , which was adjusted for daily exposure using default occupational ventilation rates (10 m ³ /8 hour day) and for continuous exposure using default ventilation rate for ambient exposure (20 m ³ /24 hour day). The LOAEL was adjusted for continuous exposure to a LOAELADJ of 2.5 mg/m ³ . A total uncertainty factor of 3000 was applied (1 for interspecies variation, 10 for intraspecies variation, 10 for extrapolating from a LOAEL to a NOAEL, 3 for subchronic to chronic extrapolation, 10 for database deficiencies).	US EPA- US EPA value was selected as it is a more conservative value.
										Cal OEHHA: Screening value is based on the same study as the US EPA RSL. However, a total uncertainty factor of 300 (10 for extrapolation from LOAEL to NOAEL, 3 for subchronic to chronic extrapolation, and 1 for interspecies variation, 10 for intraspecies variation) was applied to the RfC.	
										TCEQ: Screening value based on a health endpoint (interim, supporting documentation not available).	
Other											
Silica, crystalline	7631-86-9	NC	-	-	-	3.1	3	-	2	US EPA RSL/Cal OEHHA REL: Screening value based on occupational silicosis observed in a study by Hnizdo & Sluis-Cremer (1993; as cited in Cal OEHHA 2008a). US EPA adopted the Cal OEHHA (2008a) REL as a resident screening level. Cal OEHHA REL is based on a study that followed 2235 gold miners in South Africa, with a minimum of 10 years and an average of 24 years of work exposure 8 hours per day, 5 days per week. Chronic silicosis was observed in 313 (14%) of individuals. A NOAEL of 600 µg/m ³ -years was determined (assuming 30% of dust is silica). A BMCL ₀₁ of 636 µg/m ³ -years was determined and set as the POD. An adjustment for continuous exposure was performed to determine a POD _{HEC} of 9.8 µg/m ³ . An uncertainty factor of 3 for intraspecies uncertainty was applied to determine the REL. Based on respirable fraction as defined by the occupational hygiene methods described by ACGIH (≤ 4 µm).	TCEQ- TCEQ value selected as it is the most conservative value.
										TCEQ: The screening value is based on silicosis in an occupational study of 2,235 gold miners by Hnizdo and Sluis-Cremer (1993; as cited in TCEQ 2013b). Miners had an average of 24 years of occupational exposure and average cumulative dust exposure was 6.6 ± 2.7 mg/m ³ per year. The BMCL01 (95% lower bound estimate of the concentration at which 1% of the population develops silicosis) of 0.635 mg/m ³ per year was selected as the occupational POD based on dust assumed to contain 30% quartz. This value was adjusted to account for a more appropriate 54% quartz, calculated as 1.143 mg/m ³ per year. The PODHEC adjusted for continuous lifetime exposure was calculated as 6.04 µg/m ³ . A total uncertainty factor of 3 was applied (intraspecies uncertainty), resulting in a chronic ReV of 2 µg/m ³ .	

Notes:

µg/g = microgram per gram; µg/L = micrograms per litre; µg/m³ = microgram per cubic metre; µm = micrometre or micron; AAQC = Ambient Air Quality Criteria; AAQO = Ambient Air Quality Objective; ACB = air contaminant benchmark; ACGIH = American Conference of Governmental Industrial Hygienists; ADJ = adjusted; AMCV = Air Monitoring Comparison Value; AQG = Air Quality Guideline; ATSDR = Agency for Toxic Substances and Disease Registry; BC ENV = British Columbia Ministry of the Environment and Climate Change Strategy; BMCL_x = benchmark concentration lower confidence limit of x% effect level; BMDL_x = benchmark dose lower confidence limit of x% of effect level; C = carcinogenic; CAAQS = Canadian Ambient Air Quality Standard; Cal OEHHA = California Office of Environmental Health Hazard Assessment; CAS = Chemical abstract service; CCME = Canadian Council of Ministers of the Environment; DPM = diesel particulate matter; ESL = Effects Screening Level; FEV1 = forced expiratory volume in one second; g/mol = grams per mole; HEC = human equivalent concentration; HQ = hazard quotient; IQ = intelligence quotient; ILCR = incremental lifetime cancer risk; IRIS = Integrated Risk Information System; IUR = inhalation unit risk; LOAEL = lowest observed adverse effect level; MECP = Ministry of the Environment, Conservation and Parks; mg/kg/day = milligrams per kilogram per day; mg/m³ = milligrams per cubic metre; NAAQO = National Ambient Air Quality Objective; NAAQS = National Ambient Air Quality Standard; NC = non-carcinogenic; ng/m³ = nanogram per cubic metre; NIOSH = National Institute for Occupational Safety and Health; NOAEL = No observed adverse effect level; NO₂ = nitrogen dioxide; NTP = National Toxicology Program; OEL = occupational exposure limit; OSHA = Occupational Safety and Health Administration; PAH = polycyclic aromatic hydrocarbon; PM_{2.5} = particulate matter equal to or less than 2.5 microns in diameter; PM₁₀ = particulate matter equal to or less than 10 microns in diameter; ppb = parts per billion; ppm = parts per million; POD = point of departure; REL = Reference Exposure Level; ReV = Reference value; RfC = reference concentration; RSL = Regional Screening Level; SO₂ = sulphur dioxide; SPM = suspended particulate matter; TCEQ = Texas Commission on Environmental Quality; TSP = total suspended particulates; TLV = threshold limit value; TWA = time-weight average; URF = unit risk factor; US EPA = United States Environmental Protection Agency; VOC = volatile organic compound; WHO = World Health Organization.

- = Guideline not available

Concentrations are in microgram per cubic metre (µg/m³), unless otherwise noted.

Concentrations in parts per million (ppm) were converted to mg/m³ by applying the formula: molecular weight (grams per mol) x ppm / 24.45.

Concentrations in parts per billion (ppb), provided in brackets, were converted to µg/m³ by applying the formula: molecular weight (grams per mol) x ppb / 24.45. The conversion is based on the assumption of 25 °C and an atmospheric pressure of 1.

^(d) MECP AAQC based on 24-hour averaging times are based on the protection against chronic effects.

^(e) MECP (2023) Air Contaminant Benchmark (ACB) was summarized because MECP (2020) Ambient Air Quality Criteria (AAQC) were unavailable. The ACBs are standards, guidelines and screening levels for assessing point of impingement concentrations.

^(a) US EPA values recorded as ppm or ppb have been converted from µg/m³ assuming 25 °C and an atmospheric pressure of 1.

^(b) RSLs are based on a target HQ of 1 (non-carcinogenic values) and a carcinogenic risk of 10⁻⁶, the latter of which are the values shown in brackets. For the purpose of this assessment, carcinogenic RSLs are adjusted to a target of 10⁻⁵, which are the values which are not in brackets.

^(c) Cal OEHHA IURs are based on a cancer risk level of 1 in 1,000,000 (10⁻⁶); for this assessment carcinogenic REL were calculated for risk level of 1 in 100,000 by dividing 10⁻⁶ by the IUR then multiplying by a factor of 10.

^(d) MECP derived carcinogenic AAQC based on a target cancer risk of 10⁻⁵ (value in brackets). For the purpose of this assessment, carcinogenic AAQC were adjusted to a target cancer risk of 10⁻⁶ (value not in brackets).

^(e) For parameters where a final ESL is available, the AMCV and/or ReV (derived based on a HQ of 1) were selected as the TCEQ air criteria because final ESLs were derived based on an HQ of 0.3. For parameters with interim values, an adjustment to the screening value was not made for parameters where supporting documentation for these interim values is not available.

^(f) MECP (2023) Air Contaminant Benchmark (ACB) was summarized because MECP (2020) Ambient Air Quality Criteria (AAQC) were unavailable. The ACBs are standards, guidelines and screening levels for assessing point of impingement concentrations.

For the selection of a screening criterion, the following hierarchy was applied: The lower of the values available from the MECP AAQC and CCME CAAQS/NAAQO was generally preferentially selected. In the absence of MECP and CCME values, available values from WHO AQG, US EPA NAAQS, Cal OEHHA REL, BC ENV AAQO and TCEQ ESL/AMCV/ReV were reviewed. Values with supporting documentation available, values based on more current studies, or values based on studies which are more relevant to human health (i.e., human studies) were preferentially selected.

Selected and highlighted = Selected air screening criterion

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Table C1-7: Tier 1 Screening of Air Quality Parameters for 24-Hours Averaging Period

Parameter	Units	Selected Screening Criteria ⁽¹⁾	Selected Criteria Source	Baseline Maximum ⁽²⁾	Maximum Predicted Concentration (Construction) ⁽⁶⁾	Maximum Predicted Concentration (Operations) ⁽⁶⁾	Maximum Predicted Concentration (Construction) (Baseline + Project) ⁽⁷⁾	Maximum Predicted Concentration (Operations) (Baseline + Project) ⁽⁷⁾	COPC for Human Health?
Criteria Air Parameters									
Respirable Particulate (PM _{2.5})	µg/m ³	27	MECP AAQC 2023	1.00E+01	6.60E+00	6.40E+00	1.66E+01	1.64E+01	No
Inhalable Particulate (PM ₁₀)	µg/m ³	50	MECP AAQC 2023	1.83E+01	1.79E+01	1.79E+01	3.62E+01	3.62E+01	No
Suspended Particulate Matter (SPM)	µg/m ³	120	MECP AAQC 2023	2.14E+01	2.11E+01	2.34E+01	4.25E+01	4.48E+01	No
Carbon Monoxide (CO)	µg/m ³	NV	NA	NV	NV	NV	NA	NA	No ⁽³⁾
Nitrogen Dioxide (NO ₂)	µg/m ³	200	MECP AAQC 2023	3.90E+00	4.34E+01	5.34E+01	4.73E+01	5.73E+01	No
Sulphur Dioxide (SO ₂)	µg/m ³	40	WHO AQG 2021	3.20E+00	1.75E+01	1.08E+00	2.07E+01	4.28E+00	No
Diesel Particulate Matter (DPM)	µg/m ³	NV	NA	1.90E-01	5.76E+00	4.20E+00	5.95E+00	4.39E+00	No ⁽³⁾
Metals									
Aluminum	µg/m ³	12	MECP ACB 2021	NV	1.80E+00	2.01E+00	1.80E+00	2.01E+00	No
Antimony	µg/m ³	25	MECP AAQC 2023	NV	4.21E-05	4.69E-05	4.21E-05	4.69E-05	No
Arsenic	µg/m ³	0.3	MECP AAQC 2023	2.80E-03	1.58E-02	1.76E-02	1.86E-02	2.04E-02	No
Barium	µg/m ³	10	MECP AAQC 2023	NV	1.10E-02	1.22E-02	1.10E-02	1.22E-02	No
Beryllium	µg/m ³	0.01	MECP AAQC 2023	NV	2.49E-05	2.77E-05	2.49E-05	2.77E-05	No
Bismuth	µg/m ³	2.5	MECP ACB 2021	NV	9.94E-05	1.11E-04	9.94E-05	1.11E-04	No ⁽⁴⁾
Boron	µg/m ³	120	MECP AAQC 2023	NV	8.42E-05	9.37E-05	8.42E-05	9.37E-05	No
Cadmium	µg/m ³	0.025	MECP AAQC 2023	9.20E-04	2.75E-04	3.06E-04	1.20E-03	1.23E-03	No
Calcium	µg/m ³	NV	NA	NV	1.31E+00	1.46E+00	1.31E+00	1.46E+00	No ⁽⁴⁾
Calcium Oxide (CaO)	µg/m ³	10	MECP AAQC 2023	1.70E+00	2.68E-01	2.68E-01	1.97E+00	1.97E+00	No
Chromium (total)	µg/m ³	0.5	MECP AAQC 2023	2.30E-03	2.74E-03	3.05E-03	5.04E-03	5.35E-03	No
Cobalt	µg/m ³	0.1	MECP AAQC 2023	9.20E-04	1.04E-03	1.16E-03	1.96E-03	2.08E-03	No
Copper	µg/m ³	50	MECP AAQC 2023	9.50E-02	6.15E-03	6.84E-03	1.01E-01	1.02E-01	No
Copper Sulphate (CuSO ₄)	µg/m ³	50 ⁽⁵⁾	NA	NV	1.54E-01	1.54E-01	1.54E-01	1.54E-01	No
Iron	µg/m ³	4	MECP AAQC 2023	1.30E-01	2.70E+00	3.00E+00	2.83E+00	3.13E+00	No
Lead	µg/m ³	0.5	MECP AAQC 2023	1.40E-03	1.19E-03	1.32E-03	2.59E-03	2.72E-03	No
Magnesium	µg/m ³	120	MECP AAQC 2023 - magnesium oxide	NV	5.05E-01	5.62E-01	5.05E-01	5.62E-01	No ⁽⁴⁾
Manganese - in PM _{2.5}	µg/m ³	0.1	MECP AAQC 2023	7.10E-03	1.55E-02	1.72E-02	2.26E-02	2.43E-02	No
Manganese - in SPM	µg/m ³	0.4	MECP AAQC 2023	7.10E-03	5.49E-02	6.12E-02	6.20E-02	6.83E-02	No
Manganese - in PM ₁₀	µg/m ³	0.2	MECP AAQC 2023	7.10E-03	3.94E-02	4.38E-02	4.65E-02	5.09E-02	No
Mercury	µg/m ³	2	MECP AAQC 2023	9.30E-06	5.22E-06	5.81E-06	1.45E-05	1.51E-05	No
Molybdenum	µg/m ³	120	MECP AAQC 2023	NV	9.81E-05	1.09E-04	9.81E-05	1.09E-04	No
Nickel - in PM ₁₀	µg/m ³	0.1	MECP AAQC 2023	1.40E-03	1.91E-03	2.15E-03	3.31E-03	3.55E-03	No
Nickel - in SPM	µg/m ³	0.2	MECP AAQC 2023	1.40E-03	1.91E-03	2.15E-03	3.31E-03	3.55E-03	No
Phosphorus	µg/m ³	0.5	MECP ACB 2021	NV	1.45E-02	1.62E-02	1.45E-02	1.62E-02	No ⁽⁴⁾
Potassium	µg/m ³	10	MECP ACB 2021	NV	7.08E-01	7.87E-01	7.08E-01	7.87E-01	No ⁽⁴⁾
Selenium	µg/m ³	10	MECP AAQC 2023	4.60E-03	1.84E-04	2.05E-04	4.78E-03	4.81E-03	No
Silver	µg/m ³	1	MECP AAQC 2023	NV	1.03E-04	1.15E-04	1.03E-04	1.15E-04	No
Strontium	µg/m ³	120	MECP AAQC 2023	NV	6.74E-03	7.50E-03	6.74E-03	7.50E-03	No
Sulphur	µg/m ³	NV	NA	3.80E-01	1.07E+00	1.19E+00	1.45E+00	1.57E+00	No ⁽⁴⁾
Thallium	µg/m ³	0.5	MECP ACB 2021	NV	1.85E-05	2.06E-05	1.85E-05	2.06E-05	No ⁽⁴⁾
Thorium	µg/m ³	NV	NA	NV	6.06E-04	6.74E-04	6.06E-04	6.74E-04	No ⁽⁴⁾
Tin	µg/m ³	10	MECP ACB 2021	NV	1.26E-04	1.41E-04	1.26E-04	1.41E-04	No
Titanium	µg/m ³	120	MECP AAQC 2023	NV	1.34E-01	1.50E-01	1.34E-01	1.50E-01	No
Tungsten	µg/m ³	5	MECP ACB 2021	NV	2.03E-04	2.25E-04	2.03E-04	2.25E-04	No ⁽⁴⁾
Uranium	µg/m ³	NV	NA	NV	4.83E-05	5.37E-05	4.83E-05	5.37E-05	No ⁽³⁾
Vanadium	µg/m ³	2	MECP AAQC 2023	2.30E-03	5.85E-03	6.51E-03	8.15E-03	8.81E-03	No
Yttrium	µg/m ³	5	MECP ACB 2021	NV	4.38E-04	4.87E-04	4.38E-04	4.87E-04	No ⁽⁴⁾
Zinc	µg/m ³	120	MECP AAQC 2023	1.30E-02	4.38E-02	4.87E-02	5.68E-02	6.17E-02	No
Zirconium	µg/m ³	25	MECP ACB 2021	NV	5.77E-03	6.42E-03	5.77E-03	6.42E-03	No ⁽⁴⁾
Polycyclic Aromatic Hydrocarbons (PAHs)									
Benzo(a)pyrene	µg/m ³	0.0005	MECP AAQC 2023	1.30E-05	6.40E-06	6.69E-06	1.94E-05	1.97E-05	No
Volatile Organic Compounds (VOCs)									
1,3-Butadiene	µg/m ³	100	MECP AAQC 2023	5.60E-01	1.09E-01	1.06E-01	6.69E-01	6.66E-01	No
Benzene	µg/m ³	23	MECP AAQC 2023	5.50E-01	1.37E+00	1.32E+00	1.92E+00	1.87E+00	No
Hydrogen Cyanide	µg/m ³	8	MECP AAQC 2023	NV	1.30E+00	1.30E+00	1.30E+00	1.30E+00	No
Other Parameters									
Respirable Silica (<10 µm)	µg/m ³	5	MECP AAQC 2023	9.20E-01	1.34E+00	1.34E+00	2.26E+00	2.26E+00	No

Notes:

AAQC= Ambient Air Quality Criteria; ACB= Air Contaminant Benchmark; AQG= Air Quality Objective; BC ENV = British Columbia Ministry of the Environment and Climate Change Strategy; CAAQS= Canadian Ambient Air Quality Standards; Cal OEHHA= California Office of Environmental Health Hazard Assessment; CCME= Canadian Council of Ministers of the Environment; MECP= Ministry of Environment, Conservation, and Parks; NA= not applicable; NV= no value available; PAH= polycyclic aromatic hydrocarbon; TCEQ= Texas Commission of Environmental Quality; US EPA= United States Environmental Protection Agency; VOC= volatile organic compounds; WHO= World Health Organization; $\mu\text{g}/\text{m}^3$ = microgram per cubic metre; μm = micrometre

⁽¹⁾ Screening criteria were selected according to the following hierarchy: The lower of the values available from MECP and CCME were preferentially selected. In the absence of MECP and CCME values, available values from WHO, US EPA, Cal OEHHA, BC ENV and TCEQ were reviewed. Values with supporting documentation available, values based on more current studies, or values based on studies which are more relevant to human health (i.e., human studies) were preferentially selected. The hierarchy expands upon the hierarchy of the Air Quality Assessment (WSP 2025), which considered MECP and CCME. Please see Table C3-2 for more detail on the selection of air quality screening criteria for the 24-hour averaging period.

⁽²⁾ Baseline air concentrations were obtained from the Great Bear Project Air Quality Assessment (WSP 2025). For the 24-hours averaging period, baseline concentrations were calculated as the 90th percentile of measured 24-hours average concentrations.

⁽³⁾ Acute inhalation exposure to this parameter is assessed using the 1-hour exposure scenario.

⁽⁴⁾ This parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. See text for further discussion.

⁽⁵⁾ In the absence of screening criteria for copper sulphate, the screening criterion for copper was applied. This is consistent with the approach used in the Great Bear Project Air Quality Assessment (WSP 2025). Air quality predictions for copper sulphate were only provided by the Air Quality discipline for the 24-hours averaging period (WSP 2025).

⁽⁶⁾ Maximum predicted concentration represents the maximum predicted air concentration at the maximum point of impingement (MPOI) for each parameter for the specified Project phase.

⁽⁷⁾ Maximum predicted concentrations represents the sum of the maximum baseline air concentration and the maximum predicted air concentration at the MPOI, where both values are available. Where only predicted air concentrations were available, these were assumed to represent the maximum concentration for each respective Project phase.

Bold and Shaded= Parameter concentration exceeds the selected screening criterion.

References:

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Table C1-8: Tier 1 Screening of Air Quality Parameters for Annual Averaging Period

Parameter	Units	Selected Non-Carcinogenic Screening Criteria ⁽¹⁾	Selected Criteria Source	Selected Carcinogenic Screening Criteria ⁽¹⁾	Selected Criteria Source	Air Quality Results ⁽³⁾					COPC for Human Health?
						Baseline Maximum ⁽²⁾	Maximum Predicted Concentration (Construction) ⁽⁶⁾	Maximum Predicted Concentration (Operations) ⁽⁶⁾	Maximum Predicted Concentration (Baseline + Construction) ⁽⁹⁾	Maximum Predicted Concentration (Baseline + Operations) ⁽⁹⁾	
Criteria Air Parameters											
Respirable Particulate (PM _{2.5})	µg/m ³	8.8	MECP AAQC 2023	NA	NA	5.80E+00	6.59E-01	1.47E+00	6.46E+00	7.27E+00	No
Inhalable Particulate (PM ₁₀)	µg/m ³	15	WHO AQG 2021	NA	NA	9.60E+00	1.08E+00	1.50E+00	1.07E+01	1.11E+01	No
Suspended Particulate Matter (SPM)	µg/m ³	60	MECP AAQC 2023	NA	NA	5.80E+00	2.34E+00	1.84E+00	8.14E+00	7.64E+00	No
Carbon Monoxide	µg/m ³	NV	NA	NA	NA	NV	NV	NV	NA	NA	No ⁽⁵⁾
Nitrogen Dioxide (NO ₂)	µg/m ³	23	CCME AAQS 2025	NA	NA	3.00E-01	1.19E+01	4.95E+00	1.22E+01	5.25E+00	No
Sulphur Dioxide (SO ₂)	µg/m ³	10	CCME AAQS 2025	NA	NA	3.00E-01	3.79E-01	1.31E-02	6.79E-01	3.13E-01	No
Diesel Particulate Matter (DPM)	µg/m ³	5	Health Canada 2016 ⁽⁴⁾	0.033	Cal OEHA REL 2025	8.90E-02	6.59E-01	1.46E+00	7.48E-01	1.55E+00	Yes - Carcinogenic
Metals											
Aluminum	µg/m ³	5.2	US EPA RSL 2024	NA	NA	NV	2.01E-01	1.58E-01	2.01E-01	1.58E-01	No
Antimony	µg/m ³	0.31	US EPA RSL 2024	NA	NA	NV	4.69E-06	3.69E-06	4.69E-06	3.69E-06	No
Arsenic	µg/m ³	0.016	US EPA RSL 2024	0.0065	US EPA RSL 2024	2.00E-03	1.76E-03	1.38E-03	3.76E-03	3.38E-03	No
Barium	µg/m ³	0.52	US EPA RSL 2024	NA	NA	NV	1.22E-03	9.59E-04	1.22E-03	9.59E-04	No
Beryllium	µg/m ³	0.007	Cal OEHA REL 2025	0.0042	Cal OEHA REL 2025	NV	2.76E-06	2.18E-06	2.76E-06	2.18E-06	No
Bismuth	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	1.11E-05	8.70E-06	1.11E-05	8.70E-06	No ⁽⁶⁾
Boron	µg/m ³	20.9	US EPA RSL 2024	NA	NA	NV	9.37E-06	7.37E-06	9.37E-06	7.37E-06	No
Cadmium	µg/m ³	0.005	MECP AAQC 2023	0.0024	Cal OEHA REL 2025	6.50E-04	3.06E-05	2.41E-05	6.81E-04	6.74E-04	No
Calcium	µg/m ³	NV	NA	NA	NA	NV	1.46E-01	1.15E-01	1.46E-01	1.15E-01	No ⁽⁶⁾
Calcium Oxide (CaO)	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	5.14E-02	5.14E-02	5.14E-02	5.14E-02	No
Chromium (total)	µg/m ³	0.14	HC 2021	NA	NA	1.60E-03	3.05E-04	2.40E-04	1.90E-03	1.84E-03	No
Cobalt	µg/m ³	0.0063	US EPA RSL 2024	0.0031	US EPA RSL 2024	6.50E-04	1.16E-04	9.14E-05	7.66E-04	7.41E-04	No
Copper	µg/m ³	1	TCEQ ESL/AMCV/ReV 2025	NA	NA	6.10E-02	6.84E-04	5.38E-04	6.17E-02	6.15E-02	No
Iron	µg/m ³	NV	NA	NA	NA	6.30E-02	3.00E-01	2.36E-01	3.63E-01	2.99E-01	No ⁽⁷⁾
Lead	µg/m ³	0.15	US EPA RSL 2024	NA	NA	1.00E-03	1.32E-04	1.04E-04	1.13E-03	1.10E-03	No
Magnesium	µg/m ³	4	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	5.62E-02	4.42E-02	5.62E-02	4.42E-02	No ⁽⁶⁾
Manganese - in PM2.5	µg/m ³	0.09	Cal OEHA REL 2025	NA	NA	3.10E-03	1.72E-03	1.35E-03	4.82E-03	4.45E-03	No
Manganese - in SPM	µg/m ³	0.09	Cal OEHA REL 2025	NA	NA	3.10E-03	6.11E-03	4.81E-03	9.21E-03	7.91E-03	No
Manganese - in PM10	µg/m ³	0.09	Cal OEHA REL 2025	NA	NA	3.10E-03	4.39E-03	3.45E-03	7.49E-03	6.55E-03	No
Mercury	µg/m ³	0.03	Cal OEHA REL 2025	NA	NA	6.50E-06	5.81E-07	4.57E-07	7.08E-06	6.96E-06	No
Molybdenum	µg/m ³	2.1	USEPA RSL 2024	NA	NA	NV	1.09E-05	8.59E-06	1.09E-05	8.59E-06	No
Nickel - in PM10	µg/m ³	0.02	MECP AAQC 2023	0.02	MECP AAQC 2023	1.00E-03	2.13E-04	1.69E-04	1.21E-03	1.17E-03	No
Nickel - in SPM	µg/m ³	0.04	MECP AAQC 2023	0.04	MECP AAQC 2023	1.00E-03	2.13E-04	1.69E-04	1.21E-03	1.17E-03	No
Phosphorus	µg/m ³	0.1	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	1.62E-03	1.27E-03	1.62E-03	1.27E-03	No ⁽⁶⁾
Potassium	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	7.87E-02	6.19E-02	7.87E-02	6.19E-02	No ⁽⁶⁾
Selenium	µg/m ³	20	Cal OEHA REL 2025	NA	NA	3.20E-03	2.05E-05	1.61E-05	3.22E-03	3.22E-03	No
Silver	µg/m ³	0.01	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	1.15E-05	9.03E-06	1.15E-05	9.03E-06	No
Strontium	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	7.50E-04	5.90E-04	7.50E-04	5.90E-04	No
Sulphur	µg/m ³	5	TCEQ ESL/AMCV/ReV 2025	NA	NA	2.20E-01	1.19E-01	9.33E-02	3.39E-01	3.13E-01	No ⁽⁶⁾
Thallium	µg/m ³	0.1	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	2.06E-06	1.62E-06	2.06E-06	1.62E-06	No ⁽⁶⁾
Thorium	µg/m ³	NV	NA	NA	NA	NV	6.74E-05	5.30E-05	6.74E-05	5.30E-05	No ⁽⁶⁾
Tin	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	1.41E-05	1.11E-05	1.41E-05	1.11E-05	No
Titanium	µg/m ³	5	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	1.49E-02	1.18E-02	1.49E-02	1.18E-02	No
Tungsten	µg/m ³	5	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	2.25E-05	1.77E-05	2.25E-05	1.77E-05	No ⁽⁶⁾
Uranium	µg/m ³	0.03	MECP AAQC 2023	NA	NA	NV	5.37E-06	4.23E-06	5.37E-06	4.23E-06	No
Vanadium	µg/m ³	0.1	US EPA RSL 2024	NA	NA	1.60E-03	6.51E-04	5.12E-04	2.25E-03	2.11E-03	No
Yttrium	µg/m ³	1	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	4.87E-05	3.83E-05	4.87E-05	3.83E-05	No ⁽⁶⁾
Zinc	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	7.30E-03	4.87E-03	3.83E-03	1.22E-02	1.11E-02	No
Zirconium	µg/m ³	5	TCEQ ESL/AMCV/ReV 2025	NA	NA	NV	6.42E-04	5.05E-04	6.42E-04	5.05E-04	No ⁽⁶⁾

Polycyclic Aromatic Hydrocarbons (PAHs)											
Benzo(a)pyrene	µg/m ³	0.0021	US EPA RSL 2024	0.0001	MECP AAQC 2023	5.00E-06	1.05E-06	1.06E-06	6.05E-06	6.06E-06	No
Volatile Organic Compounds (VOCs)											
1,3-Butadiene	µg/m ³	2.1	US EPA RSL 2024	20	MECP AAQC 2023	5.60E-01	8.14E-03	8.14E-03	5.68E-01	5.68E-01	No
Benzene	µg/m ³	3	Cal OEHHA REL 2025	4.5	MECP AAQC 2023	3.40E-01	1.02E-01	1.02E-01	4.42E-01	4.42E-01	No
Hydrogen Cyanide	µg/m ³	0.83	US EPA RSL 2024	NA	NA	NV	2.49E-01	2.49E-01	2.49E-01	2.49E-01	No
Other Parameters											
Respirable Silica (<10 µm)	µg/m ³	2	TCEQ ESL/AMCV/ReV 2025	NA	NA	5.30E-01	8.07E-02	1.13E-01	6.11E-01	6.43E-01	No

Notes:

AAQC= Ambient Air Quality Criteria; AQG= Air Quality Objective; BC ENV = British Columbia Ministry of the Environment and Climate Change Strategy; CAAQS= Canadian Ambient Air Quality Standards; Cal OEHHA= California Office of Environmental Health Hazard Assessment; CCME= Canadian Council of Ministers of the Environment; ESL= environmental screening value; MECP= Ministry of Environment, Conservation, and Parks; NA= not applicable; NV= no value available; PAH= polycyclic aromatic hydrocarbon; REL= reference exposure level; RSL= regional screening level; TCEQ= Texas Commission of Environmental Quality; US EPA= United States Environmental Protection Agency; VOC= volatile organic compounds; WHO= World Health Organization; µg/m³ = microgram per cubic metre; µm = micrometre

⁽¹⁾ Screening criteria were selected according to the following hierarchy: The lower of the values available from MECP and CCME were preferentially selected. In the absence of MECP and CCME values, available values from WHO, US EPA, Cal OEHHA, BC ENV and TCEQ were reviewed. Values with supporting documentation available, values based on more current studies, or values based on studies which are more relevant to human health (i.e., human studies) were preferentially selected. The hierarchy expands upon the hierarchy of the Air Quality Assessment (WSP 2025), which considered MECP and CCME. Please see Table C3-3 for more detail on the selection of air quality screening criteria for the annual averaging period.

⁽²⁾ Baseline air concentrations were obtained from the Great Bear Project Air Quality Assessment (WSP 2025). For the annual averaging period, baseline concentrations were calculated as the maximum annual average of measured concentrations.

⁽³⁾ Air quality results are being screened against the lowest available value of the selected non-carcinogenic and carcinogenic criteria.

⁽⁴⁾ In the absence of guidance from the MECP and CCME, available 1 hour screening criterion from Health Canada was selected.

⁽⁵⁾ Health effects linked to carbon monoxide are associated with shorter term exposures (i.e., 1- or 8- hours), therefore carbon monoxide was not assessed for a chronic exposure averaging period.

⁽⁶⁾ This parameter is an essential element and/or trace element, ubiquitous in the environment, generally non-toxic to human receptors, and often lacking toxicity data. See text for further discussion.

⁽⁷⁾ Iron is assessed indirectly using particulate matter as a surrogate for the annual averaging period. TCEQ states that concentrations of iron "must meet National Ambient Air Quality Standards", indicating that assessment of iron is not required if analysis of particulate matter has been completed (TCEQ 2025). TCEQ considers iron to be a component of total particulate matter, therefore the assessment of particulate matter encompasses iron.

⁽⁸⁾ Maximum predicted concentration represents the maximum predicted air concentration at the maximum point of impingement (MPOI) for each parameter for the specified Project phase.

⁽⁹⁾ Maximum predicted concentrations represents the sum of the maximum baseline air concentration and the maximum predicted air concentration at the MPOI, where both values are available. Where only predicted air concentrations were available, these were assumed to represent the maximum concentration for each respective Project phase.

Bold and Shaded= Parameter concentration exceeds the selected screening criterion.

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Table C1-9: Tier 2 Screening of Ingestion of Surface Water as Drinking Water

Parameter	Units	Human Health		Selected Human Health Screening Criteria ⁽¹⁾	Source	Maximum Projected Water Quality Concentration ⁽⁴⁾																				COPC for Human Health ⁽⁵⁾ ?
						Surface Water Quality Node																				
		Chukuni River				Dixie Creek					Pakwash Lake					Small Unnamed Waterbodies and Watercourses			Genesee Lake	Maximum Annual Average of All Nodes						
		Health Canada MAC ⁽¹⁾	MECP GW1 ⁽²⁾			MECP GW1	CHK_1	CHK_2	Chunkuni River Maximum	DIX_1	DIX_2	DIX_3	DIX_4	DIX_5	Dixie Creek Maximum	WQ_PAK_IN	WQ_PAK_L	WQ_PAK_OUT	PAK_IN_2		Pakwash Lake Maximum	UN_3	UN_5	UN_L6	GENL	
Existing Conditions																										
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	8.07E-03	7.71E-03	8.07E-03	2.18E-03	2.18E-03	2.18E-03	2.21E-03	2.26E-03	2.26E-03	7.71E-03	5.12E-03	5.08E-03	1.79E-03	7.71E-03	3.24E-03	1.96E-03	3.45E-03	1.96E-03	8.07E-03	Yes ⁽⁶⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	8.54E-07	9.09E-07	9.09E-07	1.26E-06	1.33E-06	1.34E-06	1.56E-06	1.63E-06	1.63E-06	9.09E-07	1.10E-06	1.14E-06	1.40E-06	1.40E-06	2.84E-06	6.65E-07	3.20E-06	5.55E-07	3.20E-06	Yes ⁽⁷⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	1.05E-04	1.06E-04	1.06E-04	9.71E-05	9.79E-05	9.85E-05	1.16E-04	1.17E-04	1.17E-04	1.06E-04	9.58E-05	9.63E-05	8.63E-05	1.06E-04	1.22E-04	7.96E-05	1.25E-04	7.66E-05	1.25E-04	Yes ⁽⁷⁾	
Construction																										
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	8.09E-03	7.73E-03	8.09E-03	2.29E-03	2.30E-03	2.30E-03	2.31E-03	2.41E-03	2.41E-03	7.73E-03	5.66E-03	5.35E-03	1.80E-03	7.73E-03	4.57E-03	2.14E-03	4.84E-03	2.13E-03	8.09E-03	Yes ⁽⁶⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	8.70E-07	9.24E-07	9.24E-07	1.29E-06	1.36E-06	1.37E-06	1.59E-06	1.68E-06	1.68E-06	9.24E-07	1.17E-06	1.17E-06	1.40E-06	1.40E-06	3.41E-06	6.63E-07	3.77E-06	5.95E-07	3.77E-06	Yes ⁽⁷⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	1.08E-04	1.09E-04	1.09E-04	9.75E-05	9.82E-05	9.87E-05	1.16E-04	1.18E-04	1.18E-04	1.09E-04	1.05E-04	1.01E-04	8.65E-05	1.09E-04	1.29E-04	7.89E-05	1.33E-04	7.69E-05	1.33E-04	Yes ⁽⁷⁾	
Operations																										
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	8.10E-03	7.73E-03	8.10E-03	2.30E-03	2.31E-03	2.32E-03	2.30E-03	2.39E-03	2.39E-03	7.73E-03	5.65E-03	5.35E-03	1.80E-03	7.73E-03	4.27E-03	2.31E-03	4.50E-03	2.29E-03	8.10E-03	Yes ⁽⁶⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	1.08E-06	1.12E-06	1.12E-06	1.29E-06	1.32E-06	1.32E-06	1.57E-06	1.65E-06	1.65E-06	1.12E-06	1.29E-06	1.29E-06	1.40E-06	1.40E-06	3.27E-06	7.30E-07	3.55E-06	6.33E-07	3.55E-06	Yes ⁽⁷⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	1.34E-04	1.33E-04	1.34E-04	9.89E-05	1.01E-04	1.01E-04	1.19E-04	1.20E-04	1.20E-04	1.33E-04	1.20E-04	1.17E-04	8.65E-05	1.33E-04	1.27E-04	9.46E-05	1.30E-04	7.74E-05	1.34E-04	Yes ⁽⁷⁾	
Closure																										
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	8.10E-03	7.73E-03	8.10E-03	2.20E-03	2.19E-03	2.20E-03	2.22E-03	2.28E-03	2.28E-03	7.73E-03	5.65E-03	5.34E-03	1.80E-03	7.73E-03	3.36E-03	2.20E-03	3.51E-03	2.18E-03	8.10E-03	Yes ⁽⁶⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	8.71E-07	9.24E-07	9.24E-07	1.28E-06	1.68E-06	1.68E-06	1.80E-06	1.87E-06	1.87E-06	9.24E-07	1.16E-06	1.17E-06	1.40E-06	1.40E-06	3.04E-06	7.12E-07	3.35E-06	6.09E-07	3.35E-06	Yes ⁽⁷⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	1.08E-04	1.09E-04	1.09E-04	9.86E-05	1.23E-04	1.22E-04	1.32E-04	1.32E-04	1.32E-04	1.09E-04	1.05E-04	1.01E-04	8.65E-05	1.09E-04	1.26E-04	9.15E-05	1.31E-04	7.70E-05	1.32E-04	Yes ⁽⁷⁾	
Post Closure																										
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	8.10E-03	7.71E-03	8.10E-03	2.18E-03	2.16E-03	2.22E-03	2.24E-03	2.28E-03	2.28E-03	7.71E-03	5.65E-03	5.35E-03	1.80E-03	7.71E-03	3.19E-03	1.98E-03	3.25E-03	2.00E-03	8.10E-03	Yes ⁽⁶⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	8.58E-07	9.45E-07	9.45E-07	1.28E-06	1.64E-06	2.14E-06	2.10E-06	2.13E-06	2.14E-06	9.45E-07	1.18E-06	1.18E-06	1.40E-06	1.40E-06	3.00E-06	7.37E-07	3.23E-06	5.63E-07	3.23E-06	Yes ⁽⁷⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	1.06E-04	1.10E-04	1.10E-04	9.86E-05	1.20E-04	1.70E-04	1.63E-04	1.61E-04	1.70E-04	1.10E-04	1.05E-04	1.02E-04	8.65E-05	1.10E-04	1.25E-04	8.59E-05	1.28E-04	7.62E-05	1.70E-04	Yes ⁽⁷⁾	

Notes:
 GW1 = groundwater component value protective of drinking water; mg/L = milligram per litre; MAC = maximum acceptable concentration; MECP = Ministry of the Environment, Conservation and Parks; MGRA = Modified Generic Risk Assessment; NV = no value available; POPC = parameter of potential concern.
 All concentrations presented are for total metals.
¹ Health Canada Guidelines for Canadian Drinking Water Quality. Maximum acceptable concentration (MAC), unless otherwise indicated (Health Canada, 2025).
² MECP MGRA Groundwater Components for Potable Water Scenario, coarse textured soil (GW1) (MOECC, 2016).
³ The lower of the available values from Health Canada and MECP was selected.
⁴ Projected water quality concentrations calculated as the maximum annual average for each node.
⁵ A parameter is retained as a COPC for human health if the projected surface water concentration is greater than the selected screening criteria for human health.
⁶ This parameter not identified as a COPC based on screening against surface water criteria, however, it will be carried forward to the multi-pathway assessment in the HHERA since it is a COPC in soil.
⁷ This parameter was not identified as a COPC based on screening against surface water criteria, however, it is carried forward to the multi-pathway assessment in the HHERA since it is considered a bioaccumulative substance. Further, mercury was identified as a parameter of concern by Indigenous communities.
 Shaded = Exceeds screening criteria

References
 Health Canada. 2025. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
 MECP (Ontario Ministry of Environment and Parks). 2024. Toxicity Reference Values (TRVs) Selected for Use at Contaminated Sites in Ontario. Human Toxicology and Air Standards Section, Technology Assessment and Standards Branch, Ontario Ministry of the Environment Conservation and Parks. March 2024.
 MOECC (Ontario Ministry of the Environment and Climate Change). 2016. Modified Generic Risk Assessment "Approved Model". Standards Development Branch. Revised version, November 1, 2016 (with updated GW1 component values based on the most recent toxicological reference values (TRVs) provided by the MECP (MECP, 2024). Queen's Printer for Ontario, 2016. PIBS 7381e01

Table C1-10: Tier 2 Screening of Surface Water for Swimming/Bathing Exposure

Parameter	Units	Human Health		Selected Human Health Screening Criteria ⁽³⁾	Source	Adjusted Selected Human Health Screening Criteria ⁽⁴⁾	Maximum Projected Water Quality Concentration ⁽⁶⁾																				POPC for Human Health ⁽⁷⁾
							Surface Water Quality Node																				
		Chukuni River					Dixie Creek					Pakwash Lake					Small Unnamed Waterbodies and Watercourses			Genesee Lake	Maximum Annual Average of All Nodes						
		CHK_1	CHK_2				Chukuni River Maximum	DIX_1	DIX_2	DIX_3	DIX_4	DIX_5	Dixie Creek Maximum	WQ_PAK_IN	WQ_PAK_L	WQ_PAK_OUT	PAK_IN_2	Pakwash Lake Maximum	UN_3	UN_5		UN_L6	GENL				
Existing Conditions																											
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	0.2	8.07E-03	7.71E-03	8.07E-03	2.18E-03	2.18E-03	2.18E-03	2.21E-03	2.26E-03	2.26E-03	7.71E-03	5.12E-03	5.08E-03	1.79E-03	7.71E-03	3.24E-03	1.96E-03	3.45E-03	1.96E-03	8.07E-03	Yes ⁽⁷⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	0.02	8.54E-07	9.09E-07	9.09E-07	1.26E-06	1.33E-06	1.34E-06	1.56E-06	1.63E-06	1.63E-06	9.09E-07	1.10E-06	1.14E-06	1.40E-06	1.40E-06	2.84E-06	6.65E-07	3.20E-06	5.55E-07	3.20E-06	Yes ⁽⁸⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	0.2	1.05E-04	1.06E-04	1.06E-04	9.71E-05	9.79E-05	9.85E-05	1.16E-04	1.17E-04	1.17E-04	1.06E-04	9.58E-05	9.63E-05	8.63E-05	1.06E-04	1.22E-04	7.96E-05	1.25E-04	7.66E-05	1.25E-04	Yes ⁽⁸⁾	
Construction																											
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	0.20	8.09E-03	7.73E-03	8.09E-03	2.29E-03	2.30E-03	2.30E-03	2.31E-03	2.41E-03	2.41E-03	7.73E-03	5.66E-03	5.35E-03	1.80E-03	7.73E-03	4.57E-03	2.14E-03	4.84E-03	2.13E-03	8.09E-03	Yes ⁽⁷⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	0.02	8.70E-07	9.24E-07	9.24E-07	1.29E-06	1.36E-06	1.37E-06	1.59E-06	1.68E-06	1.68E-06	9.24E-07	1.17E-06	1.17E-06	1.40E-06	1.40E-06	3.41E-06	6.63E-07	3.77E-06	5.95E-07	3.77E-06	Yes ⁽⁸⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	0.20	1.08E-04	1.09E-04	1.09E-04	9.75E-05	9.82E-05	9.87E-05	1.16E-04	1.18E-04	1.18E-04	1.09E-04	1.05E-04	1.01E-04	8.65E-05	1.09E-04	1.29E-04	7.89E-05	1.33E-04	7.69E-05	1.33E-04	Yes ⁽⁸⁾	
Operations																											
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	0.2	8.10E-03	7.73E-03	8.10E-03	2.30E-03	2.31E-03	2.32E-03	2.30E-03	2.39E-03	2.39E-03	7.73E-03	5.65E-03	5.35E-03	1.80E-03	7.73E-03	4.27E-03	2.31E-03	4.50E-03	2.29E-03	8.10E-03	Yes ⁽⁷⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	0.02	1.08E-06	1.12E-06	1.12E-06	1.29E-06	1.32E-06	1.32E-06	1.57E-06	1.65E-06	1.65E-06	1.12E-06	1.29E-06	1.29E-06	1.40E-06	1.40E-06	3.27E-06	7.30E-07	3.55E-06	6.33E-07	3.55E-06	Yes ⁽⁸⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	0.2	1.34E-04	1.33E-04	1.34E-04	9.89E-05	1.01E-04	1.01E-04	1.19E-04	1.20E-04	1.20E-04	1.33E-04	1.20E-04	1.17E-04	8.65E-05	1.33E-04	1.27E-04	9.46E-05	1.30E-04	7.74E-05	1.34E-04	Yes ⁽⁸⁾	
Closure																											
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	0.2	8.10E-03	7.73E-03	8.10E-03	2.20E-03	2.19E-03	2.20E-03	2.22E-03	2.28E-03	2.28E-03	7.73E-03	5.65E-03	5.34E-03	1.80E-03	7.73E-03	3.36E-03	2.20E-03	3.51E-03	2.18E-03	8.10E-03	Yes ⁽⁷⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	0.02	8.71E-07	9.24E-07	9.24E-07	1.28E-06	1.68E-06	1.68E-06	1.80E-06	1.87E-06	1.87E-06	9.24E-07	1.16E-06	1.17E-06	1.40E-06	1.40E-06	3.04E-06	7.12E-07	3.35E-06	6.09E-07	3.35E-06	Yes ⁽⁸⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	0.2	1.08E-04	1.09E-04	1.09E-04	9.86E-05	1.23E-04	1.22E-04	1.32E-04	1.32E-04	1.32E-04	1.09E-04	1.05E-04	1.01E-04	8.65E-05	1.09E-04	1.26E-04	9.15E-05	1.31E-04	7.70E-05	1.32E-04	Yes ⁽⁸⁾	
Post Closure																											
Arsenic	mg/L	0.010	0.025	0.010	Health Canada MAC	0.2	8.10E-03	7.71E-03	8.10E-03	2.18E-03	2.16E-03	2.22E-03	2.24E-03	2.28E-03	2.28E-03	7.71E-03	5.65E-03	5.35E-03	1.80E-03	7.71E-03	3.19E-03	1.98E-03	3.25E-03	2.00E-03	8.10E-03	Yes ⁽⁷⁾	
Mercury	mg/L	0.0010	0.0010	0.0010	Health Canada MAC & MECP GW1	0.02	8.58E-07	9.45E-07	9.45E-07	1.28E-06	1.64E-06	2.14E-06	2.10E-06	2.13E-06	2.14E-06	9.45E-07	1.18E-06	1.18E-06	1.40E-06	1.40E-06	3.00E-06	7.37E-07	3.23E-06	5.63E-07	3.23E-06	Yes ⁽⁸⁾	
Selenium	mg/L	0.050	0.010	0.010	MECP GW1	0.2	1.06E-04	1.10E-04	1.10E-04	9.86E-05	1.20E-04	1.70E-04	1.63E-04	1.61E-04	1.70E-04	1.10E-04	1.05E-04	1.02E-04	8.65E-05	1.10E-04	1.25E-04	8.69E-05	1.28E-04	7.62E-05	1.70E-04	Yes ⁽⁸⁾	

Notes:
 GW1 = groundwater component value protective of drinking water; mg/L = milligram per litre; MAC = maximum acceptable concentration; MECP = Ministry of the Environment, Conservation and Parks; MGRA = Modified Generic Risk Assessment; NV = no value available; POPC = parameter of potential concern.
 All concentrations presented are for total metals.
¹ Health Canada Guidelines for Canadian Drinking Water Quality. Maximum acceptable concentration (MAC), unless otherwise indicated (Health Canada, 2025).
² MECP MGRA Groundwater Components for Potable Water Scenario, coarse textured soil (GW1) (MOECC, 2016).
³ The lower of the available values from Health Canada and MECP was selected.
⁴ Health-based drinking water criteria were adjusted by a factor of 20x based on the ratio of ingestion rates used to derive the drinking water criteria and the amount of water ingested when swimming (WHO 2021).
⁵ Projected water quality concentrations calculated as the maximum annual average for each node.
⁶ A parameter is retained as a COPC for human health if the projected surface water concentration is greater than the selected screening criteria for human health.
⁷ This parameter not identified as a COPC based on screening against surface water criteria, however, it will be carried forward to the multi-pathway assessment in the HHERA since it is a COPC in soil.
⁸ This parameter was not identified as a COPC based on screening against surface water criteria, however, it is carried forward to the multi-pathway assessment in the HHERA since it is considered a bioaccumulative substance. Further, mercury was identified as a parameter of concern by Indigenous communities.
 Shaded = Exceeds screening criteria

References
 Health Canada. 2025. Guidelines for Canadian Drinking Water Quality—Summary Tables. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
 MECP (Ontario Ministry of Environment and Parks). 2024. Toxicity Reference Values (TRVs) Selected for Use at Contaminated Sites in Ontario. Human Toxicology and Air Standards Section, Technology Assessment and Standards Branch, Ontario Ministry of the Environment Conservation and Parks. March 2024.
 MOECC (Ontario Ministry of the Environment and Climate Change). 2016. Modified Generic Risk Assessment “Approved Model”. Standards Development Branch. Revised version, November 1, 2016 (with updated GW1 component values based on the most recent toxicological reference values (TRVs) provided by the MECP (MECP, 2024). Queen’s Printer for Ontario, 2016. PIBS 7381e01
 WHO (World Health Organization). 2021. Guidelines on recreational water quality: Volume 1 coastal and fresh waters. July 13 2021. Available at: <https://www.who.int/publications/i/item/9789240031302>

Table C1-11: Tier 2 Screening of Soil Quality for Ecological Risk Assessment

Parameter	Units	Direct Contact		Soil and Food Ingestion		Baseline Soil Maximum Concentration	Predicted Maximum Concentration - Construction ⁽³⁾	Predicted Maximum Concentration - Operations ⁽³⁾	Predicted Maximum Concentration - Closure ⁽³⁾	POPC for Plants and Soil Invertebrates ²⁽⁴⁾	POPC for Terrestrial Wildlife ²⁽⁴⁾
		CCME SQGE, soil contact, Agricultural ⁽¹⁾	MECP Table 2 plants and soil organisms, Agricultural, Coarse Soil ⁽²⁾	CCME SQGE, soil and food ingestion, Agricultural ⁽¹⁾	MECP Table 2 mammals and birds, Agricultural, Coarse Soil ⁽²⁾						
Metals											
Arsenic	mg/kg	17	20	380	51	18	19	20	21	Yes	No
Mercury	mg/kg	12	10	NV	20	0.19	0.19	0.19	0.19	No	RET ⁽⁵⁾
Selenium	mg/kg	1	10	4.5	2.4	0.49	0.5	0.51	0.52	No	No ⁽⁶⁾

Notes:
 CCME = Canadian Council of Ministers of Environment; ERA = ecological risk assessment; NV= no value available; MECP = Ontario Ministry of the Environment, Conservation and Parks; mg/kg= milligrams per kilogram; POPC= Parameter of potential concern; SQGE = environmental soil quality guideline

¹ CCME Environmental Soil Quality Guidelines for Agricultural Land Use, Soil Contact guideline and Soil and Food Ingestion guideline (CCME 1999, current to 2025). Specific factsheets for arsenic (CCME 1999a), mercury (CCME 1999b), and selenium (CCME 2009).

² MECP Soil Components for Table 2 - Full Depth, Potable Water Scenario, Agricultural Land Use, Coarse Textured Soil, Plants and Soil Organisms and Mammals and Birds Component Values (MOECC, 2016).

³ Maximum predicted soil concentrations for the construction and operations Project phases. While not specifically modelled, it was assumed that predicted deposition rates during the closure phase would be equal to the construction phase. The predicted soil concentration during the operations and closure phases include contribution from soil deposition during the previous Project phases. It is assumed there would be no air emissions and therefore no soil deposition in the post-closure phase.

⁴ A parameter is retained as a POPC if the predicted maximum soil concentration is greater than the lowest screening criteria for direct contact (plants and soil invertebrates) or soil and food ingestion (terrestrial wildlife), unless otherwise noted.

⁵ This parameter was not identified as a POPC based on screening against soil criteria, however, it is carried forward to the multi-pathway (food chain) assessment in the ERA since it is considered a bioaccumulative substance in the aquatic environment and was retained in surface water for the evaluation of aquatic-feeding wildlife. It was not considered further for terrestrial wildlife as predicted soil concentrations are below the soil criteria which are protective of the food consumption pathway.

⁶ This parameter was not identified as a POPC based on screening against soil criteria. While selenium is considered a bioaccumulative substance in the aquatic environment, it was not retained as a POPC in the ERA because predicted surface water concentrations were below surface water criteria protective of the bioaccumulation pathway for ecological receptors.

Bolded = Concentrations are higher than soil screening criteria.

Shaded = Predicted concentrations are higher than baseline soil concentration.

References

CCME (Canadian Council of Ministers of the Environment). 1999, with updates current to 2025. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health. Last Accessed October 2025.
 CCME. 1999a. Canadian Soil Quality Guidelines: Arsenic (Environmental and Human Health Effects). Scientific Supporting Document. Revised December 1999.
 CCME. 1999b. Canadian soil quality guidelines for the protection of environmental and human health: Mercury (inorganic)(1999). In: Canadian environmental quality guidelines, 1999. Canadian Council of Ministers of the Environment, Winnipeg.
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Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Chukuni River				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	CHK-1				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.057^(P)	0.057^(P)	0.057^(P)	0.057^(P)	0.057^(P)
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.25	0.25	0.26	0.25	0.25
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.012^(Cc)	0.012^(Cc)	0.012^(Cc)	0.012^(Cc)	0.012^(Cc)
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.0011	0.0011	0.0011	0.0011	0.0011
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0017	0.0017	0.0018	0.0017	0.0017
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.31	0.31	0.33	0.31	0.31
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00021	0.00021	0.00022	0.00021	0.00021
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000013	0.0000013	0.0000016	0.0000013	0.0000013
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00012	0.00013	0.00015	0.00013	0.00012

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Chukuni River				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	CHK-2				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.056^(P)	0.056	0.056	0.056	0.056
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.25	0.25	0.25	0.25	0.24
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.011^(Ce)	0.011^(Ce)	0.011^(Ce)	0.011^(Ce)	0.011^(Ce)
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.0010	0.0010	0.0010	0.0010	0.0010
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0017^(Fc)	0.0017^(Fc)	0.0017^(Fc)	0.0017^(Fc)	0.0017^(Fc)
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.32	0.32	0.34	0.32	0.32
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00021	0.00021	0.00022	0.00021	0.00021
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000014	0.0000014	0.0000016	0.0000014	0.0000014
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00013	0.00013	0.00015	0.00013	0.00013

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Dixie Creek				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	DIX-1				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.037	0.037	0.037	0.037	0.036
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.18	0.19	0.19	0.18	0.18
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0031	0.0032	0.0032	0.0031	0.0031
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00067	0.00068	0.00068	0.00068	0.00067
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0011	0.0012	0.0012	0.0011	0.0011
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.55	0.55	0.55	0.55	0.55
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00019	0.00027	0.00027	0.00020	0.00020
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000013	0.0000013	0.0000013	0.0000013	0.0000013
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00014	0.00014	0.00014	0.00014	0.00014

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Dixie Creek				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.037	0.037	0.037	0.037	0.036
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.20	0.20	0.19	0.18	0.17
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0031	0.0032	0.0032	0.0031	0.0031
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00068	0.00068	0.00068	0.00070	0.00069
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0011	0.0012	0.0012	0.0012	0.0011
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.55^(Fc)	0.56^(Fc)	0.55^(Fc)	0.55^(Fc)	0.53^(Fc)
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00019	0.00028	0.00028	0.00020	0.00019
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000015	0.0000015	0.0000013	0.0000021	0.0000019
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00014	0.00014	0.00015	0.00017	0.00017

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Dixie Creek				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	DIX-3				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.037	0.037	0.037	0.037	0.036
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.20	0.21	0.19	0.18	0.17
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0031	0.0032	0.0032	0.0031	0.0031
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00068	0.00069	0.00068	0.00070	0.00067
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0011	0.0012	0.0012	0.0012	0.0011
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.55	0.56	0.55	0.55	0.52
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00019	0.00028	0.00028	0.00020	0.00019
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000015	0.0000016	0.0000013	0.0000021	0.0000029
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00014	0.00014	0.00015	0.00017	0.00027

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Dixie Creek				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	DIX-4				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.037	0.037	0.037	0.037	0.036
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.23	0.23	0.22	0.22	0.21
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0032	0.0032	0.0032	0.0032	0.0031
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00077	0.00078	0.00078	0.00078	0.00077
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0011	0.0012	0.0012	0.0012	0.0011
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.61	0.61	0.61	0.61	0.59
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00021	0.00027	0.00025	0.00022	0.00021
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000019	0.0000019	0.0000018	0.0000020	0.0000026
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00023	0.00023	0.00024	0.00025	0.00026

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Dixie Creek				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.036	0.036	0.036	0.036	0.036
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.22	0.23	0.23	0.21	0.20
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0032	0.0033	0.0033	0.0032	0.0031
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00077	0.00078	0.00078	0.00078	0.00076
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0011	0.0012	0.0012	0.0011	0.0011
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.60	0.61	0.61	0.6	0.58
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00020	0.00030	0.00028	0.00021	0.00020
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000020	0.0000020	0.0000019	0.0000021	0.0000026
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00023	0.00023	0.00024	0.00025	0.00026

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Genessee Lake				
						GEN-1				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.017	0.017	0.017	0.017	0.017
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.013	0.050	0.070	0.053	0.019
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0020	0.0022	0.0024	0.0023	0.0020
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00025	0.00028	0.00030	0.00028	0.00025
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.00025	0.00035	0.00040	0.00036	0.00027
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.17	0.19	0.21	0.20	0.17
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.000025	0.00020	0.00029	0.00021	0.000054
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.00000055	0.00000062	0.00000066	0.00000063	0.00000056
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.000077	0.000077	0.000078	0.000077	0.000076

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Genessee Lake				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	GEN-L				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.017	0.017	0.017	0.017	0.017
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.013	0.038	0.057	0.046	0.019
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0020	0.0021	0.0023	0.0022	0.0020
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00025	0.00027	0.00029	0.00028	0.00025
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.00025	0.00032	0.00037	0.00034	0.00027
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.17	0.18	0.20	0.19	0.17
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.000025	0.00014	0.00023	0.00018	0.000053
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.00000055	0.00000060	0.00000064	0.00000061	0.00000056
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.000077	0.000077	0.000077	0.000077	0.000076

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Pakwash Lake				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	PAK-IN				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.056	0.056	0.056	0.056	0.056
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.25	0.25	0.25	0.25	0.24
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.011^(Cc)	0.011^(Cc)	0.011^(Cc)	0.011^(Cc)	0.011^(Cc)
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.0010	0.0010	0.0010	0.0010	0.0010
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0017	0.0017	0.0017	0.0017	0.0017
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.32	0.32	0.34	0.32	0.32
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00021	0.00021	0.00022	0.00021	0.00021
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000014	0.0000014	0.0000016	0.0000014	0.0000014
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00013	0.00013	0.00015	0.00013	0.00013

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Pakwash Lake				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	PAK-L				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.037	0.037	0.037	0.037	0.037
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.22	0.22	0.22	0.22	0.22
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0067^(c6)	0.0067^(c6)	0.0067^(c6)	0.0067^(c6)	0.0067^(c6)
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00064	0.00064	0.00065	0.00064	0.00064
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0016	0.0016	0.0017	0.0016	0.0016
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.28	0.28	0.29	0.28	0.28
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00015	0.00015	0.00015	0.00015	0.00014
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000013	0.0000013	0.0000014	0.0000013	0.0000013
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00011	0.00012	0.00013	0.00012	0.00012

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Pakwash Lake				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	PAK-OUT				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.031	0.032	0.032	0.032	0.032
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.20	0.20	0.21	0.20	0.20
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0058^(Cc)	0.0061^(Cc)	0.0061^(Cc)	0.0060^(Cc)	0.0061^(Cc)
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00057	0.00058	0.00059	0.00058	0.00058
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0015	0.0015	0.0016	0.0015	0.0015
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.26	0.27	0.28	0.27	0.27
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00013	0.00013	0.00014	0.00013	0.00013
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000012	0.0000012	0.0000013	0.0000012	0.0000012
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00010	0.00011	0.00012	0.00011	0.00011

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Pakwash Lake				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	PAK-IN-2				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.027	0.027	0.027	0.027	0.027
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.24	0.24	0.24	0.24	0.24
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0018	0.0018	0.0018	0.0018	0.0018
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00058	0.00058	0.00058	0.00058	0.00058
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.0013	0.0013	0.0013	0.0013	0.0013
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.29	0.29	0.29	0.29	0.29
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00012	0.00012	0.00012	0.00012	0.00012
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000014	0.0000014	0.0000014	0.0000014	0.0000014
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.000087	0.000087	0.000087	0.000087	0.000087

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Small Unnamed Waterbodies and Watercourses				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	UN-3				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.021	0.022	0.022	0.022	0.022
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.096	0.28	0.26	0.11	0.092
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0033	0.0048	0.0045	0.0034	0.0032
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00057	0.00076	0.00072	0.00057	0.00054
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.00066	0.0012	0.0011	0.00070	0.00068
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.38	0.54	0.51	0.38	0.37
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.000095	0.00095	0.00083	0.00017	0.000094
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000030	0.0000035	0.0000034	0.0000031	0.0000030
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00012	0.00013	0.00013	0.00013	0.00013

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Small Unnamed Waterbodies and Watercourses				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	UN-5				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.022	0.019	0.022	0.021	0.019
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.032	0.045	0.061	0.051	0.025
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0020	0.0022	0.0023	0.0022	0.0020
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00027	0.00028	0.00030	0.00029	0.00027
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.00037	0.00036	0.00042	0.00039	0.00031
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.21	0.20	0.21	0.20	0.19
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.000045	0.00015	0.00023	0.00019	0.000054
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.00000076	0.00000068	0.00000074	0.00000075	0.00000075
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.000082	0.000079	0.000096	0.000094	0.000087

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				Maximum Predicted Surface Water Concentration				
		Wildlife		Aquatic Life		Small Unnamed Waterbodies and Watercourses				
		Selected Screening Criteria	Source	Selected Screening Criteria	Source	UN-L6				
						Baseline	Construction	Operations	Closure	Post Closure
Nutrients										
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	0.021	0.023	0.023	0.023	0.023
Total Metals										
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	0.12	0.33	0.29	0.12	0.10
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	0.0035	0.0050	0.0049	0.0036	0.0033
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	0.00067	0.00088	0.00082	0.00065	0.00060
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	0.00072	0.0013	0.0012	0.00073	0.00074
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	0.46	0.63	0.59	0.44	0.43
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	0.00010	0.0011	0.00095	0.00017	0.000096
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	0.0000034	0.0000038	0.0000037	0.0000034	0.0000033
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	0.00013	0.00013	0.00013	0.00013	0.00013

Table C1-12: Tier 2 Screening of Surface Water Quality for Ecological Risk Assessment

Parameter	Unit	Criteria for the protection of:				POPC for Wildlife Health ⁶ ?	POPC for Aquatic Health ⁷ ?
		Wildlife		Aquatic Life			
		Selected Screening Criteria	Source	Selected Screening Criteria	Source		
Nutrients							
Total phosphorus	mg-P/L	NV	NA	0.02 (lakes); 0.03 (rivers)	MECP PWQO ³	No	No
Total Metals							
Aluminum	mg/L	5.0	CCME WQG ¹	0.37 - 0.99 ^(a,b,c)	ECCC FWQG ⁴	No	No
Arsenic	mg/L	0.025	CCME WQG ¹	0.0050	CCME WQG ⁵	No	Yes (PAK-OUT)
Chromium	mg/L	0.050	CCME WQG ¹	0.0050 ^(d)	ECCC FWQG ⁴	No	No
Copper	mg/L	0.50	CCME WQG ¹	0.00075 - 0.0073 ^(e,1)	ECCC FWQG ⁴	No	No
Iron	mg/L	NV	NA	0.46 - 0.80 ^(b,c)	ECCC FWQG ⁴	No	Yes (DIX-2)
Lead	mg/L	0.10	CCME WQG ¹	0.0071 - 0.016 ^(b,c)	ECCC FWQG ⁴	No	No
Mercury	mg/L	0.0030	CCME WQG ¹	0.000026	CCME WQG ⁵	RET ⁸	No
Selenium	mg/L	0.0020	BC MWLRS ²	0.0010	CCME WQG ⁵	No	No

Notes:

mg/L= milligrams per liter; mg-P/L= milligrams phosphorus per liter; NV= no value; NA= not applicable; CCME= Canadian Council of Ministers of the Environment; ECCC= Environment and Climate Change Canada; FWQG= federal water quality guideline; WQG= water quality guideline; BC= British Columbia; MECP = Ministry of the Environment, Conservation and Parks; MWLRS= Ministry of Water, Land and Resource Stewardship; POPC = parameter of potential concern; PWQO = Provincial Water Quality Objective

All concentrations presented are for total metals.

¹ CCME WQG for the Protection of Agriculture; Livestock. (CCME 1999, 2025)

² BC MWLRS Approved Water Quality Guideline - wildlife (BC MWLRS 2025). The BC MWLRS guideline was selected over the CCME guideline because selenium is bioaccumulative and dietary accumulation is the most critical toxicological endpoint. Birds are the most sensitive receptor and the main exposure pathway from selenium is aquatic, based on a mechanism of bioaccumulation up the food chain into eggs where it can cause reproductive effects.

³ MECP PWQO (MOEE 1994). Values for lakes and rivers were applied, consistent with the surface water modelling report (WSP, 2025).

⁴ ECCC FWQG (ECCC 2026)

⁵ CCME WQG for the Protection of Aquatic Life, Freshwater, Long-term. (CCME 1999, 2025)

⁶ A parameter is retained as a POPC for wildlife health if the predicted surface water concentration is greater than the selected screening guideline for wildlife and greater than existing conditions at the water quality modelling node, unless otherwise noted.

⁷ A parameter is retained as a POPC for aquatic health if the predicted surface water concentration is greater than the selected screening guideline for aquatic life and greater than existing conditions at the water quality modelling node, unless otherwise noted.

⁸ This parameter was not identified as a POPC based on screening against surface water screening criteria, however, it is carried forward to the multi-pathway (food chain) assessment in the ERA since it is considered a bioaccumulative substance in the aquatic environment and was retained in surface water for the evaluation of aquatic-feeding wildlife.

(a) The guideline is pH dependent. The guideline range shown is based on the pH range observed in the dataset (6.4 to 7.3). The guideline is calculated based on the individual pH for each waterbody from the baseline dataset.

(b) The guideline is hardness dependent. The guideline range shown is based on the hardness range observed in the dataset (30 to 49 mg/L). The guideline is calculated based on the individual predicted hardness value for each Project phase for each specific modelling node.

(c) The guideline is dissolved organic carbon (DOC) dependent. The guideline range shown is based on the DOC concentration range observed in the dataset (4.6 to 19 mg/L). The guideline is calculated based on the individual DOC concentration for each waterbody from the baseline dataset.

(d) The guideline is for chromium VI.

(e) The guideline is for dissolved copper, but comparison to total copper is appropriate when no dissolved copper concentrations are available as total copper concentrations are expected to be higher. The long-term dissolved copper guideline is pH, temperature, hardness and DOC dependent. The guideline that results in the minimum long-term copper guideline (0.75 µg/L) is based on the combination of field pH (6.4), temperature (5.7 °C), hardness (31 mg/L), and DOC (11 mg/L). Guidelines calculated with pH, temperature, hardness, and DOC values falling outside the defined range (i.e., pH 5.5 to 8.8, temperature 8.5 to 27 °C, hardness 7.9 to 525 mg/L, and DOC 0.2 to 33.4 mg/L) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH, temperature, hardness, and DOC extremes. The guideline is calculated based on the individual pH, temperature, hardness, and DOC measurements for each Project phase and modelling node.

(f) The guideline was generated using the copper biotic ligand model is available from ECCC.

(Cc) = concentration is higher than the chronic aquatic life CCME guideline.

(Fc) = concentration is higher than the chronic FEQG guideline.

(w) = concentration is higher than the wildlife drinking water guidelines (none meet this criteria)

Bolded = Concentrations are higher than water quality guidelines.

Shaded = Predicted concentrations are higher than baseline concentrations at the water quality modelling node.

RET (italicized) = Retained as a bioaccumulative substance. See Note 8.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision *after* comparisons to guidelines. Therefore, values slightly above guidelines may be

References

BC MWLRS (British Columbia Ministry of Water, Land and Resource Stewardship). 2025. B.C. Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture. Guideline Summary - May 2025. Water CCME (Canadian Council of Ministers of the Environment). 1999, with updates current to 2025. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Last Accessed October 2025. CCME (Canadian Council of Ministers of the Environment). 1999, with updates current to 2025. Canadian Water Quality Guidelines for the Protection of Agriculture, Livestock. Last Accessed October 2025. ECCC (Environment and Climate Change Canada). 2026. Federal Water Quality Guidelines. Last Accessed February 2026.

Attachment D

HHRA Inhalation Model Description



1 HUMAN HEALTH INHALATION MODEL

The human health risk assessment (HHRA) is focused on evaluating potential human health risks associated with the Great Bear Gold Project (Project). Individuals that reside in or visit the area surrounding the Project, defined as the local study area (LSA) and regional study area (RSA) may be exposed to parameters of potential concern (POPCs) originating from Project activities through primary exposure pathways with various media, such as inhalation. The LSA and RSA are illustrated in Figure 2- 2 and Figure 2-3 of the Human Health and Ecological Risk Assessment (HHERA) report, respectively.

This Attachment describes the inhalation model used in the HHRA to evaluate potential human health exposure and risks associated with inhalation of POPCs in air originating from the Project which were carried forward after the human health screening. As detailed in Section 4.1.1 of the HHERA and Attachment C (Screening), the following POPCs were retained for quantitative evaluation in the inhalation assessment:

- Nitrogen Dioxide (NO₂):
 - Retained for the 1-hour averaging period for evaluation in the acute inhalation assessment.
- Diesel Particulate Matter (DPM):
 - Retained for the 1-hour averaging period for evaluation in the acute inhalation assessment.
 - Retained for the annual averaging period based on carcinogenic screening criteria for evaluation in the chronic inhalation assessment. DPM was not identified as a POPC based on non-carcinogenic screening criteria.

People may be exposed to POPCs present in airborne emissions from Project activities through the inhalation of air exposure pathway. Therefore, inhalation through air was identified as an exposure pathway for the HHRA and is evaluated through the inhalation assessment model described herein.

The model inputs, equations and assumptions for the inhalation assessment are described herein, including sample calculations. The approach used to estimate concentrations in air and assess potential risk to human health from the Project align with guidance provided by Health Canada (2023, 2024) and the United States Environmental Protection Agency (US EPA 2005a,b,c).

Exposure to POPCs originating from Project activities may also occur through multiple exposure pathways with various media, such as ingestion of surface water as drinking water, incidental ingestion and dermal contact with soil, and food ingestion. Multi-media exposure and risk estimates were evaluated separately from inhalation in a Multi-Media Assessment, presented in Attachment E.

2 RECEPTOR CHARACTERIZATION

As described in Section 4.1.2 of the HHERA report, receptors assessed in the HHRA were selected based on the identification of persons with the greatest potential to be adversely affected by POPC exposures originating from the Project. The receptors selected for evaluation are based on current and future use of the area around the Project and are intended to represent a range of possible exposure scenarios.

For the purposes of the Air Quality assessment (WSP, 2025), 29 points of reception (PORs) were selected to represent areas with human activity within the LSA and RSA, which may include traditional land and resources uses. These PORs consist of residences, potential recreational use, cabins, lodges and camp sites identified through field work and a review of the Ministry of Natural Resources Geospatial Ontario (formerly Land Information Ontario) geospatial datasets. In some cases where a land use covered a large area, representative points were selected. For the purposes of the HHRA, additional PORs were added to this initial list (for a total of 41 PORs), in part based on review of available traditional knowledge and land use studies to represent areas of potential short- and long-term human activity within the RSA, as further discussed in Section 4.1.4.1 of the HHERA. Consultation and engagement activities with Indigenous communities are provided in detail within the Participation and Engagement section (Section 3, Participation and Engagement) of the Impact Statement, and within Impact Statement Appendix C (Record of Consultation) which provides the record of consultation including detailed comments received, and responses provided, during the development of the Impact Statement.

While on the Project site, the health of workers is protected by occupational health and safety standards, codes and regulations established by various provincial and federal governments; thus, potential risks to on-site camp workers associated with Project-related POPCs is not addressed in the scope of this assessment.

The receptor selected for the HHRA to represent realistic but conservative exposure within the LSA and RSA in the inhalation assessment is an Indigenous resident:

- **Indigenous Resident Receptor:** The Project lies within Treaty 3 territory, on the traditional territories of Asubpeeschoseewagong Netum Anishinabek (ANA), Lac Seul First Nation (LSFN), Wabauskang First Nation (WFN) and the Northwestern Ontario Métis Community (NWOMC), and therefore these four communities were considered in the HHRA. Indigenous peoples in Red Lake and Ear Falls (RL/EF) were also considered as a fifth community. Several locations (PORs) were identified within the LSA and RSA where both indigenous- and non-indigenous people could spend substantial time on a long term (chronic) basis (such as cabins, residences, camps or lodges). It is not known that these areas are frequently used by indigenous residents, however, it was conservatively assumed that they could. Several other locations (PORs) were identified where both indigenous- and non-indigenous people could spend time on a short term (acute) basis (such as fishing, hunting, cultural or recreation areas). An Indigenous Resident was selected as the main receptor for the inhalation assessment. Indigenous Residents were assumed to live in the LSA or RSA year-round for their entire lifetime and be potentially exposed to POPCs through inhalation of outdoor air in areas within the LSA and RSA frequented by these individuals.

The assessment of the Indigenous Resident is considered to be protective of non-Indigenous residents that may live in and fish, hunt or recreate in the area given that Indigenous residents are assumed to have greater potential for exposure to outdoor air due to their traditional land and resource use practices. Similarly, the assessment of Indigenous Resident Receptors is considered to be protective of Indigenous and non-Indigenous people who reside outside the LSA and RSA and who may visit the LSA and RSA to take part in various traditional land use or recreational activities such as hunting, fishing, gathering, cultural practices, camping, hiking, swimming and/or boating.

2.1 GENERAL RECEPTOR CHARACTERISTICS

As discussed below in Sections 3 and 4, measured baseline air quality concentrations and predicted air quality concentrations ($\mu\text{g}/\text{m}^3$) for Project phases were compared directly to toxicity reference values (mg/m^3) appropriate to the inhalation exposure duration (acute or chronic). Concentrations were not adjusted based on receptor characteristics such as body weight, age range duration and inhalation rate. The inhalation assessment is protective of a general Indigenous Resident receptor of any lifestage (i.e., infant, toddler, child, teen, adult). As such, no receptor characteristics were required as inputs into exposure and risk calculations.

2.2 EXPOSURE DURATION

The inhalation assessment consisted of evaluating both acute (i.e., 1-hour, 24-hours averaging periods) and chronic (i.e., annual averaging period) inhalation exposures. It was conservatively assumed that the Indigenous Resident was present in the LSA or RSA continuously throughout their entire lifetime. As discussed in Section 4, risk estimates for each averaging period were calculated using toxicity reference values (TRVs) specific to each averaging period. As such, no adjustment to exposure time based on time spent outside of the LSA or RSA was made, equating to an exposure term of 1 for each averaging period (i.e., Indigenous Resident is present for the entirety of each averaging period).

2.3 INCORPORATION OF INDIGENOUS AND TRADITIONAL KNOWLEDGE

As part of the Project, ANA, LSFN, WFN, NWOMC, and additionally Indigenous Peoples living in Red Lake and Ear Falls, were engaged by Great Bear Resources to participate in the Impact Assessment process and to provide Indigenous knowledge (IK) and Traditional Knowledge Land Resource Use Study (TKLUS) reports. The incorporation of IK and Traditional Knowledge in the HHERA is described in further detail in Section 2.6 of the HHERA report.

The TKLUS reports and secondary sources were used to validate the Points of Reception (POR) locations identified by the Air Quality discipline (WSP 2025) and to identify the additional PORs to be assessed in the HHRA inhalation assessment. This process was carried out by comparing described land use areas and provided mapping to POR locations selected by the Air Quality discipline (WSP 2025). PORs considered in the inhalation assessment are described below in Section 3.

3 EXPOSURE ASSESSMENT

3.1 POINTS OF RECEPTION

To develop the exposure scenarios for the inhalation assessment, PORs were identified to represent baseline and predicted air quality at locations where individuals (i.e., receptors) may reasonably be found spending time outside of the Project Area (PA), but within the LSA and RSA. As such, receptors were evaluated in the inhalation assessment based on exposure to POPCs at the identified PORs.

The PORs evaluated for air quality exposure in the inhalation assessment are listed in Table D-1 below and presented in Figure 4-1 in the HHERA report. They include:

- Initial Air Quality PORs: PORs 1-29 which consist primarily of long-term stay locations representing areas with human activity (e.g., residence, cottage, cabin, lodge, camp), with the exception of POR1, which is a short-term stay storage area. These represent the POR locations which were originally identified by the Air Quality discipline (WSP 2025). These PORs were identified by the Air Quality discipline through field work and a review of Ministry of Natural Resources Geospatial Ontario datasets and were assumed to potentially include traditional land use activities. Inhalation exposures at PORs 2-29 (long-term stay) were evaluated through the chronic inhalation assessment, and exposures at POR1 (short-term stay) was evaluated through the acute inhalation assessment.
- Additional PORs: PORs 30-41. PORs 30-38 and 40 consist of short-term stay locations identified through TKLUS reports or chosen to represent exposure on water bodies. POR 39 is a potential overnight stay location which was conservatively considered a long-term stay location. POR41 is a long term stay location that represents residential areas in and near Red Lake which is located within the RSA. Predicted air quality data for these PORs was specifically requested by the HHERA discipline for the purposes of the HHRA and provided by the Air Quality discipline. Inhalation exposures at PORs 30-38 and 40 were evaluated through the acute inhalation assessment, and exposures at POR39 and POR41 were evaluated through the chronic inhalation assessment.
- Maximum Point of Impingement (MPOI): The MPOI is a theoretical point where maximum air emissions are predicted just outside of the Project property boundaries, in close proximity to the PA. This point is not a specific, static location, but rather varies for various parameters and emission sources, and is typically used for the human health worst-case scenario. It represents the highest predicted ground level air concentrations anticipated to occur in close proximity to the PA. It is noted that human receptors in the LSA are not expected to spend an appreciable amount of time at the MPOI and, therefore, the short-term and long-term stay POR locations more accurately represent potential human receptor exposure to POPCs in airborne emissions from the Project. As use or access of the MPOI by the public is considered to be on an infrequent basis, inhalation exposure at the MPOI was evaluated through the acute inhalation assessment.

ATTACHMENT D: Inhalation Model Description And Worked Example

Table D- 1: Points of Receptions for the Inhalation Assessment

POR ID	POR Type ⁽¹⁾	Exposure Type	Easting	Northing
POR1	Initial Air Quality POR	Acute	456965	5639223
POR2	Initial Air Quality POR	Chronic	465624	5635180
POR3	Initial Air Quality POR	Chronic	465611	5635303
POR4	Initial Air Quality POR	Chronic	451915	5639044
POR5	Initial Air Quality POR	Chronic	451671	5630891
POR6	Initial Air Quality POR	Chronic	465139	5634939
POR7	Initial Air Quality POR	Chronic	467085	5631026
POR8	Initial Air Quality POR	Chronic	447866	5639124
POR9	Initial Air Quality POR	Chronic	451051	5639187
POR10	Initial Air Quality POR	Chronic	452237	5640215
POR11	Initial Air Quality POR	Chronic	458555	5640149
POR12	Initial Air Quality POR	Chronic	450762	5642634
POR13	Initial Air Quality POR	Chronic	447708	5641952
POR14	Initial Air Quality POR	Chronic	446385	5641886
POR15	Initial Air Quality POR	Chronic	446675	5642960
POR16	Initial Air Quality POR	Chronic	447897	5645762
POR17	Initial Air Quality POR	Chronic	446102	5646375
POR18	Initial Air Quality POR	Chronic	465476	5635383
POR19	Initial Air Quality POR	Chronic	446876	5642540
POR20	Initial Air Quality POR	Chronic	447444	5642109
POR21	Initial Air Quality POR	Chronic	447961	5637216
POR22	Initial Air Quality POR	Chronic	469646	5628897
POR23	Initial Air Quality POR	Chronic	469091	5623932
POR24	Initial Air Quality POR	Chronic	470572	5630691
POR25	Initial Air Quality POR	Chronic	463047	5614594
POR26	Initial Air Quality POR	Chronic	467430	5631399
POR27	Initial Air Quality POR	Chronic	468788	5623627
POR28	Initial Air Quality POR	Chronic	465478	5635052
POR29	Initial Air Quality POR	Chronic	447525	5643902
POR30	Additional POR	Acute	445667	5649233
POR31	Additional POR	Acute	457668	5647234
POR32	Additional POR	Acute	473668	5637233
POR33	Additional POR	Acute	460268	5633434
POR34	Additional POR	Acute	460863	5633431
POR35	Additional POR	Acute	461466	5633437
POR36	Additional POR	Acute	466166	5629732
POR37	Additional POR	Acute	466167	5628231
POR38	Additional POR	Acute	467656	5627233
POR39	Additional POR	Chronic	450668	5634484

ATTACHMENT D: Inhalation Model Description And Worked Example

POR40	Additional POR	Acute	452918	5632234
POR41	Additional POR	Chronic	440829	5650824

Notes:

ID= Identification; POR= Point of reception

- 1 Initial Air Quality PORs were identified by the Air Quality discipline through field work and a review of Ministry of Natural Resources Geospatial Ontario datasets (WSP 2025). Additional PORs were identified as additional locations selected by the Human Health and Ecological Risk Assessment (HHERA) discipline for the purposes of the Human Health Risk Assessment (HHRA).
-

3.2 HUMAN HEALTH EXPOSURE POINT CONCENTRATIONS

Exposure point concentrations (EPCs) are estimates of the concentrations of POPCs that people may be exposed to in each relevant exposure media (i.e., air). EPCs for air were characterized for several assessment phases in the HHRA as summarised below, which are aligned with the Project temporal boundaries described in Section 3.3 in the HHERA report:

- **Baseline (i.e., existing conditions)** – representing measured POPC concentrations in air prior to implementation of the Project. It was assumed that no air emissions from the Project would occur during baseline as there was no Project activities that would generate air emissions occurring during this period (WSP 2025).
- **Construction Phase** - representing measured POPC concentrations in air (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in air associated with the Project during construction, which spans 3 years.
- **Operations Phase** - representing measured POPC concentrations in air (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in air associated with the Project during operations, which spans 26 years.
- **Closure Phase** - representing measured POPC concentrations in air (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in air associated with the Project during active closure (during the decommissioning period), which spans approximately 3 years when air emissions are assumed to be similar to during construction.
- **Post-Closure** – representing measured POPC concentrations in air (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in the environment associated with the Project during post-closure. It is noted that, for the purposes of the inhalation assessment, air quality during this phase was assumed to be equivalent to baseline (no incremental changes to POPC concentrations in air associated with the Project) as notable sources of air emissions that would warrant an air quality assessment were not expected to occur after decommissioning of the Project is completed.

A corresponding Project-alone incremental change case is also evaluated to assess contributions related to the Project during each Project phase (e.g., construction phase minus baseline).

Both measured and predicted concentrations were used in the inhalation assessment. Concentrations were either directly measured or predicted using models. Measured data were available for baseline air quality as presented in the Air Quality Assessment (WSP 2025) and summarized in Attachment A of the HHERA. Predicted Project phase air quality concentrations used in the HHRA are based on air quality predictions modelled by the Air Quality Discipline for the MPOI and PORs (WSP 2025). The statistic applied as the EPC for each POPC in the inhalation assessment are presented in Table D-2.

Table D- 2: Methods for Deriving EPCs for Human Health Risk Assessment

POPC – Averaging Period Assessed	Selected EPC
NO ₂ – 1-hour averaging period	<p>The 90th percentile of the measured 1-hour average concentrations of NO₂ was selected as the EPC for the baseline condition.</p> <p>The CCME CAAQS for NO₂ is based on the maximum average of predicted 98th percentile results from three consecutive years (CCME 2025). The matching statistic was selected as the EPC for NO₂ for the MPOI and each POR for each Project phase. This is consistent with the approach applied by the Air Quality discipline (WSP 2025).</p>
DPM – 1-hour averaging period	<p>The 90th percentile of the measured 1-hour average concentrations of DPM was selected as the EPC for the baseline condition.</p> <p>The maximum predicted 1-hour average concentration of DPM at each applicable POR (i.e., long term/chronic PORs) was selected as the EPC for Project phases.</p> <p>The maximum predicted annual average concentrations with meteorological anomalies removed for DPM for each Project phase was selected as the EPC for the MPOI. The method was used to address the potential for meteorological anomalies to overly influence the results of air dispersion modelling, as outlined in the ADMGO (MECP 2017) and is consistent with the approach applied by the Air Quality discipline (WSP 2025)</p>
DPM – Annual Averaging Period	<p>The annual average of measured concentrations of DPM was selected as the EPC for the baseline condition.</p> <p>The maximum predicted annual average concentration of DPM at each applicable POR (i.e., long term/chronic PORs) was selected as the EPC for Project phases.</p>

Notes:

ADMGO = Guideline A-11: Air Dispersion Modelling Guideline for Ontario; CAAQS = Canadian Ambient Air Quality Standards; CCME = Canadian Council of Ministers of the Environment; EPC = exposure point concentration; DPM = diesel particulate matter; MPOI = maximum point of impingement; NO₂ = nitrogen dioxide; POPC = parameter of potential concern; POR = point of reception.

The EPC concentration for each selected POR and MPOI for use in calculations of exposure and risk are presented Table D1-1, Attachment D1.

3.3 HUMAN EXPOSURE ESTIMATES

3.3.1 ACUTE INHALATION

For the acute inhalation assessment, the estimated acute exposure from inhalation of ambient air is assumed to be the predicted 1-hour air concentration in mg/m³ (i.e., EPC) as provided by the Air Quality discipline (WSP 2025).

Exposure Estimate (EE)= Concentration in air (C_{air})

$$Exposure\ Estimate\ (EE) = Concentration\ in\ air\ (C_{air})$$

As discussed in Section 3.1, 1-hour inhalation exposures at all PORs and the MPOI were evaluated through the acute inhalation assessment. The statistic applied as the EPC for each POPC in the inhalation assessment are presented in Table D-2.

Acute exposure estimates (i.e., EPCs) for POPCs assessed in the inhalation HHRA are presented Table D1-1, Attachment D1.

3.3.2 CHRONIC INHALATION

For the chronic inhalation assessment, which relies on annual air quality predictions, exposure assessment involves estimating the amount of time that people might spend at a receptor location where they may be exposed to POPCs in air. For chronic PORs, it was conservatively assumed that the Indigenous Resident receptor was present in the LSA or RSA continuously throughout their entire lifetime. As such, no adjustment to exposure time based on time spent outside of the LSA or RSA was made. Therefore, as with the acute assessment, the EPCs in air were assumed to be the exposure estimate.

Exposure Estimate (EE)= Concentration in air (C_{air})

$$Exposure\ Estimate\ (EE) = Concentration\ in\ air\ (C_{air})$$

The statistic applied as the EPC for each POPC in the inhalation assessment are presented in Table D-2. Chronic exposure estimates (i.e., EPCs) for POPCs assessed in the inhalation HHRA are presented Table D1-1, Attachment D1. As discussed in Section 3.0, inhalation exposures at PORs 2- 29 (Initial Air Quality PORs) as well as PORs 39 and 41 (Additional PORs) were evaluated through the chronic inhalation assessment. Short-term PORs and the MPOI were excluded from the chronic inhalation assessment as people are unlikely to be at those locations for extended durations of time.

4 TOXICITY ASSESSMENT

Toxicity assessment involves the classification of the toxic effects of parameters and identifying TRVs used to quantitatively estimate human health risk through inhalation for the HHRA. Inhalation TRVs are an estimation of the amounts of parameters that people can be exposed to through inhalation over a given time period without experiencing adverse health effects. For each POPC, a TRV was determined based on a reported mode of action (i.e., threshold or non-threshold) and the applicable exposure duration (e.g., 1-hour or annual).

4.1 PARAMETER CLASSIFICATION

Regulatory agencies (e.g., Health Canada and US EPA) classify constituents based on their effect (i.e., carcinogenic versus non-carcinogenic) as well as mode of action (i.e., threshold versus non-threshold parameters). Parameters may also exhibit different toxicological mechanisms of action depending on the route of exposure (e.g., inhalation). Therefore, TRVs are developed based on the exposure route (e.g., inhalation) and carcinogenic or non-carcinogenic effects. The TRVs are typically derived by characterizing critical effects observed from studies in laboratory study animals or exposed human populations (e.g., occupational studies) at high exposures and extrapolating to the low exposures expected to be received by human receptors in the environment (i.e., a non-laboratory setting). In developing TRVs, safety or uncertainty factors are applied to account for unknowns and variability when extracting information from animal studies or occupational data for application to the greater population.

For non-carcinogenic parameters, a threshold level exists below which no adverse health effects are anticipated to occur. For the inhalation pathway, the TRV that represents this acceptable level of exposure is typically referred to as a tolerable concentration (TC) or reference concentration (RfC) in units of micrograms per cubic metre ($\mu\text{g}/\text{m}^3$). These TRVs are an estimate of daily inhalation exposure to the human population (including susceptible subgroups) that is likely to be without an appreciable risk of deleterious, non-cancer effects during a specified duration.

In contrast, carcinogenic parameters are considered to have some potential for risk of adverse effects at any level of exposure (i.e., non-threshold). TRVs that represent carcinogenic potency for the inhalation pathway are typically expressed as inhalation unit risks (IURs) in units of the rate of cancer incidence per unit concentration ($(\mu\text{g}/\text{m}^3)^{-1}$). Non-threshold acting parameters may also cause threshold effects; therefore, parameters that exhibit carcinogenic effects may also cause non-carcinogenic effects. DPM is considered a carcinogen, thus, was assessed as a carcinogen in the HHRA. As recommended by Health Canada (2016; 2023), DPM was assessed as carcinogen only for the chronic inhalation assessment. DPM did not exceed the screening against non-carcinogenic based guidelines.

4.2 TOXICITY REFERENCE VALUES

TRVs are based on critical effect levels or no-effect levels observed from studies in exposed human populations or animal species.

For the acute (i.e., 1-hour) inhalation assessment, the 1-hour air quality screening criteria applied in the Tier 1 screening (detailed in Attachment C of the HHERA) were used as the acute TRVs (i.e., RfCs). POPCs identified for the acute inhalation assessment based on the 1-hour averaging period included NO_2 and DPM. Note there were no POPCs identified for the 24-hour exposure durations, therefore, acute TRVs were selected for the 1-hour exposure duration only. Details regarding the selected 1-hour TRVs are presented in Table D-5.

ATTACHMENT D: Inhalation Model Description And Worked Example

Table D- 3: Selected TRVs for the Acute Inhalation Assessment

POPC	TRV ($\mu\text{g}/\text{m}^3$)	Source	Basis
NO ₂	79	CCME CAAQS (CCME 2025)	The CAAQS is a three-year average of the annual 98th percentile of the daily maximum 1-hour average nitrogen dioxide concentrations (CCME 2025). The CAAQS of 60 and 42 ppb were converted to 113 and 79 $\mu\text{g}/\text{m}^3$, respectively using a molecular weight of 46.01 g/mol.
DPM	10	Health Canada (2016)	Value based on a LOAEL of 100 $\mu\text{g}/\text{m}^3$ for respiratory effects (increased airway resistance and respiratory inflammation) in healthy and/or mildly asthmatic subjects exposed to DPM for 2 hours in human exposure studies under controlled conditions (Mudway et al. 2004; Riedl et al. 2012; Stenfors et al. 2004; Behndig et al.; 2006, as cited in Health Canada 2016). Respiratory endpoints were the most sensitive endpoints documented in these controlled human exposure studies. The LOAEL of 100 $\mu\text{g}/\text{m}^3$ for respiratory effects was selected as the POD and an uncertainty factor of 10 was applied by Health Canada to determine the short-term exposure screening value of 10 $\mu\text{g}/\text{m}^3$.

Notes:

$\mu\text{g}/\text{m}^3$ = microgram per cubic metre; CAAQS = Canadian Ambient Air Quality Standards; CCME = Canadian Council of Ministers of the Environment; DPM = diesel particulate matter; g/mol = grams per mole; LOAEL = lowest observed adverse effect level; NO₂ = nitrogen dioxide; POD = point of departure; POPC = parameter of potential concern; ppb = parts per billion; TRV = toxicity reference value.

For the chronic (i.e., annual) inhalation assessment, the annual air quality screening criteria applied for the Tier 1 screening (detailed in Attachment C of the HHERA) was derived based on an adjusted California Office of Environmental Health Hazard Assessment (Cal OEHHA) IUR. The IUR was used as the chronic TRV. Details regarding the selected annual TRVs are presented in Table D-4.

Table D- 4: Selected Carcinogenic TRVs for the Chronic Inhalation Assessment

POPC	TRV ($\mu\text{g}/\text{m}^3$) ⁻¹	Source	Basis
DPM	0.0003	Cal OEHHA (2011)	Cal OEHHA (2011) derived an IUR for DPM based on epidemiological data of occupationally exposed individuals with elevated risks of developing lung cancer (Garshick et al. 1988, as cited in Cal OEHHA 1998 and Cal OEHHA 2011). Since the available data were from an occupational setting, a factor of 0.33 was applied to account for the non-continuous exposure duration.

Notes:

$\mu\text{g}/\text{m}^3$ = micrograms per cubic metre; Cal OEHHA = California Office of Environmental Health Hazard Assessment; DPM = diesel particulate matter; IUR = inhalation unit risk; POPC= parameter of potential concern; TRV = toxicity reference value.

5 RISK CHARACTERIZATION

Risk estimates were calculated by comparing the estimated EPCs with those exposures that were determined to be acceptable (i.e., TRVs). EPCs doses are provided in Table D1-1, Attachment D2 and risk estimates are provided in Table D1-2 and are summarized in and Table D1-3a and Table D1-3b, Attachment D.

5.1 ACUTE INHALATION

For the acute assessment, POPCs were evaluated for threshold (i.e., non-carcinogenic risk), where the risk estimate is expressed as a hazard quotient (HQ). HQs for threshold POPCs were calculated by dividing the exposure dose (i.e., concentration of POPC in air) by the TRV (i.e., RfC) as follows:

$$HQ = \frac{C_{Air}}{Acute\ Inhalation\ TRV} \quad \text{Equation 1}$$

Where:

HQ = Hazard quotient (unitless)

C_{Air} = POPC concentration in air ($\mu\text{g}/\text{m}^3$) (i.e., exposure dose)

TRV = acute inhalation reference concentration ($\mu\text{g}/\text{m}^3$)

A target HQ of 1.0 for POPCs is considered acceptable for inhalation exposures that incorporate background exposure (Project plus baseline), below which indicates that exposures would not be expected to result in adverse human health effects and risks are likely negligible (Health Canada 2023). Given that conservative assumptions are used by regulatory authorities in the development of the TRVs, HQs greater than 1.0 do not necessarily indicate that adverse human health impacts will occur, but that the likelihood that an adverse effect will increase as the HQ value rises above 1.0

Example 5-1: DPM Hazard Quotient for the 1-hour Averaging Period at POR 21 (Operations Phase – Project Alone)

$$HQ = \frac{4.23\ \mu\text{g}/\text{m}^3}{10\ \mu\text{g}/\text{m}^3} \quad \text{Equation 1}$$

$$HQ = 0.42$$

A discussion of the interpretation of the calculated risk estimates is provided in Section 4.4.11.4 of the HHERA.

5.2 CHRONIC INHALATION

For the chronic inhalation assessment, DPM was evaluated as a carcinogen. For non-threshold (i.e., carcinogenic) parameters, risk estimates are expressed as incremental lifetime cancer risk (ILCR), as recommended by Health Canada (2024). ILCR values are related to increased cancer risks as a result of incremental parameter exposures originating from the Project. ILCR values were compared to an acceptable threshold of 1 in 100,000 or 1.0E-05 (Health Canada 2024). Given that conservative assumptions are used by regulatory authorities in the development of the slope factor, ILCR values exceeding 1.0E-05 do not necessarily indicate that adverse human health impacts will actually occur, but only the likelihood that an adverse effect will increase as the ILCR value increases.

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Cancer risk for DPM in the chronic inhalation assessment were calculated as ILCRs by multiplying the exposure dose (i.e., concentration of POPC in air) by the TRV (i.e., IUR) as follows:

$$ILCR = \sum C_{Air} \times TR_i \times ADAF_i \times IUR \quad \text{Equation 2}$$

Where:

ILCR = Incremental lifetime cancer risk (unitless)

C_{Air} = POPC concentration in air ($\mu\text{g}/\text{m}^3$)

TR_i = fraction of time exposed for period i (year/80 year), where a lifespan is assumed to be 80 years (Health Canada 2024)

$ADAF_i$ = Age-dependant adjustment factor for carcinogens and life stage i (unitless)

IUR = Inhalation unit risk ($\mu\text{g}/\text{m}^3$)⁻¹

Age-dependant adjustment factor (ADAF) is applied to non-threshold carcinogens POPCs that act through a mutagenic mode of action (Health Canada 2024). As stated in Section 2.9.2 of the HHERA, none of the carcinogenic POPC (i.e., arsenic) are assumed to be mutagenic, so the ADAFs were set as 1 for each life stage.

Example 5-2: ILCR for DPM for the Annual Averaging Period at POR 4

$$ILCR = \left(0.044 \frac{\mu\text{g}}{\text{m}^3} \times \frac{26}{80} \times 0.0003 \left(\frac{\mu\text{g}}{\text{m}^3}\right)^{-1}\right) + \left(0.053 \frac{\mu\text{g}}{\text{m}^3} \times \frac{3}{80} \times 0.0003 \left(\frac{\mu\text{g}}{\text{m}^3}\right)^{-1}\right) + \left(0.053 \frac{\mu\text{g}}{\text{m}^3} \times \frac{3}{80} \times 0.0003 \left(\frac{\mu\text{g}}{\text{m}^3}\right)^{-1}\right)$$

Equation 2

$$ILCR = 5.5 \text{ E} - 06$$

A discussion of the interpretation of the calculated risk estimates is provided in Section 4.4.1 of the HHERA.

5.2.1 DPM ADDITIONAL LUNG CANCER MORTALITY (ALCM) MODEL

DPM is regarded as a non-threshold air pollutant and is considered to be carcinogenic (Health Canada 2016; 2023). In addition to the calculation of ILCRs and assessment methods outlined in Health Canada (2016), cancer risk for DPM was also estimated in the HHRA inhalation assessment using an approach recommended by Health Canada (2023). The approach was used to provide an estimate of the additional lung cancer mortality (ALCM) associated with additional DPM emissions related to the Project at the chronic PORs (i.e., POR 2-29, 39, 41). Three Project phases were evaluated: construction, operations and active closure.

5.2.1.1 APPROACH

Health Canada (2023) derived an approach to estimate ALCM based on the quantitative risk estimate of developing lung cancer from particulate matter less than or equal to 2.5 micrometres ($\text{PM}_{2.5}$) environmental exposure in Canada, which was assumed to be representative of DPM. Health Canada (2022) conducted a meta-analysis and derived a pooled hazard ratio for lung cancer mortality in Canada of 1.127 (95 percent [%] confidence interval: 1.085, 1.170) per 10 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) increase of long-term exposure to ambient $\text{PM}_{2.5}$. Health Canada (2023) used the following calculation with the pooled hazard ratio to derive a slope coefficient (β) of 0.01196:

$$e^{\beta \times 10 \mu\text{g}/\text{m}^3} = 1.127 \quad \text{Equation 3}$$

$$\beta \times 10 \mu\text{g}/\text{m}^3 = \ln 1.127$$
$$\beta = \frac{\ln 1.127}{(10 \mu\text{g}/\text{m}^3)}$$

$$\beta = 0.01196$$

ATTACHMENT D: Inhalation Model Description And Worked Example

This slope coefficient of 0.01196 was then used to estimate the ALCM associated with Project-related DPM emissions for each of the Project phases. ALCM was estimated using the following equation:

$$ALCM = \left(\frac{e^{\beta \times Exposure} - 1}{\beta \times Exposure} \right) \times Baseline\ rate \times Years \quad \text{Equation 4}$$

where:

ALCM = additional lung cancer mortality cases per 100,000 in the Canadian population

β = slope coefficient (see Equation 1 above; Health Canada 2023)

Exposure = estimated DPM (diesel exhaust PM_{2.5}) concentration from the Project ($\mu\text{g}/\text{m}^3$); which includes diesel exhaust PM_{2.5} from all Project sources (does not include baseline diesel exhaust PM_{2.5} exposure; Table D-8)

Baseline rate = baseline rate for lung cancer incidence (45.5 per 100,000; Health Canada 2023)

Years = Project or Project phase duration in years

Inputs to the calculation of ALCMs are provided in Table D-5. DPM concentrations used to calculate ALCM are provided in Table D-6.

Table D- 5: Variable Inputs for the Estimation of Additional Lung Cancer Mortality

Variable		Input	Units	Notes
β		0.01196	$(\mu\text{g}/\text{m}^3)^{-1}$ per 100,000	Slope coefficient based on the pooled hazard ratio for lung cancer mortality in Canada (Health Canada (2022), as cited in Health Canada (2023)).
Baseline mortality rate		45.5	cases per 100,000	Based on the current age standardized mortality rate for lung cancer in Canada (Canadian Cancer Society 2020, as cited in Health Canada (2023)).
Exposure		Maximum predicted annual concentration of DPM	$\mu\text{g}/\text{m}^3$	The maximum predicted annual concentration of DPM for each POR for each Project phase was used to estimate additional lung cancer mortality (See Table D-8).
Project phase duration	Construction	3	Years	Representing the primary period of Project construction (Years -3 to -1)
	Operations	26	Years	Years 1 to 26
	Active Closure	3	Years	Closure phase in planned to be 5 years (Years 27 to 31), where Years 27 to 29 represent the active closure period, Year 30 is a passive closure period, and Year 31 is the final closure period. For this assessment, active closure was selected to represent the closure scenario since there will be no Project related air emissions after this period.
Project duration	Total	32	Years	Total of all Project phases where air emissions are anticipated

Notes:

β = slope coefficient; $\mu\text{g}/\text{m}^3$ = micrograms per cubic metre; $(\mu\text{g}/\text{m}^3)^{-1}$ = per microgram per cubic metre. DPM = diesel particulate matter; POR = Point of Reception.

Table D-6: Diesel Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)

POR	Construction	Operations	Closure
POR2	0.030	0.025	0.029
POR3	0.029	0.024	0.029
POR4	0.053	0.044	0.053
POR5	0.042	0.039	0.042
POR6	0.034	0.029	0.034
POR7	0.017	0.014	0.017
POR8	0.022	0.019	0.022
POR9	0.042	0.035	0.042
POR10	0.042	0.036	0.042
POR11	0.053	0.042	0.053
POR12	0.023	0.019	0.023
POR13	0.017	0.014	0.017
POR14	0.015	0.013	0.015
POR15	0.014	0.012	0.014
POR16	0.012	0.0103	0.012
POR17	0.0101	0.0085	0.0101
POR18	0.029	0.024	0.029
POR19	0.015	0.012	0.015
POR20	0.016	0.014	0.016
POR21	0.024	0.020	0.024
POR22	0.011	0.0091	0.011
POR23	0.0084	0.0071	0.0084
POR24	0.011	0.0092	0.011
POR25	0.0053	0.0045	0.0053
POR26	0.017	0.014	0.017
POR27	0.0084	0.00701	0.0084
POR28	0.031	0.026	0.031
POR29	0.014	0.012	0.014
POR39	0.075	0.050	0.075
POR41	0.0056	0.0048	0.0056

Notes:

POR = point of reception

5.2.1.2 RESULTS

The estimated ALCM associated with Project-related DPM emissions are provided in Table D-9. The estimated ALCM values were calculated for each Project phase, as well as total incremental ALCM to estimate potential carcinogenic effects from DPM associated with all phases of the Project, which is calculated as the sum of the ALCM for the three Project phases. These estimates were compared to the Health Canada acceptable incremental lifetime cancer risk of no more than 1 in 100,000 (Health Canada 2024). The estimated ALCM values associated with the Project-related DPM emissions were less than 1 case per 100,000 for all chronic PORs for all Project phases. Therefore, lung cancer associated with Project-related DPM emissions is likely to be negligible.

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Further discussion of the interpretation of risk characterization for the Project is provided in Section 4.4.1.4.1 of the HHERA.

Example 5-3: Calculation of ALCM for the Construction Phase at POR2

$$ALCM = \left(\frac{e^{0.01196 \times 0.02921} - 1}{e^{0.01196 \times 0.02921}} \right) \times 45.5 \times 3 \quad \text{Equation 4}$$

$$ALCM = 0.05$$

Table D-7: Estimated Additional Lung Cancer Mortality Cases from the Project per 100,000 People in the Canadian Population

POR	Project Phase			
	Construction	Operations	Active Closure	Total Project ALCM
POR2	0.05	0.35	0.05	0.44
POR3	0.05	0.34	0.05	0.44
POR4	0.09	0.63	0.09	0.80
POR5	0.07	0.55	0.07	0.68
POR6	0.06	0.41	0.06	0.52
POR7	0.03	0.20	0.03	0.26
POR8	0.04	0.26	0.04	0.34
POR9	0.07	0.50	0.07	0.64
POR10	0.07	0.50	0.07	0.64
POR11	0.09	0.60	0.09	0.77
POR12	0.04	0.27	0.04	0.35
POR13	0.03	0.20	0.03	0.26
POR14	0.02	0.18	0.02	0.23
POR15	0.02	0.17	0.02	0.21
POR16	0.02	0.15	0.02	0.19
POR17	0.02	0.12	0.02	0.15
POR18	0.05	0.35	0.05	0.44
POR19	0.02	0.18	0.02	0.22
POR20	0.03	0.19	0.03	0.25
POR21	0.04	0.28	0.04	0.36
POR22	0.02	0.13	0.02	0.16
POR23	0.01	0.10	0.01	0.13
POR24	0.02	0.13	0.02	0.17
POR25	0.01	0.06	0.01	0.08
POR26	0.03	0.20	0.03	0.25
POR27	0.01	0.10	0.01	0.13
POR28	0.05	0.37	0.05	0.47
POR29	0.02	0.17	0.02	0.21
POR39	0.12	0.71	0.12	0.95
POR41	0.01	0.07	0.01	0.09
Benchmark Value (ALCM) ⁽¹⁾ = 1				

Notes:

ALCM = additional lung cancer mortality per 100,000; POR = point of reception

1 An incremental lifetime cancer risk of 1 in 100,000 is considered negligible (Health Canada 2023)).

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Sub-Attachment D1
Inhalation Assessment Inputs,
Calculations and Outputs



ATTACHMENT D1: HUMAN HEALTH INHALATION MODEL

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D1-1. Exposure Point Concentrations in Air Used for the Inhalation Assessment: The concentration of POPCs present in air relevant to human exposure.

D1-2. Calculation of Acute and Chronic Risk Estimates for Each Project Phase, POR and Parameter: Calculation of risk resulting from exposure to air parameters.

D1-3a. Maximum Acute (1-Hour) Hazard Quotients (HQs) for NO₂ and DPM in Air at PORs and MPOI: Summary of hazard quotients resulting from acute exposure to POPCs.

D1-3b. Incremental Lifetime Cancer Risk Estimates for Project Alone DPM in Air for the Indigenous Receptor: Summary of incremental lifetime cancer risks resulting from chronic exposure to DPM.

In the HHRA Inhalation model the assessment cases are represented by the following terms:

Baseline = baseline without incremental concentrations from the Project

Construction/Closure = incremental concentrations from construction or closure phase phase

Operations = incremental concentrations from Operations phase

Abbreviations:

[$\mu\text{g}/\text{m}^3$]⁻¹ = per microgram per metre cube

$\mu\text{g}/\text{m}^3$ = Microgram per cubic metre

DPM - Diesel particulate matter

HQ = Hazard quotient

ILCR = Incremental lifetime cancer risk

IUR = Inhalation unit risk

met = meteorological anomalies

MPOI = Maximum point of impingement

NO₂ = Nitrogen dioxide

POR = Point of reception

RfC = Reference concentration

TRV = Toxicity reference value

Table D1-1: Exposure Point Concentrations ($\mu\text{g}/\text{m}^3$) in Air Used for the Inhalation Assessment						
POPC	POR or MPOI	Averaging Period	Exposure group	Baseline	Construction/Closure ^(1,2)	Operations
NO ₂	POR1	1-hour	Acute	4.80	44.0	44.7
NO ₂	POR2	1-hour	Chronic	4.80	12.7	14.0
NO ₂	POR3	1-hour	Chronic	4.80	12.4	14.0
NO ₂	POR4	1-hour	Chronic	4.80	23.5	29.7
NO ₂	POR5	1-hour	Chronic	4.80	20.0	26.6
NO ₂	POR6	1-hour	Chronic	4.80	12.6	14.7
NO ₂	POR7	1-hour	Chronic	4.80	9.8	10.6
NO ₂	POR8	1-hour	Chronic	4.80	16.5	20.3
NO ₂	POR9	1-hour	Chronic	4.80	20.4	25.4
NO ₂	POR10	1-hour	Chronic	4.80	20.7	26.6
NO ₂	POR11	1-hour	Chronic	4.80	26.8	29.1
NO ₂	POR12	1-hour	Chronic	4.80	14.1	17.8
NO ₂	POR13	1-hour	Chronic	4.80	12.1	14.0
NO ₂	POR14	1-hour	Chronic	4.80	11.3	13.0
NO ₂	POR15	1-hour	Chronic	4.80	10.3	11.2
NO ₂	POR16	1-hour	Chronic	4.80	8.9	10.5
NO ₂	POR17	1-hour	Chronic	4.80	7.4	9.5
NO ₂	POR18	1-hour	Chronic	4.80	12.2	14.2
NO ₂	POR19	1-hour	Chronic	4.80	10.9	11.7
NO ₂	POR20	1-hour	Chronic	4.80	11.8	13.1
NO ₂	POR21	1-hour	Chronic	4.80	17.7	21.6
NO ₂	POR22	1-hour	Chronic	4.80	7.0	8.6
NO ₂	POR23	1-hour	Chronic	4.80	6.4	7.4
NO ₂	POR24	1-hour	Chronic	4.80	7.2	8.6
NO ₂	POR25	1-hour	Chronic	4.80	4.8	5.6
NO ₂	POR26	1-hour	Chronic	4.80	9.5	11.1
NO ₂	POR27	1-hour	Chronic	4.80	6.1	6.9
NO ₂	POR28	1-hour	Chronic	4.80	12.3	14.1
NO ₂	POR29	1-hour	Chronic	4.80	9.5	11.5
NO ₂	POR30	1-hour	Acute	4.80	7.5	8.9
NO ₂	POR31	1-hour	Acute	4.80	11.1	13.8
NO ₂	POR32	1-hour	Acute	4.80	6.8	8.1
NO ₂	POR33	1-hour	Acute	4.80	50.1	38.9
NO ₂	POR34	1-hour	Acute	4.80	40.9	33.1
NO ₂	POR35	1-hour	Acute	4.80	33.9	28.7
NO ₂	POR36	1-hour	Acute	4.80	10.3	12.0
NO ₂	POR37	1-hour	Acute	4.80	9.3	10.0
NO ₂	POR38	1-hour	Acute	4.80	7.8	8.5
NO ₂	POR39	1-hour	Chronic	4.80	43.1	50.7
NO ₂	POR40	1-hour	Acute	4.80	34.8	45.9
NO ₂	POR41	1-hour	Chronic	4.80	4.7	5.9
NO ₂	MPOI (Max, with met removed)	1-hour	Acute	4.80	50.8	68.9

Table D1-1: Exposure Point Concentrations ($\mu\text{g}/\text{m}^3$) in Air Used for the Inhalation Assessment						
POPC	POR or MPOI	Averaging Period	Exposure group	Baseline	Construction/Closure ^(1,2)	Operations
DPM	POR1	1-hour	Acute	0.46	4.36	3.66
DPM	POR2	1-hour	Chronic	0.46	2.52	2.60
DPM	POR3	1-hour	Chronic	0.46	2.57	2.59
DPM	POR4	1-hour	Chronic	0.46	3.13	3.11
DPM	POR5	1-hour	Chronic	0.46	3.44	3.38
DPM	POR6	1-hour	Chronic	0.46	2.42	2.55
DPM	POR7	1-hour	Chronic	0.46	3.01	2.53
DPM	POR8	1-hour	Chronic	0.46	2.38	2.16
DPM	POR9	1-hour	Chronic	0.46	2.77	2.75
DPM	POR10	1-hour	Chronic	0.46	2.65	2.60
DPM	POR11	1-hour	Chronic	0.46	3.17	2.49
DPM	POR12	1-hour	Chronic	0.46	1.85	2.08
DPM	POR13	1-hour	Chronic	0.46	1.56	1.51
DPM	POR14	1-hour	Chronic	0.46	1.50	1.43
DPM	POR15	1-hour	Chronic	0.46	1.27	1.29
DPM	POR16	1-hour	Chronic	0.46	1.51	1.70
DPM	POR17	1-hour	Chronic	0.46	1.38	1.07
DPM	POR18	1-hour	Chronic	0.46	2.61	2.59
DPM	POR19	1-hour	Chronic	0.46	1.36	1.26
DPM	POR20	1-hour	Chronic	0.46	1.48	1.40
DPM	POR21	1-hour	Chronic	0.46	4.62	4.23
DPM	POR22	1-hour	Chronic	0.46	1.37	1.21
DPM	POR23	1-hour	Chronic	0.46	1.40	1.46
DPM	POR24	1-hour	Chronic	0.46	2.99	2.77
DPM	POR25	1-hour	Chronic	0.46	1.04	0.89
DPM	POR26	1-hour	Chronic	0.46	3.39	3.17
DPM	POR27	1-hour	Chronic	0.46	1.17	1.11
DPM	POR28	1-hour	Chronic	0.46	2.46	2.57
DPM	POR29	1-hour	Chronic	0.46	1.63	1.46
DPM	POR30	1-hour	Acute	0.46	0.27	0.24
DPM	POR31	1-hour	Acute	0.46	0.37	0.30
DPM	POR32	1-hour	Acute	0.46	0.30	0.24
DPM	POR33	1-hour	Acute	0.46	2.29	1.54
DPM	POR34	1-hour	Acute	0.46	1.76	1.24
DPM	POR35	1-hour	Acute	0.46	1.42	1.04
DPM	POR36	1-hour	Acute	0.46	0.34	0.27
DPM	POR37	1-hour	Acute	0.46	0.52	0.37
DPM	POR38	1-hour	Acute	0.46	0.47	0.34
DPM	POR39	1-hour	Chronic	0.46	2.30	2.24
DPM	POR40	1-hour	Acute	0.46	1.46	1.66
DPM	POR41	1-hour	Chronic	0.46	1.24	1.05
DPM	MPOI (Max, with met removed)	1-hour	Acute	0.46	28.34	28.61

Table D1-1: Exposure Point Concentrations ($\mu\text{g}/\text{m}^3$) in Air Used for the Inhalation Assessment						
POPC	POR or MPOI	Averaging Period	Exposure group	Baseline	Construction/Closure ^(1,2)	Operations
DPM	POR2	Annual	Chronic	0.09	0.03	0.02
DPM	POR3	Annual	Chronic	0.09	0.03	0.02
DPM	POR4	Annual	Chronic	0.09	0.05	0.04
DPM	POR5	Annual	Chronic	0.09	0.04	0.04
DPM	POR6	Annual	Chronic	0.09	0.03	0.03
DPM	POR7	Annual	Chronic	0.09	0.02	0.01
DPM	POR8	Annual	Chronic	0.09	0.02	0.02
DPM	POR9	Annual	Chronic	0.09	0.04	0.04
DPM	POR10	Annual	Chronic	0.09	0.04	0.04
DPM	POR11	Annual	Chronic	0.09	0.05	0.04
DPM	POR12	Annual	Chronic	0.09	0.02	0.02
DPM	POR13	Annual	Chronic	0.09	0.02	0.01
DPM	POR14	Annual	Chronic	0.09	0.01	0.01
DPM	POR15	Annual	Chronic	0.09	0.01	0.01
DPM	POR16	Annual	Chronic	0.09	0.01	0.01
DPM	POR17	Annual	Chronic	0.09	0.01	0.01
DPM	POR18	Annual	Chronic	0.09	0.03	0.02
DPM	POR19	Annual	Chronic	0.09	0.01	0.01
DPM	POR20	Annual	Chronic	0.09	0.02	0.01
DPM	POR21	Annual	Chronic	0.09	0.02	0.02
DPM	POR22	Annual	Chronic	0.09	0.01	0.01
DPM	POR23	Annual	Chronic	0.09	0.01	0.01
DPM	POR24	Annual	Chronic	0.09	0.01	0.01
DPM	POR25	Annual	Chronic	0.09	0.01	0.00
DPM	POR26	Annual	Chronic	0.09	0.02	0.01
DPM	POR27	Annual	Chronic	0.09	0.01	0.01
DPM	POR28	Annual	Chronic	0.09	0.03	0.03
DPM	POR29	Annual	Chronic	0.09	0.01	0.01
DPM	POR39	Annual	Chronic	0.09	0.08	0.05
DPM	POR41	Annual	Chronic	0.09	0.01	0.005

Notes: DPM= diesel particulate matter; MPOI= maximum point of impingement; NO₂= nitrogen dioxide; POPC= parameter of potential concern; POR= point of reception

1. Air emissions associated with the Project during Active Closure are assumed to be the same as during Construction.
2. Air emissions associated with the Project are assumed to be 0 during Post-Closure (following Project decommissioning).

Table D1-2: Calculation of Acute and Chronic Risk Estimates (Hazard Quotient or Incremental Lifetime Cancer Risks) for Each Project Phase, POR and Parameter ^(1,2)

Phase	POR ID	Parameter	POR Type	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	TRV RfC ($\mu\text{g}/\text{m}^3$)	HQ (Unitless)	TRV IUR ($\mu\text{g}/\text{m}^3$) ⁻¹	ILCR (Unitless)
Operations	POR2	DPM	Chronic	Annual	0.025	N/A	N/A	0.0003	2.41E-06
Operations	POR3	DPM	Chronic	Annual	0.024	N/A	N/A	0.0003	2.35E-06
Operations	POR4	DPM	Chronic	Annual	0.044	N/A	N/A	0.0003	4.33E-06
Operations	POR5	DPM	Chronic	Annual	0.039	N/A	N/A	0.0003	3.76E-06
Operations	POR6	DPM	Chronic	Annual	0.029	N/A	N/A	0.0003	2.83E-06
Operations	POR7	DPM	Chronic	Annual	0.014	N/A	N/A	0.0003	1.38E-06
Operations	POR8	DPM	Chronic	Annual	0.019	N/A	N/A	0.0003	1.82E-06
Operations	POR9	DPM	Chronic	Annual	0.035	N/A	N/A	0.0003	3.44E-06
Operations	POR10	DPM	Chronic	Annual	0.036	N/A	N/A	0.0003	3.47E-06
Operations	POR11	DPM	Chronic	Annual	0.042	N/A	N/A	0.0003	4.12E-06
Operations	POR12	DPM	Chronic	Annual	0.019	N/A	N/A	0.0003	1.88E-06
Operations	POR13	DPM	Chronic	Annual	0.014	N/A	N/A	0.0003	1.41E-06
Operations	POR14	DPM	Chronic	Annual	0.013	N/A	N/A	0.0003	1.22E-06
Operations	POR15	DPM	Chronic	Annual	0.012	N/A	N/A	0.0003	1.14E-06
Operations	POR16	DPM	Chronic	Annual	0.010	N/A	N/A	0.0003	1.00E-06
Operations	POR17	DPM	Chronic	Annual	0.009	N/A	N/A	0.0003	8.31E-07
Operations	POR18	DPM	Chronic	Annual	0.024	N/A	N/A	0.0003	2.38E-06
Operations	POR19	DPM	Chronic	Annual	0.012	N/A	N/A	0.0003	1.21E-06
Operations	POR20	DPM	Chronic	Annual	0.014	N/A	N/A	0.0003	1.34E-06
Operations	POR21	DPM	Chronic	Annual	0.020	N/A	N/A	0.0003	1.92E-06
Operations	POR22	DPM	Chronic	Annual	0.009	N/A	N/A	0.0003	8.88E-07
Operations	POR23	DPM	Chronic	Annual	0.007	N/A	N/A	0.0003	6.89E-07
Operations	POR24	DPM	Chronic	Annual	0.009	N/A	N/A	0.0003	8.97E-07
Operations	POR25	DPM	Chronic	Annual	0.004	N/A	N/A	0.0003	4.35E-07
Operations	POR26	DPM	Chronic	Annual	0.014	N/A	N/A	0.0003	1.35E-06
Operations	POR27	DPM	Chronic	Annual	0.007	N/A	N/A	0.0003	6.83E-07
Operations	POR28	DPM	Chronic	Annual	0.026	N/A	N/A	0.0003	2.56E-06
Operations	POR29	DPM	Chronic	Annual	0.012	N/A	N/A	0.0003	1.14E-06
Operations	POR1	NO2	Acute	1hr	44.7	79	0.57	N/A	N/A
Operations	POR2	NO2	Chronic	1hr	14.0	79	0.18	N/A	N/A
Operations	POR3	NO2	Chronic	1hr	14.0	79	0.18	N/A	N/A
Operations	POR4	NO2	Chronic	1hr	29.7	79	0.38	N/A	N/A
Operations	POR5	NO2	Chronic	1hr	26.6	79	0.34	N/A	N/A
Operations	POR6	NO2	Chronic	1hr	14.7	79	0.19	N/A	N/A
Operations	POR7	NO2	Chronic	1hr	10.6	79	0.13	N/A	N/A
Operations	POR8	NO2	Chronic	1hr	20.3	79	0.26	N/A	N/A
Operations	POR9	NO2	Chronic	1hr	25.4	79	0.32	N/A	N/A
Operations	POR10	NO2	Chronic	1hr	26.6	79	0.34	N/A	N/A
Operations	POR11	NO2	Chronic	1hr	29.1	79	0.37	N/A	N/A
Operations	POR12	NO2	Chronic	1hr	17.8	79	0.22	N/A	N/A
Operations	POR13	NO2	Chronic	1hr	14.0	79	0.18	N/A	N/A
Operations	POR14	NO2	Chronic	1hr	13.0	79	0.16	N/A	N/A
Operations	POR15	NO2	Chronic	1hr	11.2	79	0.14	N/A	N/A
Operations	POR16	NO2	Chronic	1hr	10.5	79	0.13	N/A	N/A
Operations	POR17	NO2	Chronic	1hr	9.5	79	0.12	N/A	N/A
Operations	POR18	NO2	Chronic	1hr	14.2	79	0.18	N/A	N/A
Operations	POR19	NO2	Chronic	1hr	11.7	79	0.15	N/A	N/A
Operations	POR20	NO2	Chronic	1hr	13.1	79	0.17	N/A	N/A
Operations	POR21	NO2	Chronic	1hr	21.6	79	0.27	N/A	N/A
Operations	POR22	NO2	Chronic	1hr	8.6	79	0.11	N/A	N/A
Operations	POR23	NO2	Chronic	1hr	7.4	79	0.09	N/A	N/A
Operations	POR24	NO2	Chronic	1hr	8.6	79	0.11	N/A	N/A
Operations	POR25	NO2	Chronic	1hr	5.6	79	0.07	N/A	N/A
Operations	POR26	NO2	Chronic	1hr	11.1	79	0.14	N/A	N/A
Operations	POR27	NO2	Chronic	1hr	6.9	79	0.09	N/A	N/A
Operations	POR28	NO2	Chronic	1hr	14.1	79	0.18	N/A	N/A
Operations	POR29	NO2	Chronic	1hr	11.5	79	0.15	N/A	N/A
Operations	POR30	NO2	Acute	1hr	8.9	79	0.11	N/A	N/A
Operations	POR31	NO2	Acute	1hr	13.8	79	0.17	N/A	N/A
Operations	POR32	NO2	Acute	1hr	8.1	79	0.10	N/A	N/A
Operations	POR33	NO2	Acute	1hr	38.9	79	0.49	N/A	N/A
Operations	POR34	NO2	Acute	1hr	33.1	79	0.42	N/A	N/A
Operations	POR35	NO2	Acute	1hr	28.7	79	0.36	N/A	N/A
Operations	POR36	NO2	Acute	1hr	12.0	79	0.15	N/A	N/A
Operations	POR37	NO2	Acute	1hr	10.0	79	0.13	N/A	N/A
Operations	POR38	NO2	Acute	1hr	8.5	79	0.11	N/A	N/A
Operations	POR1	DPM	Acute	1hr	3.7	10	0.37	N/A	N/A
Operations	POR2	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Operations	POR3	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Operations	POR4	DPM	Chronic	1hr	3.1	10	0.31	N/A	N/A
Operations	POR5	DPM	Chronic	1hr	3.4	10	0.34	N/A	N/A
Operations	POR6	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Operations	POR7	DPM	Chronic	1hr	2.5	10	0.25	N/A	N/A
Operations	POR8	DPM	Chronic	1hr	2.2	10	0.22	N/A	N/A
Operations	POR9	DPM	Chronic	1hr	2.7	10	0.27	N/A	N/A
Operations	POR10	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Operations	POR11	DPM	Chronic	1hr	2.5	10	0.25	N/A	N/A
Operations	POR12	DPM	Chronic	1hr	2.1	10	0.21	N/A	N/A
Operations	POR13	DPM	Chronic	1hr	1.5	10	0.15	N/A	N/A
Operations	POR14	DPM	Chronic	1hr	1.4	10	0.14	N/A	N/A
Operations	POR15	DPM	Chronic	1hr	1.3	10	0.13	N/A	N/A
Operations	POR16	DPM	Chronic	1hr	1.7	10	0.17	N/A	N/A
Operations	POR17	DPM	Chronic	1hr	1.1	10	0.11	N/A	N/A
Operations	POR18	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Operations	POR19	DPM	Chronic	1hr	1.3	10	0.13	N/A	N/A
Operations	POR20	DPM	Chronic	1hr	1.4	10	0.14	N/A	N/A
Operations	POR21	DPM	Chronic	1hr	4.2	10	0.42	N/A	N/A
Operations	POR22	DPM	Chronic	1hr	1.2	10	0.12	N/A	N/A
Operations	POR23	DPM	Chronic	1hr	1.5	10	0.15	N/A	N/A
Operations	POR24	DPM	Chronic	1hr	2.8	10	0.28	N/A	N/A
Operations	POR25	DPM	Chronic	1hr	0.89	10	0.09	N/A	N/A
Operations	POR26	DPM	Chronic	1hr	3.1732	10	0.32	N/A	N/A
Operations	POR27	DPM	Chronic	1hr	1.1	10	0.11	N/A	N/A
Operations	POR28	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Operations	POR29	DPM	Chronic	1hr	1.5	10	0.15	N/A	N/A

Table D1-2: Calculation of Acute and Chronic Risk Estimates (Hazard Quotient or Incremental Lifetime Cancer Risks) for Each Project Phase, POR and Parameter ^(1,2)									
Phase	POR ID	Parameter	POR Type	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	TRV RfC ($\mu\text{g}/\text{m}^3$)	HQ (Unitless)	TRV IUR ($\mu\text{g}/\text{m}^3$) ⁻¹	ILCR (Unitless)
Operations	POR30	DPM	Acute	1hr	0.24	10	0.02	N/A	N/A
Operations	POR31	DPM	Acute	1hr	0.30	10	0.03	N/A	N/A
Operations	POR32	DPM	Acute	1hr	0.24	10	0.02	N/A	N/A
Operations	POR33	DPM	Acute	1hr	1.54	10	0.15	N/A	N/A
Operations	POR34	DPM	Acute	1hr	1.24	10	0.12	N/A	N/A
Operations	POR35	DPM	Acute	1hr	1.04	10	0.10	N/A	N/A
Operations	POR36	DPM	Acute	1hr	0.27	10	0.03	N/A	N/A
Operations	POR37	DPM	Acute	1hr	0.37	10	0.04	N/A	N/A
Operations	POR38	DPM	Acute	1hr	0.34	10	0.03	N/A	N/A
Operations	POR39	DPM	Chronic	Annual	0.050	N/A	N/A	0.0003	4.88E-06
Operations	POR39	NO2	Chronic	1hr	50.7	79	0.64	N/A	N/A
Operations	POR39	DPM	Chronic	1hr	2.2	10	0.22	N/A	N/A
Operations	POR40	NO2	Acute	1hr	45.9	79	0.58	N/A	N/A
Operations	POR40	DPM	Acute	1hr	1.7	10	0.17	N/A	N/A
Construction/Closure	POR2	DPM	Chronic	Annual	0.029	N/A	N/A	0.0003	6.57E-07
Construction/Closure	POR3	DPM	Chronic	Annual	0.029	N/A	N/A	0.0003	6.45E-07
Construction/Closure	POR4	DPM	Chronic	Annual	0.053	N/A	N/A	0.0003	1.20E-06
Construction/Closure	POR5	DPM	Chronic	Annual	0.042	N/A	N/A	0.0003	9.51E-07
Construction/Closure	POR6	DPM	Chronic	Annual	0.034	N/A	N/A	0.0003	7.68E-07
Construction/Closure	POR7	DPM	Chronic	Annual	0.017	N/A	N/A	0.0003	3.87E-07
Construction/Closure	POR8	DPM	Chronic	Annual	0.022	N/A	N/A	0.0003	4.97E-07
Construction/Closure	POR9	DPM	Chronic	Annual	0.042	N/A	N/A	0.0003	9.55E-07
Construction/Closure	POR10	DPM	Chronic	Annual	0.042	N/A	N/A	0.0003	9.48E-07
Construction/Closure	POR11	DPM	Chronic	Annual	0.053	N/A	N/A	0.0003	1.20E-06
Construction/Closure	POR12	DPM	Chronic	Annual	0.023	N/A	N/A	0.0003	5.13E-07
Construction/Closure	POR13	DPM	Chronic	Annual	0.017	N/A	N/A	0.0003	3.82E-07
Construction/Closure	POR14	DPM	Chronic	Annual	0.015	N/A	N/A	0.0003	3.31E-07
Construction/Closure	POR15	DPM	Chronic	Annual	0.014	N/A	N/A	0.0003	3.10E-07
Construction/Closure	POR16	DPM	Chronic	Annual	0.012	N/A	N/A	0.0003	2.74E-07
Construction/Closure	POR17	DPM	Chronic	Annual	0.010	N/A	N/A	0.0003	2.27E-07
Construction/Closure	POR18	DPM	Chronic	Annual	0.029	N/A	N/A	0.0003	6.55E-07
Construction/Closure	POR19	DPM	Chronic	Annual	0.015	N/A	N/A	0.0003	3.29E-07
Construction/Closure	POR20	DPM	Chronic	Annual	0.016	N/A	N/A	0.0003	3.65E-07
Construction/Closure	POR21	DPM	Chronic	Annual	0.024	N/A	N/A	0.0003	5.31E-07
Construction/Closure	POR22	DPM	Chronic	Annual	0.011	N/A	N/A	0.0003	2.48E-07
Construction/Closure	POR23	DPM	Chronic	Annual	0.008	N/A	N/A	0.0003	1.90E-07
Construction/Closure	POR24	DPM	Chronic	Annual	0.011	N/A	N/A	0.0003	2.50E-07
Construction/Closure	POR25	DPM	Chronic	Annual	0.0053	N/A	N/A	0.0003	1.19E-07
Construction/Closure	POR26	DPM	Chronic	Annual	0.017	N/A	N/A	0.0003	3.79E-07
Construction/Closure	POR27	DPM	Chronic	Annual	0.0084	N/A	N/A	0.0003	1.88E-07
Construction/Closure	POR28	DPM	Chronic	Annual	0.031	N/A	N/A	0.0003	6.97E-07
Construction/Closure	POR29	DPM	Chronic	Annual	0.014	N/A	N/A	0.0003	3.10E-07
Construction/Closure	POR1	NO2	Acute	1hr	44.0	79	0.56	N/A	N/A
Construction/Closure	POR2	NO2	Chronic	1hr	12.7	79	0.16	N/A	N/A
Construction/Closure	POR3	NO2	Chronic	1hr	12.4	79	0.16	N/A	N/A
Construction/Closure	POR4	NO2	Chronic	1hr	23.5	79	0.30	N/A	N/A
Construction/Closure	POR5	NO2	Chronic	1hr	20.0	79	0.25	N/A	N/A
Construction/Closure	POR6	NO2	Chronic	1hr	12.6	79	0.16	N/A	N/A
Construction/Closure	POR7	NO2	Chronic	1hr	9.8	79	0.12	N/A	N/A
Construction/Closure	POR8	NO2	Chronic	1hr	16.5	79	0.21	N/A	N/A
Construction/Closure	POR9	NO2	Chronic	1hr	20.4	79	0.26	N/A	N/A
Construction/Closure	POR10	NO2	Chronic	1hr	20.7	79	0.26	N/A	N/A
Construction/Closure	POR11	NO2	Chronic	1hr	26.8	79	0.34	N/A	N/A
Construction/Closure	POR12	NO2	Chronic	1hr	14.1	79	0.18	N/A	N/A
Construction/Closure	POR13	NO2	Chronic	1hr	12.1	79	0.15	N/A	N/A
Construction/Closure	POR14	NO2	Chronic	1hr	11.3	79	0.14	N/A	N/A
Construction/Closure	POR15	NO2	Chronic	1hr	10.3	79	0.13	N/A	N/A
Construction/Closure	POR16	NO2	Chronic	1hr	8.9	79	0.11	N/A	N/A
Construction/Closure	POR17	NO2	Chronic	1hr	7.4	79	0.09	N/A	N/A
Construction/Closure	POR18	NO2	Chronic	1hr	12.2	79	0.15	N/A	N/A
Construction/Closure	POR19	NO2	Chronic	1hr	10.9	79	0.14	N/A	N/A
Construction/Closure	POR20	NO2	Chronic	1hr	11.8	79	0.15	N/A	N/A
Construction/Closure	POR21	NO2	Chronic	1hr	17.7	79	0.22	N/A	N/A
Construction/Closure	POR22	NO2	Chronic	1hr	7.0	79	0.09	N/A	N/A
Construction/Closure	POR23	NO2	Chronic	1hr	6.4	79	0.08	N/A	N/A
Construction/Closure	POR24	NO2	Chronic	1hr	7.2	79	0.09	N/A	N/A
Construction/Closure	POR25	NO2	Chronic	1hr	4.8	79	0.06	N/A	N/A
Construction/Closure	POR26	NO2	Chronic	1hr	9.5	79	0.12	N/A	N/A
Construction/Closure	POR27	NO2	Chronic	1hr	6.1	79	0.08	N/A	N/A
Construction/Closure	POR28	NO2	Chronic	1hr	12.3	79	0.16	N/A	N/A
Construction/Closure	POR29	NO2	Chronic	1hr	9.5	79	0.12	N/A	N/A
Construction/Closure	POR30	NO2	Acute	1hr	7.5	79	0.09	N/A	N/A
Construction/Closure	POR31	NO2	Acute	1hr	11.1	79	0.14	N/A	N/A
Construction/Closure	POR32	NO2	Acute	1hr	6.8	79	0.09	N/A	N/A
Construction/Closure	POR33	NO2	Acute	1hr	50.1	79	0.63	N/A	N/A
Construction/Closure	POR34	NO2	Acute	1hr	40.9	79	0.52	N/A	N/A
Construction/Closure	POR35	NO2	Acute	1hr	33.9	79	0.43	N/A	N/A
Construction/Closure	POR36	NO2	Acute	1hr	10.3	79	0.13	N/A	N/A
Construction/Closure	POR37	NO2	Acute	1hr	9.3	79	0.12	N/A	N/A
Construction/Closure	POR38	NO2	Acute	1hr	7.8	79	0.10	N/A	N/A

Phase	POR ID	Parameter	POR Type	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	TRV Rfc ($\mu\text{g}/\text{m}^3$)	HQ (Unitless)	TRV IUR ($\mu\text{g}/\text{m}^3$) ⁻¹	ILCR (Unitless)
Construction/Closure	POR1	DPM	Acute	1hr	4.4	10	0.44	N/A	N/A
Construction/Closure	POR2	DPM	Chronic	1hr	2.5	10	0.25	N/A	N/A
Construction/Closure	POR3	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Construction/Closure	POR4	DPM	Chronic	1hr	3.1	10	0.31	N/A	N/A
Construction/Closure	POR5	DPM	Chronic	1hr	3.4	10	0.34	N/A	N/A
Construction/Closure	POR6	DPM	Chronic	1hr	2.4	10	0.24	N/A	N/A
Construction/Closure	POR7	DPM	Chronic	1hr	3.0	10	0.30	N/A	N/A
Construction/Closure	POR8	DPM	Chronic	1hr	2.4	10	0.24	N/A	N/A
Construction/Closure	POR9	DPM	Chronic	1hr	2.8	10	0.28	N/A	N/A
Construction/Closure	POR10	DPM	Chronic	1hr	2.7	10	0.27	N/A	N/A
Construction/Closure	POR11	DPM	Chronic	1hr	3.2	10	0.32	N/A	N/A
Construction/Closure	POR12	DPM	Chronic	1hr	1.8	10	0.18	N/A	N/A
Construction/Closure	POR13	DPM	Chronic	1hr	1.6	10	0.16	N/A	N/A
Construction/Closure	POR14	DPM	Chronic	1hr	1.5	10	0.15	N/A	N/A
Construction/Closure	POR15	DPM	Chronic	1hr	1.3	10	0.13	N/A	N/A
Construction/Closure	POR16	DPM	Chronic	1hr	1.5	10	0.15	N/A	N/A
Construction/Closure	POR17	DPM	Chronic	1hr	1.4	10	0.14	N/A	N/A
Construction/Closure	POR18	DPM	Chronic	1hr	2.6	10	0.26	N/A	N/A
Construction/Closure	POR19	DPM	Chronic	1hr	1.4	10	0.14	N/A	N/A
Construction/Closure	POR20	DPM	Chronic	1hr	1.5	10	0.15	N/A	N/A
Construction/Closure	POR21	DPM	Chronic	1hr	4.6	10	0.46	N/A	N/A
Construction/Closure	POR22	DPM	Chronic	1hr	1.4	10	0.14	N/A	N/A
Construction/Closure	POR23	DPM	Chronic	1hr	1.4	10	0.14	N/A	N/A
Construction/Closure	POR24	DPM	Chronic	1hr	3.0	10	0.30	N/A	N/A
Construction/Closure	POR25	DPM	Chronic	1hr	1.0	10	0.10	N/A	N/A
Construction/Closure	POR26	DPM	Chronic	1hr	3.4	10	0.34	N/A	N/A
Construction/Closure	POR27	DPM	Chronic	1hr	1.2	10	0.12	N/A	N/A
Construction/Closure	POR28	DPM	Chronic	1hr	2.5	10	0.25	N/A	N/A
Construction/Closure	POR29	DPM	Chronic	1hr	1.6	10	0.16	N/A	N/A
Construction/Closure	POR30	DPM	Acute	1hr	0.27	10	0.03	N/A	N/A
Construction/Closure	POR31	DPM	Acute	1hr	0.37	10	0.04	N/A	N/A
Construction/Closure	POR32	DPM	Acute	1hr	0.30	10	0.03	N/A	N/A
Construction/Closure	POR33	DPM	Acute	1hr	2.3	10	0.23	N/A	N/A
Construction/Closure	POR34	DPM	Acute	1hr	1.8	10	0.18	N/A	N/A
Construction/Closure	POR35	DPM	Acute	1hr	1.4	10	0.14	N/A	N/A
Construction/Closure	POR36	DPM	Acute	1hr	0.34	10	0.03	N/A	N/A
Construction/Closure	POR37	DPM	Acute	1hr	0.52	10	0.05	N/A	N/A
Construction/Closure	POR38	DPM	Acute	1hr	0.47	10	0.05	N/A	N/A
Construction/Closure	POR39	DPM	Chronic	Annual	0.075	N/A	N/A	0.0003	1.70E-06
Construction/Closure	POR39	NO2	Chronic	1hr	43.1	79	0.55	N/A	N/A
Construction/Closure	POR39	DPM	Chronic	1hr	2.3	10	0.23	N/A	N/A
Construction/Closure	POR40	NO2	Acute	1hr	34.8	79	0.44	N/A	N/A
Construction/Closure	POR40	DPM	Acute	1hr	1.5	10	0.15	N/A	N/A
Operations	MPOI	NO2	Acute	1hr	68.9	79	0.87	N/A	N/A
Operations	MPOI	DPM	Acute	1hr	28.6	10	2.9	N/A	N/A
Construction/Closure	MPOI	NO2	Acute	1hr	50.8	79	0.64	N/A	N/A
Construction/Closure	MPOI	DPM	Acute	1hr	28.3	10	2.8	N/A	N/A
Baseline	POR41	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR41	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR41	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Construction/Closure	POR41	DPM	Chronic	Annual	0.0056	N/A	N/A	0.0003	1.26E-07
Construction/Closure	POR41	NO2	Chronic	1hr	4.7	79	0.060	N/A	N/A
Construction/Closure	POR41	DPM	Chronic	1hr	1.2	10	0.124	N/A	N/A
Operations	POR41	DPM	Chronic	Annual	0.0048	N/A	N/A	0.0003	4.63E-07
Operations	POR41	NO2	Chronic	1hr	5.9	79	0.075	N/A	N/A
Operations	POR41	DPM	Chronic	1hr	1.05	10	0.105	N/A	N/A
Baseline	POR2	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR3	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR4	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR5	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR6	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR7	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR8	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR9	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR10	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR11	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR12	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR13	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR14	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR15	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR16	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR17	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR18	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR19	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR20	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR21	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR22	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR23	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR24	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR25	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR26	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR27	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR28	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR29	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A

Table D1-2: Calculation of Acute and Chronic Risk Estimates (Hazard Quotient or Incremental Lifetime Cancer Risks) for Each Project Phase, POR and Parameter ^(1,2)									
Phase	POR ID	Parameter	POR Type	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$)	TRV RfC ($\mu\text{g}/\text{m}^3$)	HQ (Unitless)	TRV IUR ($\mu\text{g}/\text{m}^3$) ⁻¹	ILCR (Unitless)
Baseline	POR1	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR2	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR3	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR4	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR5	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR6	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR7	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR8	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR9	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR10	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR11	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR12	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR13	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR14	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR15	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR16	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR17	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR18	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR19	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR20	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR21	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR22	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR23	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR24	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR25	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR26	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR27	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR28	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR29	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR30	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR31	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR32	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR33	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR34	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR35	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR36	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR37	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR38	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR1	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR2	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR3	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR4	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR5	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR6	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR7	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR8	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR9	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR10	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR11	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR12	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR13	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR14	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR15	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR16	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR17	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR18	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR19	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR20	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR21	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR22	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR23	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR24	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR25	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR26	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR27	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR28	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR29	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR30	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR31	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR32	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR33	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR34	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR35	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR36	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR37	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR38	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR39	DPM	Chronic	Annual	0.089	N/A	N/A	0.0003	N/A
Baseline	POR39	NO2	Chronic	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR39	DPM	Chronic	1hr	0.46	10	0.046	N/A	N/A
Baseline	POR40	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	POR40	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A
Baseline	MPOI	NO2	Acute	1hr	4.8	79	0.061	N/A	N/A
Baseline	MPOI	DPM	Acute	1hr	0.46	10	0.046	N/A	N/A

Notes: DPM= diesel particulate matter; hr= hour; ILCR= incremental lifetime cancer risk; IUR= inhalation unit risk; MPOI= maximum point of impingement; NO₂= nitrogen dioxide; POPC= parameter of potential concern; POR= point of reception; RfC= reference concentration; TRV= toxicity reference value; $\mu\text{g}/\text{m}^3$ = micrograms per metre; $(\mu\text{g}/\text{m}^3)^{-1}$ = per microgram per unit metre

Bold = HQ is above target risk of 1 or ILCR is above the target risk threshold of 1 in 100,000 (i.e., 10E-05)

1. Air emissions associated with the Project during Active Closure are assumed to be the same as during Construction.
2. Air emissions associated with the Project are assumed to be 0 during Post-Closure (following Project decommissioning).

Table D1-3a: Maximum Acute (1-Hour) Hazard Quotients (HQs) for NO₂ and DPM in Air at PORs and MPOI

POPC	Exposure Period	Receptor Group	Risk Estimate	Baseline	Project Alone ⁽²⁾		Project + Baseline ⁽²⁾		POR with Max HQ
					Construction/ Closure ⁽¹⁾	Operations	Construction/ Closure ⁽¹⁾	Operations	
NO ₂	1-Hour	MPOI	HQ	0.06	0.64	0.87	0.70	0.93	N/A
NO ₂	1-Hour	Air Quality POR	HQ	0.06	0.56	0.57	0.62	0.63	POR1
NO ₂	1-Hour	Additional POR	HQ	0.06	0.63	0.64	0.70	0.70	POR33 - Construction/ Active Closure POR39 - Operations
DPM	1-Hour	MPOI	HQ	0.046	2.8	2.9	2.9	2.9	N/A
DPM	1-Hour	Air Quality POR	HQ	0.046	0.46	0.42	0.51	0.47	POR21
DPM	1-Hour	Additional POR	HQ	0.046	0.23	0.22	0.28	0.27	POR39

Notes: DPM= diesel particulate matter; HQ= hazard quotient; MPOI= maximum point of impingement; NO₂= nitrogen dioxide; POPC= parameter of potential concern; POR= point of reception

1. Air emissions associated with the Project during Active Closure are assumed to be the same as during Construction.
2. Air emissions associated with the Project are assumed to be 0 during Post-Closure (following Project decommissioning).

Bold = HQ is above target risk of 1.

Table D1-3b: Incremental Lifetime Cancer Risk Estimates for Project Alone DPM in Air for the Indigenous Receptor

POPC	Exposure Period	Receptor Group	Risk Estimate	Construction/ Active Closure ⁽¹⁾	Operations	Total ILCR ⁽²⁾	POR with Max ILCR
DPM	Annual	Air Quality POR	ILCR	1.2E-06	4.3E-06	5.5E-06	POR4
DPM	Annual	Additional POR	ILCR	1.7E-06	4.9E-06	6.6E-06	POR39

Notes: DPM= diesel particular matter; ILCR= incremental lifetime cancer risk; POPC = parameter of potential concern; POR= point of reception

ILCR is based on an lifespan of 80 years.

1. Air emissions associated with the Project during Active Closure are assumed to be the same as during Construction.
2. Air emissions associated with the Project are assumed to be 0 during Post-Closure (following Project decommissioning).

Bold = ILCR is above the target risk threshold of 1 in 100,000 (i.e., 10E-05)

Attachment E

HHRA Multi-media Model Description



1 HUMAN HEALTH MULTI-MEDIA MODEL

The human health risk assessment (HHRA) is focused on evaluating potential human health risks associated with the Great Bear Gold Project (Project). Individuals that reside in or visit the area surrounding the Project, defined as the local study area (LSA) and regional study area (RSA) (see Figures 2-2 and 2-3 of the human health and ecological risk assessment (HHERA) report) may be exposed to Project related parameters of potential concern (POPCs) in site media which may include air, soil, groundwater, surface water and foods. Exposure to these POPCs may be through primary exposure pathways such as soil contact and ingestion of surface water as drinking water, as well as through secondary exposure pathways, such as food ingestion.

This attachment describes the multi-media model used in the HHRA to evaluate potential human health exposure and risks associated with the applicable receptor-pathway-POPC combinations carried forward after the human health Tier 2 Screening, as described in Section 4.1.1 and Attachment C (Screening) of the HHERA report. POPC carried forward for evaluation in the multi-media model include:

- Arsenic: Retained based on concentrations above human health screening criteria for soil (see Attachment C).
- Mercury: Retained due to bioaccumulation potential and identified as a parameter of concern to the public/community; no concentration above human health screening criteria was identified (see Attachment C).
- Selenium: Retained due to bioaccumulation potential; no concentrations above human health screening criteria (see Attachment C).

The multi-media model considers potential exposure to POPC originating from Project activities in all site media except air. Direct exposure to POPCs originating from Project activities may also occur through the inhalation of airborne emissions. Inhalation exposure and risk estimates were evaluated separately from other media in an Inhalation Assessment, presented in Attachment D.

The multi-media model inputs, equations and assumptions for the multi-media assessment, are described herein, including sample calculations. The approach used to estimate concentrations in various environmental media and assess potential risk to human health from the Project align with guidance provided by Health Canada (Health Canada 2023 and Health Canada 2024) and the United States Environmental Protection Agency (US EPA 2005a,b,c).

2 RECEPTOR CHARACTERIZATION

As described in Section 4.1.2 of the HHERA report, receptors assessed in the HHRA were selected based on the identification of persons with the greatest potential to be adversely affected by POPC exposures originating from the Project. The receptors selected for evaluation are based on current and future use of the area around the Project and are intended to represent a range of possible exposure scenarios.

For the purposes of the Air Quality assessment (WSP, 2025a), 29 points of reception (PORs) were selected to represent areas with human activity within the LSA and RSA, which may include traditional land and resources uses. These PORs consist of residences, potential recreational use, cabins, lodges and camp sites identified through field work and a review of the Ministry of Natural Resources Geospatial Ontario (formerly Land Information Ontario) geospatial datasets. In some cases where a land use covered a large area, representative points were selected. For the purposes of the HHRA, additional PORs were added to this initial list (for a total of 41 PORs), in part based on review of available traditional knowledge and land use studies to represent areas of potential short and long-term human activity within the RSA, as further discussed in Section 4.1.4 of the HHERA. Consultation and engagement activities with Indigenous communities are provided in detail within the Participation and Engagement section (Section 3, Participation and Engagement) of the Impact Statement, and within Impact Statement Appendix C (Record of Consultation) which provides the record of consultation including detailed comments received, and responses provided, during the development of the Impact Statement.

While on the Project site, the health of workers is protected by occupational health and safety standards, codes and regulations established by various provincial and federal governments; thus, potential risks to on-site Project camp workers associated with Project-related POPCs is not addressed in the scope of this assessment.

The receptors selected for the HHRA identified to represent realistic but conservative exposure within the LSA and RSA in the multi-media assessment is an Indigenous resident:

- **Indigenous Resident Receptor:** The Project lies within Treaty 3 territory, on the traditional territories of Asubpeeschoseewagong Netum Anishinabek (ANA), Lac Seul First Nation (LSFN), Wabauskang First Nation (WFN) and the Northwestern Ontario Métis Community (NWOMC), and therefore these four communities were considered in the HHRA. The Municipality of Red Lake and the Township of Ear Falls were jointly considered as a fifth community in the HHRA, as a large population of Indigenous people reside in these communities. Members of Indigenous communities may use land and resources for Traditional purposes and thus may experience higher levels of exposure than members of the general population (e.g., higher rates of traditional foods ingestion, or more time spent outdoors). An Indigenous community member may also include the other critical subgroups noted (e.g., a toddler and/or pregnant female). Several locations (PORs) were identified within the LSA and RSA where both indigenous- and non-indigenous people could spend substantial time on a long-term basis (such as cabins, residences, camps or lodges). It is not known that these areas are frequently used by indigenous residents, however, it was conservatively assumed that they could. Several other locations (PORs) were identified where both indigenous- and non-indigenous people could spend time on a shorter-term basis (such as fishing, hunting, cultural or recreation areas). As such, an Indigenous Resident was conservatively selected as the main receptor for the multi-media assessment. This receptor is representative of Indigenous individuals who are assumed to reside in the LSA or RSA year-round for their entire lifetime and are potentially exposed to POPCs in soil, surface water and foods through direct soil contact (ingestion, dermal contact and particulate inhalation), consumption of traditional foods (fish, wild game, berries, traditional plants), consumption of backyard below- and above-ground garden produce, ingestion of surface water as a drinking water source, and direct surface water contact while swimming or bathing. This is considered a highly

conservative assumption since most of the POR locations within the LSA and RSA where chronic (long term) exposure was assumed are cabins, lodges or camps that are not known to be used as full time residences, and most Indigenous people in the area reside outside the LSA and RSA. All life stages prescribed by Health Canada (2024) were modelled for this receptor. This includes an infant, toddler (the most sensitive life stage due to their exposure rates relative to body weight), child, teen, and adult (or Elder). A woman of childbearing age was also specifically evaluated for mercury given it is considered a developmental toxicant.

Two types of Indigenous Resident receptors were assessed to capture exposures from varying levels of traditional foods consumption (e.g., berries, traditional plants, fish, and wild game), including the following:

- **Indigenous Resident (Heavy Consumer):** The heavy consumer Indigenous Resident was based on a receptor that consumes high amounts of traditional foods (i.e., 95th percentile consumption rates).
- **Indigenous Resident (Average Consumer):** The average consumer Indigenous Resident was based on a receptor that consumes average amounts of traditional foods (i.e., mean consumption rates). The Average Consumer Indigenous Resident was considered to represent the general Indigenous population.

The assessment of Indigenous Resident receptors is considered to be protective of non-Indigenous residents that may live or spend extended periods within the LSA and RSA given that Indigenous residents are assumed to have greater potential for exposure to traditional foods. For instance, it was assumed that all traditional food consumed by an Indigenous Resident is from the LSA or RSA, this receptor is continuously exposed to POPCs originating from the Project throughout their entire lifetime, and 95th percentile traditional food consumption rates (further discussed in Section 2.1.2) were assumed for the Heavy Consumer Indigenous Resident. Similarly, the assessment of Indigenous Resident Receptors is considered to be protective of Indigenous and non-Indigenous people who reside outside the LSA and RSA and who may visit the LSA and RSA to take part in various traditional land use or recreational activities such as hunting, fishing, gathering, cultural practices, camping, hiking, swimming and/or boating.

2.1 GENERAL RECEPTOR CHARACTERISTICS

Consistent with HHRA guidance (Health Canada 2024), the toddler was evaluated for the assessment of exposure and risks due to non-carcinogenic POPCs as the toddler life stage has the highest relative soil ingestion rate or food ingestion rate per unit body weight in comparison to other life stages (i.e., infant, child, teen, and adult). Non-carcinogenic exposure and risks were also calculated for the adult (age 20+ years) life stage considered representative of the general population, and for an adult female considered representative of sensitive populations for exposure to developmental toxicants. The composite receptor (all ages) was evaluated for the assessment of carcinogenic POPCs. The composite receptor considers an exposure over an assumed 80-year lifespan of an individual based on Health Canada (2024) guidance, comprising 5 months as an infant, 4.5 years as a toddler, 7 years as a child, 8 years as a teen, and 60 years as an adult (Health Canada, 2024). It was assumed that all phases of the Project occur within the receptor's 80 year lifespan, Details of carcinogenic vs. non-carcinogenic POPCs are provided in Section 4.

The general receptor characteristics used in the HHRA are provided in Table E-1 for each life stage. Receptor characteristics were preferentially selected based on Health Canada (2024), with the exception of the incidental surface water ingestion rates for swimming/bathing which were obtained from US EPA (2019) in the absence of Health Canada values.

For dermal contact pathways, the following assumptions were made:

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- **Soil:** Hands, arms (upper and lower), and legs (upper and lower) are available for soil contact. It was assumed that the infant could be exposed to soil (e.g., while playing in a sandbox or sitting on the ground) via incidental soil ingestion and/or dermal contact, and their feet would also be exposed to soil.
- **Surface water:** The whole body is available for dermal contact with surface water during swimming/bathing. It was assumed that infants do not participate in recreational in-water activities, therefore they would not be exposed via incidental ingestion of or dermal contact with surface water during swimming, however it was assumed the infant would be exposed to surface water via dermal contact during bathing.

It is noted that exposure to sediment and groundwater was not considered operable pathways in the multi-media model; therefore, receptor characteristics related to sediment and groundwater exposure were not provided. A discussion on the exclusion of sediment and groundwater exposure pathways is discussed in Section 2.2.3 below.

Table E-1: General Receptor Characteristics

Receptor Characteristics (1)	Units	Infant	Toddler	Child	Teen	Adult (7)
Age	years	<6 mo.	6 mo to <5	5 to <12	12 to <20	≥20
Body weight (BW)	kg	8.2	16.5	32.9	59.7	70.7
Soil ingestion rate (SIR)	mg/day	20	80	20	20	20
Inhalation rate (AIR)	m ³ /day	2.2	8.3	14.5	15.6	16.6
Water ingestion rate for drinking (WIR)	L/day	0.3	0.6	0.8	1	1.5
Incidental water ingestion rate (swimming/bathing) (2)	L/hour	n/a (3)	0.044	0.044	0.033	0.028
Swimming/bathing exposure duration (4)	Hours/event	0.5	2	2	2	2
Swimming/bathing exposure frequency	Events/day	1	1	1	1	1
Skin surface area (5)						
Hands (SAH)	cm ²	320	430	590	800	890
Arms (upper and lower) (SAO)	cm ²	550	890	1,480	2,230	2,500
Legs (upper and lower) (SAO)	cm ²	910	1,690	3,070	4,970	5,720
Feet (SAO) (6)	cm ²	250	430	720	1,080	1,190
Total body (SAT)	cm ²	3,620	6,130	10,140	15,470	17,640
Soil loading to exposed skin						
Hands (SLH)	kg/cm ² /event	1x10 ⁻⁷	1x10 ⁻⁷	1x10 ⁻⁷	1x10 ⁻⁷	1x10 ⁻⁷
Surfaces other than hands (SLO)	kg/cm ² /event	1x10 ⁻⁸	1x10 ⁻⁸	1x10 ⁻⁸	1x10 ⁻⁸	1x10 ⁻⁸

Notes: ≥ = greater than or equal to; < = less than; cm² = square centimetre; kg = kilogram; L/day = litres per day; L/hour = litres per hour; m³/day = cubic metre per day; mg/day = milligrams per day; mo = month; n/a = not applicable.

- Unless noted otherwise, general receptor characteristics were obtained from Health Canada (2024).
- Based on water ingestion rates (mean) during swimming from a swimming pool study by Dufour (2017) as cited by US EPA (2019). Study authors report that swimming behaviour of recreational pool swimmers may be similar to freshwater swimmers. The water ingestion rate for the more conservative 11 to <16 years age group was used for the toddler and child, the 16 to <21 years age group was used to represent a teen, and the 21+ years age group was used for the adult.
- Infants were assumed to not participate in in-water activities such as swimming in a surface water body but were assumed to be bathed daily.
- Swimming/bathing was assumed to occur for 2 hours per day except for the infant, where bathing only was assumed to occur for 0.5 hour per day.
- Hands, arms and legs were assumed to be potentially exposed through soil dermal contact. Total body was assumed to be potentially exposed through surface water dermal contact while swimming/ bathing.
- The surface area of the feet was only incorporated into the SAO value for infants in the soil dermal contact pathway. It is assumed other life stages wear footwear during soil contact events.
- Adult general receptor characteristics were applied for both an adult (general population) and an adult female (of child-bearing age; sensitive population). Adult female specific toxicity reference values (TRVs) were used for evaluation of risks to the adult female, as discussed in Section 4.

2.2 TRADITIONAL FOOD SPECIES AND CONSUMPTION RATES ASSUMPTIONS

As stated in Section **Error! Reference source not found.**, the Project lies within, or is in proximity to, several traditional territories including ANA, LSFN and WFN. NWOMC and Indigenous people living in Red Lake, Ear Falls and within the District of Kenora, are also residing in proximity of the Project.

Therefore, the HHRA considered the specialized diets and lifestyles of Indigenous populations, including the reliance on wild plants and animals as food sources. Health Canada (2024) recommends using site-specific food ingestion rates whenever possible. A traditional food study specifically related to the Project was not available for the Indigenous groups considered in the HHRA; however, Indigenous food ingestion rates of traditional foods are available for the region of the Project (Ecozone 1 – Boreal Shield) from the First Nations Food, Nutrition, and Environment Study (FNFNES) conducted for Ontario (Chan et al. 2014, 2021).

The goal of the FNFNES was to gather information on the food consumed by various Indigenous groups across Canada to provide a comprehensive compilation of traditional foods consumed by Indigenous people. Chan et al. (2014) completed a food survey with 18 Indigenous communities throughout Ontario in 2011 and 2012. Some of the survey results are presented by ecozone: Boreal Shield / Subarctic (Ecozone 1), Boreal Shield / Northeast (Ecozone 2), Hudson Plains / Subarctic (Ecozone 3), and Mixedwood Plains / Northwest (Ecozone 4) in Ontario. Chan et al. (2014) provides the mean (average) and 95th percentile of the amount of traditional foods consumed per day, for traditional food consumers only, broken down by ecozone. The LSA and RSA fall within the Boreal Shield / Subarctic (Ecozone 1). As such, food survey results for the Boreal Shield / Subarctic (Ecozone 1) in Ontario were considered representative of local Indigenous people and will be presented in the subsequent sections.

Chan et al. (2021) additionally developed a Supplemental Data report which provides consumption rates for mean and 95th percentile of the amount of traditional foods consumed per day in the broader Boreal Shield region, not specific to Ecozone 1. Where Ecozone 1 consumption rates were lacking, Boreal Shield consumption rates were applied, as further discussed below.

Chan et al. (2014) provides consumption rates for the top three species reported to be consumed within Ecozone 1 in Ontario, based on data collected through the FNFNES, for each of the following categories: fish, game meat, game organs, birds and plants. In Ecozone 1, the most consumed species identified by the FNFNES are:

- Fish: walleye, lake whitefish, northern pike
- Game meat: moose, deer, rabbit
- Game organs: moose liver, moose kidney, caribou liver
- Birds: Canada goose, partridge, ducks
- Plants: blueberries, raspberries, wild rice

2.2.1.1 *INCORPORATION OF INDIGENOUS KNOWLEDGE*

As part of the Project, ANA, LSFN, WFN, NWOMC, and additionally Indigenous Peoples living in Red Lake and Ear Falls, were engaged by Great Bear Resources to participate in the Impact Assessment process and to provide Indigenous knowledge (IK) and Traditional Knowledge Land Use Study (TKLUS) information, as described in Impact Statement (IS) Section 3 (Participation and Engagement) and detailed in Impact Statement Appendix C (Record of Consultation). It is understood that the IK / TKLUS reports received are confidential; however, IK has been considered throughout the Impact Statement, as described in IS Section 7.1 (pVC Analysis of Changes to Pathway Valued Components - Influence of Consultation and Engagement).

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Each TKLUS report provided by Indigenous communities was systematically reviewed to identify and extract information relevant to the HHRA. This included both mapping and documenting reported areas of cultural importance and traditional land use activities occurring within the LSA and RSA to help with selection of POR locations, and identifying species of cultural significance and those commonly consumed as part of traditional food diets to help validate the important species as presented in Chan et al. 2014 and listed above.

It is noted that at the time of producing this report, the ANA is currently undertaking a Land Use and Occupancy Study that would identify current use of the Project Area (PA), LSA, and RSA by ANA for harvesting and cultural use (including species, areas, and sites of cultural importance). At the time of producing this Attachment, the results of the study were not available. Therefore, it is acknowledged that the species described as being “identified” by ANA below in this section were not explicitly identified by the community but rather were assumed to be consumed by ANA community members based on publicly available secondary sources, for the purposes of the multi-media HHRA model development. The secondary sources used to inform which species are potentially consumed by ANA are included in IS Section 3 (Participation and Engagement) and detailed in Impact Statement Appendix C (Record of Consultation).

Similarly, there was no TKLUS report available explicitly for the Indigenous peoples in Red Lake / Ear Falls (RL/EF). For the development of the multi-media HHRA model, the species were identified from TKLUS reports by LSFN, WFN and NWOMC were considered applicable to Indigenous peoples living in RL/EF.

The TKLUS reports and secondary sources were reviewed to identify traditional foods and species of cultural significance for further consideration in the HHRA (Section 4) and the ERA (Section 5) or the HHERA report.

- All five communities (LSFN, WFN, ANA, NWOMC, Indigenous people in RL/EF) identified walleye (pickarel), lake whitefish, northern pike (jackfish), moose, deer, rabbit, blueberries, raspberries and wild rice (manoomin) as frequently consumed traditional foods. As these were also identified by the FNFNES as top three consumed species in their respective food type categories for Ecozone 1 with available consumption rates (Chan et al. 2014), they were selected for inclusion in the HHRA.
- For birds, four of five communities identified goose, duck and grouse/partridge as frequently consumed, which aligns with the bird species identified in the FNFNES for Ecozone 1 with available consumption rates, therefore they were included in the HHRA. The partridge ingestion rates for Ecozone 1 from Chan et al. (2014) were considered to be applicable for grouse and partridge given that these species are both ground nesting, insectivorous birds (Carroll et al. 2020, Schroeder et al. 2021).
- For berries, all five communities additionally identified chokecherry/pin cherry and cranberry as frequently consumed species. No consumption rates for Ecozone 1 were available for chokecherry/pin cherry and cranberry. Boreal Shield consumption rates were available in the Chan et al. (2021) Supplemental Data report, and a comparison of chokecherry/pin cherry and cranberry Boreal Shield consumptions rates to Ecozone 1 consumption rates for blueberries and raspberries showed that Ecozone 1 consumption rates for blueberries and raspberries were higher than and therefore protective of consumption rates for chokecherry/pin cherry and cranberry. Therefore, only blueberry and raspberry Ecozone 1 consumption rates were considered in the HHRA.
- For traditional plants, all five communities identified Labrador tea and four communities identified mint as frequently consumed. Ecozone 1 consumption data is not available for these species, however Chan et al. (2021) provides Boreal Shield consumption rates for Labrador tea and mint. The Boreal Shield consumption rates were selected for use in the HHRA in the absence of Ecozone 1 consumption rates for an appropriate surrogate species for traditional plants.
- For wild game, caribou were identified by three communities as frequently consumed. No Ecozone 1 consumption data is available for caribou, however Chan et al. (2021) provides Boreal Shield consumption rates for caribou. Given the unique diet of caribou which would not be appropriately reflected by selection of a surrogate species, Boreal Shield caribou consumption rates were selected for the HHRA.

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- Beaver and muskrat were additional wildlife species identified by three communities as species which were hunted and/or trapped, however based on the information available in the TKLUS reports these species are consumed less frequently than other wild game such as moose, deer, rabbit, which were identified as top consumed species by both the TKLUS reports and Chan et al. (2014). Given the lower reported frequency of consumption and the lack of Ecozone 1 consumption rates for these species, beaver and muskrat were not considered in the HHRA. It is noted that these species were evaluated in the ecological risk assessment (ERA), detailed in Attachment F.

It is recognized that the traditional foods evaluated in the HHRA do not represent the full range of species ingested by Indigenous people in the area of the Project. However, through consideration of both species reported as most frequently consumed in the TKLUS reports and top consumed species identified based on the FNFNES report (Chan et al. 2014), the HHRA provides a reasonable evaluation of potential exposure to Project-related POPCs through ingestion of traditional foods.

For evaluation of the potential consumption of wildlife species (i.e., mammals and birds), the multi-media model considered small and large wildlife species categories representing different trophic levels and dietary preferences. These species categories are based on the consumption of game meat and/or game organs and include small mammals (game meat), large mammals (game meat), large mammals (organ meat), and birds.

A summary of the species selected for the multi-media model, informed by the FNFNES (Chan et al., 2014, 2021) and TKLUS reports, is provided in Table E-2 below. It is noted that these are specific to traditional food items, and do not include other food items considered in the multi-media model (e.g., garden produce).

Table E-1: Summary of Traditional Food Species Selected for the Multi-Media Model

Species Category	FNFNES Top 3 Species (Chan et al. 2014) (2)	Selected for HHRA	Rationale
Small Mammals (game meat)	Rabbit	ü	Identified in TKLUS reports for 5 communities (1).
Large Mammals (game meat)	Moose	ü and caribou	Identified in TKLUS reports for 5 communities (1). Caribou was identified by 3 communities.
	Deer	ü	Identified in TKLUS reports for 5 communities (1).
Large Mammals (organ meat)	Moose liver	ü	Top consumed species (Chan et al. 2014).
	Moose kidney	ü	Top consumed species (Chan et al. 2014).
	Caribou liver	ü	Top consumed species (Chan et al. 2014).
Fish	Walleye	ü	Identified in TKLUS reports for 5 communities (1).
	Lake Whitefish	ü	Identified in TKLUS reports for 5 communities (1).
	Northern Pike	ü	Identified in TKLUS reports for 5 communities (1).
Traditional Plants	Wild rice	ü and Labrador tea, mint	Identified in TKLUS reports for 5 communities(1). Labrador tea was identified by 5 communities and mint by 4 communities.
Berries	Blueberries	ü	Identified in TKLUS reports for 5 communities (1). Chokecherries/pin cherries and cranberries were also frequently consumed; however blueberries were used in the model (3).
	Raspberries	ü	Identified in TKLUS reports for 5 communities (1).
Birds	Canada goose	ü	Identified in TKLUS reports for 4 out of 5 communities.
	Partridge	ü and grouse	Identified in TKLUS reports for 4 out of 5 communities. Partridge and grouse were both listed as consumed species by the communities. The wildlife characteristics of these birds are similar therefore, a single receptor was used to represent both partridge and grouse.
	Ducks	ü	Identified in TKLUS reports for 4 out of 5 communities.

Notes:

ANA = Asubpeeschoseewagong Netum Anishinabek; FNFNES = First Nations Food Nutrition and Environment Study; LSFN = Lac Seul First Nation; HHRA= human health risk assessment; NWOMC =Northwestern Ontario Métis Community; RL/EF = Red Lake and Ear Falls; TKLUS = Traditional Knowledge Land Use Study; WFN = Wabauskang First Nation.

- 1 The five communities include ANA, LSFN, WFN, NWMOC and RL/EF
- 2 The most consumed species from Ecozone 1
3. While chokecherry/pin cherry and cranberry were identified as frequently consumed, based on a comparison of available consumption rates, the blueberry and raspberry consumption rates from Ontario Ecozone 1 were considered protective of the

Ontario-wide Boreal Shield consumption rates for the chokecherry/pin cherry and cranberry. Therefore, the blueberry and raspberry species were selected for the multi-media model.

2.2.1.2 SUMMARY OF TRADITIONAL FOOD AND GARDEN PRODUCE CONSUMPTION RATES

The food consumption rate and dietary proportions applied in the HHRA are summarized in Table E-3.

For wild game meat, organ meat, fish meat, traditional plants and berries, the consumption rates for the infant (berries only), toddler and child were calculated by multiplying the adult female consumption rate from Chan et al. (2014, 2021) by the ratios determined in Table E-6. This approach is reflective of Health Canada (2025) which provides toxicity reference values (TRVs) for both sensitive populations and general population for methylmercury, wherein women (of childbearing age) and youth <12 years of age (i.e., infant, toddler, child and adult female life stages) are considered sensitive populations. For teens and adults, general population TRVs were considered to be applicable, therefore consumption rates for game meat, organ meat, fish meat, traditional plants and berries were calculated by multiplying the total adult (i.e., combined male and female) consumption rates from Chan et al. (2014, 2021) by the ratios determined in Table E-4. Full details of TRVs utilized in the HHRA are provided in Section 4.

For aboveground and belowground garden produce, consumption rates provided by Richardson (1997) for “other vegetable” and “root vegetables”, respectively were selected. For the toddler and child life stages, female only consumption rates were selected based on the above rationale for sensitive populations. For the teen life stage, combined (i.e., male and female) consumption rates were selected. As previously discussed, infants were not assumed to consume garden produce.

It is noted that the total amount of food assumed to be consumed for the Average and Heavy Consumer in the HHRA is also presented in Table E-3. For an adult Heavy Consumer Indigenous Resident, a total of 587 grams of food from the LSA/RSA (i.e., traditional food and garden produce) was assumed to be consumed every day based on the consumption rates considered for the HHRA. In comparison, an adult Average Consumer Indigenous Resident was assumed to consume a total of 166 grams per day. While these consumption rates do not necessarily represent a total level of food intake (i.e., a typical adult consumes around 2,000 calories per day, which translates to an average or 95th percentile total food intake of 1,110 to 2,010 grams of food per day, respectively [US EPA 2011]), they are still considered to be conservative assumptions for intake of traditional foods and garden produce (i.e., non-market food). The FNFNES 95th percentile of traditional foods consumed per day, by comparison, is 220 grams per day; the total amount of traditional foods for the adult Heavy Consumer Indigenous Resident (i.e., 587 grams per day) assumed in the HHRA is greater than this amount.

It is noted that for the Adult life stage, total consumption rates provided by Chan et al. (2014) for Ecozone 1 were selected, which consider both male and female consumption rates. For the Adult Female, female consumption rates were selected. Female consumption rates from Ecozone 1 (Chan et al., 2014) were available and used when characterizing exposure from consumption of various traditional foods. However, female-specific consumption rates were not provided in the Chan et al. (2021) Supplemental Data report, therefore general Adult consumption rates were applied when characterizing traditional food items obtained from this report (i.e., caribou meat, Labrador tea and mint).

Chan et al. (2014, 2021) does not provide consumption rates for non-adult life stages, Therefore, consumption rates for the infant (applicable for berries only), toddler, child and teen life stages were calculated using ratios of relative consumption rates. While infants may not start consuming solid foods until around 6 months of age, the HHRA assumed that infants living within Indigenous communities in the area of the Project may ingest berries; no other traditional food items were assumed to be consumed by infants. Relative consumption rates of ‘other’ vegetables, and root vegetables, for infants, toddlers, children, teens, and adults for the general Canadian population, and fish and wild game ingestion rates for the Canadian Indigenous population and Canadian general population are available from Richardson (1997). These ingestion rates were used to adjust the adult ingestion rate to ingestion rates for other life stages as detailed in Section 2.1.2.3, below.

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Table E-3: Assumptions for Traditional Food and Garden Produce Consumption Rates

Assumption	Consumer	Life stage						Source
		Infant	Toddler	Child	Teen	Adult	Adult Female	
		Consumption Rate – g/day						
Moose meat consumption rate	Heavy	n/a	17.8	26.2	29.9	46.2	30.1	Chan et al. 2014
	Average	n/a	3.75	5.51	7.84	12.1	9.70	
Rabbit meat consumption rate	Heavy	n/a	5.18	7.62	8.69	13.4	13.4	Chan et al. 2014
	Average	n/a	1.34	1.98	2.26	3.48	2.95	
Caribou meat consumption rate ⁽¹⁾	Heavy	n/a	39.8	58.5	66.8	103	103	Chan et al. 2021
	Average	n/a	7.42	10.9	12.4	19.2	19.2	
Deer meat consumption rate	Heavy	n/a	4.40	6.84	7.39	11.4	6.58	Chan et al. 2014
	Average	n/a	1.38	2.03	2.32	3.58	1.88	
Moose liver consumption rate	Heavy	n/a	10.4	15.2	17.4	26.8	26.8	Chan et al. 2014
	Average	n/a	2.40	3.53	4.03	6.22	6.45	
Moose kidney consumption rate	Heavy	n/a	10.4	15.2	17.4	26.8	61.8	Chan et al. 2014
	Average	n/a	2.96	4.35	4.96	7.66	8.96	
Caribou liver consumption rate	Heavy	n/a	11.9	17.6	20.0	30.9	30.9	Chan et al. 2014
	Average	n/a	5.01	7.36	8.40	13.0	19.7	
Grouse/partridge meat consumption rate	Heavy	n/a	4.65	6.84	7.80	12.0	6.02	Chan et al. 2014
	Average	n/a	0.96	1.41	1.61	2.49	1.64	
Duck meat consumption rate	Heavy	n/a	4.65	6.84	7.80	12.0	11.0	Chan et al. 2014
	Average	n/a	1.84	2.71	3.09	4.77	4.76	
Canada goose meat consumption rate	Heavy	n/a	12.4	18.2	20.8	32.1	36.1	Chan et al. 2014
	Average	n/a	3.82	5.62	6.41	9.89	9.19	
Dietary proportion of wild game from LSA/RSA	n/a	n/a	1.00	1.00	1.00	1.00	1.00	Assumption
Northern Pike meat consumption rate	Heavy	n/a	20.1	36.0	36.6	40.2	37.7	Chan et al. 2014
	Average	n/a	5.72	10.2	10.4	11.4	10.2	
Walleye meat consumption rate	Heavy	n/a	50.3	90.0	91.5	101	37.5	Chan et al. 2014
	Average	n/a	9.08	16.2	16.5	18.2	10.3	
Whitefish meat consumption rate	Heavy	n/a	31.2	55.9	56.8	62.5	37.7	Chan et al. 2014
	Average	n/a	6.59	11.8	12.0	13.2	9.84	
Berry consumption rate ⁽²⁾	Heavy	12.4	10.7	15.7	24.2	27.6	26.1	Chan et al. 2014
	Average	3.13	2.31	3.40	5.24	5.98	6.62	
Dietary proportion of berries harvested from LSA/RSA	n/a	n/a	1.00	1.00	1.00	1.00	1.00	Assumption
Traditional plant consumption rate ^(1,3)	Heavy	n/a	0.85	1.24	1.42	2.19	2.19	Chan et al. 2021
	Average	n/a	0.21	0.31	0.48	0.55	0.55	
Garden Produce - root vegetables (belowground plants) consumption rate	Heavy and Average	n/a	9.90	14.3	22.7	18.8	15.7	Richardson, 1997
Garden Produce - other vegetables (aboveground plants) consumption rate	Heavy and Average	n/a	6.50	9.50	12.0	13.7	12.9	Richardson, 1997
Wild rice consumption rate	Heavy	n/a	2.41	3.55	5.47	6.25	3.64	Chan et al. 2014

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Assumption	Consumer	Life stage						Source
		Infant	Toddler	Child	Teen	Adult	Adult Female	
		Consumption Rate – g/day						
	Average	n/a	0.81	1.19	1.83	2.09	1.07	
Dietary proportion of produce from backyard gardens	N/A	n/a	0.1	0.1	0.1	0.1	0.1	CCME 2006
Total Amount of Traditional Food Consumed	Heavy	12.4	247	395	442	587	499	Calculated
	Average	3.13	62.1	98.0	111	166	152	

Notes:

CCME = Canadian Council of Ministers of the Environment; g/day = grams per day; LSA = local study area; N/A = not applicable; RSA = regional study area.

Potential exposure to the infant life stage were assumed to be negligible for the assessment of traditional foods except berries.

- 1 Caribou and traditional plant consumption rates are based on responses from consumers within the Boreal Shield Ecozone.
- 2 Sum of the consumption rates for blueberries and raspberries.
- 3 Sum of the consumption rates for Labrador tea and mint.

2.2.1.3 ESTIMATION OF CONSUMPTION RATES FOR NON-ADULT RECEPTORS

Since Chan et al 2014 only provides food consumption rates for adults, food consumption rates for infants (berries only), toddlers, children, teens, and adults from Richardson (1997), presented in Tables E-4 and E-5 below, were used to determine ratios of non-adult consumption in relation to adults (Table E-6) for estimation of food consumption rates for non-adult receptors.

It is noted that the “other vegetables” consumption rates from Richardson (1997) were selected for aboveground garden produce consumption rates, as presented in Table E-4 and E-5 below. Ratios did not need to be calculated for garden produce as Richardson (1997) provides consumption rates for each life stage. However, the “other vegetables” consumption ratios were used to calculate the consumption rates of foraged foods and traditional plants, such as berries and wild rice.

Ratios for the calculation of consumption rates for the infant (berries only), toddler, and child presented in Table E-6 were based on the relative consumption rates for these life stages (presented in Table E-4) to an adult female consumption rate (presented in Table E-5). The adult female consumption rate was used to calculate the ratio of consumption rates for the infant, toddler, and child as it was assumed that the dietary intake of these life stages was better aligned with the adult female of the household rather than the adult male or combined sexes. For example, Richardson (1997) demonstrates that the toddler consumption rate of subsistence fish is 50% of the adult female consumption rate, whereas the toddler rate is 35% of the adult male consumption rate. The ratios for the calculation of consumption rates for teens are calculated using the combined male and female consumption rates presented in Table E-4. This is because it was conservatively assumed that teens would not be as significantly influenced by the adult female of the household. Additionally, at the teen life stage, there are significant deviations between the male and female consumption rates, and a combined rate would better represent real world scenarios.

The ratios used to convert the adult consumption rates from Chan et al 2014 (FNFNES) to infant, toddler, child, and teen ingestion rates are presented in Table E-. The ratios were applied to the Chan et al 2014 consumption rates for the combined adult. This would establish that the assessment captures the variability of both sexes.

Table E-4: Arithmetic Means of Combined Male and Female Consumption Rates from Richardson 1997

Receptor Characteristic	Infant (0–6 months)	Toddler (7 months–4 years)	Child (5–11 years)	Teen (12–19 years)	Adult (≥20 years)
Canadian General Population (kg/day)					
Other vegetables	0.072	0.067	0.098	0.120	0.137
Canadian Indigenous Populations (kg/day)					
Wild Game	0 ⁽¹⁾	0.085	0.125	0.175	0.270
Fish	0 ⁽¹⁾	0.095	0.170	0.200	0.220

Notes:

kg/day = kilogram per day.

From Richardson (1997; Other vegetables - Table 5.4 (combined male and female); Wild game – Table 6.5; Fish – Table 6.2).

Arithmetic mean values for ‘eaters only’.

- 1 Non-zero ingestion rate for other vegetables only applies to berries for the infant, as it was assumed that infants do not consume any other solid food item. Consumption rates based on ratio of relative consumption to adult female.

Table E-5: Arithmetic Means of Female Consumption Rates from Richardson 1997

Receptor Characteristic	Infant (0–6 months)	Toddler (7 months–4 years)	Child (5–11 years)	Teen (12–19 years)	Adult (≥20 years)
Canadian General Population (kg/day)					
Other vegetables	0.061	0.065	0.095	0.119	0.129
Canadian Indigenous Populations (kg/day)					
Wild Game	0 ⁽¹⁾	0.085	0.125	0.175	0.220
Fish	0 ⁽¹⁾	0.095	0.170	0.150	0.190

Notes:

≥ = greater than or equals to; kg/day = kilogram per day

From Richardson (1997; Other vegetables - Table 5.2 (female); Wild game – Table 6.5; Fish – Table 6.2). Arithmetic mean values for 'eaters only'.

- 1 Non-zero ingestion rate for other vegetables only applies to berries for the infant, as it was assumed that infants do not consume any other solid food item. Consumption rates based on ratio of relative consumption to adult female.

Table E-6: Ratio of Non-Adult Consumption in Relation to Adult Consumption

Receptor Characteristic	Infant (0–6 months) ⁽⁴⁾	Toddler (7 months–4 years)	Child (5–11 years)	Teen (12–19 years)	Adult (≥20 years)
Combined Male + Female					
Other vegetables ⁽¹⁾	0.53	0.49	0.72	0.88	1.0
Wild Game ⁽²⁾	0.0	0.32	0.46	0.69	1.0
Fish ⁽³⁾	0.0	0.43	0.77	0.91	1.0
Female Only					
Other vegetables ⁽⁵⁾	0.47	0.50	0.74	0.92	1.0
Wild Game ⁽⁶⁾	0.0	0.39	0.57	0.80	1.0
Fish ⁽⁷⁾	0.0	0.5	0.89	0.79	1.0

Notes:

- 1 Other vegetables relative consumption rate ratios were applied for berries and traditional plants (leaves and rice) for the adolescent.
- 2 Wild game relative consumption rate ratios were applied for wild game meat and organ meat for the adolescent.
- 3 Fish relative consumption rate ratios were applied for fish meat for the adolescent.
- 4 Non-zero ingestion ratios for other vegetables only applies to berries for the infant, as it was assumed that infants do not consume any other solid food item. Consumption ratio based on ratio of relative consumption to adult female.
- 5 Other vegetables relative consumption rate ratios were applied for berries and traditional plants (leaves and rice) for the toddler and child.
- 6 Wild game relative consumption rate ratios were applied for wild game meat and organ meat for the toddler and child.
- 7 Fish relative consumption rate ratios were applied for fish meat for the toddler and child.

2.2.2 EXPOSURE DURATION

To define the amount of time the Indigenous Resident will spend at a POR location and be in contact with POPCs originating from the Project in different environmental media, exposure durations were characterized.

It was conservatively assumed that the Indigenous Resident receptor was present in the LSA or RSA continuously throughout their entire lifetime. As such, an exposure factor of 1 was applied in the multi-media model (i.e., no adjustment to exposure time based on time spent outside of the LSA or RSA) for soil (direct contact, inhalation of soil dust), surface water (ingestion of surface water as drinking water, dermal contact), and traditional food (ingestion). This is considered a highly conservative assumption since most of the POR locations within the LSA and RSA where chronic (long term) exposure was assumed are cabins, lodges or camps that are not known to be used as full time residences, and most Indigenous people in the area reside outside the LSA and RSA.

While soil contact may occur for the entire duration spent at a POR location, dermal contact with surface water while swimming or bathing was assumed to occur for 2 hours per day, every day, for the entirety of

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their toddler through adult life stages (i.e., year-round). Infants were not considered to take part in in-water activities. The assumption that people could be swimming or bathing in nearby waterbodies year-round is considered to be a highly conservative assumption given Climate Normals data available from 1991 to 2020 for Red Lake (Government of Canada, 2025) indicate that average monthly temperature is only above 15 degrees Celsius for 3 months of the year.

The Indigenous Resident was also assumed to harvest enough traditional food from the land and preserve it for consumption year-round.

The use of an exposure term of 1 is further discussed in Section 2.2.2.1 below. The exposure durations are defined for the Indigenous Resident in Table E-7E-7 below.

Table E-7: Receptor Exposure Durations

Exposure Term	Units	Indigenous Resident (Heavy & Average Consumer)
Hours spent swimming/bathing (for surface water dermal contact)	hours/day	2
Dermal exposure events	events/day	1
Days spent swimming/bathing	days/week	7
Weeks spent swimming/bathing	weeks/year	52
Days spent at a receptor location (POR)	days/week	7
Weeks spent at a receptor location (POR)	weeks/year	52
Days that food is ingested from LSA or RSA	days/week	7
Weeks that food is ingested from LSA or RSA	weeks/year	52
Total years exposed for composite receptor	years	Infant: 0.5, Toddler: 4.5, Child: 7, Teen: 8, Adult: 60
Life expectancy	years	80

Notes:

LSA = local study area; POR = point of reception; RSA = regional study area.

2.2.2.1 LESS THAN CHRONIC EXPOSURES

Health Canada (2013; 2023; 2025) has proposed an approach for the evaluation of cancer and non-cancer health risks from exposure to parameters where health effects in an assessment are predicted to be related to chronic (or lifetime) and/or less-than-chronic (less-than-lifetime or short-duration) exposures. A lifetime of exposure is defined as exposure occurring for 24 hours/day; 365 days/year over an 80-year lifetime. Less than chronic exposure scenarios, which are defined to occur between 14 to 90 days are considered sub-chronic (Health Canada 2025) and present a unique pattern of exposure and risk where the parameter may not be eliminated entirely before the next exposure event. Health Canada (2025) states that in these circumstances the HHRA should avoid use of dose averaging with chronic TRVs, therefore no amortization can be applied when calculating risks. Health Canada (2023) suggests that if elimination mechanisms are not saturated, approximately 97% of the parameter present in the body would be eliminated via depuration after a period of five half-lives, as such, 5 half-lives are a minimum expectation between exposures to allow dose averaging with a chronic TRV for a POPC. It is important to note that sub-chronic TRVs are in general not readily available from Health Canada and other regulatory agencies. No dose averaging should be considered when developmental effects are of particular concern, which may occur at a susceptible life stage and during a short-term exposure period.

Typically, less than chronic exposures are assessed for POPCs with non-carcinogenic (i.e., threshold) effects by initially comparing an unadjusted daily exposure to the chronic TRV (i.e., exposures are expressed with an exposure term of 1).

As a conservative evaluation, an exposure term of 1 was assumed for all receptors and exposure pathways in terms of the days exposed per year and the total years exposed per lifetime.

2.2.3 EXPOSURE PATHWAY IDENTIFICATION

POPCs emitted to the atmosphere from Project activities via airborne emissions may be deposited onto the soils, surface water and plants in the surrounding areas. Project contact water may also discharge POPCs into surface water. Depending on the fate, transport and persistence of the POPCs in the environment, atmospheric deposition and changes in surface water quality could affect the POPC concentrations in local traditional foods (i.e., plants, wild game and fish) within the LSA.

As detailed in Section 4.1.1 of the HHERA and Attachment C (Screening), the following POPCs were retained for quantitative evaluation in the multi-media assessment:

- Arsenic: Retained based on concentrations above human health screening criteria for soil (see Attachment C).
- Mercury: Retained due to high bioaccumulation potential and identified as a parameter of concern to the public/community; no concentration above human health screening criteria was identified (see Attachment C).
- Selenium: Retained due to bioaccumulation potential; no concentrations above human health screening criteria (see Attachment C).

Potential human health risks from the Project were characterized for the following exposure pathways in the multi-media assessment:

- Direct contact with POPCs in soil (incidental ingestion, dermal contact, soil dust inhalation) due to baseline conditions plus aerial deposition from Project activities.
- Ingestion of berries that have bioaccumulated POPCs from soil due to baseline conditions plus aerial deposition from Project activities.
- Ingestion of other traditional plants (i.e., Labrador tea, mint) that have bioaccumulated POPCs from soil due to baseline conditions plus aerial deposition from Project activities.
- Ingestion of garden produce (aboveground plants) that have bioaccumulated POPCs from soil due to baseline conditions plus aerial deposition from Project activities.
- Ingestion of garden produce (belowground plants) that have bioaccumulated POPCs from soil due to baseline conditions.
- Ingestion of POPCs in surface water used as drinking water due to baseline conditions plus aerial deposition from Project activities and discharge from Project contact water.
- Incidental ingestion of, and dermal contact with, POPCs in surface water while swimming and bathing due to baseline conditions plus aerial deposition from Project activities and discharge from Project contact water.
- Ingestion of fish meat (Walleye, Northern Pike and Lake Whitefish fillets) and wild rice that have bioaccumulated POPCs from surface water due to baseline conditions plus aerial deposition from Project activities and discharge from Project contact water.
- Ingestion of wild game that have bioaccumulated POPCs from soil, surface water and dietary items (i.e., plants, other animals) due to baseline conditions plus aerial deposition and discharge from Project contact water.

It was assumed in the HHRA that an Indigenous Resident would only have access to groundwater via groundwater wells. The locations of 10 potential water supply wells, including those of unknown use, based on a search of available water well records from the online Water Well Information System is illustrated in Figure 4-2.. As discussed in Chapter 7.5 of the Impact Statement, there are no groundwater water wells (including drinking water wells) present within the LSA and RSA which will be affected by the Project. All of the water supply wells are north of the Property, to the northwest, close to Boyden Creek, or north and northeast close to Gullrock Lake, and lie on far sides of groundwater divides (represented by local watershed boundaries illustrated in Figure 4-3) from aspects of the Project that are likely to affect

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groundwater (Impact Statement Section 7.5.4, WSP 2025e). In addition, Section 7.1 of the Hydrogeology Baseline Report (WSP 2025e) indicates that “To date, no discrete natural springs have been located at the property. This is likely due to hydrogeology not being conducive to spring development due to the widespread presence of low permeability surficial clay and deeper layers in the subsurface that would generally preclude the formation of discrete conduits for groundwater flow that could express on surface as identifiable springs.” Groundwater exposure pathways were therefore considered to be incomplete for the Project, and groundwater was not considered in the HHRA multi-media model.

While sediment is present within waterbodies in the LSA and RSA, Project related changes to these waterbodies are assessed through receiver surface water quality modelling and changes to sediment are considered insignificant in comparison. The majority of predicted surface water quality concentrations during construction and operations phases are within baseline ranges, with all predicted surface water quality concentrations within baseline ranges post-closure (details presented by Water Quality Discipline; WSP 2025b). Further, runoff is being controlled, collected and treated throughout the Project to mitigate changes to the surrounding aquatic environment. As such, sediment quality is not anticipated to be impacted by the Project and sediment projections were not modelled (i.e., it was assumed that there would not be a material change in sediment quality and the incremental change from the Project was assumed to be zero). While several nearby lakes and creeks located within the vicinity of the Project may be accessed by people during fishing, swimming or boating, the larger lakes are deep reducing the likelihood for sediment contact. Swimming may occur off docks at personal waterfront residences (lodges, cabins), and limited sediment contact is expected. Although some smaller lakes and creeks may be shallow enough or have near-shore areas where people could contact sediment while wading or fishing, any such contact during these activities is expected to be minimal and it is anticipated that shoes would be worn during these activities. There is a beach present along Pakwash Lake Provincial Park within the RSA where sediment exposure can occur along the shore, however this exposure potential can be considered through the soil exposure assessment. The assessment of potential Project impacts to soil and surface water are considered to be protective of Project-related change to sediment quality. Sediment exposure pathways were therefore not considered in the HHRA multi-media model.

Exposure pathways applicable to each receptor retained for the multi-media HHRA are presented in Table E-8.

Table E-8: Exposure Pathways Evaluated in the Multi-media Assessment

Media	Exposure Pathway	Indigenous Resident
Soil	Incidental ingestion	✓
	Dermal contact	
	Soil Dust inhalation	
Groundwater	Ingestion	✗
	Dermal contact (while bathing)	
Surface Water	Ingestion (as a drinking water source)	✓
	Dermal contact (during recreation / bathing)	✓
	Incidental ingestion (during recreation / bathing)	✓ bathing only for infant)
Sediment	Incidental ingestion	✗
	Dermal contact (during recreation / bathing)	
Berries	Ingestion	✓
Traditional Plants (Labrador tea, mint, wild rice)	Ingestion	✓ (✗ for infant)
Garden Produce (aboveground and belowground)	Ingestion	✓ (✗ for infant)
Fish Meat (Walleye, Northern Pike and Lake Whitefish fillets)	Ingestion	✓ (✗ for infant)
Wild Game Meat (moose, caribou, deer, rabbit, grouse/partridge, duck, Canada goose)	Ingestion	✓ (✗ for infant)

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Media	Exposure Pathway	Indigenous Resident
Organ Meat (moose liver, moose kidney, caribou liver, caribou kidney)	Ingestion	✓ (✗ for infant)

Notes: ✓ = pathway evaluated; ✗ = pathway not evaluated.

3 EXPOSURE ASSESSMENT

3.1 BIOAVAILABILITY

Bioavailability (also referred to as absorption efficiency) is a measure of the amount of a parameter that is absorbed and retained within the body. Consideration of bioavailability is important under the following circumstances (US EPA 1989, Health Canada 2010):

- If the medium of exposure is different than the medium on which the toxicity reference value is based (e.g., exposure is from soil, but the toxicity reference value is based on exposure from water),
- If the route of exposure is different than the route of exposures in the study used to derive the toxicity reference value (e.g., oral route of exposure, but based on an inhalation study),
- The toxicity reference value derived by the regulatory agency has been adjusted for bioavailability, or
- Multiple routes of exposure are evaluated in the risk assessment, but the toxicity reference value is based on a single route of exposure.

Bioavailability was considered by using parameter-specific relative absorption factors (RAFTs). RAFTs represent the fraction of the parameter that is absorbed relative to the fraction absorbed in the study used to derive the TRV. Unless site specific bioavailability data is available, an RAFT of 1 (i.e., 100% oral absorption efficiency) was considered for the oral pathway as per Health Canada (2024) guidance. Inhalation exposures were also assumed to have a RAFT of 100% (RAFT = 1) (Health Canada 2024). Given that few TRVs exist for the dermal exposure route, and that dermal TRVs are not available for the parameters retained as POPCs in this HHRA, the dermal exposure doses were compared to the oral TRVs considering dermal absorption efficiency for soil (i.e., the use of dermal RAFTs). The dermal RAFTs used in the HHRA were based on Health Canada (2025).

An in-vitro bioaccessibility assay for arsenic (IVBA) was performed on site specific baseline soil samples collected in support of the Project. This simulates the relative absorption of arsenic from soil in the gut. Using Health Canada (2017) guidance, relative bioavailability (RBA) was estimated. The RBA estimates the proportion of arsenic in soil that can be absorbed into the body, relative to the medium used in the critical study of the TRV. The IVBA of site-specific soil was assumed to be the average of all collected samples presented in Table A1-2 (Attachment A). The RBA of arsenic in site specific soil was calculated using the following method (Health Canada 2017):

$$RBA_{soil} = 0.79 \times IVBA + 0.03$$

Where:

RBA_{soil} = Relative bioavailability of arsenic in soil (unitless)

IVBA = Proportion of arsenic extracted from in vitro bioaccessibility assay (unitless) – 0.245

A worked example of the calculation of the arsenic RBA is provided below.

Example 3-1: Relative Bioavailability of Arsenic in Site-Specific Soil

$$RBA_{soil} = 0.79 \times 0.245 + 0.03$$

$$RBA_{soil} = 0.224$$

The RAFTs for the oral, dermal and soil inhalation routes, along with the permeability coefficients applied in the calculation of surface water exposure doses, for the POPCs considered in the multi-media assessment are presented in Table E-9 below.

Table E-9: Relative Absorption Factors and Parameter-Specific Factors

Parameter of Potential Concern	Relative Absorption Factors (Unitless)				Permeability Coefficient (Kp) (cm/hour)
	Oral (Soil)	Oral (Food, Water)	Dermal (Soil)	Inhalation	
Arsenic	0.22 ⁽¹⁾	1 ⁽²⁾	0.03 ⁽³⁾	1 ⁽²⁾	0.001 ^(2,4)
Mercury	1 ⁽²⁾	1 ⁽²⁾	1 ⁽³⁾	1 ⁽²⁾	0.001 ⁽⁴⁾
Methylmercury	1 ⁽⁵⁾	1 ⁽²⁾	0.06 ⁽³⁾	1 ⁽²⁾	0.001 ⁽⁴⁾
Selenium	1 ⁽²⁾	1 ⁽²⁾	0.01 ⁽³⁾	1 ⁽²⁾	0.001 ^(2,4)

Notes:

cm/hour= centimetres per hour

1 Site specific relative bioavailability (RBA) of arsenic in soil based on site-specific in-vitro bioaccessibility assay

2 Default value for inorganic substances (Health Canada 2024).

3 Health Canada (2025).

4 US EPA (2004).

5 Ontario Ministry of the Environment, Conservation and Parks (MOE 2011) recommends a value of 0.5 but a default value of 1 was conservatively used.

The exposure dose for dermal contact with surface water was calculated following the US EPA's supplemental guidance for dermal risk assessment (US EPA 2004). The absorbed dose is based on the POPC concentration in surface water, parameter-specific properties (permeability coefficient), skin surface area, and exposure duration. The permeability coefficients represent the rate for specific parameters to be absorbed through the skin surface and are reported in units of cm/hour. The permeability coefficients (i.e., Kp) for calculating the absorbed dose for POPCs from water were obtained from US EPA (2004) and are presented in Table E-9 and Table E1-16.

3.2 PARAMETER SPECIATION

3.2.1 ARSENIC

Arsenic speciation in the environment is critical when predicting human exposures and health risks. Environmental arsenic exists in two forms (i.e., inorganic and organic) that have a large determination on toxicity. Soluble, inorganic forms of arsenic (i.e., arsenite and arsenate) are much more toxic to humans than organic forms of arsenic (i.e., arsenobetaine-AsB, dimethylarsenic acid-DMA and monomethylarsonic acid-MMA) (Schoof et al. 1999). It is important to consider speciation of inorganic arsenic in environmental media as the toxicity reference values used in the HHRA are in the inorganic form. In estimating the average daily intake of inorganic arsenic for Canadians, Health Canada (1995) assumed that 37% of arsenic in food is in the inorganic form. More recently, Health Canada (2006) recommended that 25% of arsenic in food can be considered inorganic and 75% organic. The Agency for Toxic Substances and Disease Registry (ATSDR 2016) noted that the consensus in the literature is that 10% or less of total arsenic in food is in the inorganic form.

Schoof et al. (1999) conducted a market basket survey that measured total arsenic and the inorganic arsenic content in food (i.e., fats, oils, sweets, milk, yogurt, cheese, meat, poultry, fish, eggs, nuts, vegetables, fruits, bread, cereal, rice and pasta) and determined that supermarket foods provide varying amounts of inorganic arsenic. At least two recent studies have used the results of Schoof et al. (1999) together with more comprehensive total diet study data for total arsenic to estimate typical background intakes of inorganic arsenic for Canadians and Americans (Yost et al. 2004; Tsuji et al. 2007). The results of the Schoof et al. (1999) market basket study were sufficient to calculate a 95th upper confidence limit on the mean (95% UCLM) on most of the foods and in some instances (due to limited sample size), an upper elevated estimate (e.g., maximum) were assumed. The proportion of inorganic arsenic was very low in meat, poultry and market finfish (< 1%) but was relatively higher in fruit, vegetables and grains. Inorganic arsenic was not detected in skim or whole milk.

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A more recent study from Tanamal et al. (2020) assessed the inorganic arsenic content in fish in Yellowknife, Northwest Territories. Tanamal et al. (2020) measured the total and inorganic arsenic in locally caught fish from over 1,000 residents in Yellowknife caught between 2017 and 2018 including members of the Dene First Nation. It is important to note that fish samples in the study have been exposed to legacy mining parameters (e.g., Giant Mine in Yellowknife). The study presents the measured total arsenic and inorganic arsenic concentrations in various fish species (i.e., lake whitefish, northern pike, and burbot) across lakes in Yellowknife. The results of the study were considered applicable for the evaluation of arsenic speciation for the Great Bear Project multi-media assessment, as lake whitefish and northern pike are fish species that are also consumed by the Indigenous people in the area of the Project. In addition, the results of Tanamal et al. (2020) were based on fish harvested from lake environments, which reflects the fishing practices of these communities.

Rice consumption is a major source of arsenic exposure globally. A study by Williams et al. (2005) performed a market basket analysis of rice from supermarkets in Asia, Europe and North America. The results report the concentration of arsenic in several varieties of rice, as well as the species of arsenic present. Several samples of wild rice were collected in Canada, with a proportion of inorganic arsenic ranging from 71% to 76%. The range and average proportion of inorganic arsenic in Canadian wild rice was greater than samples taken in Asia (36%-74%), Europe (44%-65%) and the United States (10%-61%).

For the purposes of the multi-media assessment, the results of the market basket study by Schoof et al. (1999) were used to estimate the inorganic arsenic content in vegetables, fruit, meat, and fish. When sufficient data were available, a 95% UCLM or an average of the data presented in the Schoof et al. (1999) study was used as the parameter speciation proportion. Arsenic speciation data from Tanamal et al. (2020) was used for fish. This is because Tanamal et al. (2020) used wild caught lake species that are more similar to those found in the LSA/RSA than those used in Schoof et al. (1999), which were based on a market finfish. An average of inorganic arsenic proportion from Canadian wild rice samples from Williams et al. (2005) was used to estimate wild rice arsenic speciation.

A summary of inorganic arsenic speciation assumptions used in the HHRA can be found in Table E-10.

Table E-10: Inorganic Arsenic Speciation

Food Type	Inorganic Arsenic (% of Total Arsenic)	Reference
Water and Soil/Soil Dust	100%	Assumed
Above-Ground Produce	68%	Schoof et al. 1999 Average of data provided for above-ground plants (beans, corn, cucumber, lettuce, peas, spinach, tomato)
Below-Ground Produce	39%	Schoof et al. 1999 Average value provided for below-ground plants (carrots, onions, potatoes)
Berries	40%	Schoof et al. 1999 Average of data provided for berries
Traditional Plants	68%	Schoof et al. 1999 Average of data provided for above-ground plants (beans, corn, cucumber, lettuce, peas, spinach, and tomato)
Wild Game Meat	5.4%	Schoof et al. 1999 95% UCLM (ProUCL) of data provided for meats Grouse data assumed for Canada goose and duck Hoary marmot data assumed for rabbit
Fish	8.5%	Tanamal et al. 2020 95% UCLM of data based on 180 fish samples including lake whitefish, northern pike and burbot
Wild Rice	74%	Williams et al. 2005 Average of sampled wild rice species in Canada

Notes:

% = percent; 95% UCLM = 95% upper confidence limit of the mean.

3.2.2 MERCURY

The toxicity of mercury differs based on speciation. Mercury is present in the environment as organic or inorganic forms and TRVs are available for each form. The most common form of organic mercury is methylmercury which is the predominant form present in fish tissue. The ratio of mercury speciation in environmental media was determined after an exhaustive literature review, with relevant findings detailed below.

3.2.2.1 SOIL AND TERRESTRIAL PLANTS

The proportion of methylmercury found in soil and terrestrial plants was assumed to be negligible in comparison to that of surface water, fish and wild game. For example, methylmercury was found to make up less than 1% of total mercury in soils of Devon Island in Canada's high Arctic (Oiffer and Siciliano 2009, as cited in Aboriginal Affairs and Northern Development Canada [AANDC] 2012). US EPA (1997) found that the fraction of methylmercury to total mercury ranges from 0.5 to 1.5% in soils from Washington state. Mailman and Bodaly (2005) reported a methylmercury content of 1.9% in Labrador tea and 3.6% in wild blueberry plants collected in northwestern Ontario.

3.2.2.2 SURFACE WATER

In surface water, Health Canada (1986) suggests that methylmercury is estimated to constitute only 1% of the total mercury content of water. However, CCME (2003) states that methylmercury typically represents up to 10% of total mercury in surface waters.

Other studies reported a range of methylmercury content in surface water. Krabbenhoft et al. (1999) looked at surface water samples from 106 sites (predominately streams) from 21 basins across the United States as part of the United States Geological Survey (USGS) National Mercury Pilot Study and reported that methylmercury constituted 1% to 11% of the total mercury. When considered separately, the background/reference sites had a mean methylmercury concentration of 0.13 ng/L, which represented 3.8% of the mean total mercury. St. Louis et al. (2004) flooded a wetland complex in northwestern Ontario and measured the biogeochemical cycling of methylmercury in the wetland. For the two years prior to flooding, methylmercury concentrations averaged 0.15 and 0.08 ng/L or approximately 5-10% of the total mercury was methylmercury. Litten (1996) sampled 11 tributaries to Lake Ontario and found the proportion of methylmercury ranged between <1% to 46.04% (median 2.4%). Another study conducted on tributaries to Onondaga Lake in New York State found that methylmercury constituted between 2.10% and 10.00% (median: 3.45%) (PTI 1993). US EPA (1997) looked at the proportion of methylmercury in Swedish lakes, Lake Crescent in Washington state, and Little Rock Lake in north-central Wisconsin, and found that the percentage of methylmercury range from 1.0-12%, <2.5%, and 5%, respectively.

As these reports and studies suggest, there is a wide range in the proportion of methylmercury in surface waters. Some of the biotic and abiotic factors reported to influence methylmercury concentrations in surface waters include:

- Acidity (pH)
- Temperature
- Redox conditions (anoxia)
- Dissolved organic carbon / humic matter
- Presence of complexing agents
- Sulfate
- Nutrients (nitrogen and phosphorus)
- Salinity
- Suspended particulate matter

- Watershed characteristics (e.g., presence of wetlands, catchment type, land use, soil organic content).

The review of the literature highlights the importance of understanding the study area of interest and the use of site-specific values, wherever possible. As part of the Baseline Water Quality Assessment (WSP 2025c), surface water sampling of the English River system was performed between 2021 and 2024. This system runs through the LSA and beyond, and includes large sections of the Chukuni River, the main effluent discharge site. Within the Mercury Study Report, to represent surface water quality within the LSA, the average proportion of methylmercury in surface water across sampling locations and years in the Chukuni River was calculated to be 4.1% (WSP 2026; Table 5-1). Assuming that 4.1% of total mercury consists of methylmercury in surface waters, this appears to be a conservative estimate as it is close to the means reported in the studies discussed above.

3.2.2.3 FISH

Methylmercury in fish tissue is often assumed to be nearly 100% of total mercury (Health Canada 2007). US EPA (2000) acknowledged that the proportion of methylmercury to total mercury varies greatly in fish tissues, between 30 and 100 percent, and that because of the high costs of methylmercury analysis in labs, it should be conservatively assumed that all of the mercury present in fish tissues be methylmercury. However recent studies by Foster and Mathieu (2023) found that the proportion of methylmercury in freshwater fish sampled in Washington State, was 66 ±16%. Moreover, a study by Canuel et al. (2006) used an assumption that 85% of mercury in fish was methylmercury.

As previously stated, the methylation potential of mercury in surface water can vary alongside a number of parameters. This will affect the proportion of methylmercury present in fish tissue and highlights the importance of site-specific values. As part of the Fisheries Resources Baseline sampling program, (WSP 2025d) fish (i.e., northern pike, walleye and different types of forage fish) were collected from waterbodies within the LSA from 2022 to 2024. Tissues were analysed for total mercury and methylmercury. Of these collected samples, individuals of species and sizes relevant for human consumption were identified, and their tissue methylmercury proportions were averaged to characterize conditions within the LSA. Details on species and size ranges relevant to human consumption, and the average proportion of methylmercury can be found in Table E-11.

Table E-11: Site-Specific Methylmercury Proportions in Fish Tissues Relevant to the HHRA

Fish Species	Size Range (cm)	Average MeHg Proportion (%)
Northern Pike	40-70 cm	85%
Walleye	28-52 cm	85%
Forage Fish (i.e., Yellow perch, white sucker)	>25 cm	68%

Notes:

% = percent; > = greater than; cm = centimetre; HHRA = Human Health Risk Assessment; MeHg = methylmercury

The average site-specific methylmercury proportion in the collected fish tissue from the Fisheries Resources Baseline sampling program, (WSP 2025d), calculated by dividing the methylmercury concentration by the total mercury concentration, fall close to the average reported in Foster and Mathieu (2023) and are below or close to the assumption made by Canuel et al. (2006). It was determined that the site-specific fish tissue methylmercury proportions were similar to those found in literature. Therefore, the site-specific values were selected to represent fish tissue apportionments for the purpose of the HHRA.

3.2.2.4 WILD GAME

The proportion of methylmercury concentrations to total mercury tissue concentrations in wild game tissues were estimated from literature. US EPA (1997) assumes that methylmercury makes up 13% of total mercury in herbivorous mammals for the purpose of calculating exposure parameters for mercury in beef. An assessment conducted as part of the Northern Contaminants Program (AANDC 2012) and a study conducted by Gamberg et al. (2015) on mercury in the Canadian Arctic terrestrial environment reported that the fraction of methylmercury to total mercury in caribou muscle and moose muscle are approximately 75% and 90%, respectively. In general, the kidney and liver contain the highest levels of

mercury, even higher than muscle because these organs filter for toxins and waste (AANDC 2012). In fact, the kidney is often used for monitoring mercury in terrestrial species.

No information on methylmercury to total mercury ratios for duck, grouse/partridge, Canada goose, rabbit, or deer, were found, although AANDC (2012) noted that Arctic hare and a variety of rodents sampled from the Canadian Arctic had low concentrations of total mercury in muscle, and willow ptarmigan collected from northern Canada from 1985 to 1994 had low concentrations of total mercury in the liver and kidney. Where site-specific or literature-based mercury speciation values were unavailable, it was conservatively assumed that methylmercury content in the caribou muscle was an appropriate surrogate for other mammals and birds, namely the rabbit, Canada goose, grouse/partridge and duck. Similarly, the mercury speciation for moose muscle was applied to the caribou liver and deer.

Summary

A summary of mercury speciation assumptions can be found in Table E-12.

Table E-12: Organic Mercury Speciation

Media	Organic Mercury (% of Total Mercury)	Reference
Soil	1.5%	US EPA 1997
Traditional Plant	1.9%	Mailman and Bodaly 2005
Wild Rice	1.9%	Assumed same as traditional plants
Aboveground Garden Produce	1.9%	Assumed same as traditional plants
Belowground Garden Produce	1.9%	Assumed same as traditional plants
Berry	3.6%	Mailman and Bodaly 2005
Surface Water	4.1%	Site-specific, average (all stations all years); WSP 2026 Mercury Study Report; Table 5-1
Pike	84.0%	Site-specific; Average of samples 40-70 cm
Walleye	60.0%	Site-specific; Average of samples 28-52 cm
Whitefish	68.0%	Site-specific; Average of samples > 25 cm
Caribou	75%	AANDC 2012
Caribou Liver	75%	Assumed same as caribou muscle
Moose	90.0%	AANDC 2012
Moose Kidney	90.0%	Assumed same as moose muscle
Moose Liver	90.0%	Assumed same as moose muscle
Deer	90.0%	Assumed same as moose muscle
Rabbit	75%	Assumed same as caribou muscle
Canada Goose	75%	Assumed same as caribou muscle
Grouse/Partridge	75.0%	Assumed same as caribou muscle
Duck	75.0%	Assumed same as caribou muscle

Notes:

% = percent; > = greater than; AANDC = Aboriginal Affairs and Northern Development Canada; cm = centimetre; CCME = Canadian Council of Ministers of the Environment; US EPA = United States Environmental Protection Agency.

3.3 HUMAN HEALTH EXPOSURE POINT CONCENTRATIONS

Exposure point concentrations (EPCs) are estimates of the concentrations of POPCs that people may be exposed to in each relevant exposure media under baseline conditions as well as during each of the

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Project phases. EPCs for each media were characterized for the following assessment phases in the HHRA, which are aligned with the Project temporal boundaries described in Section 3.3 in the HHERA report:

- **Baseline (existing conditions)** - representing POPC concentrations in the existing environment (i.e., measured soil, water, vegetation, fish and game meat concentrations prior to implementation of the Project).
- **Construction Phase** - representing POPC concentrations in the existing environment (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in the environment associated with the Project during construction, which spans 3 years.
- **Operations Phase** - representing POPC concentrations in the existing environment (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in the environment associated with the Project during operations, which spans approximately 26 years.
- **Closure Phase** - representing POPC concentrations in the existing environment (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in the environment associated with the Project during active closure, which spans approximately 3 years when air emissions are assumed to be similar during construction. For the purpose of water quality modelling, the closure phase was modelled for 6 years to account for closure related activities specific to water quality, such as active effluent treatment.
- **Post-Closure** - representing POPC concentrations in the existing environment (i.e., baseline) in addition to predicted incremental changes to POPC concentrations in the environment associated with the Project post-closure. Post-closure spans approximately 2 years (1 year of passive closure and 1 year of Final Close Out) and is associated with the gradual return to baseline air particle dispersion rates. For the purpose of water quality modelling, post-closure was modelled for 36 years to account for related activities specific to water quality, such as passive effluent leaching.

Corresponding Project-Alone incremental change is also considered to assess contributions related to the Project during each Project phase (e.g., construction phase minus baseline).

Both measured and predicted concentrations were used in the HHRA. Depending on the media, concentrations were either directly measured or predicted using models and/or bioaccumulation factors (BAFs). Measured data were available for soil, surface water, terrestrial vegetation (including berries and traditional plants), fish tissue (muscle) and small game tissue (liver), as presented in Attachment A of the HHERA. Where measured concentrations were available, site-specific BAFs were calculated, as detailed in Attachment A of the HHERA.

Where measured data was not available, concentrations were predicted using models and/or BAFs available from literature or assumed based on available data from other regions (e.g., lichen). Details are discussed in the sections below.

A summary of the type of environmental data used in the HHRA for deriving baseline, and Project phases (construction, operations, closure and post-closure) EPCs are summarised in Table E-13 for each media type assessed in the multi-media assessment.

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Table E-13: Methods for Deriving EPCs for Human Health Risk Assessment

Environmental Media	EPC Rationale
Soil	<p>A Baseline Soil and Traditional Foods Sampling Program was conducted in 2023 to characterize the baseline metal and polycyclic aromatic hydrocarbons (PAH) concentrations (Attachment A). The 95 upper confidence limit of the mean (95% UCLM) concentration of the soil analytical results was selected as the EPC.</p> <p>The annual mean of the highest deposition rates predicted for each POR for each assessment phase (as provided by Air Quality discipline, see Attachment B) was used to calculate the incremental soil concentration due to Project deposition during each phase. This was summed with the baseline EPC to calculate total EPCs for each assessment phase. It was assumed no atmospheric deposition of POPCs during baseline and the post-closure phase.</p>
Soil Dust	<p>EPCs for soil dust were predicted based on total surface soil concentrations (i.e., sum of measured baseline surface soil concentration and predicted surface soil concentration from deposition) for each assessment phase. Soil dust concentration was calculated using a standard dust ratio prescribed by Health Canada 2024.</p>
Surface Water	<p>Maximum monthly surface water concentrations were predicted for every Project year at each water quality node, provided by the Water Quality discipline (WSP, 2025b). Predicted annual average concentrations were calculated by averaging the maximum monthly concentrations for each individual year, at each individual water quality node. For each Project phase, an average concentration was calculated by averaging the maximum annual average for each year within a specific Project phase. These phase averages were then averaged across water quality modeling nodes and, and the resultant average was selected as the EPC.</p>
Dietary Items	
Berries ⁽¹⁾	<p>Baseline concentrations of berries were obtained from the Baseline Soil and Traditional Foods Sampling Program conducted in 2023 to characterize baseline metals and PAH concentrations (Attachment A). Due to a sample size of less than 10, the maximum concentration was selected as the baseline EPC for berries.</p> <p>Predicted berries EPCs were derived based on the calculated dust deposition to plant surfaces using models from US EPA (2005a), and plant uptake from predicted soil bioaccumulation based on the site-specific BAFs and predicted soil concentrations. Site-specific BAFs were calculated using the maximum berry and 95 UCLM soil concentrations from the Baseline Soil and Traditional Foods Sampling Program. In instances where the baseline program did not have any available samples with detections of POPCs in berries, a literature BAF from Baes et al 1984 was used. Predicted berry concentrations from soil bioaccumulation and deposition were then summed to calculate total predicted berry concentrations as the EPCs for the different assessment phases.</p>
Traditional Plants ⁽¹⁾	<p>Baseline concentrations of traditional plants were obtained from the Baseline Soil and Traditional Foods Sampling Program conducted in 2023 (Attachment A). The 95% UCLM concentration was selected as the statistic for the calculation of the site-specific BAF.</p> <p>Predicted traditional plant EPCs were derived based on the calculated dust deposition to plant surfaces using on models from US EPA (2005a), and plant uptake from predicted soil bioaccumulation based on site-specific BAFs and predicted concentration in soil.</p> <p>Site-specific BAFs were calculated using the 95 UCLMs of baseline traditional plant concentrations and soil concentrations from the Baseline Soil and Traditional Foods Sampling Program (i.e., baseline traditional food concentration divided by baseline soil concentrations).</p> <p>Predicted plant tissue concentrations from soil bioaccumulation and deposition were then summed to calculate total predicted plant concentrations as the EPCs for the different assessment phases.</p>
Garden Produce	<p>Above and below ground garden produce EPCs were based on collected soil samples from the Baseline Soil and Traditional Foods Sampling Program conducted in 2023. EPCs in in each Project phase for garden produce were derived based on the predicted changes to soil quality due to dust deposition from the Project. Predicted aboveground produce concentrations from dust deposition to plant surfaces were predicted using models from US EPA (2005a).</p>

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Environmental Media	EPC Rationale
	<p>Predicted above and belowground produce concentrations from soil uptake were predicted based on the literature BAFs from US EPA (2005a) and predicted soil concentrations.</p> <p>Predicted aboveground produce concentrations from soil bioaccumulation and deposition were then summed to calculate total predicted garden produce concentrations as the EPCs for the different assessment phases.</p>
Wild Rice	<p>Baseline wild rice EPCs were based on collected surface water sampling from the Water Quality Baseline Assessment (WSP 2025c) and the site-specific BAFs.</p> <p>Predicted wild rice EPCs in each Project phase were derived based on the predicted surface water quality during that Project phase and site-specific BAFs.</p> <p>The site-specific BAFs were calculated using a sample of wild rice collected from the Soil and Traditional Foods Sampling Program completed in 2023 (Attachment A) and the baseline surface water EPC.</p>
Fish ⁽¹⁾	<p>Fish tissue samples were collected from 2022 to 2024 as part of the 2022 to 2025 fisheries resources assessment (as provided by Aquatics discipline, WSP 2025d).</p> <p>Baseline fish tissue EPCs were calculated based on collected surface water sampling from the Water Quality Baseline Assessment (WSP 2025c) and the site-specific BAFs. Project phase fish tissue EPCs were estimated using predicted surface water concentrations and site-specific BAFs.</p> <p>Baseline EPCs for each fish species relevant to human consumption (northern pike, walleye, forage fish) were calculated as the 95% UCLM. Baseline fish samples included in the calculation of the 95% UCLM were only those within size ranges considered relevant for human consumption: 40-70 cm of Northern Pike, 28-52 cm for Walleye, and greater than 25 cm for Lake Whitefish. These size ranges were selected to be similar to the size ranges used in the Ministry of Environment Conservation and Parks (MECP) fish consumption advisories (MECP 2014). Site-specific BAFs were derived using the 95% UCLM of measured fish data and annual average baseline surface water concentrations.</p>
Wild Game Meat	<p>Game meat EPCs were derived from the wildlife exposure model (see Section 3.2.6). The model considered baseline, and predicted changes in concentrations of POPCs in soil, surface water, and dietary items for wildlife from the Project. Baseline EPCs for wild game were calculated using baseline media exposures and Site-specific bio-transfer factors (BTFs). Since the BTFs were calculated as the ratio of game meat concentrations published in the FNFNES to the baseline media exposures, the resulting baseline EPCs match the game meat concentrations published in the FNFNES (Chan et al 2014, 2021). Project phase EPCs in wild game were calculated by multiplying the media exposure, during Project phases, by the Site-specific BTFs. Measured wild game tissue concentrations were obtained from the FNFNES for the Ontario Boreal Shield/Ecozone 1 (Chan et al. 2014, 2021).</p> <p>Baseline concentrations in wildlife dietary items (i.e., browse, aquatic invertebrates, terrestrial invertebrates, and aquatic plants) were derived from measured baseline soil EPCs, baseline surface water EPCs and site-specific and/or literature-based BAFs available for these dietary items; see Table E1-12 of this Attachment for further details.</p> <p>Site-specific BTFs are meant to characterize the potential absorption of parameters from all environmental media and food consumed by wildlife, into tissues. The BTFs for wild game were calculated using measured wild game meat concentrations from Chan et al. (2021) divided by estimated baseline daily intake, from all media and foods in the wildlife exposure model.</p>

Notes:

% = percent; 95% UCLM = 95% upper confidence limit of the mean; BAF = bioaccumulation factor, BTF = biotransfer factor; cm = centimeter; EPC = exposure point concentration; FNFNES = First Nations Food, Nutrition and Environment Study; LSA = local study area; MECP = Ministry of Environment, Conservation, and Parks; PAH = polycyclic aromatic hydrocarbon; POPC = parameter of potential concern; POR = point of reception; UCLM = upper confidence limit of the mean; US EPA = United States Environmental Protection Agency.

- 1 The derivation of site-specific BAFs for berries, fish and traditional plants is provided in Attachment A, sub Attachment A1, which considered measured concentrations in berries, fish, traditional plants and soil within the LSA, in addition to predicted concentrations of soil and surface water. Literature based BAFs were used when sample data were not available or detected.

3.3.1 SOIL

The baseline soil concentrations and calculated baseline soil EPC (95% UCLM) are presented in Table A1-2 (Attachment A). Predicted soil EPCs for each phase were calculated by summing the baseline soil EPC concentration with the POPC concentration in dust predicted to be deposited as a result of the Project. Incremental changes to soil quality from the Project due to aerial deposition of dust were modelled as part of the HHRA, as discussed in detail below.

3.3.1.1 DEPOSITION MODELLING

The baseline soil EPC concentration and the predicted deposition rates (Attachment B) were used to predict soil EPCs for each of the Project phases. Incremental changes to soil concentrations due to airborne emissions during the Project phases were calculated from annual deposition rates provided by the Air Quality discipline (WSP 2025a). The rationale for the selection of PORs for the HHRA is detailed in Attachment B. It was assumed that deposition rates would be the same during construction and active closure phases as Project activities are expected to be similar during these phases. It was assumed that no deposition occurred during the baseline and post-closure phases as there would be no Project activities occurring during baseline, and notable sources of air emissions that would warrant an air quality assessment are not expected to occur during post-closure (WSP 2025a).

Atmospheric parameter deposition to soil was calculated using a procedure published by the US EPA Office of Solid Waste (US EPA 2005a), where the concentration in soil resultant from deposition (during the construction, operations and closure phases) was calculated using the following equation:

$$Soil_{dep} = \frac{Q}{Z \times BD} \times \frac{1 - e^{(-ks \times t)}}{ks}$$

Where:

Soil_{dep} = Estimated concentration of POPC in soil attributed to particulate deposition from air (mg/kg)

Q = Rate of airborne particle deposition (mg/m²/year)

Z = Soil depth (m)

BD = Bulk density of soil (kg/m³)

ks = Soil loss constant (year⁻¹)

t = Time period of deposition (years)

The equation represents a simple soil compartment model that assumes that deposition represents a mass input of parameter per unit volume of soil. The equation allows for loss (i.e., removal) of parameters from the unit volume of soil through various processes including abiotic and biotic degradation (degradation without and with involvement of living organisms, respectively), erosion (movement of soil from one area to another via wind, rain, or other processes), surface runoff (unconfined flow of water over the ground surface), leaching (loss of substance from surface soil into the subsurface or nearby waterbodies), and volatilization (vapour loss to the atmosphere). In the absence of site-specific information and to be conservative, US EPA (1999; 2005a) assumes default values of zero (i.e., no loss) for erosion, surface runoff, volatilization, and leaching processes. The soil loss constant for metals and metalloids were assumed to be based on a half-life of 25 years (i.e., 9,125 days or rate constant of 0.028 year⁻¹), which is almost equal to the length the operations phase of the Project, to establish that metals and metalloids accumulated in soil for each of the mine phases with negligible losses occurring over the period of deposition. The assumption of minimal or negligible losses from soil for metals and metalloids is conservative and likely results in an overestimate of the predicted soil concentrations.

The bulk density was assumed to be 1,500 kg/m³ and soil concentrations were predicted for two mixing depths (i.e., 2 cm and 20 cm) to calculate surface soil concentrations for direct human contact and uptake into plants consumed by humans, respectively, as recommended by US EPA (2005a). The time of deposition was assumed to be the length of the Project phase being modelled: construction phase (3 years), operations phase (26 years), closure phase (3 years).

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The EPCs for deposition were calculated based on the average of the maximum deposition rates for each air quality POR for the HHRA. There are no Points of Reception locations within the PA. Rationale for selection of PORs is explained in Attachment B.

Inputs for calculating soil deposition concentrations are presented in Table E-14. Air deposition rates are provided in Table B1-3 (Attachment B), and calculated deposition to soil concentrations and total soil concentrations (i.e., EPCs) are provided in Table B1-4 (Attachment B).

Table E-14: Soil Deposition Calculation Inputs

Input	Value	Units	Reference
Rate of airborne particle deposition (Q)	POR-Specific	mg/m ² /year	Values provided by Air Quality Discipline; Tables B1-3 and B1-4 (Attachment B)
Soil depth (Z)	0.02	m	US EPA 2005a; direct human contact
	0.2		US EPA 2005a; uptake into plants consumed by humans
Bulk density of soil (BD)	1500	kg/m ³	US EPA 2005a; mean value for loam soil
Soil loss constant (ks) – Deposition modelling for X	0.028	Year ⁻¹	Assumed long half-life to be conservative
Time period of deposition	26 (operations) 3 (construction) 3 (active closure)	Years	Project-specific

Notes:

kg/m³ = kilograms per cubic metre; m = metres; mg/m²/year = milligrams per metres squared per year; POR = point of reception; US EPA= United State Environmental Protection Agency

Calculation of soil loss constant:

$$ks = \frac{\ln(2)}{\text{Half Life}_{\text{assumed}}/C}$$

$$ks = \frac{\ln(2)}{9125/365}$$

Where:

- ks = Soil loss constant (year⁻¹)
 HalfLife_{assumed} = Assumed POPC half-life (days)
 C = Conversion factor (365 days/year)

A worked example of the calculation of deposition to soil for arsenic is provided below.

Example 3-2: Deposition of Arsenic to Soil in the Operations Phase

Surface Soil (i.e., top 2 cm)

$$\text{Soil}_{\text{dep}} = \frac{0.4206 \text{ mg/m}^2/\text{year}}{0.02 \text{ m} \times 1500 \text{ kg/m}^3} \times \frac{1 - e^{-0.0277 \text{ years}^{-1} \times 26 \text{ years}}}{0.0277 \text{ years}^{-1}}$$

$$\text{Soil}_{\text{dep}} = 0.26 \text{ mg/kg}$$

Sub-Surface Soil (i.e., top 20 cm)

$$Soil_{dep} = \frac{0.4206 \text{ mg/m}^2/\text{year}}{0.2 \text{ m} \times 1500 \text{ kg/m}^3} \times \frac{1 - e^{-0.0277 \text{ years}^{-1} \times 26 \text{ years}}}{0.0277 \text{ years}^{-1}}$$

$$Soil_{dep} = 0.026 \text{ mg/kg}$$

3.3.1.2 CUMULATIVE DEPOSITION CONCENTRATION

It is conservatively assumed that POPCs in soil do not degrade or erode appreciably in soil. Therefore, Project related contribution to POPC concentration in soil via deposition accumulates over the phases of the Project. The total amount of POPC deposited to soil is calculated using the following equation:

$$Soil_{dep-cumulative} = \sum Soil_{dep-phase}$$

Where:

$Soil_{dep-cumulative}$ = Total estimated concentration of a POPC in soil attributed to particulate deposition from air, including all previous Project phases (mg/kg)

$Soil_{dep-phase}$ = Total estimated concentration of a POPC in soil attributed to particulate deposition from air, attributed to a specific Project phase (mg/kg)

A worked example of the calculation to derive the cumulative deposition concentration for arsenic is provided below.

Example 3-3: Cumulative Deposition of Arsenic to Soil During Operations (Surface Soil [i.e., top 2 cm])

$$Soil_{dep-cumulative} = Soil_{dep-Construction} + Soil_{dep-Operations}$$

$$Soil_{dep-cumulative} = 0.048 \text{ mg/kg} + 0.26 \text{ mg/kg}$$

$$Soil_{dep-cumulative} = 0.31 \text{ mg/kg}$$

3.3.1.3 TOTAL PREDICTED SOIL CONCENTRATION

Predicted soil concentrations were calculated by summing the 95% UCLM measured baseline (i.e., existing conditions) soil concentrations with the amount predicted to be deposited as a result of the Project. The total concentration of POPCs in soil following deposition (i.e., Baseline + Project) was calculated using the following equation:

$$Soil_{total} = Soil_{dep-cumulative} + Soil_{base}$$

Where:

$Soil_{total}$ = Total predicted soil concentration of a POPC

$Soil_{dep-cumulative}$ = Total estimated concentration of a POPC in soil attributed to particulate deposition from air, including all applicable Project phases (mg/kg)

$Soil_{base}$ = Measured baseline soil concentration of a POPC (95% UCLM of baseline soil concentrations)

Predicted soil EPCs can be found in Table E1-1; following this Attachment. Baseline soil concentrations are provided in Table A1-2 (Attachment A).

A worked example of the calculation of total predicted soil EPCs for arsenic for the operations phase is provided below.

Example 3-4: Total Predicted Concentration of Arsenic in Soil During Operations

$$Soil_{total} = Soil_{dep-cumulative} + Soil_{base}$$

Surface Soil (i.e., top 2 cm)

$$Soil_{tot} = 0.31 \text{ mg/kg} + 8.11 \text{ mg/kg}$$

$$Soil_{tot} = 8.42 \text{ mg/kg}$$

Sub-Surface Soil (i.e., top 20 cm)

$$Soil_{tot} = 0.031 \text{ mg/kg} + 8.11 \text{ mg/kg}$$

$$Soil_{tot} = 8.14 \text{ mg/kg}$$

3.3.2 SOIL DUST

Concentrations of POPCs in soil dust were estimated based on baseline or predicted surface soil concentrations and the default airborne concentrations of respirable particulate matter in air from Health Canada (2024), as follows:

$$C_D = \frac{C_s \times P_{air}}{CF}$$

Where:

C_D = POPC concentration in soil dust (mg/m^3)

C_s = POPC concentration in surface soil (mg/kg). Total surface soil concentration calculated from soil attributed to particulate deposition from air and measured baseline soil concentration

P_{air} = Default airborne concentration of respirable particulate matter, $0.76 \mu\text{g}/\text{m}^3$ (Health Canada 2024)

CF = conversion factor from $\mu\text{g}/\text{m}^3$ to kg/m^3 ; 10^9

A worked example of the calculation of the predicted arsenic in soil dust concentration for the operations phase is provided below.

Example 3-5: Concentration of Arsenic in Soil Dust During Operations

$$C_D = \frac{8.42 \text{ mg/kg} \times 0.76 \mu\text{g}/\text{m}^3}{10^9 \mu\text{g}/\text{m}^3 \text{ per } \text{kg}/\text{m}^3}$$

$$C_D = 6.40E^{-9} \text{ mg}/\text{m}^3$$

Soil dust EPCs for each assessment phase can be found in Table E1-1 (Attachment E).

3.3.3 SURFACE WATER

Surface water quality baseline EPCs were provided by the Water Quality discipline (WSP 2025b). Baseline surface water quality EPCs (Model Baseline) for Project area watercourses and waterbodies, including the Chukuni River (the receiving environment) are equivalent to monthly median (or average) baseline concentrations, where the number of samples available for each month were greater than three. In cases where only one or two baseline data samples were available for that month (e.g., winter months

when monitoring locations could not be safely accessed during the baseline sampling program), source term inputs for unnamed watercourses were instead developed as seasonal inputs (i.e. quarterly grouping: November to January, February to April, May to July, August to October). For unnamed waterbodies, if less than three datapoints per month were available, source terms were developed for under ice versus. open water seasons (November to April and May to October).

Surface water quality predictions were generated for all Project phases including the baseline, construction phase, operations phase, closure phase, and post-closure.

The predicted EPCs for surface water were as follows:

- Project EPCs for each Project phase were calculated as an annual average of predicted surface water concentrations across all relevant water quality nodes. Details of the water quality node locations which were considered in the HHRA are provided in Attachment B, and full details of the water quality modelling is provided in WSP 2025b.
- Project + Baseline EPCs were calculated as the maximum annual average surface water concentration for baseline summed with the maximum predicted annual average surface water concentration for each Project phase.
- Incremental Project Alone water quality EPCs were calculated from predicted water quality by subtracting the model baseline concentrations from each of the predicted Project phase concentrations. If an incremental change was negative, a value of 0 was used as the EPC.

Surface water EPCs for each Project phase can be found in Table B1-5 (Attachment B).

3.3.4 TERRESTRIAL VEGETATION

Baseline concentrations of terrestrial vegetation including berries and traditional plants were obtained from the Soil and Traditional Foods Sampling Program conducted in 2023 and detailed in Attachment A. For garden produce and traditional plants, baseline concentrations were predicted based on the baseline soil quality and using Site-specific and literature BAFs.

Predicted EPCs for terrestrial vegetation were calculated by summing the POPC concentration taken up into plant tissue from soil with the concentrations predicted to be deposited to the plant surface as a result of airborne dust related to the Project. Incremental changes to terrestrial vegetation quality from the Project due to aerial deposition of dust were modelled as part of the HHRA, discussed in detail below.

3.3.4.1 DEPOSITION TO PLANT SURFACE MODELLING

Atmospheric parameter deposition to plant surfaces was calculated using a procedure published by the US EPA (2005a). The US EPA method for calculating the concentration of POPC in plant tissue attributed to deposition from air tabulates outputs in mg/kg dry weight; a conversion to wet weight was added using moisture content. Moisture content for berries and traditional plants was site-specific, where available, while above ground plants was taken from US EPA (2005a). The predicted POPC concentration in plants from dust deposition was calculated using the following equation:

$$Plant_{dep} = \frac{Q \times Rp \times (1 - e^{-kp \times tp})}{Yp \times kp} \times (1 - MC)$$

Where:

Plant_{dep} = Concentration of POPC in plant tissue attributed to deposition from air (mg/kg wet weight ww)

Q = Rate of airborne particle deposition (mg/m²/year)

Rp = Intercept fraction of the edible portion of the plant (unitless)

kp = Plant surface loss coefficient (year⁻¹)

tp = Length of plant exposure to deposition per harvest of edible portion of plant (years)

Yp = Yield or standing crop biomass of the edible portion of the plant (kg-dry weight (dw)/m²)

MC = Moisture content (kg water/ kg tissue ww)

As a conservative assumption, the current assessment did not adjust concentrations in plants for human consumption with a washing and peeling factor to account for potential reduction in exposures where washing or peeling occurs.

Inputs for calculating deposition to plant surfaces were acquired from US EPA (2005a) and the Air Quality Discipline, and are provided in Table E1-1 (deposition rate input) and Table E1-10 (plant inputs) (Attachment E). The EPCs representing the POPC concentrations in plant tissue from plant surface deposition are provided in Table E1-1 (Attachment E).

Sample calculations are provided below for berries, above ground garden produce, and traditional plants for arsenic in the operations phase. Dust deposition of POPCs to below ground plant surfaces was assumed to be negligible (zero); however, below ground plant concentrations incorporated changes to soil concentrations from atmospheric deposition, which is detailed in Section 3.3.1.

Example 3-6: Deposition of Arsenic to Berries During Operations

$$Berries_{dep} = \frac{4.21E^{-1} \text{mg/m}^2/\text{year} \times 0.053 \times (1 - e^{-18 \text{ years}^{-1} \times 0.164 \text{ years}})}{0.25 \text{ kg} - DW/\text{m}^2 \times 18 \text{ years}^{-1}} \times (1 - 0.85 \text{ kg/kg})$$

$$Berries_{dep} = 6.99E^{-4} \text{mg/kg ww}$$

Example 3-7: Deposition of Arsenic to Above Ground Produce During Operations

$$AG - Plant_{dep} = \frac{4.21E^{-1} \text{mg/m}^2/\text{year} \times 0.39 \times (1 - e^{-18 \text{ years}^{-1} \times 0.164 \text{ years}})}{2.24 \text{ kg} - DW/\text{m}^2 \times 18 \text{ years}^{-1}} \times (1 - 0.87 \text{ kg/kg})$$

$$AG - Plant_{dep} = 4.99E^{-4} \text{mg/kg ww}$$

Example 3-8: Deposition of Arsenic to Traditional Plants During Operations

$$Trad - Plant_{dep} = \frac{4.21E^{-1} \text{mg/m}^2/\text{year} \times 0.982 \times (1 - e^{-18 \text{ years}^{-1} \times 0.164 \text{ years}})}{5.66 \text{ kg} - DW/\text{m}^2 \times 18 \text{ years}^{-1}} \times (1 - 0.51 \text{ kg/kg})$$

$$Trad - Plant_{dep} = 1.88E^{-3} \text{mg/kg ww}$$

3.3.4.2 PLANT UPTAKE FROM SOIL

Site-specific BAFs, calculated as the ratio of the parameter concentration in vegetation tissue to the parameter concentration in soil, were used to model uptake of POPCs from baseline soil or predicted sub-surface soil (0.2 m depth) into plants as follows:

$$Plant_{soil} = C_s \times BAF$$

Where:

Plant_{soil} = Concentration of POPC in plant tissue attributed to soil uptake (mg/kg wet weight ww)

C_s = Concentration of POPC in soil (mg/kg dry weight dw); Total soil concentration calculated from soil attributed to particulate deposition from air and measured baseline soil concentration

BAF = Bioaccumulation factor (mg POPC/kg ww tissue) / (mg/kg dw media)

Site-specific BAFs were derived for berries and traditional plants from measured baseline data. For berries, due to a sample size of less than 10 samples, the maximum concentration of each POPC was selected as the statistic for the calculation of the site-specific berries BAF. For traditional plants, sufficient sampling data was available to allow for the selection of the 95% UCLM as the statistic for the calculation of the site-specific traditional plant BAF. The derivation of site-specific BAFs based on baseline data is presented in Attachment A of the HHERA.

Literature-based BAFs from US EPA (2005c) and Baes et al. (1984) were used for garden produce (i.e., above and belowground produce) in absence of site-specific data. The BAFs can be found in Table E1-12 (Attachment E). In instances where the baseline samples did not have any samples with detections of POPCs in berries, a literature BAF from Baes et al. 1984 was used. Literature BAFs presented in units of dry weight were converted to wet weight using either site-specific moisture content values or literature moisture content values for the various vegetation types found in Table E1-10 (Attachment E).

The plant EPCs from soil uptake can be found in Table E1-1 (Attachment E).

Sample calculations are provided below for derivation of EPCs for berries, above ground garden produce, below ground garden produce and traditional plants.

Example 3-9: Soil Bioaccumulation of Arsenic to Berries During Operations

$$Berries_{soil} = 8.14 \text{ mg/kg} \times 3.24E^{-3}$$

$$Berries_{soil} = 0.026 \text{ mg/kg ww}$$

Example 3-10: Soil Bioaccumulation of Arsenic to Above Ground Garden Produce During Operations

$$AG - Plant_{soil} = 8.14 \text{ mg/kg} \times 8.23E^{-4}$$

$$AG - Plant_{soil} = 0.0067 \text{ mg/kg ww}$$

Example 3-11: Soil Bioaccumulation of Arsenic to Below Ground Garden Produce During Operations

$$BG - Plant_{soil} = 8.14 \text{ mg/kg} \times 1.04E^{-3}$$

$$BG - Plant_{soil} = 0.0085 \text{ mg/kg ww}$$

Example 3-12: Soil Bioaccumulation of Arsenic to Traditional Plants

$$Trad - Plant_{soil} = 8.14 \text{ mg/kg} \times 7.11E^{-3}$$

$$Trad - Plant_{soil} = 0.058 \text{ mg/kg ww}$$

3.3.4.3 TOTAL PLANT CONCENTRATIONS

The total concentration of POPCs in berries, above ground produce, and traditional plants were calculated as follows, accounting for POPC concentrations attributed to both deposition directly onto plant surfaces, and deposition to soil which is then taken up by plants:

$$Plant_{total} = Plant_{soil} + Plant_{dep}$$

Where:

Plant_{total} = Total concentration of POPC in plant tissue (mg/kg wet weight 'ww')

Plant_{soil} = Concentration of POPC in plant tissue attributed to soil uptake (mg/kg ww)

Plant_{dep} = Concentration of POPC in plant tissue attributed to deposition from air (mg/kg ww)

The total plant EPCs are presented in Table E1-1 (Attachment E). Sample calculations are provided below for berries, above ground garden produce, and traditional plants. Belowground garden produce is assumed to only be influenced by POPCs via soil uptake.

Example 3-13: Total Concentration of Arsenic in Berries During Operations

$$Berries_{tot} = 0.026 \text{ mg/kg} + 6.99E^{-4} \text{ mg/kg}$$

$$Berries_{tot} = 0.027 \text{ mg/kg ww}$$

Example 3-14: Total Concentration of Arsenic in Above Ground Garden Produce During Operations

$$AG - Plant_{tot} = 0.0067 \text{ mg/kg} + 4.99E^{-4} \text{ mg/kg}$$

$$AG - Plant_{tot} = 0.0072 \text{ mg/kg ww}$$

Example 3-15: Total Concentration of Arsenic in Traditional Plants During Operations

$$Trad - Plant_{tot} = 0.058 \text{ mg/kg} + 1.88E^{-3} \text{ mg/kg}$$

$$Trad - Plant_{tot} = 0.060 \text{ mg/kg ww}$$

3.3.5 SURFACE WATER TO FISH AND WILD RICE BIOACCUMULATION MODELING

Site-specific BAFs were used to model uptake of POPCs from surface water into fish tissue and wild rice. As discussed in Section 2.2, based on consumption data from the FNFNES (Chan et al. 2014; 2021) and TKLUS reports from Indigenous people with the potential to be impacted by the Project (ANA, LSFN, WFN, NWOMC, RL/EF), Project POPC concentrations were modelled for three fish species – Northern pike, walleye, and lake whitefish. POPC concentrations for all three species were calculated with the same linear uptake model, however with the application of species-specific BAFs. The POPC concentrations in fish tissue were calculated as follows:

Fish tissue samples were collected from 2022 to 2024. Site-specific BAFs were derived using the 95% UCLM of measured baseline fish tissue collected within the LSA (Chukuni river, Dixie Creek, Genesee Lake, and several unnamed waterbodies and streams) for arsenic and selenium and annual average baseline surface water concentrations. Fish samples included in the calculation of the fish EPC for consideration in the HHRA were only those species and size ranges relevant to human consumption, as outlined in Table E-11. Table E-12. Full details of the calculation of site-specific BAFs are presented in Attachment A of the HHERA. Mercury (i.e., inorganic and methylmercury) concentrations in the HHRA were derived from the Mercury Bioaccumulation Study (WSP 2026) and were based on fish tissue samples collected from 2022 to 2024 from Chukuni River.

BAFs applied for the calculation of fish tissue EPCs are provided in E1-12 (Attachment E).

$$Fish = C_w \times BAF$$

Where:

Fish = Concentration of POPC in fish tissue (mg/kg wet weight 'ww')

C_w = Concentration of POPC in surface water (mg/L)

BAF = Bioaccumulation factor (L/kg ww)

Fish EPCs can be found in Table E1-1 (Attachment E).

Example 3-16: Bioaccumulation of Total Arsenic to Northern Pike Tissue During Operations

$$Fish = 0.00399 \text{ mg/L} \times 48.4 \text{ L/kg}$$

$$Fish = 0.19 \text{ mg/kg}$$

Example 3-17: Bioaccumulation of Total Arsenic to Walleye Tissue During Operations

$$Fish = 0.00399 \text{ mg/L} \times 24.8 \text{ L/kg}$$

$$Fish = 0.099 \text{ mg/kg}$$

Example 3-18: Bioaccumulation of Total Arsenic to Whitefish Tissue During Operations

$$Fish = 0.00399 \text{ mg/L} \times 31.3 \text{ L/kg}$$

$$Fish = 0.13 \text{ mg/kg}$$

A wild rice sample was collected as a part of the Soil and Traditional Foods Sampling Program (Table A1-7, Attachment A). To model EPCs for human ingestion of wild rice, a site-specific BAF was calculated. This was done by dividing the concentration of POPCs in the sampled wild rice by the modelled baseline annual average surface water concentrations. Wild rice EPCs were then calculated using the site-specific

BAF multiplied by the predicted surface water concentrations for each Project phase. Full details of the calculation of site-specific BAFs are presented in Attachment A.

BAFs applied for the calculation of wild rice EPCs are provided in E1-12 (Attachment E).

$$\text{Wild Rice} = C_w \times \text{BAF}$$

Where:

Wild Rice = Concentration of POPC in fish tissue (mg/kg ww)

C_w = Concentration of POPC in surface water (mg/L)

BAF = Bioaccumulation factor (L/kg ww)

Example 3-19: Bioaccumulation of Total Arsenic to Wild Rice During Operations

$$\text{Wild Rice} = 0.00399 \text{ mg/L} \times 20.46$$

$$\text{Wild Rice} = 0.0816 \text{ mg/kg}$$

The fish tissue and wild rice EPCs are presented in Table E1-1 (Attachment E).

3.3.6 WILD GAME

EPCs for wild game tissue consumed by humans were derived using the ERA food chain model for all assessment phases, as presented in Attachment F.

The wild game tissue concentrations for moose (meat, liver and kidney), deer (meat only), caribou (meat and liver), rabbit, grouse/partridge, Canada goose, and duck were derived in the ERA food chain model and included in the multi-media model.

Wild game tissue concentrations were calculated following US EPA (2005a) methodology. To estimate tissue concentrations, wildlife species were assumed to be exposed to POPCs through incidental soil/sediment ingestion, inhalation of soil dust, ingestion of surface water and ingestion of food (i.e., aquatic and/or terrestrial components). The ERA food chain model incorporates dietary items, body weight of the receptor, water ingestion, soil/sediment ingestion rates, and moisture content of food items to calculate a total daily intake of a POPC in milligrams per day (mg/day). The total daily intake is then multiplied by the site-specific biotransfer factor (BTF) (or a literature transfer factor in the absence of a site-specific BTF) to calculate a tissue concentration. The predicted tissue concentrations for the wild game (as food items) are then entered into the HHRA multi-media model and used to predict a daily dose for the human receptor.

To estimate wild game meat concentrations, a BTF was calculated based on the approach outlined by Research Triangle Institute (RTI 2005). The site-specific BTF was calculated by dividing the measured baseline wild game tissue concentrations from FNFNES in the Boreal Shield ecozone, where the project occurs (Chan et al. 2014; 2021; Table F1-14 [Attachment F1]; and Table A4-2 [Attachment A]) by the calculated baseline total daily intakes (Table F1-2, Attachment F1). In some instances, the baseline tissue concentration reported by Chan et al. (2021) was based on a reported detection limit and there was uncertainty regarding the actual concentration. In these cases, a BTF reported in the literature was used from US EPA (2004) (e.g., arsenic in caribou meat and liver). Selected BTFs used in the ERA are presented in Attachment F1, Table F1-15. For reference, literature BTFs are shown alongside site-specific BTFs.

A worked example of the calculation of biotransfer factors and wild game meat concentrations is provided below.

$$BTF_{\text{wild game}-i} = \frac{C_{\text{wild game}-i}}{EDI_{\text{wild game}-i}}$$

Where:

- $BTF_{wild\ game-i}$ = Biotransfer factor for wild game i (day / kg - ww)
 $C_{wild\ game-i}$ = Concentration of POPC in wild game i (mg POPC/kg BW)
 $EDI_{wild\ game-i}$ = Total daily POPC dose for wild game i (mg POPC/ day)

Example 3-20: Biotransfer Factor of Arsenic in Duck

$$BTF_{duck-arsenic} = \frac{7.00 \times 10^{-2} mg/kg\ BW}{4.23 \times 10^{-1} mg/day}$$

$$BTF_{duck-arsenic} = 0.166\ day/kg - ww$$

The ERA food chain model (Attachment F) was used to calculate concentrations of POPCs in wild game tissues that were used as inputs to the human health multi-media model. Wild game tissue concentrations were calculated for the following wild game: caribou, moose, rabbit (modelled based on snowshoe hare), Canada goose, deer (modelled based on white-tailed deer), grouse/partridge (modelled as spruce grouse) and duck (modelled based on mallard). In addition, concentrations of POPCs in the following organ tissues were calculated: caribou liver, moose liver and moose kidney.

POPC concentrations in wild game tissues were calculated using the following equation (US EPA 2005b).

$$C_{tissue} = EDI_{total-w} \times BTF_{wild\ game-i}$$

Where:

- C_{tissue} = Concentration of POPC in wild game tissue (mg/kg ww tissue)
 $EDI_{total-w}$ = Estimated total daily intake of POPC during Project Phase w (mg/day)
 $BTF_{wild\ game-i}$ = Biotransfer factor for wild game i (day / kg - ww)

Example 3-21: Tissue Concentration of Total Arsenic in Duck Meat during Operations Phase

$$C_{tissue} = 4.23 \times 10^{-1} mg/day \times 0.166\ day/kg - ww$$

$$C_{tissue} = 7.01 \times 10^{-2} mg/kg$$

The wild game EPCs are presented in Table F1-4 (Attachment F) and Table E1-1 (Attachment E).

3.4 HUMAN EXPOSURE ESTIMATES

Human exposure from all relevant pathways was evaluated in a multi-media evaluation that considered the ingestion of dietary items, ingestion of soil and surface water, dermal contact with soil and surface water, and inhalation of soil dust. The estimated daily intake (EDI; mg/day) was calculated based on receptor-specific parameters such as ingestion rates, dietary preferences, the amount of time a person spends at a location, and the concentration of POPCs in the environmental media (e.g., surface water, soil, vegetation, fish and wild game).

Further details on the derivation of human exposure estimates are provided below, along with sample calculations for arsenic for the toddler life stage of the Indigenous Resident for the operations phase. Human health exposure estimates expressed as estimated daily intakes are provided in Table E1-2 (Attachment E). EPCs and receptor characteristics for estimating human exposures are provided in Table E1-1 and Table E1-13, respectively.

3.4.1 SOIL CONTACT

Potential exposure from direct contact with soil was determined from the sum of exposure from incidental ingestion, dermal contact and soil dust inhalation pathways as outlined below for the operations phase.

3.4.1.1 SOIL INGESTION

Potential soil ingestion exposures were estimated by incidental soil ingestion rates and soil concentrations. Humans were assumed to be directly exposed to surface soil. The following equation was used based on Health Canada (2023).

$$EDI_{soil-ing} = C_S \times IR_S \times EF \times CA \times RAF_{oral} \times RBA_{soil}$$

Where:

- $EDI_{soil-ing}$ = Estimated daily intake of POPC from soil ingestion (mg/day)
- C_S = POPC concentration in surface soil (mg/kg)
- IR_S = Soil ingestion rate (kg/day)
- EF = Exposure frequency (days/365 days; assumed to be 1)
- CA = Chemical apportionment (unitless, applicable to arsenic and mercury)
- RAF_{oral} = Relative absorption factor from the gastrointestinal tract (i.e., unitless, assumed to be 1)
- RBA_{soil} = Relative bioavailability in soil (unitless; site-specific applicable to arsenic)

Example 3-21: Inorganic Arsenic Exposure via Soil Ingestion for a Toddler (Operations Phase)

$$EDI_{soil-ing} = 8.42 \text{ mg/kg} \times 8.0E^{-5} \text{ kg/day} \times 1 \times 1 \times 1 \times 0.224$$

$$EDI_{soil-ing} = 1.51 \times 10^{-4} \text{ mg/day}$$

3.4.1.2 SOIL DERMAL CONTACT

Potential soil dermal exposures were estimated by soil loading rates to exposed skin, skin surface areas, dermal absorption factors and soil concentrations. Dermal exposures were estimated separately for hands only and for surfaces other than hands (arms and legs). Humans were assumed to be directly exposed to surface soil and Table E-15 presents the dermal relative absorption factors (RAFs) that were used to calculate dermal exposure. The following equation was used based on Health Canada (2023).

$$EDI_{soil-dem} = C_S \times [(SA_H \times SL_H) + \{(SA_L + SA_A + SA_f) \times SL_O\}] \times RAF_{derm} \times nEv \times EF \times CA$$

Where:

- $EDI_{soil-derm}$ = Estimated daily intake from dermal contact with POPC in soil (mg/day)
- C_S = POPC concentration in surface soil (mg/kg)
- SA_H = Surface area of hands exposed for dermal contact (cm²)
- SL_H = Soil loading rate to exposed hands and forearms (kg/cm²/event)
- SA_L (cm²) = Surface area of lower legs exposed for dermal contact (i.e., other than hands)
- SA_A = Surface area of forearms exposed for dermal contact (cm²)
- SA_f = Surface area of feet exposed for dermal contact (cm²)

SLo (kg/m ² /event)	= Soil loading rate to exposed skin (other than hands, i.e., lower legs and/or feet)
RAF _{derm}	= Relative absorption factor via dermal contact (unitless, POPC-specific)
nEv	= Number of dermal exposure events (event/day; assumed to be 1)
EF	= Exposure frequency (days/365days; assumed to be 1)
CA	= Chemical apportionment (unitless, applicable to arsenic and mercury)

Example 3-22: Inorganic Arsenic Exposure via Soil Dermal Contact for a Toddler (Operations Phase)

$$\begin{aligned}
 EDI_{soil-derm} &= 8.42 \text{ mg/kg} \\
 &\times [(430 \text{ cm}^2 \times 1 \text{ E}^{-7} \text{ kg/cm}^2/\text{event}) \\
 &+ \{(1690 \text{ cm}^2 + 890 \text{ cm}^2 + 0 \text{ cm}^2) \times 1 \text{ E}^{-8} \text{ g/cm}^2/\text{event}\}] \times 0.03 \times 1 \text{ event/day} \times 1 \times 1 \\
 EDI_{soil-derm} &= 1.74 \times 10^{-5} \text{ mg/day}
 \end{aligned}$$

3.4.1.3 SOIL DUST INHALATION

Potential soil dust inhalation exposures were estimated by the predicted dust concentrations in air (see Section 3.3.2) and inhalation rates. Particulate concentrations are published in Health Canada (2024). Humans were assumed to be directly exposed to surface soil. The following equation was used based on Health Canada (2023).

$$EDI_{dust} = C_{dust} \times IR_A \times RAF_{inh} \times EF \times CA$$

Where:

EDI _{dust}	= Estimated daily intake from inhalation of POPC on soil dust (mg/day)
C _{dust}	= POPC concentration in soil dust (mg/m ³)
IR _A	= Receptor inhalation rate (m ³ /day)
RAF _{inh}	= Relative absorption factor via inhalation (unitless; assumed to be 1)
EF	= Exposure frequency (days/365days; assumed to be 1)
CA	= Chemical apportionment (unitless, applicable to arsenic and mercury)

Example 3-23: Inorganic Arsenic Exposure via Soil Dust Inhalation for a Toddler (Operations Phase)

$$\begin{aligned}
 EDI_{dust} &= 6.40 \times 10^{-9} \text{ mg/m}^3 \times 8.3 \text{ m}^3/\text{day} \times 1 \times 1 \times 1 \\
 EDI_{dust} &= 5.31 \times 10^{-8} \text{ mg/day}
 \end{aligned}$$

3.4.1.4 TOTAL DAILY INTAKE FROM SOIL CONTACT

$$EDI_{soil} = EDI_{soil-ing} + EDI_{soil-derm} + EDI_{dust}$$

Where:

EDI _{soil}	= Estimated daily intake from all soil contact pathways
EDI _{soil-ing}	= Estimated daily intake from incidental soil ingestion
EDI _{soil-derm}	= Estimated daily intake from soil dermal contact
EDI _{dust}	= Estimated daily intake from soil dust inhalation

Example 3-24: Total Inorganic Arsenic Daily Intake via Soil Contact for a Toddler (Operations Phase)

$$\begin{aligned}
 EDI_{soil} &= 1.51 \times 10^{-4} \text{ mg/day} + 1.74 \times 10^{-5} \text{ mg/day} + 5.31 \times 10^{-8} \text{ mg/day} \\
 EDI_{soil} &= 1.68 \times 10^{-4} \frac{\text{mg}}{\text{day}}
 \end{aligned}$$

Human health Estimated daily intake estimates expressed as daily intakes are provided in Table E1-2 (Attachment E).

3.4.2 SURFACE WATER CONTACT

Potential exposure from direct contact with surface water was determined from the sum of exposure through use of surface water as drinking water and incidental ingestion while swimming/bathing as outlined below.

3.4.2.1 DRINKING WATER INGESTION

Potential exposures from drinking water ingestion were estimated by drinking water ingestion rates and surface water concentrations. The following equation was used based on Health Canada (2023).

$$EDI_{DW} = C_W \times IR_W \times RAF_{oral} \times EF \times CA$$

Where:

- EDI_{DW} = Estimated daily intake from POPCs in surface water for drinking (mg/day)
- C_W = POPC concentration in surface water (mg/L)
- IR_W = Water ingestion rate (L/day)
- RAF_{Oral} = Relative absorption factor from the gastrointestinal tract (unitless, assumed to be 1)
- EF = Exposure frequency (days/365days; assumed to be 1)
- CA = Chemical apportionment (unitless, applicable to arsenic)

Example 3-25: Inorganic Arsenic Exposure via Ingestion of Drinking Water for a Toddler (Operations Phase)

$$EDI_{DW} = 0.00399 \text{ mg/L} \times 0.6 \text{ L/day} \times 1 \times 1 \times 1$$
$$EDI_{DW} = 2.39 \times 10^{-3} \text{ mg/day}$$

3.4.2.2 SWIMMING AND BATHING

Potential exposure from direct contact with surface water while swimming and bathing was determined from the sum of incidental ingestion and dermal contact as outlined below.

INCIDENTAL INGESTION

Potential exposures from incidental water ingestion from swimming and bathing were estimated by incidental water ingestion rates, surface water concentrations and the number of hours spent swimming/bathing per day. The following equation was used based on Health Canada (2023).

$$EDI_{swim-ing} = C_W \times IR_W \times RAF_{oral} \times EF \times CA \times ED$$

Where:

- $EDI_{swim-ing}$ = Estimated daily intake from incidental ingestion of POPC in surface water from swimming/bathing (mg/day)
- C_W = POPC concentration in surface water (mg/L)
- IR_W = Incidental water ingestion rate (L/hour)
- RAF_{Oral} = Relative absorption factor from the gastrointestinal tract (unitless; assumed to be 1)
- EF = Exposure frequency (days/365days; assumed to be 1)
- CA = Chemical apportionment (unitless, applicable to arsenic and mercury)
- ED = Exposure duration (hours/day)

Example 3-26: Inorganic Arsenic Exposure via Incidental Ingestion of Water for a Toddler While Swimming/Bathing (Operations Phase)

$$EDI_{swim-ing} = 0.00399 \text{ mg/L} \times 0.044 \text{ L/hour} \times 1 \times 1 \times 1 \times 2 \text{ hours}$$

$$EDI_{swim-ing} = 3.51 \times 10^{-4} \text{ mg/day}$$

DERMAL CONTACT

Potential dermal exposures with water were estimated by dermal absorption rates, skin surface areas and surface water concentrations. The following equation was used to estimate dermal exposure from swimming and bathing based on US EPA (2004). Since highly conservative assumptions are made about the exposure frequency of swimming and bathing (i.e., exposure 365 days a year), a simplification of the US EPA (2004) equation for a dermally absorbed dose (equation 3.1; US EPA 2004) was applied to assume one swimming/bathing event every day throughout the year (see Section 2.1.3 for exposure duration details). Dose was not normalized to bodyweight in this step. Additionally, dermally absorbed dose calculation was simplified to calculate dose in one step, instead of calculating an intake per swimming event (equation 3.4; US EPA 2004).

$$EDI_{swim-derm} = C_w \times CF \times DA \times SA \times ED \times EF \times CA$$

Where:

$EDI_{swim-derm}$ = Estimated daily intake from dermal contact with POPC in surface water from swimming/bathing (mg/day)

C_w = POPC concentration in surface water (mg/L)

CF = Conversion factor of 0.001 L/cm³

DA = Dermal absorption rate of POPC (cm/h; see Table E1-16 – Attachment E)

SA = Skin surface area for dermal contact (cm²)

ED = Exposure duration (hours/day)

EF = Exposure Frequency (unitless; assumed to be 1)

CA = Chemical apportionment (unitless, applicable to arsenic and mercury)

Example 3-27: Inorganic Arsenic Exposure via Dermal Contact with Water for a Toddler While Swimming/Bathing (Operations Phase)

$$EDI_{swim-derm} = 0.00399 \text{ mg/L} \times 0.001 \text{ L/cm}^3 \times 0.001 \text{ cm/h} \times 6130 \text{ cm}^2 \times 2 \text{ h/day} \times 1 \times 1$$

$$EDI_{swim-derm} = 4.89 \times 10^{-5} \text{ mg/day}$$

TOTAL SWIMMING AND BATHING EXPOSURE

$$EDI_{swim} = EDI_{swim-ing} + EDI_{swim-derm}$$

Where:

EDI_{swim} = Estimated daily intake of POPC in surface water via swimming (mg/day)

$EDI_{swim-ing}$ = Estimated daily intake from incidental ingestion of POPC in surface water (mg/day)

$EDI_{swim-derm}$ = Estimated daily intake from dermal contact with POPC in surface water (mg/day)

Example 3-28: Total Inorganic Arsenic Exposure via Swimming and Bathing for a Toddler (Operations Phase)

$$EDI_{swim} = 3.51 \times 10^{-4} \text{ mg/day} + 4.89 \times 10^{-5} \text{ mg/day}$$

$$EDI_{swim} = 4.00 \times 10^{-4}$$

3.4.2.3 TOTAL DAILY INTAKE FROM SURFACE WATER

$$EDI_{water} = EDI_{dw} + EDI_{swim}$$

Where:

- EDI_{water} = Estimated daily intake of POPC in surface water from all pathways (mg/day)
 EDI_{dw} = Estimated daily intake from ingestion of POPC in surface water as drinking water (mg/day)
 EDI_{swim} = Estimated daily intake of POPC in surface water via swimming/bathing (mg/day)

Example 3-29: Total Inorganic Arsenic Daily Intake via Surface Water Contact for a Toddler (Operations Phase)

$$EDI_{water} = 2.39 \times 10^{-3} + 4.00 \times 10^{-4}$$

$$EDI_{water} = 2.79 \times 10^{-3}$$

Human health estimated daily intakes are provided in Table E1-2 (Attachment E).

3.4.3 FOOD INGESTION

Potential food ingestion exposures were estimated by ingestion rates and tissue concentrations of each food item. The following equation was used based on Health Canada (2023).

$$EDI_{food\ i} = C_{food\ i} \times IR_{food\ i} \times RAF_{oral} \times EF \times CA$$

Where:

- $EDI_{food\ i}$ = Estimated daily intake from ingestion of POPC in food item i (mg/day)
 $C_{food\ i}$ = POPC concentration in food i (mg/kg ww)
 $IR_{food\ i}$ = Food i ingestion rate (kg ww/day)
 RAF_{oral} = Relative absorption factor from the gastrointestinal tract (i.e., unitless, assumed to be 1)
 EF = Exposure frequency (days/365 days; assumed to be 1)
 CA = Chemical apportionment (unitless, applicable to arsenic and mercury)

Sample calculations are provided below for each type of food item consumed by a Heavy Consumer Indigenous receptor for the toddler life stage.

Example 3-30: Inorganic Arsenic Exposure via Berry Ingestion (Operations Phase)

$$EDI_{berries} = 2.71 \times 10^{-2} \text{ mg/kg} \times 1.07 \times 10^{-2} \text{ kg/day} \times 1 \times 1 \times 0.40$$

$$EDI_{berries} = 1.16 \times 10^{-4} \text{ mg/day}$$

Example 3-31: Inorganic Arsenic Exposure via Above Ground Produce Ingestion (Operations Phase)

$$EDI_{ag-plant} = 7.20 \times 10^{-3} \text{ mg/kg} \times 6.70 \times 10^{-3} \text{ kg/day} \times 1 \times 1 \times 0.68$$

$$EDI_{ag-plant} = 3.29 \times 10^{-5} \text{ mg/day}$$

Example 3-32: Inorganic Arsenic Exposure via Below Ground Produce Ingestion (Operations Phase)

$$EDI_{bg-plant} = 8.47 \times 10^{-3} \text{ mg/kg} \times 1.05 \times 10^{-2} \text{ kg/day} \times 1 \times 1 \times 0.39$$

$$EDI_{bg-plant} = 3.45 \times 10^{-5} \text{ mg/day}$$

Example 3-33: Inorganic Arsenic Exposure via Traditional Plant Ingestion (Operations Phase)

$$EDI_{trad-plant} = 5.98 \times 10^{-2} mg/kg \times 8.46 \times 10^{-4} kg/day \times 1 \times 1 \times 0.68$$

$$EDI_{trad-plant} = 3.45 \times 10^{-5} mg/day$$

Example 3-34: Inorganic Arsenic Exposure via Wild Rice Ingestion (Operations Phase)

$$EDI_{wildrice} = 8.16 \times 10^{-2} mg/kg \times 2.41 \times 10^{-3} kg/day \times 1 \times 1 \times 0.74$$

$$EDI_{wildrice} = 1.45 \times 10^{-4} mg/day$$

Example 3-35: Inorganic Arsenic Exposure via Northern Pike Ingestion (Operations Phase)

$$EDI_{pike} = 1.93 \times 10^{-1} mg/kg \times 2.01 \times 10^{-2} kg/day \times 1 \times 1 \times 0.085$$

$$EDI_{pike} = 3.30 \times 10^{-4} mg/kg$$

Example 3-36: Inorganic Arsenic Exposure via Walleye Ingestion (Operations Phase)

$$EDI_{walleye} = 9.90 \times 10^{-2} mg/kg \times 5.03 \times 10^{-2} kg/day \times 1 \times 1 \times 0.085$$

$$EDI_{walleye} = 4.23 \times 10^{-4} mg/kg$$

Example 3-37: Inorganic Arsenic Exposure via Whitefish Ingestion (Operations Phase)

$$EDI_{whitefish} = 1.25 \times 10^{-1} mg/kg \times 3.12 \times 10^{-2} kg/day \times 1 \times 1 \times 0.085$$

$$EDI_{whitefish} = 3.31 \times 10^{-4} mg/kg$$

Example 3-38: Inorganic Arsenic Exposure via Grouse/Partridge Ingestion (Operations Phase)

$$EDI_{grouse} = 1.18 \times 10^{-2} mg/kg \times 4.65 \times 10^{-3} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{grouse} = 2.97 \times 10^{-6} mg/day$$

Example 3-39: Inorganic Arsenic Exposure via Goose Ingestion (Operations Phase)

$$EDI_{goose} = 2.30 \times 10^{-2} mg/kg \times 1.24 \times 10^{-2} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{goose} = 1.54 \times 10^{-5} mg/day$$

Example 3-40: Inorganic Arsenic Exposure via Duck Ingestion (Operations Phase)

$$EDI_{duck} = 7.00 \times 10^{-2} mg/kg \times 4.65 \times 10^{-3} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{duck} = 1.76 \times 10^{-5} mg/day$$

Example 3-41: Inorganic Arsenic Exposure via Deer Ingestion (Operations Phase)

$$EDI_{deer} = 1.22 \times 10^{-2} mg/kg \times 4.40 \times 10^{-3} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{deer} = 2.90 \times 10^{-6} mg/day$$

Example 3-42: Inorganic Arsenic Exposure via Moose Ingestion (Operations Phase)

$$EDI_{moose} = 1.06 \times 10^{-2} mg/kg \times 1.78 \times 10^{-2} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{moose} = 1.03 \times 10^{-5} mg/day$$

Example 3-43: Inorganic Arsenic Exposure via Moose Liver Ingestion (Operations Phase)

$$EDI_{mooseliver} = 2.11 \times 10^{-2} mg/kg \times 1.04 \times 10^{-2} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{mooseliver} = 1.19 \times 10^{-5} mg/day$$

Example 3-44: Inorganic Arsenic Exposure via Moose Kidney Ingestion (Operations Phase)

$$EDI_{moosekidney} = 3.17 \times 10^{-2} mg/kg \times 1.04 \times 10^{-2} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{moosekidney} = 1.79 \times 10^{-5} mg/day$$

Example 3-45: Inorganic Arsenic Exposure via Caribou Ingestion (Operations Phase)

$$EDI_{caribou} = 3.91 \times 10^{-4} mg/kg \times 3.96 \times 10^{-2} kg/day \times 1 \times 1 \times 0.054$$

$$EDI_{caribou} = 8.39 \times 10^{-7} \text{mg/day}$$

Example 3-46: Inorganic Arsenic Exposure via Caribou Liver Ingestion (Operations Phase)

$$EDI_{caribouliver} = 3.91 \times 10^{-4} \text{mg/kg} \times 1.19 \times 10^{-2} \text{kg/day} \times 1 \times 1 \times 0.054$$

$$EDI_{caribouliver} = 2.52 \times 10^{-7} \text{mg/day}$$

Example 3-47: Inorganic Arsenic Exposure via Rabbit Ingestion (Operations Phase)

$$EDI_{rabbit} = 2.31 \times 10^{-2} \text{mg/kg} \times 5.18 \times 10^{-3} \text{kg/day} \times 1 \times 1 \times 0.054$$

$$EDI_{rabbit} = 6.46 \times 10^{-6} \text{mg/day}$$

Example 3-48: Total Inorganic Arsenic Daily Intake from Food Ingestion (Operations Phase)

$$\begin{aligned} EDI_{food} = & 1.16 \times 10^{-4} \text{mg/day} + 3.29 \times 10^{-5} \text{mg/day} + 3.45 \times 10^{-5} \text{mg/day} + 3.45 \times 10^{-4} \text{mg/day} \\ & + 1.45 \times 10^{-4} \text{mg/day} + 3.30 \times 10^{-4} \text{mg/kg} + 4.23 \times 10^{-4} \text{mg/kg} + 3.31 \times 10^{-4} \text{mg/kg} \\ & + 2.97 \times 10^{-6} \text{mg/day} + 1.54 \times 10^{-5} \text{mg/day} + 1.76 \times 10^{-5} \text{mg/day} + 2.90 \times 10^{-6} \text{mg/day} \\ & + 1.03 \times 10^{-5} \text{mg/day} + 1.19 \times 10^{-5} \text{mg/day} + 1.79 \times 10^{-5} \text{mg/day} + 8.39 \times 10^{-7} \text{mg/day} \\ & + 2.52 \times 10^{-7} \text{mg/day} + 6.46 \times 10^{-6} \text{mg/day} \end{aligned}$$

$$EDI_{food} = 1.53 \times 10^{-3} \text{mg/day}$$

3.4.4 TOTAL HUMAN DAILY INTAKE

Total daily intake was calculated by summing the exposures from each media (i.e., soil, water, food).

$$EDI_{total} = EDI_{soil} + EDI_{water} + EDI_{food}$$

Where:

EDI_{total} = Total estimated daily intake of POPC for all media (mg/day)

EDI_{soil} = Estimated daily intake from soil contact (mg/day)

EDI_{water} = Estimated daily intake from surface water contact (mg/day)

EDI_{food} = Estimated daily intake from food ingestion (mg/day)

Example 3-49: Total Arsenic Estimated Daily Intake for a Toddler (Operations Phase)

$$EDI_{total} = 1.68 \times 10^{-4} \text{mg/day} + 2.79 \times 10^{-3} \text{mg/day} + 1.53 \times 10^{-3} \text{mg/day}$$

$$EDI_{total} = 4.50E^{-3} \text{mg/day}$$

4 TOXICITY ASSESSMENT

Toxicity assessment involves the classification of the toxic effects of parameters and identifying appropriate toxicity reference values (TRVs) to quantitatively estimate human health risk for the HHRA. TRVs are an estimation of the amounts of parameters that an individual can be exposed to over a given time period without experiencing adverse health effects. For each POPC, a TRV was determined based on a reported mode of action (i.e., threshold or non-threshold) and exposure pathway (e.g., oral, dermal).

4.1 PARAMETER CLASSIFICATION

Regulatory agencies (such as Health Canada and US EPA) classify parameters based on their effect (i.e., carcinogenic versus non-carcinogenic) as well as mode of action (i.e., threshold versus non-threshold parameters). Parameters may also exhibit different toxicological mechanisms of action depending on the route of exposure (e.g., oral, dermal). Therefore, TRVs are developed based on both exposure as well as carcinogenic and/or non-carcinogenic effects. TRVs are typically derived by characterizing critical effects observed from studies in laboratory study animals or exposed human populations (e.g., occupational studies) at high doses and extrapolating to lower doses which would be more representative of expected exposure to human receptors in the environment (i.e., a non-laboratory setting). In developing TRVs, safety or uncertainty factors are applied to account for unknowns and variability when extracting information from animal studies or occupational data for application to the greater population.

For non-carcinogenic (threshold) parameters, it is assumed that a threshold level exists below which no adverse health effects are anticipated to occur. For the oral pathway, the TRV that represents this threshold level of exposure is typically referred to as a tolerable daily intake (TDI) or reference dose (RfD) in units of milligrams per kilogram body weight per day (mg/kg/day). These TRVs are an estimate of daily oral exposure to the human population (including susceptible subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

In contrast, carcinogenic (non-threshold) parameters are considered to have some potential for risk of adverse effects at any level of exposure greater than zero (i.e., non-threshold). TRVs that represent carcinogen potency for the oral pathway are typically expressed as slope factors (SFs) in units of the rate of cancer incidence per unit dose (mg/kg/d)⁻¹. A SF is the upper-bound increased cancer risk from a lifetime exposure to a parameter. Non-threshold acting parameters may also cause threshold effects; therefore, parameters that exhibit carcinogenic effects may also cause non-carcinogenic effects. Carcinogens were assessed for both threshold and non-threshold endpoints in the HHRA. Dermal TRVs are largely unavailable, as discussed in Section 4.2 below.

Several national and international agencies classify parameters based on this mode of action (i.e., threshold versus non-threshold). The carcinogen classification systems for the United States Environmental Protection Agency (US EPA 1986; US EPA 2005b), International Agency for Research on Cancer (IARC 2025), and Health Canada (2025) are presented in Table E-14. The US EPA moved from classifying parameters by categories (US EPA 1986) to classifying using narrative statements (US EPA 2005b). The US EPA provides classifications for parameters using either the 1986 guidelines or 2005 guidelines, depending on when the parameter was last reviewed.

Table E-14: Carcinogen Classification System

US EPA (1986)	US EPA (2005b)	IARC (2025)	Health Canada (2025)
Group A – Carcinogenic to humans	Carcinogenic to humans	Group 1 – Carcinogenic to humans	Group I – Carcinogenic to humans
Group B – Probably carcinogenic to humans	Likely to be carcinogenic to humans	Group 2A – Probably carcinogenic to humans	Group II – Probably carcinogenic to humans
Group C – Possibly carcinogenic to humans	Suggestive evidence of carcinogenic potential	Group 2B – Possibly carcinogenic to humans	Group III – Possibly carcinogenic to humans

ATTACHMENT E: Human Health Multi-Media Model Description and Worked Examples

US EPA (1986)	US EPA (2005b)	IARC (2025)	Health Canada (2025)
Group D – Not classifiable as to human carcinogenicity	Inadequate information to assess carcinogenic potential	Group 3 – Not classifiable as to its carcinogenicity to humans	Group IV – Unlikely to be carcinogenic to humans
Group E – Evidence of non-carcinogenicity for humans	Not likely to be carcinogenic to humans	Does not apply	Group V – Probably not carcinogenic to humans Group VA – Inadequate data for evaluation
Does not apply	Does not apply	Does not apply	Group VI – Unclassifiable with respect to its carcinogenicity to humans

Notes:

IARC = International Agency for Research on Cancer; US EPA = United States Environmental Protection Agency.

A POPC was classified as a carcinogen if the following applied:

- Classified as Group A or “carcinogenic to humans” by the US EPA (2025a);
- Classified as Group B or “likely to be carcinogenic to humans” by the US EPA (2025a);
- Classified as Group 1 or Group 2A Group by IARC (2025);
- Classified as Group I or Group II by Health Canada (2025); and
- A carcinogenic TRV was available.

The carcinogen classifications for POPCs retained for the HHRA, based on the US EPA, IARC, and Health Canada classifications, are summarized in Table E-15.

Table E-15: Carcinogen Classification of Parameters of Potential Concern through Oral Exposure

POPC	Carcinogen Classification			Assessed as a Carcinogen?
	US EPA (1986, 2005b)	IARC (2025)	Health Canada (2025)	
Arsenic	Carcinogenic to humans	Group 1	Group I	Yes
Mercury	Group D	Group 3	NC	No
Selenium	Group D	Group 3	NC ⁽¹⁾	No

Notes:

IARC = International Agency for Research on Cancer; NC = not classified; POPC= parameter of potential concern; US EPA = United States Environmental Protection Agency.

- 1 Environment and Climate Change Canada and Health Canada (2017) report that available information indicates that selenium compounds (other than selenium sulfide) are not human carcinogens or direct genotoxic agents.

4.2 TOXICITY REFERENCE VALUES

TRVs are based on critical effect levels or no-effect levels observed from studies in exposed human populations or animal species.

Chronic TRVs were obtained preferentially from: Health Canada (2025) . Where Health Canada (2025a) did not provide TRVs, the US EPA’s Integrated Risk Information System (US EPA 2025a).. Consideration was also given to study subjects (e.g., human versus animal study), the study duration, and whether the critical endpoint was based on a no-observed-adverse-effect level (NOAEL).

TRVs typically do not exist for the dermal exposure route. As none of the parameters retained as POPCs in this HHRA had available dermal TRVs, the dermal exposure doses were compared to the oral TRVs considering dermal absorption efficiency for soil (i.e., the use of dermal RAFs). The application of dermal RAFs is discussed in Section 3 and dermal RAFs are presented in Table E1-15. A summary of available chronic oral TRVs from Health Canada and US EPA are presented in Table E-16 for non-carcinogenic TRVs and Table E-17 for carcinogenic TRVs. Based on US EPA (2024b), none of the POPCs retained in

the HHRA are considered to be mutagenic, and therefore, age-dependent adjustment factors (ADAFs) from Health Canada (2013) do not need to be applied in the human health risk assessment.

Table E-16: Chronic Oral Tolerable Daily Intakes/Reference Doses (mg/kg bw/day)

POPC	Health Canada	Basis	US EPA	Basis
Arsenic	-	N/A	0.00006	The US EPA (2025b) RfD is based on two organ-specific RfDs, including an RfD of 0.000058 mg/kg bw/day for type 2 diabetes from a dose-response meta-analysis of four studies (Grau-Perez et al., 2017; James et al., 2013; Coronado-González et al., 2007; and Pan et al., 2013; as cited in US EPA 2025b), and an RfD of 0.000057 mg/kg bw/day for ischemic heart disease, including both fatal and incident cases from a dose-response meta-analysis of five studies (Wade et al., 2015; Wu et al., 2010; Moon et al., 2013; Chen et al., 2013; and James et al., 2015; as cited in US EPA 2025b). A composite uncertainty factor of 3 was applied to both organ-specific RfDs to account for intraspecies uncertainty (i.e., variations in susceptibility within the human population and the possibility that the database available is not representative of the dose response relationship in sensitive subgroups of the human population. In the absence of a Health Canada (2025) TRV, the US EPA RfD was selected for the HHRA.
Mercury (Inorganic)	0.0003	Health Canada (2025) adopted the US EPA RfD (1995b) as an oral TDI. The Health Canada RfD was selected for the HHRA.	0.0003	The US EPA (1995b) does not evaluate a RfD for elemental mercury but does provide an RfD for mercuric chloride (US EPA, 1995a). The RfD was back calculated from a Drinking Water Equivalent Level (DWEL) of 0.010 mg/L (RfD = 0.01 mg/L x 2 L/day/70 kg bw = 0.0003 mg/kg bw/day). The DWEL adopted by the US EPA was calculated considering three studies that report LOELs for Hg2+ of 0.226 mg/kg-day, 0.371 mg/kg/day and 0.633 mg/kg/day (dose conversions in the three studies used a 0.739 factor for HgCl ₂ to Hg2+, a 100% factor for subcutaneous to oral route of exposure and a time-weighted average for days/week of dosing).
Methylmercury	0.0002 (people of childbearing age and children under 12 years) 0.00047 (non-sensitive adults of the general population)	The Health Canada (2025) RfD for women of child-bearing age and children under 12 years is based on an approximate threshold of 10 µg/g mercury in maternal hair, corresponding to a dietary methylmercury intake level of 0.001 mg/kg bw/day for neuro-developmental toxicity in humans (children) exposed to methylmercury through diet (Grandjean et al. 1997 as cited in Health Canada 2007 and Health Canada 2025). The value was converted to a corresponding blood methylmercury level and then to a dietary methylmercury intake level using an equation employed by the US EPA (1995c; as cited in Health Canada 2007). An uncertainty factor of 5 was applied to the intake level to obtain an RfD of 0.0002 mg/kg bw/day for women of child-bearing age and young children. The Health Canada (2025) RfD for non-sensitive adults is based on an approximate threshold of 14 µg/g mercury in maternal hair, corresponding to a dietary methylmercury intake level of 0.0015 mg/kg bw/day for neuro- developmental toxicity in humans (children) exposed to methylmercury through diet. The WHO (2007) provisional tolerable weekly intake of 0.0016 mg/kg bw was multiplied by a factor of 2 (for non-sensitive adults) and divided by 7 days/week to estimate the RfD of 0.00047 mg/kg bw/day. The Health Canada RfD for the protection of the fetus, children, and childbearing women (i.e., 0.0002 mg/kg-bw/day) and adult general population (i.e., 0.00047 mg/kg-bw/day) was selected for the HHRA.	0.0001	The US EPA (2001) derived a reference dose for methylmercury based on developmental neuro-developmental effects in human epidemiological studies. Three studies were considered in the derivation of the reference dose. The first study (Myers et al. 1995, Davidson et al. 1995, 1998; as cited in US EPA 2001) consisted of 779 mother-infant pairs from a fish-eating population in the Seychelle Islands, where infants were followed from birth to 5.5 year of age and assessed for various standardized neuropsychological endpoints. The exposure endpoint was maternal hair mercury levels. The second study (Grandjean et al. 1997; as cited in US EPA 2001) consisted of approximately 900 mother-infant pairs in the Faroe Islands, in which cord-blood mercury and maternal hair mercury concentrations were measured and children were tested at age seven on a variety of tasks designed to assess behavioural function. The third study (Kjellstrom et al. 1989, 1986; as cited in US EPA 2001) was a prospective study from New Zealand in which 38 children of mothers with hair mercury levels during pregnancy greater than 6 ppm were matched with children whose mothers had lower hair mercury levels. At 6 years of age, a total of 237 children were assessed on a number of neuropsychological endpoints similar to those used in the Seychelles study (US EPA 2001). The Faroe Islands and New Zealand studies found dose-related effects on neuropsychological endpoints, and emphasis was placed on the Faroe Island study (the larger of the two) to derive the reference dose. A benchmark dose analysis was used in the derivation, and a benchmark dose lower limit was derived based on cord blood levels and converted to a daily dose using a one-compartment pharmacokinetic model. An uncertainty factor of 10 was applied (3 for pharmacokinetic variability and uncertainty in estimating ingested dose from cord-blood concentrations and 3 for pharmacodynamics variability and uncertainty), resulting in a RfD of 0.0001 mg/kg bw/day.
Selenium	0.0055 (0 – 6 months) 0.0060 (6 months - <5 years) 0.0063 (5 years - <12 years) 0.0062 (12 years- <20 years) 0.0057 (≥20 years)	Health Canada (2025) has derived age specific upper confidence limits (ULs) from ULs derived by IOM (2000). An adult upper limit (UL) for selenium was based on a NOAEL of 0.8 mg/day for chronic selenosis in humans (Yang and Zhou 1994; as cited in IOM 2000). An uncertainty factor of 2 was applied for protection of sensitive individuals, resulting in an upper limit intake level of 0.4 mg/day (or 0.0057 mg/kg bw/day) for adults 19 years and over. The Health Canada infant upper limit is based on a NOAEL of 0.06 mg/L for human infants between 0 and 6 months (Shearer and Hadjimarkos 1975; as cited in IOM 2000). The NOAEL was adjusted for the average milk intake rate of 0.78 L/day. The resulting upper limit intake levels, 47 µg/day, was rounded down to the nearest 5 µg (45 µg/day) and adjusted by body weight to an upper limit dose of 0.0055 mg/kg bw/day. The upper intake levels for toddler, child, and adolescent age groups were derived from the infant value using relative body weights. The Health Canada ULs were selected as the TRVs as they are based on more current toxicity information and RfDs were available for each life stage.	0.005	The US EPA (1991) RfD is based on a NOAEL of 0.015 mg/kg bw/day for clinical selenosis in a population living in an area with high environmental selenium levels (Yang et al. 1989b as cited in US EPA 1991). Dietary selenium intake was proportional to blood and tissue selenium levels. NOAEL and LOAEL values were calculated from a regression analysis based upon the correlation. A daily selenium intake of 1.261 mg/day (blood selenium concentration of 1.35 mg/L) resulted in signs of selenosis. The LOAEL was therefore set at 1.26 mg/day. At 0.853 mg/day (blood selenium concentration of 1.0 mg/L), no signs of selenosis were apparent and this concentration was determined to be a NOAEL. To derive the RfD, the NOAEL was adjusted for an average body weight of 55 kg. An uncertainty factor of 3 was applied for the protection of sensitive individuals.

Note(s):

- = TRV not available; % = percent; µg = microgram; µg/day = micrograms per day; µg/g = micrograms per gram; µg/kg bw/day = micrograms per kilograms of body weight per day; DWEL = drinking water equivalent level; HHRA = human health risk assessment; HgCl₂ = mercuric chloride; Hg2+ = inorganic mercury; IOM = Institute of Medicine; kg = kilogram; L/day = litres per day; LOAEL = lowest observed adverse effect level; mg/day = milligrams per day; mg/kg bw/day = milligrams per kilogram body weight per day; mg/L = milligrams per litre; N/A = not applicable; NOAEL = no observed adverse effect level; POPC= parameter of potential concern; ppm = parts per million; RfD = reference dose; TDI = tolerable daily intake; TRV = toxicity reference value; UL = Tolerable upper level; US EPA = United States Environmental Protection Agency; WHO = World Health Organization.

Shaded value indicates selected toxicity reference value.

Table E-17: Chronic Oral Slope Factors (mg/kg bw/day)⁻¹

POPC	Health Canada	Basis	US EPA	Basis
Arsenic	1.8	<p>Health Canada (2025) provides an oral slope factor of 1.8 per mg/kg bw/day based on a TRV developed by Health Canada (2006) The Health Canada (2006) slope factor is based on epidemiological studies where humans were exposed to 10 to greater than 600 µg/L arsenic in drinking water for less than or equal to 60 years (Morales et al. 2000, Chen et al. 1985, Wu et al. 1989; as cited in Health Canada 2006). The unit risks associated with ingestion of 1 µg/L of arsenic in drinking water ranged from 3.06x10⁻⁶ to 3.85x10⁻⁵ (95% upper bound ranging from 6.49x10⁻⁶ to 4.64x10⁻⁵). The most sensitive endpoint for both males and females was lung cancer. The overall unit risk associated with the ingestion of arsenic in drinking water was reported as a range, given that lifetime exposure to arsenic results in more than one cancer endpoint in different individuals. The above unit risk range has the liver cancer unit risk (3.06x10⁻⁶) as its lower bound and the lung cancer unit risk (3.85x10⁻⁵) as its upper bound. Based on these data, Health Canada (2006) derived an oral slope factor (OSF) of 1.8 (mg/kg bw/day)⁻¹. The Health Canada (2025) TRV guidance considers existing TRVs and recent literature in their development of TRVs, the 2006 TRV of 1.8 per mg/kg bw/day for arsenic was maintained.</p> <p>Health Canada SF was selected as the TRV for cancer risk as it is the appropriate jurisdiction for the Project and is based on a recent evaluation. A sensitivity analysis of the application of the US EPA TRV in comparison to the Health Canada TRV is provided in Section 4.5.</p>	32	<p>The US EPA (2025b) derived an oral slope factor of 32 per mg/kg bw/day based on a combined cancer slope factor calculated from the individual cancer slope factors for bladder cancer (17.6 per mg/kg bw) and lung cancer (21.3 per mg/kg bw/day). These individual cancer slope factors were derived through Bayesian dose-response meta-analyses of respective cancer studies, in which the slope factors correspond to the slope of the linear trendline fit to the 95% upper bound confidence limit on lifetime extra risks associated with doses above background.</p>

Note(s):

% = percent; µg/L = micrograms per liter; mg/kg bw/day = milligrams per kilogram body weight per day; mg/kg bw = milligrams per kilogram body weight; OSF = oral slope factor; POPC= parameter of potential concern; SF = slope factor; TRV = toxicity reference value; US EPA = United States Environmental Protection Agency.

Shaded value indicates selected toxicity reference value.

4.2.1 SUMMARY OF TOXICITY REFERENCE VALUES

The chronic TRVs selected for use in the multi-media assessment are presented in Table E-18 and Table E-19.

Table E-18: Chronic Oral/Dermal Reference Doses for Parameters of Potential Concern (mg/kg bw/day)

POPC	Oral/Dermal Reference Dose (mg/kg bw/day)	Target Organ(s)/Effect	Source
Arsenic	0.00006	Endocrine and cardiovascular systems	US EPA (2025b)
Inorganic Mercury	0.0003	Immunotoxicity (autoimmune glomerulonephritis)	Health Canada (2025) and US EPA (1995a)
Organic Mercury (Methylmercury)	0.0002 (Sensitive population) 0.00047 (General Population)	Neuro-developmental toxicity	Health Canada (2025)
Selenium	0.0055 (0 – 6 months) 0.0060 (6 months - <5 years) 0.0063 (5 years - <12 years) 0.0062 (12 years- <20 years) 0.0057 (≥20 years)	Hair and nail brittleness and loss (signs and symptoms of chronic selenosis)	Health Canada (2025)

Notes:
mg/kg bw/day = milligrams per kilograms of body weight per day; POPC= parameter of potential concern; US EPA = United States Environmental Protection Agency.

Table E-19: Oral Slope Factors for Parameters of Potential Concern (mg/kg bw/day)⁻¹

POPC	Oral/Dermal Slope Factor (mg/kg bw/day)⁻¹	Target Organ(s)/Effect	Source
Arsenic	1.8	Bladder, liver and lung cancer	Health Canada (2025)

Notes:
(mg/kg bw/day)⁻¹ = per milligram per kilograms of body weight per day, POPC= parameter of potential concern.

5 RISK CHARACTERIZATION

Exposure must be normalized to body weight for comparison to TRVs (expressed in mg/kg bw/day) in order to characterize risk. The estimated daily intake (EDI, in mg/kg) was converted to an exposure dose (in mg/kg bw/day) based on the life stage body weight (BW) as follows:

$$Dose_{total} = \frac{EDI_{total}}{bw}$$

Where:

$Dose_{total}$	=	Total exposure dose (mg/kg bw/day)
EDI_{total}	=	Total estimated daily intake of POPC for all media (mg/day)
bw	=	Body weight (kg)

Body weights assumed in the HHRA are based on Health Canada (2024) and provided in Table E-1.

Example 5-1: Total Inorganic Arsenic Exposure Dose for a Heavy Consumer Indigenous Resident Toddler (Operations Phase)

$$Dose_{total} = \frac{4.5 \times 10^{-3} \text{ mg/day}}{16.5 \text{ kg}}$$

$$Dose_{total} = 2.72 \times 10^{-4} \text{ mg/kg/day}$$

Risk estimates were calculated by comparing the estimated exposures (i.e., total dose) with those exposures that were determined to be acceptable (i.e., TRVs). Human health exposure doses are provided in Table E1-4 and risk estimates are provided in Table E1-5 (Attachment E).

5.1 THRESHOLD (NON-CARCINOGENIC) POPC

For threshold (i.e., non-carcinogenic) POPCs, the risk estimate is expressed as a hazard quotient (HQ). HQs for threshold POPC were calculated by dividing the total exposure dose by the TRV (i.e., RfD or tolerable daily intake) as follows:

$$HQ = \frac{Dose_{total}}{RfD}$$

Where:

HQ	=	Hazard quotient (unitless)
$Dose_{total}$	=	Estimated dose (mg/kg-bw/day)
RfD	=	Reference dose (mg/kg-bw/day)

The HQs for each threshold POPC were summed over the exposure pathways evaluated to determine the potential risk associated with total exposure to a POPC. Health Canada (2023) indicates a target HQ of 1.0 to be an applicable risk threshold for HHRAs if all potential exposure pathways for applicable media and background (i.e., baseline) exposure is considered (i.e., Project+Baseline). When evaluating for project-related exposures (i.e., Project Alone), a target HQ of 0.2 is considered to be applicable is negligible if background exposure is not considered. An HQ below the risk threshold indicates that exposures would not be expected to result in adverse human health effects. Given that conservative assumptions are used by regulatory authorities in the development of the TRVs, HQs greater than the risk threshold do not necessarily indicate that adverse human health impacts will occur, but that the likelihood that an adverse effect will increase as the HQ value rises above the risk threshold.

A target of 1 has been applied to the Project+Baseline HQs to identify potential risks. While all potential exposure pathways at the site from the Project and background have been considered in the HHRA, potential exposure through consumer goods and market foods have not been fully considered. Therefore, a target HQ of 0.2 is also considered applicable when evaluating Project-related (i.e., Project Alone) exposures.

Example 5-2: Total Arsenic Hazard Quotient for a Heavy Consumer Indigenous Resident Toddler (Operations Phase)

$$HQ = \frac{2.72 \times 10^{-4} \text{ mg/kg/day}}{6.00 \times 10^{-5} \text{ mg/kg/day}}$$

$$HQ = 4.5$$

5.2 NON-THRESHOLD (CARCINOGENIC) POPC

For non-threshold (i.e., carcinogenic) POPCs, risk estimates are expressed as incremental lifetime cancer risk (ILCR), as recommended by Health Canada (2024). ILCR values are related to increased cancer risks as a result of incremental parameter exposures originating from the Project. ILCR values were compared to an acceptable threshold of 1 in 100,000 (Health Canada 2024). Given that conservative assumptions are used by regulatory authorities in the development of the slope factor, ILCR values above 1.0E-05 do not necessarily indicate that adverse human health impacts will actually occur, but only the likelihood that an adverse effect will increase as the ILCR value increases.

The lifetime adjustment factor (LAF) is an adjustment coefficient to relate the exposure concentrations to the number of years considered to be a part of that life stage. It is calculated with the following equation:

$$LAF_i = \frac{t_i}{t_{total}}$$

Where:

LAF_i = Lifetime adjustment factor for life stage i (unitless)

T_i = Length of time of life stage i (years)

T_{total} = Total life expectancy (years)

LAFs applied for each life stage in the HHRA are calculated based on age group duration (in years) and life span duration (in years) recommended by Health Canada (2024), as presented in Table E-7.

Example 5-3: Lifetime Adjustment Factor for a Toddler

$$LAF_{toddler} = \frac{4.5 \text{ years}}{80 \text{ years}}$$

$$LAF_{toddler} = 5.63 \times 10^{-2}$$

To account for the length of each Project phase, a ratio was applied to the calculation of the ILCR to relate the exposure concentrations to the number of years of a lifetime occupied by each project phase, assuming that a receptor is born at the start of the project. This assumption allows for maximum time of exposure, resulting in a conservative estimate.

The ratio of Project phase to lifespan is calculated as follows:

$$Ratio_{P-L-i} = \frac{t_{phase-i}}{t_{total}}$$

Where:

$Ratio_{P-L-i}$ = Ratio of Project phase to lifespan for Project phase i (unitless)

$T_{phase-i}$ = Length of time of Project phase i (years)

T_{total} = Total life expectancy (years)

Example 5-4: Ratio of Project Phase to lifespan for The Operations Phase

$$Ratio_{P-L-Operations} = \frac{26 \text{ years}}{80 \text{ years}}$$

$$Ratio_{P-L-Operations} = 0.325$$

Cancer risks in toxicological studies are typically reported as an oral SF. The SF and LAFs were used in the following equation in the HHRA to calculate a total ILCR across all life stages from infant to adult (representing a composite receptor):

$$ILCR_w = \sum Dose_{total\ i} \times LAF_i \times ADAF_i \times Ratio_{P-L-w} \times SF$$

Where:

$ILCR_w$ = Incremental lifetime cancer risk (unitless) for all life stages related to incremental parameter exposures because of the Project (i.e., Project Alone) during phase w

$Dose_{total\ i}$ = Total dose for life stage i (mg/kg bw/day)

LAF_i = Lifetime adjustment factor for life stage i (unitless)

$ADAF_i$ = Age-dependant adjustment factor for carcinogens and life stage i (unitless)

$Ratio_{P-L-w}$ = Ratio of Project phase to lifespan for Project phase w (unitless)

SF = Cancer risk slope factor (mg/kg bw/day)⁻¹

ADAF (Health Canada 2024) are applied to non-threshold carcinogens POPCs that act through a mutagenic mode of action. As stated in Section 4.1, for this HHRA, none of the carcinogenic POPC (i.e., arsenic) are assumed to be mutagenic, so the ADAFs were set as 1 for each life stage.

Example 5-5: ILCR for Arsenic for a Heavy Consumer Indigenous Resident in the Project Alone for Operations Phase (referred to as 'Operations-Base' in the model)

$$ILCR = ([2.23E^{-7} \text{ mg/kg/day} \times 6.25E^{-3} \times 1] + [1.20E^{-6} \text{ mg/kg/day} \times 5.63E^{-2} \times 1] + [6.85E^{-7} \text{ mg/kg/day} \times 8.75E^{-2} \times 1] + [4.72E^{-7} \text{ mg/kg/day} \times 1.00E^{-1} \times 1] + [5.25E^{-7} \text{ mg/kg/day} \times 7.50E^{-1} \times 1]) \times 1.8 \text{ mg/kg/day}^{-1} \times 0.325$$

$$ILCR = 0.33 \text{ in } 1,000,000 \text{ or } 3.3E^{-7}$$

To estimate cancer risks across Project phases, a composite receptor is calculated as the sum of the ILCRs calculated for individual phases as follows:

$$ILCR_{composite} = \sum ILCR_w$$

Where:

$ILCR_{composite}$ = Incremental lifetime cancer risk (unitless) for all life stages related to incremental parameter exposures because of the Project (i.e., Project Alone) across all Project phases

$ILCR_w$ = Incremental lifetime cancer risk (unitless) for all life stages related to incremental parameter exposures because of the Project (i.e., Project Alone) during phase w

Example 5-6: ILCR for Arsenic for a Heavy Consumer Indigenous Resident in the Project Alone Across all Project Phases

$$ILCR_{composite} = 4.2E^{-8} + 3.3E^{-7} + 3.5E^{-8} + 2.1E^{-7}$$

$$ILCR_{composite} = 0.68 \text{ in } 1,000,000 \text{ or } 6.8E^{-7}$$

As stated above, human health exposure doses are provided in Table E1-4 and risk estimates are provided in Table E1-4 and Table E1-5. A discussion of the interpretation of the calculated risk estimates is provided in Section 4.4.2.3 of the HHERA.

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Sub-Attachment E1
Multi-media Human Health Model
Description and Worked Example



ATTACHMENT E1: HUMAN HEALTH EXPOSURE AND RISK MODEL

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In the HHRA model the assessment cases are represented by the following terms:

Base = baseline

Construction = baseline + incremental concentrations from construction phase

Operations = baseline + incremental concentrations from operations phase

Closure = baseline + incremental concentrations from closure phase

Post Closure = baseline + incremental concentrations from post-closure phase

Construction-Base = incremental concentrations from construction phase alone

Operations-Base = incremental concentrations from operations phase alone

Closure-Base = incremental concentrations from closure phase alone

Post Closure-Base = incremental concentrations from post-closure phase alone

In the HHRA model the receptors are represented by the following terms:

INDG = Indigenous Resident Receptor

Abbreviations:

95 UCLM = 95th percent upper confidence limit of the mean

AANDC = Arctic and Northern Development Canada

ADAF= Age dependant adjustment factors

AdultFEM = Adult female lifestage

AG = Aboveground

AIR = Air inhalation rate

BD = Bulk density

BG = Belowground

BW =Body Weight

cm² = square centimetres

cm/hr = Centimetres per hour

Cs = Concentration in soil

Cw = Concentration of POPC in water

DW = Dry weight

ED = Exposure duration

EDI = Estimated daily intake

EF = Exposure frequency

EPASF = Cancer risk slope factor from the US EPA

FEM = Female; or specific to female receptor

HC = Health Canada

HHRAP = Human Health Risk Assessment Protocol

hr = hour

HQ = Hazard quotient

ILCR = Incremental lifetime cancer risk

INDG_A = Indigenous average consumer receptor

INDG_H = Indigenous heavy consumer receptor

ING= Ingestion

IVBA= In vitro bioaccessibility assay

kg =Kilograms

kg/m² = Kilograms per square metre

kg/m³ = Kilograms per cubic metre

km² = Square kilometres

kp = Soil loss constant

L = Litre

LAF = Lifetime adjustment factors

LSA = Local study area

MC = Moisture content

mg/day = Milligrams per day

mg/kg = Milligrams per kilogram

mg/kg-WW = Milligrams per kilogram wet weight

mg/kg/day = Milligrams per kilogram per day

mg/L = Milligrams per litre

mg/m²/year = Mmlligrams per square metre per year

N/A = Not Applicable

Pair = Proportion of soil POPCs in soil dust

Plant-dep = Concentration in plant tissue related to plant surface deposition of airborne particles

Plant-soil = Concentration in plant tissue related to soil uptake

Plant-total = Total concentration in plant tissues from soil uptake and plant surface deposition

Plant-water = Concentration in plant tissue related to uptake from surface water

POPC = Parameter of potential concern

Q = Rate of airborne particle deposition

RAF = Relative absorption factor

RBA = Relative bioavailability

RfD = Reference dose

Rp = Intercept fraction

RSA = Regional Study Area

SA = Surface area

SAH= Surface area of hands

SAO = Surface area, other

SAT = Surface area, total

Sderm = Dermal absorption through soil pathway

Sed= Sediment

SedL = Sediment loading rate

SF = Cancer risk slope factor

SIR = Soil ingestion rate

SLH = Soil loading on hands

SLO = Soil loading, other

Soil-accum = Soil concentration attributed to airborne particle deposition cumulatively across current and previous Project phases

Soil-base = Soil baseline exposure point concentration

Soil-dep = Soil concentration attributed to airborne particle deposition

Soil-total = Total soil concentration from baseline soil and airborne particle deposition

Sw = surface water

SWIM = Inadvertent water ingestion rate while swimming/bathing

t = Time period of deposition

Tp = Length of plant exposure

TradPlant = Traditional plant

TRV = Toxicity reference value

US EPA = United States Environmental Protection Agency

WIR = Water ingestion rate

WW = Wet weight

yr = Year

Yp= Yield or productivity of plant

Z₁ = Depth of surface soil

Z₂ = Depth of sub-surface soil

Table E1-3b: Estimated Daily Intakes as a Percentage of Total Exposure from Multi-media and Bioaccumulation Models

Receptor	Pathway	Toddler		Adult Female		Adult	
		Contribution [%]	Exposure [mg/day]	Contribution [%]	Exposure [mg/day]	Contribution [%]	Exposure [mg/day]
Heavy Consumer Indigenous Resident	Arsenic						
	Soil	3.74%	1.68E-04	0.93%	8.10E-05	0.83%	8.10E-05
	Surface Water	62.14%	2.79E-03	72.64%	6.35E-03	65.34%	6.35E-03
	Plants	8.06%	3.62E-04	8.08%	7.06E-04	9.19%	8.93E-04
	Game	1.92%	8.65E-05	3.08%	2.69E-04	2.30%	2.24E-04
	Fish	24.14%	1.09E-03	15.27%	1.33E-03	22.34%	2.17E-03
	Total	100%	4.50E-03	100%	8.74E-03	100%	9.72E-03
	Mercury (inorganic)						
	Soil	0.12%	6.79E-06	0.08%	8.72E-06	0.04%	8.72E-06
	Surface Water	0.02%	8.88E-07	0.02%	2.22E-06	0.01%	2.22E-06
	Plants	1.39%	7.86E-05	1.40%	1.59E-04	0.71%	1.74E-04
	Game	2.25%	1.27E-04	3.28%	3.73E-04	1.34%	3.28E-04
	Fish	96.22%	5.43E-03	95.23%	1.09E-02	97.90%	2.40E-02
	Total	100%	5.64E-03	100%	1.14E-02	100%	2.45E-02
	Mercury (organic)						
	Soil	0.00%	5.84E-08	0.00%	2.10E-08	0.00%	2.10E-08
	Surface Water	0.00%	3.38E-08	0.00%	8.45E-08	0.00%	8.45E-08
	Plants	0.01%	1.73E-06	0.01%	3.58E-06	0.00%	3.90E-06
	Game	2.69%	6.12E-04	4.57%	2.12E-03	1.61%	1.58E-03
	Fish	97.30%	2.22E-02	95.43%	4.43E-02	98.39%	9.68E-02
	Total	100%	2.28E-02	100.00%	4.64E-02	100.00%	9.84E-02
	Selenium						
	Soil	0.05%	2.04E-05	0.01%	5.49E-06	0.01%	5.49E-06
	Surface Water	0.17%	7.68E-05	0.17%	1.75E-04	0.17%	1.75E-04
Plants	0.12%	5.25E-05	0.12%	1.18E-04	0.13%	1.28E-04	
Game	48.38%	2.13E-02	75.52%	7.70E-02	54.81%	5.52E-02	
Fish	51.28%	2.26E-02	24.19%	2.47E-02	44.89%	4.52E-02	
Total	100%	4.41E-02	100%	1.02E-01	100%	1.01E-01	
Average Consumer Indigenous Resident	Arsenic						
	Soil	4.98%	1.68E-04	1.14%	8.10E-05	1.11%	8.10E-05
	Surface Water	82.72%	2.79E-03	89.10%	6.35E-03	86.75%	6.35E-03
	Plants	4.43%	1.50E-04	3.84%	2.73E-04	4.67%	3.42E-04
	Game	0.76%	2.57E-05	0.91%	6.47E-05	0.91%	6.66E-05
	Fish	7.11%	2.40E-04	5.02%	3.58E-04	6.56%	4.80E-04
	Total	100%	3.38E-03	100%	7.12E-03	100%	7.32E-03
	Mercury (inorganic)						
	Soil	0.12%	6.79E-06	0.08%	8.72E-06	0.04%	8.72E-06
	Surface Water	0.02%	8.88E-07	0.02%	2.22E-06	0.01%	2.22E-06
	Plants	1.01%	5.56E-05	0.95%	1.05E-04	0.47%	1.15E-04
	Game	0.75%	4.15E-05	1.08%	1.20E-04	0.44%	1.07E-04
	Fish	98.10%	5.43E-03	97.87%	1.09E-02	99.04%	2.40E-02
	Total	100%	5.53E-03	100%	1.11E-02	100%	2.42E-02
	Mercury (organic)						
	Soil	0.00%	5.84E-08	0.00%	2.10E-08	0.00%	2.10E-08
	Surface Water	0.00%	3.38E-08	0.00%	8.45E-08	0.00%	8.45E-08
	Plants	0.01%	1.12E-06	0.00%	2.17E-06	0.00%	2.34E-06
	Game	0.84%	1.87E-04	1.18%	5.31E-04	0.50%	4.83E-04
	Fish	99.16%	2.22E-02	98.81%	4.43E-02	99.50%	9.68E-02
	Total	100%	2.23E-02	100.00%	4.49E-02	100.00%	9.73E-02
	Selenium						
	Soil	0.19%	2.04E-05	0.02%	5.49E-06	0.02%	5.49E-06
	Surface Water	0.71%	7.68E-05	0.77%	1.75E-04	0.69%	1.75E-04
Plants	0.20%	2.21E-05	0.20%	4.46E-05	0.19%	4.90E-05	
Game	55.76%	6.06E-03	69.94%	1.59E-02	62.01%	1.57E-02	
Fish	43.15%	4.69E-03	29.07%	6.60E-03	37.08%	9.39E-03	
Total	100%	1.09E-02	100%	2.27E-02	100%	2.53E-02	

Table E1-5: Risk Estimates By Lifestage

Receptor	Case	Parameter	Speciation	RID/SF	Lifestage HQ/ILCR (Unitless)					Threshold Max HQ/ILCR	Non-threshold Total ILCR	
					Infant	Toddler	Child	Adolescent	Adult			Adult/FEM
INDG_A	Base	Arsenic	Inorganic	RfD	2.57E+00	3.43E+00	2.23E+00	1.48E+00	1.74E+00	1.69E+00	3.43E+00	-
INDG_A	Construction	Arsenic	Inorganic	RfD	2.57E+00	3.44E+00	2.24E+00	1.48E+00	1.74E+00	1.70E+00	3.44E+00	-
INDG_A	Operations	Arsenic	Inorganic	RfD	2.55E+00	3.41E+00	2.22E+00	1.47E+00	1.73E+00	1.68E+00	3.41E+00	-
INDG_A	Closure	Arsenic	Inorganic	RfD	2.46E+00	3.30E+00	2.14E+00	1.42E+00	1.67E+00	1.62E+00	3.30E+00	-
INDG_A	Post Closure	Arsenic	Inorganic	RfD	2.44E+00	3.27E+00	2.12E+00	1.40E+00	1.65E+00	1.61E+00	3.27E+00	-
INDG_A	Construction-Base	Arsenic	Inorganic	RfD	1.59E-03	8.38E-03	5.56E-03	3.80E-03	4.13E-03	4.09E-03	8.38E-03	-
INDG_A	Operations-Base	Arsenic	Inorganic	RfD	3.72E-03	1.18E-02	5.32E-03	3.65E-03	3.76E-03	3.73E-03	1.18E-02	-
INDG_A	Closure-Base	Arsenic	Inorganic	RfD	4.30E-03	1.26E-02	5.34E-03	3.71E-03	3.67E-03	3.61E-03	1.26E-02	-
INDG_A	Post Closure-Base	Arsenic	Inorganic	RfD	4.30E-03	8.26E-03	2.18E-03	1.45E-03	1.42E-03	1.40E-03	8.26E-03	-
INDG_A	Base	Mercury	Inorganic	RfD	1.28E-03	2.07E-02	1.49E-02	1.02E-02	1.07E-02	1.09E-02	2.07E-02	-
INDG_A	Construction	Mercury	Inorganic	RfD	1.28E-03	2.12E-02	1.52E-02	1.04E-02	1.10E-02	1.11E-02	2.12E-02	-
INDG_A	Operations	Mercury	Inorganic	RfD	1.28E-03	2.10E-02	1.51E-02	1.04E-02	1.09E-02	1.10E-02	2.10E-02	-
INDG_A	Closure	Mercury	Inorganic	RfD	1.28E-03	2.08E-02	1.49E-02	1.03E-02	1.08E-02	1.09E-02	2.08E-02	-
INDG_A	Post Closure	Mercury	Inorganic	RfD	1.28E-03	2.06E-02	1.48E-02	1.02E-02	1.06E-02	1.08E-02	2.06E-02	-
INDG_A	Construction-Base	Mercury	Inorganic	RfD	4.48E-07	1.17E-03	8.64E-04	5.44E-04	7.08E-04	8.81E-04	1.17E-03	-
INDG_A	Operations-Base	Mercury	Inorganic	RfD	2.80E-06	1.08E-03	7.93E-04	4.99E-04	6.49E-04	8.23E-04	1.08E-03	-
INDG_A	Closure-Base	Mercury	Inorganic	RfD	3.30E-06	1.41E-03	1.04E-03	6.59E-04	8.52E-04	1.02E-03	1.41E-03	-
INDG_A	Post Closure-Base	Mercury	Inorganic	RfD	3.28E-06	2.22E-03	1.63E-03	1.03E-03	1.34E-03	1.52E-03	2.22E-03	-
INDG_A	Base	Mercury	Organic	RfD	9.76E-06	5.50E-02	4.06E-02	1.09E-02	1.41E-02	3.65E-02	5.50E-02	-
INDG_A	Construction	Mercury	Organic	RfD	9.77E-06	5.81E-02	4.29E-02	1.15E-02	1.49E-02	3.85E-02	5.81E-02	-
INDG_A	Operations	Mercury	Organic	RfD	9.78E-06	5.69E-02	4.20E-02	1.12E-02	1.46E-02	3.77E-02	5.69E-02	-
INDG_A	Closure	Mercury	Organic	RfD	9.79E-06	5.51E-02	4.06E-02	1.09E-02	1.41E-02	3.66E-02	5.51E-02	-
INDG_A	Post Closure	Mercury	Organic	RfD	9.79E-06	5.40E-02	3.98E-02	1.07E-02	1.39E-02	3.58E-02	5.40E-02	-
INDG_A	Construction-Base	Mercury	Organic	RfD	4.13E-09	6.33E-03	4.67E-03	1.25E-03	1.63E-03	4.66E-03	6.33E-03	-
INDG_A	Operations-Base	Mercury	Organic	RfD	2.13E-08	5.67E-03	4.18E-03	1.12E-03	1.46E-03	4.25E-03	5.67E-03	-
INDG_A	Closure-Base	Mercury	Organic	RfD	2.89E-08	7.75E-03	5.72E-03	1.53E-03	1.99E-03	5.56E-03	7.75E-03	-
INDG_A	Post Closure-Base	Mercury	Organic	RfD	2.77E-08	1.34E-02	9.87E-03	2.64E-03	3.44E-03	9.10E-03	1.34E-02	-
INDG_A	Base	Selenium	Inorganic	RfD	8.36E-04	1.07E-01	8.23E-02	4.98E-02	6.12E-02	5.49E-02	1.07E-01	-
INDG_A	Construction	Selenium	Inorganic	RfD	8.49E-04	1.10E-01	8.41E-02	5.10E-02	6.27E-02	5.62E-02	1.10E-01	-
INDG_A	Operations	Selenium	Inorganic	RfD	8.49E-04	1.10E-01	8.42E-02	5.10E-02	6.28E-02	5.63E-02	1.10E-01	-
INDG_A	Closure	Selenium	Inorganic	RfD	8.90E-04	1.15E-01	8.81E-02	5.34E-02	6.56E-02	5.88E-02	1.15E-01	-
INDG_A	Post Closure	Selenium	Inorganic	RfD	8.84E-04	1.17E-01	8.96E-02	5.43E-02	6.71E-02	6.05E-02	1.17E-01	-
INDG_A	Construction-Base	Selenium	Inorganic	RfD	1.30E-05	3.72E-03	2.74E-03	1.70E-03	2.25E-03	2.36E-03	3.72E-03	-
INDG_A	Operations-Base	Selenium	Inorganic	RfD	1.31E-05	5.78E-03	4.17E-03	2.62E-03	3.56E-03	3.77E-03	5.78E-03	-
INDG_A	Closure-Base	Selenium	Inorganic	RfD	5.41E-05	8.80E-03	6.69E-03	4.07E-03	5.10E-03	4.93E-03	8.80E-03	-
INDG_A	Post Closure-Base	Selenium	Inorganic	RfD	4.78E-05	2.35E-02	1.70E-02	1.07E-02	1.45E-02	1.50E-02	2.35E-02	-
INDG_H	Base	Arsenic	Inorganic	RfD	2.57E+00	4.56E+00	3.20E+00	2.07E+00	2.30E+00	2.07E+00	4.56E+00	-
INDG_H	Construction	Arsenic	Inorganic	RfD	2.57E+00	4.58E+00	3.22E+00	2.08E+00	2.31E+00	2.08E+00	4.58E+00	-
INDG_H	Operations	Arsenic	Inorganic	RfD	2.55E+00	4.54E+00	3.19E+00	2.06E+00	2.29E+00	2.06E+00	4.54E+00	-
INDG_H	Closure	Arsenic	Inorganic	RfD	2.46E+00	4.40E+00	3.09E+00	2.00E+00	2.22E+00	2.00E+00	4.40E+00	-
INDG_H	Post Closure	Arsenic	Inorganic	RfD	2.44E+00	4.35E+00	3.05E+00	1.97E+00	2.19E+00	1.97E+00	4.35E+00	-
INDG_H	Construction-Base	Arsenic	Inorganic	RfD	1.59E-03	1.78E-02	1.25E-02	8.80E-03	9.75E-03	1.05E-02	1.78E-02	-
INDG_H	Operations-Base	Arsenic	Inorganic	RfD	3.72E-03	2.01E-02	1.14E-02	8.06E-03	8.74E-03	9.51E-03	2.01E-02	-
INDG_H	Closure-Base	Arsenic	Inorganic	RfD	4.30E-03	1.96E-02	1.06E-02	7.69E-03	7.95E-03	8.13E-03	1.96E-02	-
INDG_H	Post Closure-Base	Arsenic	Inorganic	RfD	4.30E-03	1.03E-02	3.72E-03	2.50E-03	2.68E-03	2.90E-03	1.03E-02	-

Table E1-5: Risk Estimates By Lifestage

Receptor	Case	Parameter	Speciation	RID/SF	Lifestage HQ/ILCR (Unitless)					Adult/FEM	Threshold Max HQ/ILCR	Non-threshold Total ILCR
					Infant	Toddler	Child	Adolescent	Adult			
INDG_H	Base	Mercury	Inorganic	RfD	1.28E-03	4.21E-02	3.06E-02	2.09E-02	2.36E-02	2.50E-02	4.21E-02	-
INDG_H	Construction	Mercury	Inorganic	RfD	1.28E-03	4.34E-02	3.16E-02	2.15E-02	2.44E-02	2.59E-02	4.34E-02	-
INDG_H	Operations	Mercury	Inorganic	RfD	1.28E-03	4.29E-02	3.12E-02	2.12E-02	2.41E-02	2.55E-02	4.29E-02	-
INDG_H	Closure	Mercury	Inorganic	RfD	1.28E-03	4.22E-02	3.07E-02	2.09E-02	2.37E-02	2.50E-02	4.22E-02	-
INDG_H	Post Closure	Mercury	Inorganic	RfD	1.28E-03	4.17E-02	3.04E-02	2.07E-02	2.34E-02	2.47E-02	4.17E-02	-
INDG_H	Construction-Base	Mercury	Inorganic	RfD	4.48E-07	3.24E-03	2.39E-03	1.50E-03	1.96E-03	2.03E-03	3.24E-03	-
INDG_H	Operations-Base	Mercury	Inorganic	RfD	2.80E-06	2.96E-03	2.18E-03	1.37E-03	1.79E-03	1.84E-03	2.96E-03	-
INDG_H	Closure-Base	Mercury	Inorganic	RfD	3.30E-06	3.95E-03	2.91E-03	1.84E-03	2.38E-03	2.49E-03	3.95E-03	-
INDG_H	Post Closure-Base	Mercury	Inorganic	RfD	3.28E-06	6.24E-03	4.60E-03	2.90E-03	3.77E-03	4.15E-03	6.24E-03	-
INDG_H	Base	Mercury	Organic	RfD	9.76E-06	1.80E-01	1.33E-01	3.55E-02	4.62E-02	1.45E-01	1.80E-01	-
INDG_H	Construction	Mercury	Organic	RfD	9.77E-06	1.90E-01	1.40E-01	3.75E-02	4.88E-02	1.53E-01	1.90E-01	-
INDG_H	Operations	Mercury	Organic	RfD	9.78E-06	1.86E-01	1.37E-01	3.67E-02	4.78E-02	1.50E-01	1.86E-01	-
INDG_H	Closure	Mercury	Organic	RfD	9.79E-06	1.80E-01	1.33E-01	3.56E-02	4.63E-02	1.45E-01	1.80E-01	-
INDG_H	Post Closure	Mercury	Organic	RfD	9.79E-06	1.77E-01	1.30E-01	3.49E-02	4.54E-02	1.42E-01	1.77E-01	-
INDG_H	Construction-Base	Mercury	Organic	RfD	4.13E-09	1.86E-02	1.37E-02	3.66E-03	4.77E-03	1.33E-02	1.86E-02	-
INDG_H	Operations-Base	Mercury	Organic	RfD	2.13E-08	1.65E-02	1.21E-02	3.25E-03	4.23E-03	1.15E-02	1.65E-02	-
INDG_H	Closure-Base	Mercury	Organic	RfD	2.89E-08	2.31E-02	1.71E-02	4.57E-03	5.95E-03	1.69E-02	2.31E-02	-
INDG_H	Post Closure-Base	Mercury	Organic	RfD	2.77E-08	4.10E-02	3.02E-02	8.09E-03	1.05E-02	3.20E-02	4.10E-02	-
INDG_H	Base	Selenium	Inorganic	RfD	8.36E-04	4.35E-01	3.40E-01	2.04E-01	2.44E-01	2.46E-01	4.35E-01	-
INDG_H	Construction	Selenium	Inorganic	RfD	8.49E-04	4.45E-01	3.47E-01	2.08E-01	2.50E-01	2.52E-01	4.45E-01	-
INDG_H	Operations	Selenium	Inorganic	RfD	8.49E-04	4.45E-01	3.47E-01	2.08E-01	2.50E-01	2.53E-01	4.45E-01	-
INDG_H	Closure	Selenium	Inorganic	RfD	8.90E-04	4.66E-01	3.64E-01	2.18E-01	2.61E-01	2.64E-01	4.66E-01	-
INDG_H	Post Closure	Selenium	Inorganic	RfD	8.84E-04	4.73E-01	3.68E-01	2.21E-01	2.66E-01	2.73E-01	4.73E-01	-
INDG_H	Construction-Base	Selenium	Inorganic	RfD	1.30E-05	1.43E-02	1.06E-02	6.56E-03	8.52E-03	9.74E-03	1.43E-02	-
INDG_H	Operations-Base	Selenium	Inorganic	RfD	1.31E-05	2.12E-02	1.55E-02	9.66E-03	1.30E-02	1.69E-02	2.12E-02	-
INDG_H	Closure-Base	Selenium	Inorganic	RfD	5.41E-05	3.52E-02	2.72E-02	1.64E-02	2.00E-02	2.14E-02	3.52E-02	-
INDG_H	Post Closure-Base	Selenium	Inorganic	RfD	4.78E-05	8.52E-02	6.20E-02	3.88E-02	5.21E-02	7.23E-02	8.52E-02	-
INDG_A	Construction-Base	Arsenic	Inorganic	SF	4.03E-11	1.91E-09	1.97E-09	1.54E-09	1.26E-08	1.24E-08	1.26E-08	1.80E-08
INDG_A	Operations-Base	Arsenic	Inorganic	SF	8.16E-10	2.33E-08	1.64E-08	1.28E-08	9.89E-08	9.83E-08	1.52E-07	1.52E-07
INDG_A	Closure-Base	Arsenic	Inorganic	SF	1.09E-10	2.86E-09	1.89E-09	1.50E-09	1.11E-08	1.10E-08	1.11E-08	1.75E-08
INDG_A	Post Closure-Base	Arsenic	Inorganic	SF	1.74E-09	3.01E-08	1.23E-08	9.39E-09	6.89E-08	6.80E-08	6.89E-08	1.22E-07
INDG_H	Construction-Base	Arsenic	Inorganic	SF	4.03E-11	4.05E-09	4.44E-09	3.56E-09	2.96E-08	3.20E-08	3.20E-08	4.17E-08
INDG_H	Operations-Base	Arsenic	Inorganic	SF	8.16E-10	3.96E-08	3.50E-08	2.83E-08	2.30E-07	2.50E-07	2.50E-07	3.34E-07
INDG_H	Closure-Base	Arsenic	Inorganic	SF	1.09E-10	4.48E-09	3.74E-09	3.12E-09	2.41E-08	2.47E-08	2.47E-08	3.56E-08
INDG_H	Post Closure-Base	Arsenic	Inorganic	SF	1.74E-09	3.77E-08	2.11E-08	1.62E-08	1.30E-07	1.41E-07	1.41E-07	2.07E-07

Bolded values indicate HQ > 1.0

Table E1-6a: Risk Estimates by Assessment Case - Multi-media Assessment Model										
INDG_A	Multi-media Assessment Maximum HQ Values for Toddler/ILCR Values for Lifetime Composite [Unitless] ^{1,4}									
	Project + Baseline					Project Alone (Maximum Incremental Change)				
POPC	Base	Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	Total ILCR
Threshold - HQ Values										
Arsenic_Inorganic	3.4	3.4	3.4	3.3	3.3	0.0084	0.012	0.013	0.0083	N/A
Mercury_Inorganic	0.021	0.021	0.021	0.021	0.021	0.0012	0.0011	0.0014	0.0022	N/A
Mercury_Organic	0.055	0.058	0.057	0.055	0.054	0.0063	0.0057	0.0078	0.013	N/A
Selenium_Inorganic	0.11	0.11	0.11	0.11	0.12	0.0037	0.0058	0.0088	0.024	N/A
Non-Threshold - ILCR Values Based on Slope factor										
Arsenic_Inorganic	N/A	N/A	N/A	N/A	N/A	1.8E-08	1.5E-07	1.8E-08	1.2E-07	3.1E-07
INDG_H	Multi-media Assessment Maximum HQ Values for Toddler / ILCR Values for Lifetime Composite [Unitless] ^{1,4}									
	Project + Baseline					Project Alone (Maximum Incremental Change)				
POPC	Base	Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	Total ILCR
Threshold - HQ Values										
Arsenic_Inorganic	4.6	4.6	4.5	4.4	4.3	0.018	0.020	0.020	0.010	N/A
Mercury_Inorganic	0.042	0.043	0.043	0.042	0.042	0.0032	0.0030	0.0039	0.0062	N/A
Mercury_Organic	0.18	0.19	0.19	0.18	0.18	0.019	0.016	0.023	0.041	N/A
Selenium_Inorganic	0.44	0.45	0.45	0.47	0.47	0.014	0.021	0.035	0.085	N/A
Non-Threshold - ILCR Values Based on Slope factor										
Arsenic_Inorganic	N/A	N/A	N/A	N/A	N/A	4.2E-08	3.3E-07	3.6E-08	2.1E-07	6.2E-07

Table E1-6b: Risk Estimates by Assessment Case - Mercury Bioaccumulation Study										
Mercury Bioaccumulation Study Maximum HQ Value for the Toddler [Unitless] ^{2,4}										
	Project + Baseline					Project Alone (Maximum Incremental Change)				
Receptor / POPC	Base	Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	
INDG_A										
Mercury_Inorganic	0.28	0.28	0.3	0.3	0.28	0.00	0.019	0.019	0.00	
Mercury_Organic	1.8	1.8	1.8	1.8	1.8	0.00	0.044	0.044	0.00	
INDG_H										
Mercury_Inorganic	1.0	1.0	1.1	1.1	1.0	0.00	0.07	0.07	0.00	
Mercury_Organic	6.6	6.6	6.7	6.7	6.6	0.00	0.16	0.16	0.00	
Mercury Bioaccumulation Study Maximum HQ Value for the Adult Female [Unitless] ^{2,4}										
	Project + Baseline					Project Alone (Maximum Incremental Change)				
Receptor / POPC	Base	Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	
INDG_A										
Mercury_Inorganic	0.20	0.20	0.20	0.20	0.20	0.00	0.015	0.015	0.00	
Mercury_Organic	0.93	0.93	0.96	0.96	0.93	0.00	0.023	0.023	0.00	
INDG_H										
Mercury_Inorganic	0.54	0.54	0.57	0.57	0.54	0.00	0.038	0.038	0.00	
Mercury_Organic	3.4	3.4	3.5	3.5	3.4	0.00	0.085	0.085	0.00	

Notes:

- HQs and ILCRs represented below account for pathways calculated in the multi-media assessment. Fish ingestion and drinking water pathways for mercury are not included.
- HQs represented below account for pathways calculated in the Mercury Bioaccumulation Model. Only fish ingestion and drinking water pathways for mercury are represented here.
- HQs and ILCRs represented below are a sum on those calculated from the multi-media assessment and the Mercury Bioaccumulation Model. This accounts for all relevant pathways.
- Project Alone HQ values may be the same or greater than observed differences in HQ values for "Project + Baseline minus Baseline" as the maximum incremental change in Project Alone may not coincide with the location of the Project + Baseline maximum.

Bolded values indicate HQ > 1.0

Table E1-6c: Total Risk Estimates by Assessment Case - Multi- Media Assessment and Mercury Bioaccumulation Study for Toddler										
INDG_A	Multi-Media and Mercury Bioaccumulation Assessments Maximum HQ for Toddler / ILCR Value for Lifetime Composite [Unitless] ^{3,4}									
POPC	Base	Project + Baseline				Project Alone (Maximum Incremental Change)				
		Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	Composite
Threshold - HQ Values										
Arsenic_Inorganic	3.4	3.4	3.4	3.3	3.3	0.0084	0.012	0.013	0.0083	N/A
Mercury_Inorganic	0.30	0.30	0.32	0.32	0.30	0.0012	0.020	0.020	0.0022	N/A
Mercury_Organic	1.9	1.9	1.9	1.9	1.9	0.0063	0.049	0.052	0.013	N/A
Selenium_Inorganic	0.11	0.11	0.11	0.11	0.12	0.0037	0.0058	0.0088	0.024	N/A
Non-Threshold - LCR / ILCR Values Based on Slope factor										
Arsenic_Inorganic	N/A	N/A	N/A	N/A	N/A	1.8E-08	1.5E-07	1.8E-08	1.2E-07	3.1E-07
INDG_H	Multi-Media and Mercury Bioaccumulation Assessments Maximum HQ for Toddler / ILCR Value for Lifetime Composite [Unitless] ^{3,4}									
POPC	Base	Project + Baseline				Project Alone (Maximum Incremental Change)				
		Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	Composite
Threshold - HQ Values										
Arsenic_Inorganic	4.6	4.6	4.5	4.4	4.3	0.018	0.020	0.020	0.010	N/A
Mercury_Inorganic	1.0	1.0	1.1	1.1	1.0	0.0032	0.073	0.074	0.0062	N/A
Mercury_Organic	6.8	6.8	6.9	6.9	6.8	0.019	0.18	0.18	0.041	N/A
Selenium_Inorganic	0.44	0.45	0.45	0.47	0.47	0.014	0.021	0.035	0.085	N/A
Non-Threshold - LCR / ILCR Values Based on Slope factor										
Arsenic_Inorganic	N/A	N/A	N/A	N/A	N/A	4.2E-08	3.3E-07	3.6E-08	2.1E-07	6.8E-07

Table E1-6d: Risk Estimates by Assessment Case - Multi- Media Assessment and Mercury Bioaccumulation Study for Adult Female										
INDG_A	Multi-media Assessment Maximum HQ Values for Adult Female [Unitless] ^{1,4}									
POPC	Base	Project + Baseline				Project Alone (Maximum Incremental Change)				
		Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	
Mercury_Inorganic	0.011	0.011	0.011	0.011	0.011	0.0009	0.0008	0.0010	0.0015	
Mercury_Organic	0.036	0.038	0.038	0.037	0.036	0.0047	0.0042	0.0056	0.0091	
INDG_H	Multi-media Assessment Maximum HQ Values for Adult Female [Unitless] ^{1,4}									
POPC	Base	Project + Baseline				Project Alone (Maximum Incremental Change)				
		Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	
Mercury_Inorganic	0.025	0.026	0.026	0.025	0.025	0.0020	0.0018	0.0025	0.0041	
Mercury_Organic	0.145	0.153	0.150	0.145	0.142	0.013	0.011	0.017	0.032	
INDG_A	Multi-media and Mercury Bioaccumulation Assessment Maximum HQ Values for Adult Female [Unitless] ^{3,4}									
POPC	Base	Project + Baseline				Project Alone (Maximum Incremental Change)				
		Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	
Mercury_Inorganic	0.21	0.21	0.21	0.21	0.21	0.00088	0.016	0.016	0.0015	
Mercury_Organic	0.97	0.97	1.00	1.00	0.97	0.0047	0.027	0.028	0.0091	
INDG_H	Multi-media and Mercury Bioaccumulation Assessment Maximum HQ Values for Adult Female [Unitless] ^{3,4}									
POPC	Base	Project + Baseline				Project Alone (Maximum Incremental Change)				
		Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base	
Mercury_Inorganic	0.56	0.57	0.60	0.60	0.56	0.0020	0.040	0.040	0.0041	
Mercury_Organic	3.5	3.6	3.7	3.6	3.5	0.013	0.096	0.10	0.032	

Notes:

- HQs and ILCRs represented below account for pathways calculated in the multi-media assessment. Fish ingestion and drinking water pathways for mercury are not included.
- HQs represented below account for pathways calculated in the Mercury Bioaccumulation Model. Only fish ingestion and drinking water pathways for mercury are represented here.
- HQs and ILCRs represented below are a sum on those calculated from the multi-media assessment and the Mercury Bioaccumulation Model. This accounts for all relevant pathways.
- Project Alone HQ values may be the same or greater than observed differences in HQ values for "Project + Baseline minus Baseline" as the maximum incremental change in Project Alone may not coincide with the location of the Project + Baseline maximum.

Bolded values indicate HQ > 1.0

Table E1-7: Input Parameters Used for Predicting Soil Concentrations from Deposition Based on Site Characteristics		
Variable	Value	Reference / Comment
Time	26	t in years; Assumed equal to duration of project operations
Surface Soil Mixing Depth [metres] = Depth1	0.02	Z1; US EPA 2005
Soil Mixing Depth for Plants and Invertebrates[metres] = Depth2	0.2	Z2; US EPA 2005
Soil Bulk Density [kg/m3]	1500	BD; US EPA 2005

Table E1-8: Parameter Speciation Assumptions [%]				
Media	Parameter	Value	Reference	Comment
AG_Plant	Arsenic_Inorganic	68%	Schoof et al. 1999	Average of beans, corn, cucumber, lettuce, peas, spinach, and tomato
Wild Rice	Arsenic_Inorganic	74%	Williams 2005	Average of rice species collected in Canada
Berry	Arsenic_Inorganic	40%	Schoof et al. 1999	Average arsenic(Fruit)
BG_Plant	Arsenic_Inorganic	39%	Schoof et al. 1999	Average of carrots, onion, and potato
Caribou	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
CaribouLiver	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Deer	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Dust	Arsenic_Inorganic	100%	Assumed	-
Walleye	Arsenic_Inorganic	8.5%	Tanamal et al. 2020	95UCLM of percent inorganic arsenic based on 180 fish samples including lake whitefish, northern pike and burbot
Whitefish	Arsenic_Inorganic	8.5%	Tanamal et al. 2020	95UCLM of percent inorganic arsenic based on 180 fish samples including lake whitefish, northern pike and burbot
Pike	Arsenic_Inorganic	8.5%	Tanamal et al. 2020	95UCLM of percent inorganic arsenic based on 180 fish samples including lake whitefish, northern pike and burbot
Grouse/partridge	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Goose	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Rabbit	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Duck	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Moose	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
MooseKidney	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
MooseLiver	Arsenic_Inorganic	5.4%	Schoof et al. 1999	95UCLM (ProUCL)
Sediment	Arsenic_Inorganic	100%	Assumed	-
Soil	Arsenic_Inorganic	100%	Assumed	-
Surface_water	Arsenic_Inorganic	100%	Assumed	-
TradPlant	Arsenic_Inorganic	68.2%	Schoof et al. 1999	Average of beans, corn, cucumber, lettuce, peas, spinach, and tomato
AG_Plant	Mercury_Inorganic	98.1%	Assumed same as traditional plant	-
Wild Rice	Mercury_Inorganic	98.1%	Assumed same as traditional plant	-
Berry	Mercury_Inorganic	96.4%	Mallman and Bodaly 2005	-
BG_Plant	Mercury_Inorganic	98.1%	Assumed same as traditional plant	-
Caribou	Mercury_Inorganic	25.0%	AANDC 2012	-
CaribouLiver	Mercury_Inorganic	25.0%	AANDC 2012	-
Deer	Mercury_Inorganic	10.0%	Assumed same as moose	-
Dust	Mercury_Inorganic	100%	Assumed	-
Walleye	Mercury_Inorganic	40.0%	Site-specific	-
Whitefish	Mercury_Inorganic	32.0%	Site-specific	-
Pike	Mercury_Inorganic	16.0%	Site-specific	-
Grouse/partridge	Mercury_Inorganic	25.0%	AANDC 2012; assumed same as caribou muscle	-
Rabbit	Mercury_Inorganic	25.0%	AANDC 2012; assumed same as caribou muscle	-
Goose	Mercury_Inorganic	25.0%	AANDC 2012; assumed same as caribou muscle	-
Duck	Mercury_Inorganic	25.0%	AANDC 2012; assumed same as caribou muscle	-
Moose	Mercury_Inorganic	10.0%	AANDC 2012	-
MooseKidney	Mercury_Inorganic	10.0%	AANDC 2012	-
MooseLiver	Mercury_Inorganic	10.0%	AANDC 2012	-
Sediment	Mercury_Inorganic	98.3%	Chételat et al. 2013; as cited in AANDC 2012	-
Soil	Mercury_Inorganic	98.5%	US EPA 1997	-
Surface_water	Mercury_Inorganic	95.9%	Site-specific, average (all stations all years), WSP 2025 Mercury Study Report, Table 5-1	-
TradPlant	Mercury_Inorganic	98.1%	Mallman and Bodaly 2005	-
AG_Plant	Selenium_Inorganic	100%	Assumed	-
Wild Rice	Selenium_Inorganic	100%	Assumed	-
Berry	Selenium_Inorganic	100%	Assumed	-
BG_Plant	Selenium_Inorganic	100%	Assumed	-
Caribou	Selenium_Inorganic	100%	Assumed	-
CaribouLiver	Selenium_Inorganic	100%	Assumed	-
Deer	Selenium_Inorganic	100%	Assumed	-
Dust	Selenium_Inorganic	100%	Assumed	-
Walleye	Selenium_Inorganic	100%	Assumed	-
Whitefish	Selenium_Inorganic	100%	Assumed	-
Pike	Selenium_Inorganic	100%	Assumed	-
Grouse/partridge	Selenium_Inorganic	100%	Assumed	-
Rabbit	Selenium_Inorganic	100%	Assumed	-
Goose	Selenium_Inorganic	100%	Assumed	-
Duck	Selenium_Inorganic	100%	Assumed	-
Moose	Selenium_Inorganic	100%	Assumed	-
MooseKidney	Selenium_Inorganic	100%	Assumed	-
MooseLiver	Selenium_Inorganic	100%	Assumed	-
Sediment	Selenium_Inorganic	100%	Assumed	-
Soil	Selenium_Inorganic	100%	Assumed	-
Surface_water	Selenium_Inorganic	100%	Assumed	-
TradPlant	Selenium_Inorganic	100%	Assumed	-
AG_Plant	Arsenic_Organic	32.0%	Schoof et al. 1999	Average of beans, corn, cucumber, lettuce, peas, spinach, and tomato
Wild Rice	Arsenic_Organic	26.5%	Williams 2005	Average of rice species collected in Canada
Berry	Arsenic_Organic	60.0%	Schoof et al. 1999	Average arsenic(Fruit)
BG_Plant	Arsenic_Organic	61.0%	Schoof et al. 1999	Average of carrots, onion, and potato
Caribou	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
CaribouLiver	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Deer	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Dust	Arsenic_Organic	0.0%	Assumed	-
Walleye	Arsenic_Organic	91.5%	Tanamal et al. 2020	95UCLM of percent of organic arsenic based on 180 fish samples including lake whitefish, northern pike and burbot
Whitefish	Arsenic_Organic	91.5%	Tanamal et al. 2020	95UCLM of percent of organic arsenic based on 180 fish samples including lake whitefish, northern pike and burbot
Pike	Arsenic_Organic	91.5%	Tanamal et al. 2020	95UCLM of percent of organic arsenic based on 180 fish samples including lake whitefish, northern pike and burbot
Grouse/partridge	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Rabbit	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Goose	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Duck	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Moose	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
MooseKidney	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
MooseLiver	Arsenic_Organic	94.6%	Schoof et al. 1999	95UCLM (ProUCL)
Sediment	Arsenic_Organic	0.0%	Assumed	-
Soil	Arsenic_Organic	0.0%	Assumed	-
Surface_water	Arsenic_Organic	0.0%	Assumed	-
TradPlant	Arsenic_Organic	32.0%	Schoof et al. 1999	Average of beans, corn, cucumber, lettuce, peas, spinach, and tomato

Table E1-6: Parameter Speciation Assumptions [%]				
Media	Parameter	Value	Reference	Comment
AG_Plant	Mercury_Organic	1.9%	Assumed same as traditional plant	-
Wild Rice	Mercury_Organic	1.9%	Assumed same as traditional plant	-
Berry	Mercury_Organic	3.6%	Mallman and Bodaly 2005	-
BG_Plant	Mercury_Organic	1.9%	Assumed same as traditional plant	-
Caribou	Mercury_Organic	75.0%	AANDC 2012	-
CaribouLiver	Mercury_Organic	75.0%	AANDC 2012	-
Deer	Mercury_Organic	90.0%	Assumed same as moose	-
Dust	Mercury_Organic	0.0%	Assumed	-
Walleye	Mercury_Organic	60.0%	Site-specific	-
Whitefish	Mercury_Organic	68.0%	Site-specific	-
Pike	Mercury_Organic	84.0%	Site-specific	-
Grouse/partridge	Mercury_Organic	75.0%	AANDC 2012; assumed same as caribou muscle	-
Rabbit	Mercury_Organic	75.0%	AANDC 2012; assumed same as caribou muscle	-
Goose	Mercury_Organic	75.0%	AANDC 2012; assumed same as caribou muscle	-
Duck	Mercury_Organic	75.0%	AANDC 2012; assumed same as caribou muscle	-
Moose	Mercury_Organic	90.0%	AANDC 2012	-
MooseKidney	Mercury_Organic	90.0%	AANDC 2012	-
MooseLiver	Mercury_Organic	90.0%	AANDC 2012	-
Sediment	Mercury_Organic	5.0%	CCME 1999; Canadian Sediment Quality Guidelinefor the Protection of Aquatic Life; Midpoint of range (0.1-10%)	-
Soil	Mercury_Organic	1.5%	US EPA 1997	-
Surface_water	Mercury_Organic	4.1%	Site-specific, average (all stations all years), WSP 2026 Mercury Study Report, Table 5-1	-
TradPlant	Mercury_Organic	1.9%	Mallman and Bodaly 2005	-
AG_Plant	Selenium_Organic	0%	Assumed	-
Wild Rice	Selenium_Organic	0%	Assumed	-
Berry	Selenium_Organic	0%	Assumed	-
BG_Plant	Selenium_Organic	0%	Assumed	-
Caribou	Selenium_Organic	0%	Assumed	-
CaribouLiver	Selenium_Organic	0%	Assumed	-
Deer	Selenium_Organic	0%	Assumed	-
Dust	Selenium_Organic	0%	Assumed	-
Walleye	Selenium_Organic	0%	Assumed	-
Whitefish	Selenium_Organic	0%	Assumed	-
Pike	Selenium_Organic	0%	Assumed	-
Grouse/partridge	Selenium_Organic	0%	Assumed	-
Rabbit	Selenium_Organic	0%	Assumed	-
Goose	Selenium_Organic	0%	Assumed	-
Duck	Selenium_Organic	0%	Assumed	-
Moose	Selenium_Organic	0%	Assumed	-
MooseKidney	Selenium_Organic	0%	Assumed	-
MooseLiver	Selenium_Organic	0%	Assumed	-
Sediment	Selenium_Organic	0%	Assumed	-
Soil	Selenium_Organic	0%	Assumed	-
Surface_water	Selenium_Organic	0%	Assumed	-
TradPlant	Selenium_Organic	0%	Assumed	-

Parameter	Value	Half-life [days]	Reference / Comment
Arsenic	0.027725887	9125	Assumed life of project
Barium	0.027725887	9125	Assumed life of project
Beryllium	0.027725887	9125	Assumed life of project
Chromium	0.027725887	9125	Assumed life of project
Cobalt	0.027725887	9125	Assumed life of project
Iron	0.027725887	9125	Assumed life of project
Lead	0.027725887	9125	Assumed life of project
Manganese	0.027725887	9125	Assumed life of project
Mercury	0.027725887	9125	Assumed life of project
Molybdenum	0.027725887	9125	Assumed life of project
Selenium	0.027725887	9125	Assumed life of project

Table E1-10: Input Parameters for Predicting Plant Concentrations from Deposition

Parameter	Variable	Home-garden Aboveground ^A	Berries ^A	Traditional Plants (Labrador Tea) ^A	Home-garden Belowground
Intercept Fraction [Unitless]	Rp	0.39	0.053	0.982	NA
Plant Surface Loss Coefficient [yr ⁻¹]	Kp	18	18	18	18
Length of Plant Exposure [year]	Tp	0.164	0.164	0.164	0.164
Yield or Productivity [kg-DW/m ²]	Yp	2.24	0.25	5.66	N/A
Moisture Content [%]	MC	87 ^C	84.94 ^B	51.11 ^B	87 ^C

A) U.S. EPA. 2005. Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities, Appendix B: Estimating Media Concentration Equations and Variable Values.

B) Site-specific Data

C) U.S. EPA. 2005. Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities, Appendix A: Chemical of Potential Interest.

Table E1-11: Home Range Parameters for Predicting Exposures to Caribou		
Range	Area (Km ²)	Proportion of range
GBP LSA	314.1592654	0.99%
GBP RSA	1256.637061	3.95%
MECP 2024 Ontario Boreal Caribou Monitoring Program		
Churchill Range	21300	NA
Kesagami Range	47400	NA
Kinlock Range	26700	NA
Average Range	31800	NA

Table E1-12: Bioaccumulation Factors used to Predict Tissue Concentrations					
Media	Parameter	BAF	Media	Units	Reference / Comment
Berry	Arsenic	3.24E-03	Soil	kg-soil / kg-plant-WW	Site specific (see Attachment A) ^(a)
Berry	Selenium	2.98E-03	Soil	kg-soil / kg-plant-WW	Baes et al 1984; Converted to WW using maximum measured berry moisture ^(b)
Berry	Mercury	2.38E-02	Soil	kg-soil / kg-plant-WW	Baes et al 1984; Converted to WW using maximum measured berry moisture ^(b)
TradPlant	Arsenic	7.11E-03	Soil	kg-soil / kg-plant-WW	Site specific (see Attachment A) ^(a)
TradPlant	Selenium	1.32E-01	Soil	kg-soil / kg-plant-WW	Site specific (see Attachment A) ^(a)
TradPlant	Mercury	3.74E-01	Soil	kg-soil / kg-plant-WW	Site specific (see Attachment A) ^(a)
AG_Plant	Arsenic	8.23E-04	Soil	kg-soil / kg-plant-WW	Above ground garden produce , USEPA 2005 BAF model; Converted to WW using moisture from US EPA 2005 ^(c)
AG_Plant	Selenium	2.54E-03	Soil	kg-soil / kg-plant-WW	Above ground garden produce , USEPA 2005 BAF model; Converted to WW using moisture from US EPA 2005 ^(c)
AG_Plant	Mercury	1.17E-01	Soil	kg-soil / kg-plant-WW	Above ground garden produce , Baes et al 1984; Converted to WW using moisture from US EPA 2005 ^(c)
BG_Plant	Arsenic	1.04E-03	Soil	kg-soil / kg-plant-WW	Below ground, USEPA 2005 BAF model ^(c)
BG_Plant	Selenium	2.86E-03	Soil	kg-soil / kg-plant-WW	Below ground, USEPA 2005 BAF model ^(c)
BG_Plant	Mercury	2.60E-02	Soil	kg-soil / kg-plant-WW	Below ground, USEPA 2005 BAF model ^(c)
Walleye	Arsenic	2.48E+01	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Walleye	Selenium	1.92E+03	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Walleye	Mercury	3.15E+05	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Pike	Arsenic	4.84E+01	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Pike	Selenium	1.54E+03	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Pike	Mercury	2.63E+05	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Whitefish	Arsenic	3.13E+01	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Whitefish	Selenium	2.52E+03	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Whitefish	Mercury	1.10E+05	Surface Water	L-water/kg-fish-WW	Site specific (see Attachment A) ^(a)
Wild Rice	Arsenic	2.05E+01	Surface Water	L-water/kg-rice-WW	Site specific (see Attachment A) ^(a)
Wild Rice	Selenium	1.85E+01	Surface Water	L-water/kg-rice-WW	Site specific (see Attachment A). Calculated using selenium detection limit reported in FNFNES supplemental data (Chan et al. 2021) for Boreal Shield ^(d)
Wild Rice	Mercury	1.45E+03	Surface Water	L-water/kg-rice-WW	Site specific (see Attachment A) ^(a)

(a) The BAF for this tissue was calculated using Site-specific data collected within the LSA, as there were samples with concentrations above the detection limit for the tissue.

(b) No samples collected from the Site had concentrations above the reported detection limit. A BAF was obtained from literature.

(c) No samples of aboveground or belowground garden produce were collected from the Site. A BAF was obtained from literature.

(d) The sample collected for wild rice did not have a detected concentration of selenium, and a literature BAF was not available. The concentration reported in the FNFNES was also below detection limits. However, the detection limit reported in the FNFNES (Chan et al. 2021) was lower, and assumed to represent tissues on Site.

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	ADAF	2.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_A	AdultFEM	ADAF	1.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_A	Adult	ADAF	1.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_A	Child	ADAF	3.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_A	Infant	ADAF	1.00E+01	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_A	Toddler	ADAF	5.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_H	Adolescent	ADAF	2.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_H	AdultFEM	ADAF	1.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_H	Adult	ADAF	1.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_H	Child	ADAF	3.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_H	Infant	ADAF	1.00E+01	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_H	Toddler	ADAF	5.00E+00	Unitless	Health Canada 2013; Age dependant adjustment factor for carcinogens
INDG_A	Adolescent	AG_Plant	1.20E-02	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	AdultFEM	AG_Plant	1.29E-02	kg/day	Richardson 1997; other vegetables ingestion rate female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Adult	AG_Plant	1.37E-02	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Child	AG_Plant	9.80E-03	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Infant	AG_Plant	0.00E+00	kg/day	Assumed no vegetable consumption for infants
INDG_A	Toddler	AG_Plant	6.70E-03	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Adolescent	AG_Plant	1.20E-02	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	AdultFEM	AG_Plant	1.29E-02	kg/day	Richardson 1997; other vegetables ingestion rate female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Adult	AG_Plant	1.37E-02	kg/day	Richardson 1997 (Table 5.4); other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Child	AG_Plant	9.80E-03	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Infant	AG_Plant	0.00E+00	kg/day	Assumed no vegetable consumption for infants
INDG_H	Toddler	AG_Plant	6.70E-03	kg/day	Richardson 1997; other vegetables ingestion rate combined male and female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Adolescent	AIR	1.56E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_A	AdultFEM	AIR	1.66E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_A	Adult	AIR	1.66E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_A	Child	AIR	1.45E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_A	Infant	AIR	2.20E+00	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_A	Toddler	AIR	8.30E+00	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_H	Adolescent	AIR	1.56E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_H	AdultFEM	AIR	1.66E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_H	Adult	AIR	1.66E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_H	Child	AIR	1.45E+01	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_H	Infant	AIR	2.20E+00	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_H	Toddler	AIR	8.30E+00	m3/day	Health Canada 2024 PQRA guidance; Air inhalation rate
INDG_A	Adolescent	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_A	AdultFEM	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_A	Adult	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_A	Child	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_A	Infant	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_A	Toddler	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_H	Adolescent	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_H	AdultFEM	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_H	Adult	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_H	Child	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_H	Infant	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_H	Toddler	AIR_EF	1.00E+00	Unitless	Assumed exposure term 1 or 12 months / 12 months
INDG_A	Adolescent	Berry	5.24E-03	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.
INDG_A	AdultFEM	Berry	6.62E-03	kg/day	FNFNES 2014; blueberries + raspberries - average female consumer
INDG_A	Adult	Berry	5.98E-03	kg/day	FNFNES 2014; blueberries + raspberries - average consumer
INDG_A	Child	Berry	3.40E-03	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.
INDG_A	Infant	Berry	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.
INDG_A	Toddler	Berry	2.31E-03	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.
INDG_H	Adolescent	Berry	2.42E-02	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios. Using combined adult consumption rates to calculate teen rate. Using female adult consumption rates to calculate toddler child, and infant rates
INDG_H	AdultFEM	Berry	2.61E-02	kg/day	FNFNES 2014; blueberries + raspberries - heavy female consumer
INDG_H	Adult	Berry	2.76E-02	kg/day	FNFNES 2014; blueberries + raspberries - heavy consumer
INDG_H	Child	Berry	1.57E-02	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.
INDG_H	Infant	Berry	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.
INDG_H	Toddler	Berry	1.07E-02	kg/day	FNFNES 2014; Use Richardson 1997 "other vegetables" ratios for females. Using combined adult consumption rates to calculate infant, toddler, and child rates. Using combined male and female ratios for teen rates.

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	Berry_Ratio	8.76E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_A	Adult	Berry_Ratio	1.00E+00	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_A	Child	Berry_Ratio	7.15E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_A	Infant	Berry_Ratio	5.26E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_A	Toddler	Berry_Ratio	4.89E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_H	Adolescent	Berry_Ratio	8.76E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_H	Adult	Berry_Ratio	1.00E+00	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_H	Child	Berry_Ratio	7.15E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_H	Infant	Berry_Ratio	5.26E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_H	Toddler	Berry_Ratio	4.89E-01	Unitless	Richardson 1997; Other vegetables ratio for combined males + females
INDG_A	Adolescent	BG_Plant	2.27E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	AdultFEM	BG_Plant	1.57E-02	kg/day	Richardson 1997; Female root vegetables ingestion rate female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Adult	BG_Plant	1.88E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Child	BG_Plant	1.61E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Infant	BG_Plant	0.00E+00	kg/day	Assumed no BG plant consumption for infants
INDG_A	Toddler	BG_Plant	1.05E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Adolescent	BG_Plant	2.27E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	AdultFEM	BG_Plant	1.57E-02	kg/day	Richardson 1997; Female root vegetables ingestion rate female; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Adult	BG_Plant	1.88E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Child	BG_Plant	1.61E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_H	Infant	BG_Plant	0.00E+00	kg/day	Assumed no BG plant consumption for infants
INDG_H	Toddler	BG_Plant	1.05E-02	kg/day	Richardson 1997; Combined male and female root vegetables ingestion rate; Applied a 10% apportionment rate for local backyard produce consumption based on a residential land use (CCME 2006)
INDG_A	Adolescent	BW	5.97E+01	kg	Health Canada 2024; PQRA guidance
INDG_A	AdultFEM	BW	7.07E+01	kg	Health Canada 2024; PQRA guidance
INDG_A	Adult	BW	7.07E+01	kg	Health Canada 2024; PQRA guidance
INDG_A	Child	BW	3.29E+01	kg	Health Canada 2024; PQRA guidance
INDG_A	Infant	BW	8.20E+00	kg	Health Canada 2024; PQRA guidance
INDG_A	Toddler	BW	1.65E+01	kg	Health Canada 2024; PQRA guidance
INDG_H	Adolescent	BW	5.97E+01	kg	Health Canada 2024; PQRA guidance
INDG_H	AdultFEM	BW	7.07E+01	kg	Health Canada 2024; PQRA guidance
INDG_H	Adult	BW	7.07E+01	kg	Health Canada 2024; PQRA guidance
INDG_H	Child	BW	3.29E+01	kg	Health Canada 2024; PQRA guidance
INDG_H	Infant	BW	8.20E+00	kg	Health Canada 2024; PQRA guidance
INDG_H	Toddler	BW	1.65E+01	kg	Health Canada 2024; PQRA guidance
INDG_A	Adolescent	Caribou	1.24E-02	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_A	AdultFEM	Caribou	1.92E-02	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - caribou meat, mean; No female specific rate available
INDG_A	Adult	Caribou	1.92E-02	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - caribou meat, mean
INDG_A	Child	Caribou	1.09E-02	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_A	Infant	Caribou	0.00E+00	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_A	Toddler	Caribou	7.42E-03	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_H	Adolescent	Caribou	6.68E-02	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_H	AdultFEM	Caribou	1.03E-01	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - caribou meat, 95th percentile; No female specific rate available
INDG_H	Adult	Caribou	1.03E-01	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - caribou meat, 95th percentile
INDG_H	Child	Caribou	5.85E-02	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_H	Infant	Caribou	0.00E+00	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_H	Toddler	Caribou	3.98E-02	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_A	Adolescent	Walleye	1.65E-02	kg/day	FNFNES 2014; Use HC 2007 finfish meal ratios to get toddler and child rates
INDG_A	AdultFEM	Walleye	1.03E-02	kg/day	FNFNES 2014; walleye - average female
INDG_A	Adult	Walleye	1.82E-02	kg/day	FNFNES 2014; walleye - average
INDG_A	Child	Walleye	1.62E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Infant	Walleye	0.00E+00	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Toddler	Walleye	9.08E-03	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Adolescent	Walleye	9.15E-02	kg/day	FNFNES 2014; Use HC 2007 finfish meal ratios to get toddler and child rates
INDG_H	AdultFEM	Walleye	3.75E-02	kg/day	FNFNES 2014; walleye - heavy female
INDG_H	Adult	Walleye	1.01E-01	kg/day	FNFNES 2014; walleye - heavy
INDG_H	Child	Walleye	9.00E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Infant	Walleye	0.00E+00	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Toddler	Walleye	5.03E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates

Table E1-13: Human Exposure Variables					
Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	Whitefish	1.20E-02	kg/day	FNFNES 2014; Use HC 2007 finfish meal ratios to get toddler and child rates
INDG_A	AdultFEM	Whitefish	9.84E-03	kg/day	FNFNES 2014; whitefish - average female
INDG_A	Adult	Whitefish	1.32E-02	kg/day	FNFNES 2014; whitefish - average
INDG_A	Child	Whitefish	1.18E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Infant	Whitefish	0.00E+00	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Toddler	Whitefish	6.59E-03	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Adolescent	Whitefish	5.68E-02	kg/day	FNFNES 2014; Use HC 2007 finfish meal ratios to get toddler and child rates
INDG_H	AdultFEM	Whitefish	3.77E-02	kg/day	FNFNES 2014; whitefish - heavy female
INDG_H	Adult	Whitefish	6.25E-02	kg/day	FNFNES 2014; whitefish - heavy
INDG_H	Child	Whitefish	5.59E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Infant	Whitefish	0.00E+00	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Toddler	Whitefish	3.12E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Adolescent	Pike	1.04E-02	kg/day	FNFNES 2014; Use HC 2007 finfish meal ratios to get toddler and child rates
INDG_A	AdultFEM	Pike	1.02E-02	kg/day	FNFNES 2014; pike - average female
INDG_A	Adult	Pike	1.14E-02	kg/day	FNFNES 2014; pike - average
INDG_A	Child	Pike	1.02E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Infant	Pike	0.00E+00	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Toddler	Pike	5.72E-03	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Adolescent	Pike	3.66E-02	kg/day	FNFNES 2014; Use HC 2007 finfish meal ratios to get toddler and child rates
INDG_H	AdultFEM	Pike	3.77E-02	kg/day	FNFNES 2014; pike - heavy female
INDG_H	Adult	Pike	4.02E-02	kg/day	FNFNES 2014; pike - heavy
INDG_H	Child	Pike	3.60E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Infant	Pike	0.00E+00	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_H	Toddler	Pike	2.01E-02	kg/day	FNFNES 2014 female; Use Richardson 1997 ratios to get infant, toddler and child rates
INDG_A	Adolescent	Fish_Ratio	0.909091	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Adult	Fish_Ratio	1	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Child	Fish_Ratio	0.772727	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Infant	Fish_Ratio	0	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Toddler	Fish_Ratio	0.431818	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Adolescent	Fish_Ratio	0.909091	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Adult	Fish_Ratio	1	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Child	Fish_Ratio	0.772727	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Infant	Fish_Ratio	0	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Toddler	Fish_Ratio	0.431818	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Adolescent	Fish_Ratio_FEM	0.789474	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Adult	Fish_Ratio_FEM	1	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Child	Fish_Ratio_FEM	0.894737	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Infant	Fish_Ratio_FEM	0	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Toddler	Fish_Ratio_FEM	0.5	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Adolescent	Fish_Ratio_FEM	0.789474	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Adult	Fish_Ratio_FEM	1	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Child	Fish_Ratio_FEM	0.894737	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Infant	Fish_Ratio_FEM	0	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Toddler	Fish_Ratio_FEM	0.5	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Adolescent	Game_Ratio	6.48E-01	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Adult	Game_Ratio	1.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Child	Game_Ratio	4.63E-01	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Infant	Game_Ratio	0.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_A	Toddler	Game_Ratio	3.15E-01	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Adolescent	Game_Ratio	6.48E-01	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Adult	Game_Ratio	1.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Child	Game_Ratio	4.63E-01	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Infant	Game_Ratio	0.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means
INDG_H	Toddler	Game_Ratio	3.15E-01	Unitless	Richardson 1997; ratios for FN "eaters only" combined males + females. Calculated from arithmetic means

Table E1-13: Human Exposure Variables					
Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	Grouse/partridge	1.61E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	Grouse/partridge	1.64E-03	kg/day	FNFNES 2014; Total for average consumer - partridge female
INDG_A	Adult	Grouse/partridge	2.49E-03	kg/day	FNFNES 2014; Total for average consumer - partridge
INDG_A	Child	Grouse/partridge	1.41E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	Grouse/partridge	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	Grouse/partridge	9.62E-04	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	Grouse/partridge	7.80E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	Grouse/partridge	6.02E-03	kg/day	FNFNES 2014; Total for heavy consumer - partridge female
INDG_H	Adult	Grouse/partridge	1.20E-02	kg/day	FNFNES 2014; Total for heavy consumer - partridge
INDG_H	Child	Grouse/partridge	6.84E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	Grouse/partridge	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	Grouse/partridge	4.65E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	Goose	6.41E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	Goose	9.19E-03	kg/day	FNFNES 2014; Total for average consumer - goose female
INDG_A	Adult	Goose	9.89E-03	kg/day	FNFNES 2014; Total for average consumer - goose
INDG_A	Child	Goose	5.62E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	Goose	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	Goose	3.82E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	Goose	2.08E-02	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	Goose	3.61E-02	kg/day	FNFNES 2014; Total for heavy consumer - goose
INDG_H	Adult	Goose	3.21E-02	kg/day	FNFNES 2014; Total for heavy consumer - goose
INDG_H	Child	Goose	1.82E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	Goose	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	Goose	1.24E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	Rabbit	2.26E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	Rabbit	2.95E-03	kg/day	FNFNES 2014; Total for average consumer - rabbit female
INDG_A	Adult	Rabbit	3.48E-03	kg/day	FNFNES 2014; Total for average consumer - rabbit
INDG_A	Child	Rabbit	1.98E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	Rabbit	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	Rabbit	1.34E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	Rabbit	8.69E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	Rabbit	1.34E-02	kg/day	FNFNES 2014; Total for heavy consumer - rabbit female
INDG_H	Adult	Rabbit	1.34E-02	kg/day	FNFNES 2014; Total for heavy consumer - rabbit
INDG_H	Child	Rabbit	7.62E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	Rabbit	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	Rabbit	5.18E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	LAF	1.00E-01	Unitless	Lifetime adjustment factor
INDG_A	AdultFEM	LAF	7.50E-01	Unitless	Lifetime adjustment factor
INDG_A	Adult	LAF	7.50E-01	Unitless	Lifetime adjustment factor
INDG_A	Child	LAF	8.75E-02	Unitless	Lifetime adjustment factor
INDG_A	Infant	LAF	6.25E-03	Unitless	Lifetime adjustment factor
INDG_A	Toddler	LAF	5.63E-02	Unitless	Lifetime adjustment factor
INDG_H	Adolescent	LAF	1.00E-01	Unitless	Lifetime adjustment factor
INDG_H	AdultFEM	LAF	7.50E-01	Unitless	Lifetime adjustment factor
INDG_H	Adult	LAF	7.50E-01	Unitless	Lifetime adjustment factor
INDG_H	Child	LAF	8.75E-02	Unitless	Lifetime adjustment factor
INDG_H	Infant	LAF	6.25E-03	Unitless	Lifetime adjustment factor
INDG_H	Toddler	LAF	5.63E-02	Unitless	Lifetime adjustment factor
INDG_A	Adolescent	Duck	3.09E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	Duck	4.76E-03	kg/day	FNFNES 2014; Total for average consumer - ducks female
INDG_A	Adult	Duck	4.77E-03	kg/day	FNFNES 2014; Total for average consumer - ducks
INDG_A	Child	Duck	2.71E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	Duck	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	Duck	1.84E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	Duck	7.80E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	Duck	1.10E-02	kg/day	FNFNES 2014; Total for heavy consumer - ducks
INDG_H	Adult	Duck	1.20E-02	kg/day	FNFNES 2014; Total for heavy consumer - ducks
INDG_H	Child	Duck	6.84E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	Duck	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	Duck	4.65E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	Moose	7.84E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	Moose	9.70E-03	kg/day	FNFNES 2014; moose - average consumer female
INDG_A	Adult	Moose	1.21E-02	kg/day	FNFNES 2014; moose - average consumer
INDG_A	Child	Moose	6.87E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	Moose	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	Moose	4.67E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	Moose	2.99E-02	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	Moose	3.01E-02	kg/day	FNFNES 2014; moose - heavy consumer female
INDG_H	Adult	Moose	4.62E-02	kg/day	FNFNES 2014; moose - heavy consumer
INDG_H	Child	Moose	2.62E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	Moose	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	Moose	1.78E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	MooseKidney	4.96E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	MooseKidney	8.96E-03	kg/day	FNFNES 2014; moose kidney - average consumer female
INDG_A	Adult	MooseKidney	7.66E-03	kg/day	FNFNES 2014; moose kidney - average consumer
INDG_A	Child	MooseKidney	4.35E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	MooseKidney	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	MooseKidney	2.96E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	MooseKidney	1.74E-02	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	MooseKidney	6.18E-02	kg/day	FNFNES 2014; moose kidney - heavy consumer female
INDG_H	Adult	MooseKidney	2.68E-02	kg/day	FNFNES 2014; moose kidney - heavy consumer
INDG_H	Child	MooseKidney	1.52E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	MooseKidney	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	MooseKidney	1.04E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	MooseLiver	4.03E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFEM	MooseLiver	6.45E-03	kg/day	FNFNES 2014; moose liver - average consumer female
INDG_A	Adult	MooseLiver	6.22E-03	kg/day	FNFNES 2014; moose liver - average consumer
INDG_A	Child	MooseLiver	3.53E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	MooseLiver	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	MooseLiver	2.40E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	MooseLiver	1.74E-02	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	MooseLiver	2.68E-02	kg/day	FNFNES 2014; moose liver - heavy consumer female
INDG_H	Adult	MooseLiver	2.68E-02	kg/day	FNFNES 2014; moose liver - heavy consumer
INDG_H	Child	MooseLiver	1.52E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	MooseLiver	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	MooseLiver	1.04E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	SA_Feet	1.08E+03	cm ²	Health Canada 2024
INDG_A	AdultFEM	SA_Feet	1.19E+03	cm ²	Health Canada 2024
INDG_A	Adult	SA_Feet	1.19E+03	cm ²	Health Canada 2024
INDG_A	Child	SA_Feet	7.20E+02	cm ²	Health Canada 2024
INDG_A	Infant	SA_Feet	2.50E+02	cm ²	Health Canada 2024
INDG_A	Toddler	SA_Feet	4.30E+02	cm ²	Health Canada 2024
INDG_H	Adolescent	SA_Feet	1.08E+03	cm ²	Health Canada 2024
INDG_H	AdultFEM	SA_Feet	1.19E+03	cm ²	Health Canada 2024
INDG_H	Adult	SA_Feet	1.19E+03	cm ²	Health Canada 2024
INDG_H	Child	SA_Feet	7.20E+02	cm ²	Health Canada 2024
INDG_H	Infant	SA_Feet	2.50E+02	cm ²	Health Canada 2024
INDG_H	Toddler	SA_Feet	4.30E+02	cm ²	Health Canada 2024
INDG_A	Adolescent	SA_Forearm	1.12E+03	cm ²	Health Canada 2017
INDG_A	AdultFEM	SA_Forearm	1.25E+03	cm ²	Health Canada 2017
INDG_A	Adult	SA_Forearm	1.25E+03	cm ²	Health Canada 2017
INDG_A	Child	SA_Forearm	7.40E+02	cm ²	Health Canada 2017
INDG_A	Infant	SA_Forearm	0.00E+00	cm ²	Health Canada 2017
INDG_A	Toddler	SA_Forearm	4.50E+02	cm ²	Health Canada 2017
INDG_H	Adolescent	SA_Forearm	1.12E+03	cm ²	Health Canada 2017
INDG_H	AdultFEM	SA_Forearm	1.25E+03	cm ²	Health Canada 2017
INDG_H	Adult	SA_Forearm	1.25E+03	cm ²	Health Canada 2017
INDG_H	Child	SA_Forearm	7.40E+02	cm ²	Health Canada 2017
INDG_H	Infant	SA_Forearm	0.00E+00	cm ²	Health Canada 2017
INDG_H	Toddler	SA_Forearm	4.50E+02	cm ²	Health Canada 2017

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	SA_Hand	8.00E+02	cm ²	Health Canada 2024
INDG_A	AdultFEM	SA_Hand	8.90E+02	cm ²	Health Canada 2024
INDG_A	Adult	SA_Hand	8.90E+02	cm ²	Health Canada 2024
INDG_A	Child	SA_Hand	5.90E+02	cm ²	Health Canada 2024
INDG_A	Infant	SA_Hand	3.20E+02	cm ²	Health Canada 2024
INDG_A	Toddler	SA_Hand	4.30E+02	cm ²	Health Canada 2024
INDG_H	Adolescent	SA_Hand	8.00E+02	cm ²	Health Canada 2024
INDG_H	AdultFEM	SA_Hand	8.90E+02	cm ²	Health Canada 2024
INDG_H	Adult	SA_Hand	8.90E+02	cm ²	Health Canada 2024
INDG_H	Child	SA_Hand	5.90E+02	cm ²	Health Canada 2024
INDG_H	Infant	SA_Hand	3.20E+02	cm ²	Health Canada 2024
INDG_H	Toddler	SA_Hand	4.30E+02	cm ²	Health Canada 2024
INDG_A	Adolescent	SA_Leg	4.97E+03	cm ²	Health Canada 2024
INDG_A	AdultFEM	SA_Leg	5.72E+03	cm ²	Health Canada 2024
INDG_A	Adult	SA_Leg	5.72E+03	cm ²	Health Canada 2024
INDG_A	Child	SA_Leg	3.07E+03	cm ²	Health Canada 2024
INDG_A	Infant	SA_Leg	9.10E+02	cm ²	Health Canada 2024
INDG_A	Toddler	SA_Leg	1.69E+03	cm ²	Health Canada 2024
INDG_H	Adolescent	SA_Leg	4.97E+03	cm ²	Health Canada 2024
INDG_H	AdultFEM	SA_Leg	5.72E+03	cm ²	Health Canada 2024
INDG_H	Adult	SA_Leg	5.72E+03	cm ²	Health Canada 2024
INDG_H	Child	SA_Leg	3.07E+03	cm ²	Health Canada 2024
INDG_H	Infant	SA_Leg	9.10E+02	cm ²	Health Canada 2024
INDG_H	Toddler	SA_Leg	1.69E+03	cm ²	Health Canada 2024
INDG_A	Adolescent	SAH	8.00E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_A	AdultFEM	SAH	8.90E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_A	Adult	SAH	8.90E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_A	Child	SAH	5.90E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_A	Infant	SAH	3.20E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_A	Toddler	SAH	4.30E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_H	Adolescent	SAH	8.00E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_H	AdultFEM	SAH	8.90E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_H	Adult	SAH	8.90E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_H	Child	SAH	5.90E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_H	Infant	SAH	3.20E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_H	Toddler	SAH	4.30E+02	cm ²	Health Canada 2024; PQRA guidance; Surface area hands for soil exposure
INDG_A	Adolescent	SAO	7.20E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_A	AdultFEM	SAO	8.22E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_A	Adult	SAO	8.22E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_A	Child	SAO	4.55E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_A	Infant	SAO	1.71E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed not wearing footwear
INDG_A	Toddler	SAO	2.58E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_H	Adolescent	SAO	7.20E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_H	AdultFEM	SAO	8.22E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_H	Adult	SAO	8.22E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_H	Child	SAO	4.55E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_H	Infant	SAO	1.71E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed not wearing footwear
INDG_H	Toddler	SAO	2.58E+03	cm ²	HC 2021; Surface area other for soil contact, arms and legs. Assumed wearing footwear
INDG_A	Adolescent	SAT	1.55E+04	cm ²	Health Canada 2024; Surface area total
INDG_A	AdultFEM	SAT	1.76E+04	cm ²	Health Canada 2024; Surface area total
INDG_A	Adult	SAT	1.76E+04	cm ²	Health Canada 2024; Surface area total
INDG_A	Child	SAT	1.01E+04	cm ²	Health Canada 2024; Surface area total
INDG_A	Infant	SAT	3.62E+03	cm ²	Health Canada 2024; Surface area total
INDG_A	Toddler	SAT	6.13E+03	cm ²	Health Canada 2024; Surface area total
INDG_H	Adolescent	SAT	1.55E+04	cm ²	Health Canada 2024; Surface area total
INDG_H	AdultFEM	SAT	1.76E+04	cm ²	Health Canada 2024; Surface area total
INDG_H	Adult	SAT	1.76E+04	cm ²	Health Canada 2024; Surface area total
INDG_H	Child	SAT	1.01E+04	cm ²	Health Canada 2024; Surface area total
INDG_H	Infant	SAT	3.62E+03	cm ²	Health Canada 2024; Surface area total
INDG_H	Toddler	SAT	6.13E+03	cm ²	Health Canada 2024; Surface area total

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_A	AdultFEM	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_A	Adult	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_A	Child	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_A	Infant	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_A	Toddler	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_H	Adolescent	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_H	AdultFEM	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_H	Adult	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_H	Child	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_H	Infant	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_H	Toddler	Sed_Leg	1.60E-07	kg/cm ²	Health Canada 2017; exposure for adults clam digging in tidal flats with shoes on. Very fine to fine sand
INDG_A	Adolescent	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_A	AdultFEM	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_A	Adult	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_A	Child	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_A	Infant	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_A	Toddler	SIR	8.00E-05	kg/day	Soil ingestion rate
INDG_H	Adolescent	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_H	AdultFEM	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_H	Adult	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_H	Child	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_H	Infant	SIR	2.00E-05	kg/day	Soil ingestion rate
INDG_H	Toddler	SIR	8.00E-05	kg/day	Soil ingestion rate
INDG_A	Adolescent	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_A	AdultFEM	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_A	Adult	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_A	Child	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_A	Infant	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_A	Toddler	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_H	Adolescent	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_H	AdultFEM	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_H	Adult	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_H	Child	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_H	Infant	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_H	Toddler	SIR_EF	1.00E+00	Unitless	Soil ingestion rate exposure term assumed to be 1 (12 months / 12 months)
INDG_A	Adolescent	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_A	AdultFEM	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_A	Adult	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_A	Child	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_A	Infant	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_A	Toddler	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_H	Adolescent	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_H	AdultFEM	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_H	Adult	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_H	Child	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_H	Infant	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_H	Toddler	SLH	1.00E-07	kg/cm ² /day	Health Canada 2024; Skin loading hands for soil
INDG_A	Adolescent	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_A	AdultFEM	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_A	Adult	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_A	Child	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_A	Infant	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_A	Toddler	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_H	Adolescent	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_H	AdultFEM	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_H	Adult	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_H	Child	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_H	Infant	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil
INDG_H	Toddler	SLO	1.00E-08	kg/cm ² /day	Health Canada 2024; Skin loading other for soil

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	SWIM	3.30E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent
INDG_A	AdultFEM	SWIM	2.80E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent
INDG_A	Adult	SWIM	2.80E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent
INDG_A	Child	SWIM	4.40E-02	L/hr	Swimming water ingestion rate inadvertent; Assume age group 11-16 to be conservative
INDG_A	Infant	SWIM	0.00E+00	L/hr	USEPA 2019 Swimming water ingestion rate inadvertent; assumed 0 for infants
INDG_A	Toddler	SWIM	4.40E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent; assume most conservative for toddler
INDG_H	Adolescent	SWIM	3.30E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent
INDG_H	AdultFEM	SWIM	2.80E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent
INDG_H	Adult	SWIM	2.80E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent
INDG_H	Child	SWIM	4.40E-02	L/hr	Swimming water ingestion rate inadvertent; Assume age group 11-16 to be conservative
INDG_H	Infant	SWIM	0.00E+00	L/hr	USEPA 2019 Swimming water ingestion rate inadvertent; assumed 0 for infants
INDG_H	Toddler	SWIM	4.40E-02	L/hr	US EPA 2019 Swimming water ingestion rate inadvertent; assume most conservative for toddler
INDG_A	Adolescent	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_A	AdultFEM	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_A	Adult	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_A	Child	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_A	Infant	SWIM_ED	5.00E-01	hr/day	Assumed; Daily bathing exposure
INDG_A	Toddler	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_H	Adolescent	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_H	AdultFEM	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_H	Adult	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_H	Child	SWIM_ED	2.00E+00	hr/day	Assumed; including swimming and bathing
INDG_H	Infant	SWIM_ED	5.00E-01	hr/day	Assumed; Daily bathing exposure
INDG_H	Toddler	SWIM_ED	2.00E+00	hr/day	Assumed
INDG_A	Adolescent	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_A	AdultFEM	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_A	Adult	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_A	Child	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_A	Infant	SWIM_EF	1.00E+00	Unitless	Assumed; Daily bathing exposure
INDG_A	Toddler	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_H	Adolescent	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_H	AdultFEM	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_H	Adult	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_H	Child	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_H	Infant	SWIM_EF	1.00E+00	Unitless	Assumed; Daily bathing exposure
INDG_H	Toddler	SWIM_EF	1.00E+00	Unitless	Exposure factor set to 1 - TRV are based on chronic exposure
INDG_A	Adolescent	TradPlant	4.82E-04	kg/day	FNFNES 2021; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_A	AdultFEM	TradPlant	5.50E-04	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - mean rates, sum of mint leaves and labrador tea leaves
INDG_A	Adult	TradPlant	5.50E-04	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - mean rates, sum of mint leaves and labrador tea leaves
INDG_A	Child	TradPlant	3.13E-04	kg/day	FNFNES 2021; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_A	Infant	TradPlant	0.00E+00	kg/day	Assumed no Trad plant consumption for infants
INDG_A	Toddler	TradPlant	2.13E-04	kg/day	FNFNES 2021; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	Adolescent	TradPlant	1.92E-03	kg/day	FNFNES 2021; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	AdultFEM	TradPlant	2.19E-03	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - 95th percentile rates, sum of mint leaves and labrador tea leaves
INDG_H	Adult	TradPlant	2.19E-03	kg/day	FNFNES 2021; Table S1.3 G) Boreal Shield - 95th percentile rates, sum of mint leaves and labrador tea leaves
INDG_H	Child	TradPlant	1.24E-03	kg/day	FNFNES 2021; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	Infant	TradPlant	0.00E+00	kg/day	Assumed no Trad plant consumption for infants
INDG_H	Toddler	TradPlant	8.46E-04	kg/day	FNFNES 2021; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_A	Adolescent	Wild Rice	1.83E-03	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_A	AdultFEM	Wild Rice	1.07E-03	kg/day	FNFNES 2014; wild rice- average consumer female
INDG_A	Adult	Wild Rice	2.09E-03	kg/day	FNFNES 2014; wild rice- average consumer
INDG_A	Child	Wild Rice	1.19E-03	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_A	Infant	Wild Rice	0.00E+00	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_A	Toddler	Wild Rice	8.08E-04	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	Adolescent	Wild Rice	5.47E-03	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	AdultFEM	Wild Rice	3.64E-03	kg/day	FNFNES 2014; wild rice- heavy consumer female
INDG_H	Adult	Wild Rice	6.25E-03	kg/day	FNFNES 2014; wild rice- heavy consumer
INDG_H	Child	Wild Rice	3.55E-03	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	Infant	Wild Rice	0.00E+00	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates
INDG_H	Toddler	Wild Rice	2.41E-03	kg/day	FNFNES 2014; Use HC 2012 "other vegetables" ratios to get teen, toddler and child rates

Table E1-13: Human Exposure Variables

Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	WIR	1.00E+00	L/day	Water ingestion rate for drinking
INDG_A	AdultFEM	WIR	1.50E+00	L/day	Water ingestion rate for drinking
INDG_A	Adult	WIR	1.50E+00	L/day	Water ingestion rate for drinking
INDG_A	Child	WIR	8.00E-01	L/day	Water ingestion rate for drinking
INDG_A	Infant	WIR	3.00E-01	L/day	Water ingestion rate for drinking
INDG_A	Toddler	WIR	6.00E-01	L/day	Water ingestion rate for drinking
INDG_H	Adolescent	WIR	1.00E+00	L/day	Water ingestion rate for drinking
INDG_H	AdultFEM	WIR	1.50E+00	L/day	Water ingestion rate for drinking
INDG_H	Adult	WIR	1.50E+00	L/day	Water ingestion rate for drinking
INDG_H	Child	WIR	8.00E-01	L/day	Water ingestion rate for drinking
INDG_H	Infant	WIR	3.00E-01	L/day	Water ingestion rate for drinking
INDG_H	Toddler	WIR	6.00E-01	L/day	Water ingestion rate for drinking
INDG_A	Adolescent	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_A	AdultFEM	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_A	Adult	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_A	Child	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_A	Infant	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_A	Toddler	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_H	Adolescent	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_H	AdultFEM	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_H	Adult	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_H	Child	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_H	Infant	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_H	Toddler	WIR_EF	1.00E+00	Unitless	Assumed 12 months / 12 months
INDG_A	Adolescent	Deer	2.32E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_A	AdultFem	Deer	1.88E-03	kg/day	FNFNES 2014; Deer - average consumer female
INDG_A	Adult	Deer	3.58E-03	kg/day	FNFNES 2014; Deer - average consumer
INDG_A	Child	Deer	2.03E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	Deer	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	Deer	1.38E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	Deer	7.39E-03	kg/day	FNFNES 2014; Use HC 2012 "wild game" ratios to get teen, toddler and child rates.
INDG_H	AdultFEM	Deer	6.58E-03	kg/day	FNFNES 2014; Deer - heavy consumer female
INDG_H	Adult	Deer	1.14E-02	kg/day	FNFNES 2014; Deer - heavy consumer
INDG_H	Child	Deer	6.48E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	Deer	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	Deer	4.40E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	CaribouLiver	8.40E-03	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_A	AdultFEM	CaribouLiver	1.97E-02	kg/day	FNFNES 2014; caribou liver - average consumer female
INDG_A	Adult	CaribouLiver	1.30E-02	kg/day	FNFNES 2014; caribou liver - average consumer
INDG_A	Child	CaribouLiver	7.36E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Infant	CaribouLiver	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Toddler	CaribouLiver	5.01E-03	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Adolescent	CaribouLiver	2.00E-02	kg/day	FNFNES 2021; Use HC 2012 "wild game" ratios to get teen, toddler and child rates
INDG_H	AdultFEM	CaribouLiver	3.09E-02	kg/day	FNFNES 2014; caribou liver - heavy consumer female
INDG_H	Adult	CaribouLiver	3.09E-02	kg/day	FNFNES 2014; caribou liver - heavy consumer
INDG_H	Child	CaribouLiver	1.76E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Infant	CaribouLiver	0.00E+00	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_H	Toddler	CaribouLiver	1.19E-02	kg/day	FNFNES 2014; Use Richardson 1997 "wild game" ratios to get infant, teen, toddler and child rates.
INDG_A	Adolescent	Berry_Ratio_FEM	9.22E-01	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_A	Adult	Berry_Ratio_FEM	1.00E+00	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_A	Child	Berry_Ratio_FEM	5.68E-01	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_A	Infant	Berry_Ratio_FEM	0.00E+00	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_A	Toddler	Berry_Ratio_FEM	3.86E-01	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_H	Adolescent	Berry_Ratio_FEM	9.22E-01	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_H	Adult	Berry_Ratio_FEM	1.00E+00	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_H	Child	Berry_Ratio_FEM	5.68E-01	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_H	Infant	Berry_Ratio_FEM	0.00E+00	Unitless	Richardson 1997; Other vegetables ratio for females
INDG_H	Toddler	Berry_Ratio_FEM	3.86E-01	Unitless	Richardson 1997; Other vegetables ratio for females

Table E1-13: Human Exposure Variables					
Receptor	Lifestage	Pathway	Value	Units	Reference / Comment
INDG_A	Adolescent	Game_Ratio_FEM	7.95E-01	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Adult	Game_Ratio_FEM	1.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Child	Game_Ratio_FEM	5.68E-01	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Infant	Game_Ratio_FEM	0.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_A	Toddler	Game_Ratio_FEM	3.86E-01	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Adolescent	Game_Ratio_FEM	7.95E-01	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Adult	Game_Ratio_FEM	1.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Child	Game_Ratio_FEM	5.68E-01	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Infant	Game_Ratio_FEM	0.00E+00	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means
INDG_H	Toddler	Game_Ratio_FEM	3.86E-01	Unitless	Richardson 1997; ratios for FN "eaters only" females. Calculated from arithmetic means

Table E1-14: Toxicity Reference Values [mg/kg/day]

Parameter	Lifestage	TRV Type	Oral Exposure Limit (Soil)	Reference / Comment
Arsenic_Inorganic	Infant	RfD	6.00E-05	US EPA IRIS 2025
Arsenic_Inorganic	Toddler	RfD	6.00E-05	US EPA IRIS 2025
Arsenic_Inorganic	Child	RfD	6.00E-05	US EPA IRIS 2025
Arsenic_Inorganic	Adolescent	RfD	6.00E-05	US EPA IRIS 2025
Arsenic_Inorganic	Adult	RfD	6.00E-05	US EPA IRIS 2025
Arsenic_Inorganic	AdultFEM	RfD	6.00E-05	US EPA IRIS 2025
Arsenic_Inorganic	Infant	SF	1.80E+00	Health Canada 2025
Arsenic_Inorganic	Toddler	SF	1.80E+00	Health Canada 2025
Arsenic_Inorganic	Child	SF	1.80E+00	Health Canada 2025
Arsenic_Inorganic	Adolescent	SF	1.80E+00	Health Canada 2025
Arsenic_Inorganic	Adult	SF	1.80E+00	Health Canada 2025
Arsenic_Inorganic	AdultFEM	SF	1.80E+00	Health Canada 2025
Mercury_Inorganic	Infant	RfD	3.00E-04	Health Canada 2025
Mercury_Inorganic	Toddler	RfD	3.00E-04	Health Canada 2025
Mercury_Inorganic	Child	RfD	3.00E-04	Health Canada 2025
Mercury_Inorganic	Adolescent	RfD	3.00E-04	Health Canada 2025
Mercury_Inorganic	Adult	RfD	3.00E-04	Health Canada 2025
Mercury_Inorganic	AdultFEM	RfD	3.00E-04	Health Canada 2025
Mercury_Organic	Infant	RfD	2.00E-04	Health Canada 2025; Standard for women of child bearing age and children under 12
Mercury_Organic	Toddler	RfD	2.00E-04	Health Canada 2025; Standard for women of child bearing age and children under 12
Mercury_Organic	Child	RfD	2.00E-04	Health Canada 2025; Standard for women of child bearing age and children under 12
Mercury_Organic	Adolescent	RfD	4.70E-04	Health Canada 2025; Standard for women of child bearing age and children under 12
Mercury_Organic	AdultFEM	RfD	2.00E-04	Health Canada 2025; Standard for women of child bearing age and children under 12
Mercury_Organic	Adult	RfD	4.70E-04	Health Canada 2025; Standard for adults of the general population
Selenium_Inorganic	Infant	RfD	5.50E-03	Health Canada 2025; standard for children 0-6 months old
Selenium_Inorganic	Toddler	RfD	6.00E-03	Health Canada 2025; standard for children 6 mo to 5 yr old
Selenium_Inorganic	Child	RfD	6.30E-03	Health Canada 2025; standard for children 5 to 12 yr old
Selenium_Inorganic	Adolescent	RfD	6.20E-03	Health Canada 2025; standard for children 12 to 20 yr old
Selenium_Inorganic	Adult	RfD	5.70E-03	Health Canada 2025; standard for adults 20+ years old
Selenium_Inorganic	AdultFEM	RfD	5.70E-03	Health Canada 2025; standard for adults 20+ years old

Table E1-15: Dermal Relative Absorption Factors			
Parameter	Speciation	Value	Reference / Comment
Arsenic	Inorganic	3.0%	Health Canada 2025 TRV
Mercury	Inorganic	100.0%	Health Canada 2025 TRV
Arsenic	Organic	3.0%	Health Canada 2025 TRV
Mercury	Organic	6.0%	Health Canada 2025 TRV
Selenium	Inorganic	1.0%	Health Canada 2025 TRV
Selenium	Organic	1.0%	Health Canada 2025 TRV

Table E1-16: Dermal Permeability Coefficient in Water [cm/hr]			
Parameter	Speciation	Value	Reference / Comment
Arsenic	Inorganic	0.001	US EPA 2004
Mercury	Inorganic	0.001	US EPA 2004
Arsenic	Organic	0.001	US EPA 2004
Mercury	Organic	0.001	US EPA 2004
Selenium	Inorganic	0.001	US EPA 2004
Selenium	Organic	0.001	US EPA 2004

Table E1-17: Oral Relative Bioaccessability Factors					
Media	Parameter	Speciation	IVBA Average	RBA	Reference / Comment
Soil	Arsenic	Inorganic	0.25	0.22	HC 2017
Soil	Arsenic	Organic	N/A	1	Assumed
Soil	Mercury	Inorganic	N/A	1	Assumed
Soil	Mercury	Organic	N/A	1	Assumed
Soil	Selenium	Inorganic	N/A	1	Assumed
Soil	Selenium	Organic	N/A	1	Assumed

Table E1-18: Ratio of Time Period of Each Project Phase to Receptor Lifespan		
Project Phase	Phase Period [yr]	Phase-Lifespan Ratio
Construction	3	0.0375
Operations	26	0.325
Closure	3	0.0375
Post Closure	48	0.6
Construction-Base	3	0.0375
Operations-Base	26	0.325
Closure-Base	3	0.0375
Post Closure-Base	48	0.6

Attachment F

ERA Model Description



1 ECOLOGICAL MULTI-MEDIA (FOOD CHAIN) MODEL

The ecological risk assessment (ERA) included an evaluation of potential health risks to wildlife associated with the Great Bear Project (Project). The Project will emit parameters of potential concern (POPCs) directly into air and surface water from various sources. Wildlife species that inhabit or feed within the area surrounding the Project may be exposed to POPCs through primary contact pathways, such as surface (drinking) water ingestion, soil and sediment incidental ingestion, and secondary pathways, such as food ingestion.

Some POPCs emitted to the atmosphere via air emissions may be deposited onto the soils and plants surrounding the Project area. Effluent from the Project may also discharge POPCs into surface water. Depending on the fate, transport and persistence of the POPCs in the environment, atmospheric deposition and changes in surface water quality could change POPC concentrations in dietary items consumed by wildlife (i.e., terrestrial and aquatic plants, terrestrial and aquatic invertebrates, small mammals and fish) within the local study area (LSA).

This attachment describes the multi-media (or food chain) model used to evaluate potential wildlife health risks associated with the applicable receptor-pathway-POPC combinations carried forward after the ERA problem formulation as described in Section 5.2 of the Human Health and Ecological Risk Assessment (HHERA) report. The food chain model estimates the POPC concentrations in soil, surface water, and wildlife dietary items (i.e., berries, browse, lichen, terrestrial invertebrates, small mammals, fish, aquatic plants and aquatic invertebrates) due to air emissions and effluent discharges from the Project. It also estimates the exposure doses and potential risks to wildlife associated with changes in POPC concentrations in the media listed above.

Based on Tier 1 and 2 screenings of predicted soil and surface water concentrations, wildlife exposures to metals/metalloids were assessed in the food chain model based on their known or assumed tendency to persist and bioaccumulate in the environment and concentrations above ecological screening criteria. The following POPCs were quantitatively assessed in the food chain model:

- Mercury: predicted soil and surface water concentrations were lower than ecological screening criteria. However, surface water criteria do not account for accumulation of mercury in dietary items. Mercury is bioaccumulative in the aquatic environment (as methylmercury) and is a parameter of concern to the public/community.
- Arsenic and selenium: while not retained as POPCs for evaluation of wildlife in the ERA, these parameters were included in the food chain model to estimate wild game tissue concentrations that were used as inputs to the human health multi-media model. Risk estimates were not calculated for arsenic and selenium for wildlife receptors.

Wildlife receptors assessed in the ERA were selected considering species present in the LSA as identified during baseline habitat surveys and species inventories (including species at risk), species most likely to be exposed to POPCs due to habitat and potential Project emissions, species representative of various aquatic and terrestrial trophic levels, and species of importance to Indigenous people. A list of selected wildlife receptors and rationale for selection can be found in Section 5.2.2 of the HHERA report.

The wildlife receptors assessed included moose (importance to Indigenous people), spruce grouse (importance to Indigenous people), mallard (i.e., duck; importance to Indigenous people), muskrat, beaver (importance to Indigenous people), trumpeter swan, spotted sandpiper, northern river otter, common merganser, little brown myotis (species at risk), bald eagle (importance to Indigenous people) and belted kingfisher. Terrestrial wildlife, except for spruce grouse and bald eagle, were not selected as receptors because no POPCs were retained in soil or surface water based on screening to wildlife soil and food ingestion and surface water consumption criteria (Section 5.2.1 of the HHERA report). Wildlife feeding

ATTACHMENT F: Era Model Description

primarily from the aquatic environment and representative mammal and bird species from various trophic levels within the aquatic environment were selected as receptors.

In addition, the following species were not assessed in the ERA but were included in the food chain model to provide wild game tissue concentrations used as inputs to the Human Health Risk Assessment (HHRA) multi-media model: white-tailed deer, boreal caribou, rabbit (i.e., eastern cottontail), partridge (modelled as spruce grouse), and Canada goose.

Wildlife health risks from the Project were characterized for the following exposure pathways:

- Direct contact with POPCs in soil (incidental ingestion, soil inhalation) due to aerial deposition.
- Ingestion of browse and/or berries that have accumulated POPCs from soil and aerial deposition.
- Ingestion of lichen that have accumulated POPCs from aerial deposition.
- Ingestion of terrestrial arthropods and/or earthworms that have accumulated POPCs from soil.
- Ingestion of aquatic plants and/or invertebrates that have accumulated POPCs from surface water due to effluent discharge.
- Ingestion of POPCs in surface (drinking) water due to effluent discharge to surface water.
- Incidental ingestion of sediment containing POPCs present as part of background conditions.
- Ingestion of fish that have accumulated POPCs from surface water due to effluent discharge.
- Ingestion of small mammals that have accumulated POPCs from soil, surface water and dietary items.

This attachment provides the following: food chain model inputs, including wildlife receptor-specific information (e.g., ingestion rates, dietary composition), assumptions about parameter speciation, exposure point concentrations (EPCs) for environmental media and toxicity reference values (TRVs) for POPCs; the food chain model outputs, including exposure doses and risk estimates (hazard quotients or HQs); and the equations used in the model and sample calculations. The sample calculations are presented for the wildlife receptor with the highest calculated risk estimate, the belted kingfisher, exposed to mercury/methylmercury during the operations phase of the Project, unless otherwise noted.

2 EXPOSURE ASSESSMENT

The exposure assessment estimates the amount of a POPC to which each of the ecological receptors are exposed to via each complete (or operable) pathway. For wildlife (mammals and birds), food chain modelling is completed to calculate exposure estimates based on ingestion of abiotic media (e.g., soil, sediment, surface water) and ingestion of food items that have accumulated POPCs from abiotic media. The receptor characteristics, dietary composition and assumptions about parameter speciation (i.e., mercury) used as inputs to the food chain model and the methods for calculating EPCs and wildlife exposure estimates and doses are described in this section. Wild game tissue concentrations were calculated using the food chain model; however, details on the assumptions and methods for the calculations are provided in the human health multi-media model description (Attachment E).

2.1 RECEPTOR CHARACTERIZATION

Receptor characteristics for each species were used to estimate wildlife exposures. Where available, receptor characteristics (e.g., body weight, food ingestion rate, water ingestion rate, soil/sediment ingestion rate, dietary compositions) were obtained from the Federal Contaminated Sites Action Plan (FCSAP; 2012). In the absence of FCSAP guidance, various literature sources were consulted (US EPA 1993; Beyer et al. 1994, 2008; CWS and CWF 2017; MECP 2025; Mitchell and Eichholz 2020; Sample and Suter 1994; Thompson et al 2015; Milligan and Humphries 2010). Soil and sediment ingestion rates were adjusted to account for the percentage of terrestrial food (and thus incidental soil exposure) versus aquatic food (and thus incidental sediment exposure) in the diet for receptors with dietary links to the aquatic environment (e.g., mallard or moose). In the absence of federal or provincial guidance, air inhalation rates were calculated based on allometric equations from the United States Environmental Protection Agency (US EPA; 1993) to estimate exposure via dust inhalation.

Receptor characteristics and dietary composition for each species are summarized in Tables F-1 and F-2, respectively. Full details and references are provided in Attachment F1, Tables F1-12 and F1-13.

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Table F-1: Wildlife Receptor Characteristics

Receptor	Body Weight (kg)	Food Ingestion Rate (kg/day ww)	Food Ingestion Rate (kg/day dw)	Air Inhalation Rate (m ³ /day)	Water Ingestion Rate (L/day)	Percentage of Soil in Diet (%)	Soil Ingestion Rate (kg/day)	Percentage of Sediment in Diet (%)	Sediment Ingestion Rate (kg/day)
Moose	400	--	8.0 ⁽²⁾	66	22	1.6	0.13	0.40	0.032
White-Tailed Deer	75	--	2.3 ⁽²⁾	17	4.8	2.0	0.045	0	0
Boreal Caribou	160	--	3.5 ⁽³⁾	32	9.5	2.0	0.070	0	0
Snowshoe Hare	1.3	--	0.078 ⁽²⁾	0.67	0.13	6.3	0.0049	0	0
Rabbit (eastern cottontail)	1.25	--	0.035 ⁽³⁾	0.65	0.12	6.3	0.0022	0	0
Partridge ⁽¹⁾	0.60	--	0.042 ⁽²⁾	0.28	0.042	2.0	0.00084	0	0
Spruce Grouse	0.60	--	0.042 ⁽²⁾	0.28	0.042	2.0	0.00084	0	0
Canada Goose	3.45	0.033	0.10 ⁽⁴⁾	1.1	0.14	8.2	0.0083	0	0
Mallard	1.2	--	0.060 ⁽²⁾	0.47	0.067	0.3	0.00020	3.0	0.0018
Muskrat	1.0	--	0.070 ⁽²⁾	0.55	0.10	0	0	2.0	0.0014
Beaver	24	--	0.18 ⁽³⁾	6.9	1.7	0.50	0.00092	1.5	0.0028
Trumpeter Swan	10.8	--	0.32 ⁽³⁾	2.6	0.29	0	0	4.6	0.015
Spotted Sandpiper	0.0375	--	0.0068 ⁽²⁾	0.033	0.0065	1.2	0.000081	0.80	0.000054

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Receptor	Body Weight (kg)	Food Ingestion Rate (kg/day ww)	Food Ingestion Rate (kg/day dw)	Air Inhalation Rate (m ³ /day)	Water Ingestion Rate (L/day)	Percentage of Soil in Diet (%)	Soil Ingestion Rate (kg/day)	Percentage of Sediment in Diet (%)	Sediment Ingestion Rate (kg/day)
Northern River Otter	7.5	--	0.23 ⁽²⁾	2.7	0.61	0.10	0.00023	1.9	0.0043
Common Merganser	1.5	--	0.075 ⁽²⁾	0.56	0.077	0	0	2.0	0.0015
Little Brown Myotis	0.0075	0.0025	0.00052 ⁽⁴⁾	0.011	0.0012	0	0	0	0
Belted Kingfisher	0.148	0.075	0.017 ⁽⁴⁾	0.094	0.016	0	0	0	0
Bald Eagle	4.7	0.56	0.13 ⁽²⁾⁽⁴⁾	1.3	0.17	0	0	0	0

Notes:

% = percent; dw = dry weight; kg = kilograms; L = litres; m³ = cubic meters; ww = wet weight; "--" = not required as food ingestion rate was already provided in kg/day dw

Full details and references are provided in Attachment F1, Table F1-12.

1 Assumed same receptor characteristics as the spruce grouse.

2 Food ingestion rates from FCSAP (2012) provided in units of kg dry food/kg wet body weight/day were converted to kg/day dw by multiplying by the body weight. See Table F1-12 (Attachment F1) for details.

3 Calculated based on allometric equations from US EPA (1993), units in kg/day dw. See Table F1-12 (Attachment F1) for details.

4 Food ingestion rates provided in the literature sources in units of kg/day ww were converted to kg/day dw using total diet moisture contents. See Table F1-12 (Attachment F1) for details.

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Table F-21: Dietary Composition for Wildlife Receptors

Receptor	Dietary Composition (percentage of total diet)
Moose	Browse (80%), Aquatic Plants (20%)
White-Tailed Deer	Browse (89%), Lichen (1%), Berries (10%)
Boreal Caribou	Browse (33%), Lichen (67%)
Snowshoe Hare	Browse (90%), Berries (10%)
Rabbit (eastern cottontail) ⁽¹⁾	Browse (90%), Berries (10%)
Partridge ⁽²⁾	Browse (65%), Arthropods (5%), Berries (30%)
Spruce Grouse	Browse (65%), Arthropods (5%), Berries (30%)
Canada Goose	Browse (99%), Arthropods (1.0%)
Mallard	Aquatic Plants (50%), Aquatic Invertebrates (40%), Arthropods (5%), Berries (5%)
Muskrat	Aquatic Plants (80%), Aquatic Invertebrates (15%), Fish (5%)
Beaver	Browse (25%), Aquatic Plants (75%)
Trumpeter Swan	Aquatic Plants (100%)
Spotted Sandpiper	Aquatic Plants (5%), Aquatic Invertebrates (30%), Arthropods (30%), Earthworms (30%), Fish (5%)
Northern River Otter	Aquatic Invertebrates (15%), Small mammals ³ (5%), Fish (80%)
Common Merganser	Aquatic Plants (2%), Aquatic Invertebrates (8%), Fish (90%)
Little Brown Myotis	Aquatic Invertebrates (71%), Arthropods (29%)
Belted Kingfisher	Fish (100%)
Bald Eagle	Small mammals ⁽³⁾ (35%), Fish (65%)

Notes:

% = percent

Full details and references are provided in Attachment F1, Table F1-13.

1 Assumed same dietary composition as the snowshoe hare

2 Assumed same dietary composition as the spruce grouse.

3 "Small mammals" includes birds.

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Wildlife exposure estimates were calculated in dry weight. As such, when a wildlife receptor characteristic in the literature was reported in wet weight (i.e., food ingestion rate) it was converted to dry weight using the following equation:

$$FIR_{dw} = FIR_{ww} \times (1 - MC_{diet})$$

Where:

FIR_{dw} = Food ingestion rate in dry weight (kg/day dw)

FIR_{ww} = Food ingestion rate in wet weight (kg/day ww)

MC_{diet} = Total diet moisture content (unitless), as described below

The total diet moisture content for a species was often unavailable within the literature. To estimate this moisture content, weighted average moisture contents were calculated for each component of the diet and then the weighted average moisture contents were summed. The moisture content of individual dietary components can be found in Table F-3. Calculations for total diet moisture contents can be found in Attachment F1, Table F1-16.

Table F-3: Moisture Content of Dietary Components

Dietary Component	Moisture Content (unitless)	Reference
Browse	0.551	Site-specific; average. Attachment A; Table A1-6
Berries	0.749	Site-specific; average. Attachment A; Table A1-5
Lichen	0.153	Ardea Biological Consulting Ltd. 2015
Arthropods	0.688	Hadley 1994
Earthworms	0.833	US EPA 1999
Small Mammals	0.737	US EPA 1993; mice, voles, rabbits
Aquatic Plants	0.657	US EPA 1999; moisture content for algae
Aquatic Invertebrates	0.833	US EPA 1999
Fish	0.778	Site-specific; average for 2022 fish sampling program for small-bodied fish. Attachment A; Table A1-8

Total diet moisture content was calculated using the following equation:

$$MC_{diet} = \sum DC_i \times MCDC_i$$

Where:

MC_{diet} = Total diet moisture content (unitless)

DC_i = Proportion of dietary component i in total diet (unitless)

$MCDC_i$ = Moisture content of dietary component i (unitless)

Example 2-1: Moisture Content of Belted Kingfisher Diet

$$MC_{diet} = 1 \times 0.778$$

$$MC_{diet} = 0.778$$

Example 2-2: Dry Weight Food Ingestion Rate for Belted Kingfisher

$$FIR_{dw} = 0.075 \text{ kg/day ww} \times (1 - 0.778)$$

$$FIR_{dw} = 0.017 \text{ kg/day dw}$$

Sources of literature wildlife characteristics, such as FCSAP (2012), often report soil and sediment ingestion rates as a percentage of the food ingestion rate. Additionally, soil and sediment ingestion percentage is reported as a sum of sediment and soil. To calculate the individual soil or sediment ingestion rate for a receptor, the combined percentage was multiplied by the percentage of the receptor's diet coming from terrestrial food items or aquatic food items. Receptor dietary composition percentages are found in Attachment F1, Table F1-13 and the calculated soil and sediment percentages and ingestion rates can be found in Attachment F1, Table F1-12. The calculation was performed as below. A sample calculation for the moose receptor is provided¹.

$$P_{aq} = Plant_{aq} + Invert_{aq} + Fish$$

Where:

- P_{aq} = Percentage of diet that is aquatic (%)
- $Plant_{aq}$ = Percentage of diet that is aquatic plants (%)
- $Invert_{aq}$ = Percentage of diet that is aquatic invertebrates (%)
- $Fish$ = Percentage of diet that is fish (%)

$$P_{terr} = Browse + Berries + Lichen + Invert_{arthro} + Invert_{worm} + Mammals$$

Where:

- P_{terr} = Percentage of diet that is terrestrial (%)
- $Browse$ = Percentage of diet that is browse (%)
- $Berries$ = Percentage of diet that is berries (%)
- $Lichen$ = Percentage of diet that is lichen (%)
- $Invert_{arthro}$ = Percentage of diet that is arthropods (%)
- $Invert_{worm}$ = Percentage of diet that is earthworms (%)
- $Mammals$ = Percentage of diet that is small mammals (%)

$$P_{soil} = Soil_Sed_{combined} \times P_{terr}$$

Where:

- P_{soil} = Percentage of soil in diet (%)
- $Soil_Sed_{combined}$ = Percentage of soil + sediment in diet (%)
- P_{terr} = Percentage of diet that is terrestrial (%)

$$P_{sed} = Soil_Sed_{combined} \times P_{aq}$$

Where:

- P_{sed} = Percentage of sediment in diet (%)

¹ The belted kingfisher was not used in this example as it does not consume soil because it only feeds from the aquatic environment and it does not consume sediment because it is an aerial forager.

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Soil_Sed_{combined} = Percentage of soil + sediment in diet (%)

P_{aq} = Percentage of diet that is aquatic (%)

$$IR_s = P_{soil} \times FIR$$

Where:

IR_s = Incidental soil ingestion rate (kg/day)

P_{soil} = Percentage of soil in diet (%)

FIR = Food ingestion rate (kg/day dw)

$$IR_{sed} = P_{sed} \times FIR$$

Where:

IR_{sed} = Incidental sediment ingestion rate (kg/day)

P_{sed} = Percentage of sediment in diet (%)

FIR = Food ingestion rate (kg/day dw)

Example 2-3: Percentage of Moose Diet that is Aquatic

$$P_{aq} = 20\% + 0\% + 0\%$$

$$P_{aq} = 20\%$$

Example 2-4: Percentage of Moose Diet that is Terrestrial

$$P_{terr} = 80\% + 0\% + 0\% + 0\% + 0\% + 0\%$$

$$P_{terr} = 80\%$$

Example 2-5: Percentage of Food Ingestion as Soil Ingestion for Moose

$$P_{soil} = 2\% \times 80\%$$

$$P_{soil} = 1.6\%$$

Example 2-6: Percentage of Food Ingestion as Sediment Ingestion for Moose

$$P_{sed} = 2\% \times 20\%$$

$$P_{sed} = 0.4\%$$

Example 2-7: Incidental Soil Ingestion Rate for Moose

$$IR_s = 1.6\% \times 8 \text{ kg/day}$$

$$IR_s = 0.13 \text{ kg/day}$$

Example 2-8: Incidental Sediment Ingestion Rate for Moose

$$IR_{sed} = 0.4\% \times 8 \text{ kg/day}$$

$$IR_{sed} = 0.032 \text{ kg/day}$$

2.2 PARAMETER SPECIATION

2.2.1 MERCURY

The toxicity of mercury differs based on speciation. Mercury is present in the environment as organic or inorganic forms and TRVs are available for each form. The most common form of organic mercury is methylmercury which is the predominant form present in fish tissue. Mercury speciation in environmental media was determined after a comprehensive literature review, with relevant findings detailed below.

Soil, Terrestrial Plants, Lichen, Arthropods, Earthworms, Small Mammals and Birds

The percentage of methylmercury found in soil and terrestrial plants was assumed to be minimal in comparison to that of surface water, fish and wild game. For example, methylmercury was found to make up less than 1% of total mercury in soils of Devon Island in Canada's high Arctic (Oiffer and Siciliano 2009, as cited in Aboriginal Affairs and Northern Development Canada [AANDC] 2012). US EPA (1997) found that the fraction of methylmercury to total mercury ranges from 0.5 to 1.5% in soils from Washington State. US EPA (2005) assumes a percentage of 2% methylmercury in soil when calculating the uptake of mercury in soil via root uptake by plants and through plant surface deposition. This assumption of 2% methylmercury in soil was used in the ERA.

Mailman and Bodaly (2005) reported a methylmercury content of 1.9% in Labrador tea and 3.6% in wild blueberry plants collected in northwestern Ontario. These percentages of methylmercury in Labrador tea and wild blueberry were used to represent percentages of methylmercury in browse and berries, respectively, in the ERA.

A study by Hall et al. (2004) investigated the release and transformation of mercury in soil related to decomposing plant material. In this study, the percentage of total and methylmercury were characterized in lichen before the initiation of decomposition. The study found that the percentage of mercury in lichen that was present as methylmercury was 1.7%. This percentage was used to represent methylmercury in lichen in the ERA.

Studies of methylmercury speciation in terrestrial arthropods suggest that mercury apportionment can vary depending on several factors. A study by Zheng et al. (2008) measured total and methylmercury concentrations in three common species of terrestrial arthropods. They found that methylmercury percentage is dependant on trophic status, wherein, primary consumers contained less methylmercury than the plants they consume, but secondary consumers contained higher concentrations than their prey. Additionally, there was an observed positive correlation between body length and methylmercury concentration. The data reported by Zheng et al. (2008) varied greatly across species and sampling locations. An average of all data across species and locations from Zheng et al. (2008) was used as the percentage of methylmercury (14.8%) in terrestrial arthropods in the ERA. Furthermore, it was assumed that the percentage of methylmercury in earthworms would be similar to arthropods. Therefore, the same percentage of methylmercury for arthropods was assigned to earthworms in the ERA (14.8%).

US EPA (1997) reviewed several studies that reported the percentage of methylmercury in meats from market basket studies. It was concluded that the concentrations of methylmercury in meat were very low relative to fish tissues. The review reported the percentage of methylmercury in raw beef to be greater than 10%. It was assumed, for the purpose of the ERA, that small mammals and birds would have a similar percentage of methylmercury in their tissues as beef. Therefore, a percentage of 10% was assumed for small mammals and birds.

Sediment

Mercury can exist, accumulate, and transform within sediments. Furthermore, sediment is where a significant portion of biotransformation occurs in the freshwater mercury cycle. The Canadian Council of Ministers of the Environment (CCME; 1999) states that the percentage of mercury in sediments that is present as methylmercury generally constitutes 0.01 to 10%. As a conservative approach, it was assumed that sediments within the LSA contained 5% of total mercury as methylmercury in the ERA. This was assumed because 5% is the approximate midpoint of the range published by the CCME and should represent average conditions that were sampled in the referenced study.

Surface Water

In surface water, Health Canada (1986) suggests that methylmercury is estimated to constitute only 1% of the total mercury content of water. However, CCME (2003) states that methylmercury typically represents up to 10% of total mercury in surface waters.

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Other studies reported a range of methylmercury content in surface water. Krabbenhoft et al. (1999) looked at surface water samples from 106 sites (predominately streams) from 21 basins across the United States as part of the United States Geological Survey (USGS) National Mercury Pilot Study and reported that methylmercury constituted 1% to 11% of the total mercury. When considered separately, the background/reference sites for the USGS study had a mean methylmercury concentration of 0.13 ng/L in surface waters, which represented 3.8% of the mean total mercury. St. Louis et al. (2004) flooded a wetland complex in northwestern Ontario and measured the biogeochemical cycling of methylmercury in the wetland. For the two years prior to flooding, methylmercury concentrations in surface waters averaged 0.15 and 0.08 ng/L or approximately 5-10% of the total mercury was methylmercury. Litten (1996) sampled 11 tributaries to Lake Ontario and found the percentage of methylmercury in surface waters ranged between less than 1% to 46.04% (median 2.4%). Another study conducted on tributaries to Onondaga Lake in New York State found that methylmercury constituted between 2.10% and 10.00% (median: 3.45%) in surface waters (PTI 1993). US EPA (1997) looked at the percentage of methylmercury in surface waters in Swedish lakes, Lake Crescent in Washington State, and Little Rock Lake in north-central Wisconsin, and found that the percentage of methylmercury ranged from 1.0 to 12%, less than 2.5%, and 5%, respectively.

As these reports and studies suggest, there is a wide range in the percentage of methylmercury in surface waters. Some of the biotic and abiotic factors reported to influence methylmercury concentrations in surface waters include:

- Acidity (pH)
- Temperature
- Redox conditions (anoxia)
- Dissolved organic carbon / humic matter
- Presence of complexing agents
- Sulfate
- Nutrients (nitrogen and phosphorus)
- Salinity
- Suspended particulate matter
- Watershed characteristics (e.g., presence of wetlands, catchment type, land use, soil organic content).

The review of the literature highlights the importance of understanding the study area of interest and the use of site-specific values, wherever possible. Surface water samples collected from the Chukuni River, within the LSA, were analyzed for total and methylmercury content. An average methylmercury content of 4.1% was calculated across sampling stations and years, and this value was used in the ERA as the site-specific methylmercury content of surface water within the LSA (WSP 2025a).

Fish

Methylmercury in fish tissue is often assumed to be nearly 100% of total mercury (Health Canada 2007). US EPA (2000) acknowledged that the percentage of methylmercury to total mercury varies greatly in fish tissues, between 30 and 100%, and that because of the high costs of methylmercury analysis in labs, it should be conservatively assumed that all of the mercury present in fish tissues is methylmercury. However, recent studies by Foster and Mathieu (2023) found that the percentage of methylmercury in freshwater fish sampled in Washington State was 66 (plus or minus 16%). Moreover, a study by Canuel et al. (2006) used an assumption that 85% of mercury in fish was methylmercury.

Site-specific data for small prey-sized fish (less than 25 cm) were available for the Project. However, laboratory analysis often reported concentrations of methylmercury greater than total mercury leading to a

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lack of confidence in the methylmercury analysis of these samples. Using site-specific concentrations for small prey sized fish would likely lead to an over-estimation of methylmercury exposure; therefore, the percentage presented in Canuel et al. (2006) of 85% was selected as a conservative estimate for use in the ERA.

Aquatic Invertebrates and Plants

As previously stated, the methylation potential of mercury in surface water can vary with several parameters. This will affect the percentage of methylmercury present in aquatic plants and invertebrates. A study on the methylation of mercury within freshwater macrophytes found that methylmercury percentages increased with depth, likely as a result of lower oxygen conditions and increased sulfide in deeper water (Mauro et al. 2002). Additionally, the study reported the results of inorganic mercury dosing to several species of freshwater macrophytes. The species with the highest average percentage of mercury methylation had 17% methylation. This percentage was used as a conservative estimate for aquatic plants in the ERA.

Studies of aquatic invertebrates from boreal lakes in Sweden and Canada reported similar findings as the studies of terrestrial invertebrates. Methylmercury percentages varied greatly, depending on feeding behaviors. Reported percentages ranged from 35% in detritivores to 95% in predators. A study by Tremblay et al. (1996) reported the percentages of methylmercury in several species of aquatic invertebrates. For the purposes of the ERA, the average percentage across lakes and species taken in Quebec (57.6%) was assumed to represent all aquatic invertebrates in the LSA.

A summary of the organic mercury speciation assumptions used in the ERA can be found in Table F-4 and Attachment F1, Table F1-7.

Table F-2: Organic Mercury Speciation

Environmental Media	Organic Mercury (% of Total Mercury)	Reference
Soil	2.0%	US EPA 2005; Human Health Risk Assessment Protocol (HHRAP) Attachment B
Sediment	5.0%	CCME 1999; Canadian Sediment Quality Guidelines for the Protection of Aquatic Life; Midpoint of range (0.1-10%)
Surface Water	4.1%	Site-specific, average (all stations all years); WSP 2025 Mercury Study Report; Table 5-1
Browse	1.9%	Mailman and Bodaly 2005 (Labrador tea)
Berries	3.6%	Mailman and Bodaly 2005 (blueberry)
Lichen	1.7%	Hall 2004
Arthropods	14.8%	Zheng 2008; Average across species and sampling locations
Earthworms	14.8%	Assumed same as for arthropods
Small Mammals ⁽¹⁾	10.0%	US EPA 1997; Assumed same as raw beef tissue
Aquatic Plants	17.0%	Mauro et al. 2002; Percent mercury methylation of cultivated macrophytes
Aquatic Invertebrates	57.6%	Tremblay et al. 1996; Average across locations and species from lakes in Quebec
Fish	85.0%	Canuel et al. 2006

Notes:

% = percent.

¹ "Small mammals" also includes birds.

2.3 EXPOSURE POINT CONCENTRATIONS

Exposure point concentrations are estimates of the concentrations of POPCs that wildlife receptors may be exposed to in each relevant environmental medium. A summary of the environmental quality data and methods used for deriving EPCs for baseline conditions and each of the Project assessment phases (e.g., construction, operations and closure) and post-closure is summarised in Table F-5.

Table F-3: Methods for Deriving EPCs for Wildlife

Environmental Media	EPC Derivation Method
Soil	<p>A Baseline Soil and Traditional Foods Sampling Program was conducted in 2023 to characterize the baseline metals/metalloids concentrations (Attachment A). The 90th percentile concentrations of the soil analytical results were selected as the baseline EPCs for metals/metalloids (Table A1-2; Attachment A).</p> <p>Deposition rates were predicted at each point of reception (POR) (as provided by the Air Quality discipline, see Attachment B) and the maximum across all PORs was calculated for each assessment phase. The maximum was used to calculate the incremental soil concentration due to Project deposition for each Project phase. The incremental soil concentrations were added to the baseline EPCs to calculate EPCs for soil for each Project phase. It was assumed that there was no atmospheric deposition of POPCs under baseline conditions and during the post-closure phase.</p>
Dust	<p>EPCs for soil dust were calculated based on total surface soil concentrations (i.e., sum of measured baseline surface soil concentration and predicted surface soil concentration from deposition) for each assessment phase.</p> <p>Soil dust concentrations were calculated from the soil EPCs using a standard dust ratio provided by Health Canada (2024).</p>
Sediment	<p>It was determined that the Project would not have any material effect on the concentrations of POPCs in sediment. As a result, the EPCs for sediment were determined from the baseline sediment samples collected during the Fisheries Resources Baseline sampling program (WSP 2025c). The 90th percentile sediment concentrations of all samples collected from waterbodies within the LSA (Table A1-3, Attachment A) were used as the EPCs for wildlife for the purposes of the ERA (Table F1-1, Attachment F1).</p>
Surface Water	<p>Monthly average surface water concentrations were predicted for every month occurring in the Project, at each surface water quality modelling node, as provided by the Water Quality discipline (WSP, 2025b). The highest monthly average concentration of all surface water quality modelling nodes was identified for each Project phase. This highest monthly average concentration was selected as the EPC for each Project phase for the ERA.</p> <p>Water quality predictions provided by the Water Quality discipline also included baseline water quality concentrations, and the maximum baseline concentrations of all surface water quality modelling nodes were used as the baseline surface water EPCs. Baseline and predicted surface water EPCs can be found in Table A1-4 (Attachment A) and Table B1-5 (Attachment B), respectively.</p>
Dietary Items	
Browse	<p>Browse EPCs were determined based on dust deposition to plant surfaces, calculated using models from the US EPA (2005), and accumulation from soil, calculated using literature regression models. Literature regression models were obtained from Bechtel Jacobs Company (BJC) (1998). Site-specific co-located soil and vegetation samples</p>

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Environmental Media	EPC Derivation Method
	<p>were not used to develop bioaccumulation factors (BAFs) or regression models for browse as most of the species sampled were more relevant to human consumption than wildlife.</p> <p>Browse tissue concentrations were calculated using the regression models and the soil EPCs.</p> <p>Calculated browse tissue concentrations from air deposition and accumulation from soil were then summed to calculate total concentrations which were then used as the EPCs for the Project phases.</p>

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Environmental Media	EPC Derivation Method
Berries	<p>Berry EPCs were determined based on dust deposition to plant surfaces, calculated using models from the US EPA (2005), and accumulation from soil, calculated using site-specific BAFs (where available). Site-specific BAFs were calculated using the detected berry concentrations from the Baseline Soil and Traditional Foods Sampling Program, where available (i.e., arsenic), as described in Attachment A. In instances where the baseline samples did not have any samples with detections of POPCs in berries (i.e., mercury, selenium), a literature BAF from Baes et al. (1984) was used. Berry tissue concentrations were calculated using the BAFs and the soil EPCs. Calculated berry tissue concentrations from air deposition and accumulation from soil were then summed to calculate a total concentration which was then used as the EPC for the Project phases.</p>
Lichen	<p>Lichen EPCs were determined based on dust deposition to plant surfaces, calculated using models from the US EPA (2005). Lichen EPCs were calculated based only on dust deposition because they primarily take up parameters from the air rather than from soil. Lichen tissues were not collected or analyzed for parameters within the LSA. In the absence of Ontario-specific published lichen data, baseline sampling data from the Kemess mine project (Ardea Biological Consulting 2015) were used to establish lichen EPCs for the Project. The maximum concentrations from the Kemess data set (Table A4-1-1, Attachment A) were used to establish baseline EPCs. The EPCs for lichen were calculated as the sum of the baseline concentrations from the Kemess mine and plant surface deposition from airborne particles.</p>
Terrestrial Invertebrates: Arthropods & Earthworms	<p>Terrestrial invertebrate EPCs were determined using literature regression models for uptake from soil by terrestrial invertebrates. Literature regression models were obtained from Beyer and Sample (2017) (i.e., arsenic for arthropods) and Sample et al. (1998a) (i.e., arsenic, mercury and selenium for earthworms). Site-specific BAFs or regression models were not used as baseline sampling results for terrestrial invertebrates were not available for the Project. Terrestrial invertebrate tissue concentrations were calculated using the regression models and the soil EPCs.</p>
Small Mammals	<p>Small mammal EPCs were determined using literature BAFs and regression models for uptake from soil by small mammals obtained from Sample et al. (1998b). Site-specific BAFs or regression models were not used as baseline sampling results for small mammals were not available for the Project. Small mammal tissue concentrations were calculated using the BAFs/regression models and the soil EPCs.</p>
Aquatic Plants	<p>Aquatic plant EPCs were determined using literature bioconcentration factors (BCFs) for uptake from surface water by aquatic plants. Literature BCFs were obtained from the US EPA (1999). BCFs were published in units of wet weight tissue and were converted to dry weight using a published moisture content of 65.7% based on algae (US EPA 1999). Some baseline data are available for aquatic plants (periphyton); however, these were not used to calculate site-specific BCFs for the Project. The literature BCFs predict similar aquatic plant tissue concentrations to baseline aquatic plant tissue concentrations so this was considered to be a reasonable approach. Aquatic plant tissue concentrations were calculated using the literature BCFs and surface water EPCs.</p>

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Environmental Media	EPC Derivation Method
Aquatic Invertebrates	<p>Aquatic invertebrate EPCs were determined using literature BCFs for uptake from surface water by aquatic invertebrates. Literature BCFs were obtained from Argonne National Laboratory (2001). Some baseline data are available for aquatic invertebrates (zooplankton); however, these were not used to calculate site-specific BCFs for the Project. The literature BCFs predict similar aquatic invertebrate tissue concentrations to baseline aquatic invertebrate tissue concentrations so this was considered to be a reasonable approach.</p> <p>Aquatic invertebrate tissue concentrations were calculated using the literature BCFs and the surface water EPCs.</p>
Fish	<p>Fish tissue EPCs were determined using site-specific BCFs for uptake from surface water by fish. Composite small-bodied fish tissue samples were collected from 2022 to 2023 as part of the 2022 to 2025 fisheries resources assessment for the Project (as provided by the Aquatics discipline, WSP 2025c). Site-specific BCFs were derived using the 90th percentile of measured fish tissue concentrations and the highest of the maximum monthly average baseline water quality concentrations from all surface water quality modelling nodes (Attachment A, Table A1-10). Only small-bodied composite fish tissue samples were included in the calculation of the BCFs as these would be most relevant to wildlife consumption.</p>

Notes:

% = percent; BAF = bioaccumulation factor; BCF = bioconcentration factor; EPC = exposure point concentration; ERA = ecological risk assessment; LSA = local study area; POPC = parameter of potential concern; POR = point of reception.

As noted previously, wildlife exposure estimates were calculated in dry weight. If literature-based BAFs/BCFs were provided in units of wet weight they were converted to dry weight using the following equation:

$$BAF_{dw} = \frac{BAF_{ww}}{(1 - MC)}$$

Where:

BAF_{dw} = Bioaccumulation factor/bioconcentration factor in dry weight (mg POPC / kg dw) / (mg POPC / L)
 BAF_{ww} = Bioaccumulation factor/bioconcentration factor in wet weight (mg POPC / kg ww) / (mg POPC / L)
 MC = Moisture content (unitless)

For media where this conversion was done, the assumed moisture contents were either site-specific or based on literature values (US EPA 1999). Details on BAF/BCF and regression model sources and derivations are provided in Table F1-11 (Attachment F1). The calculations of site-specific BAFs/BCFs are provided in Table A1-10 (Attachment A).

Further details on the derivation of EPCs are provided below for each environmental medium, along with sample calculations for total mercury for the operations phase. EPCs used in the food chain model are provided in Table F1-1 (Attachment F1).

2.3.1 SOIL

Incremental changes to soil quality from the Project (i.e., due to aerial deposition of dust) were modelled as part of the ERA, discussed in detail below.

2.3.1.1 DEPOSITION MODELLING

Soil exposure concentrations for wildlife were calculated using a procedure published by the US EPA Office of Solid Waste (US EPA 2005). Atmospheric parameter deposition to soil was calculated for each Project phase using the following equation:

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$$Soil_{dep} = \frac{Q}{Z \times BD} \times \frac{1 - e^{(-ks \times t)}}{ks}$$

Where:

- Soil_{dep} = Estimated concentration of POPC in soil attributed to particulate deposition from air (mg/kg)
- Q = Rate of airborne particle deposition (mg/m²/year)
- Z = Soil depth (m)
- BD = Bulk density of soil (kg/m³)
- ks = Soil loss constant (year⁻¹)
- t = Time period of deposition (years)

The equation represents a simple soil compartment model that assumes that deposition represents a mass input of parameter per unit volume of soil. The equation allows for loss (i.e., removal) of parameters from the unit volume of soil through various processes including abiotic and biotic degradation (degradation without and with involvement of living organisms, respectively), erosion (movement of soil from one area to another via wind, rain, or other processes), surface runoff (unconfined flow of water over the ground surface), leaching (loss of substance from surface soil into the subsurface or nearby waterbodies), and volatilization (vapour loss to the atmosphere). In the absence of site-specific information, US EPA (1999; 2005) assumes default values of zero (i.e., no loss) for erosion, surface runoff, volatilization, and leaching processes. The soil loss constant for metals and metalloids were assumed to be based on a half-life of 25 years (i.e., 0.028 year⁻¹), which is almost equal to the length of the operations phase of the Project, so that metals and metalloids accumulated in soil for each of the mine phases with negligible losses occurring over the period of deposition. The assumption of minimal or negligible losses from soil for metals and metalloids is conservative and likely results in an overestimate of the predicted soil concentrations.

Wildlife could potentially reside or travel anywhere in the LSA; therefore, the maximum deposition rate predicted for each Project phase was selected for the derivation of the EPC as opposed to the average of deposition rates across all modeled locations. The bulk density of soil was assumed to be 1,500 kg/m³ (US EPA 2005) and soil concentrations were predicted for two mixing depths (i.e., 2 cm and 20 cm; US EPA 2005) to calculate surface soil concentrations for direct wildlife contact and sub-surface soil concentrations for vegetation uptake and invertebrate exposure, respectively. The time of deposition was assumed to be the length of each Project phase (e.g., 3 years for construction, 26 years for operations, 3 years for closure and 2 years for post-closure). Inputs for calculating soil deposition concentrations can be found in Table F1-1 (air deposition rates), Table F1-9 (Project and site characteristics) and Table F1-10 (soil loss constants) (Attachment F1).

Calculation of soil loss constant:

$$ks = \frac{\ln(2)}{\text{Half Life}_{\text{assumed}}/C}$$

$$ks = \frac{\ln(2)}{9125/365}$$

Where:

- ks = Soil loss constant (year⁻¹)
- Half Life_{assumed} = Assumed POPC half-life (days)
- C = Conversion factor (365 days/year)

Example 2-9: Deposition of Total Mercury to Soil for Wildlife Exposure (Operations)

$$Soil_{dep} = \frac{Q}{Z \times BD} \times \frac{1 - e^{(-ks \times t)}}{ks}$$

Surface Soil (i.e., top 2 cm)

$$Soil_{dep} = \frac{5.73 \times 10^{-4} \text{ mg/m}^2/\text{year}}{0.02 \text{ m} \times 1500 \text{ kg/m}^3} \times \frac{1 - e^{-0.0267 \text{ years}^{-1} \times 26 \text{ years}}}{0.0267 \text{ years}^{-1}}$$

$$Soil_{dep} = 3.58 \times 10^{-4} \text{ mg/kg}$$

Sub-Surface Soil (i.e., top 20 cm)

$$Soil_{dep} = \frac{5.73 \times 10^{-4} \text{ mg/m}^2/\text{year}}{0.2 \text{ m} \times 1500 \text{ kg/m}^3} \times \frac{1 - e^{-0.0267 \text{ years}^{-1} \times 26 \text{ years}}}{0.0267 \text{ years}^{-1}}$$

$$Soil_{dep} = 3.58 \times 10^{-5} \text{ mg/kg}$$

2.3.1.2 CUMULATIVE DEPOSITION CONCENTRATION

It was conservatively assumed that POPCs in soil do not degrade or erode appreciably in soil. Therefore, Project related contribution to POPC concentration in soil via deposition accumulates over the phases of the Project. The total amount of POPC deposited to soil was calculated using the following equation:

$$Soil_{dep-cumulative} = \sum Soil_{dep-phase}$$

Where:

$Soil_{dep-cumulative}$ = Total estimated concentration of a POPC in soil attributed to particulate (dust) deposition from air, including all previous Project phases (mg/kg)

$Soil_{dep-phase}$ = Total estimated concentration of a POPC in soil attributed to particulate (dust) deposition from air, attributed to a specific Project phase (mg/kg)

A worked example of the calculation to derive the cumulative deposition concentration for mercury is provided below.

Example 2-10: Cumulative Deposition of Total Mercury to Soil During Operations (Surface Soil [i.e., top 2 cm])

$$Soil_{dep-cumulative} = Soil_{dep-Construction} + Soil_{dep-Operations}$$

$$Soil_{dep-cumulative} = 1.27 \times 10^{-4} \text{ mg/kg} + 3.58 \times 10^{-4} \text{ mg/kg}$$

$$Soil_{dep-cumulative} = 4.85 \times 10^{-4} \text{ mg/kg}$$

2.3.1.3 TOTAL SOIL CONCENTRATIONS

The total concentration of a POPC in soil following deposition (i.e., baseline + Project phase) was calculated using the following equation:

$$Soil_{total} = Soil_{dep-cumulative} + Soil_{base}$$

Where:

$Soil_{total}$ = Total soil concentration of a POPC (mg/kg)

$Soil_{dep-cumulative}$ = Sum of estimated concentrations of a POPC in soil attributed to particulate (dust) deposition from air for current and previous Project phases (mg/kg)

$Soil_{base}$ = Measured baseline soil concentration of a POPC (mg/kg)

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Metals leach relatively slowly from soils. Thus, the concentration of a POPC in soil attributed to particulate (dust) deposition was assumed equal to the sum of deposition contributions for the current and previous Project phases. The 90th percentile of measured baseline soil concentrations within the LSA were used in the calculation. The calculated total soil concentrations were used as the soil EPCs in the ERA (Table F1-1, Attachment F1).

Example 2-11: Total Concentration of Total Mercury in Soil for Wildlife Exposure (Operations)

$$Soil_{tot} = Soil_{dep} + Soil_{base}$$

Surface Soil (i.e., top 2 cm)

$$Soil_{tot} = 4.85 \times 10^{-4} \text{ mg/kg} + 4.76 \times 10^{-2} \text{ mg/kg}$$

$$Soil_{tot} = 4.81 \times 10^{-2} \text{ mg/kg}$$

Sub-Surface Soil (i.e., top 20 cm)

$$Soil_{tot} = 4.85 \times 10^{-5} \text{ mg/kg} + 4.76 \times 10^{-2} \text{ mg/kg}$$

$$Soil_{tot} = 4.76 \times 10^{-2} \text{ mg/kg}$$

2.3.2 DUST

Concentrations of POPCs in dust were estimated based on surface soil concentrations and particulate (dust) concentrations in air from Health Canada (2024), as follows:

$$C_D = \frac{C_s \times P_{air}}{CF}$$

Where:

C_D = POPC concentration in dust (mg/m³)

C_s = POPC concentration in surface soil (mg/kg)

P_{air} = Default airborne concentration of respirable particulate matter (0.76 µg/m³)

CF = Conversion factor from µg/m³ to kg/m³; 10⁹

Example 2-12: Concentration of Total Mercury in Soil Dust (Operations)

$$C_D = \frac{4.81 \times 10^{-2} \text{ mg/kg} \times 0.76 \text{ } \mu\text{g/m}^3}{10^9 \text{ } \mu\text{g/m}^3 \text{ per kg/m}^3}$$

$$C_D = 3.65 \times 10^{-11} \text{ mg/m}^3$$

The dust EPCs are provided in Table F1-1, Attachment F1

2.3.3 SEDIMENT

It was determined that the Project would not have any material effect on the concentrations of POPCs in sediment. As a result, the EPCs for sediment were determined from the baseline sediment samples collected during the Fisheries Resources Baseline sampling program (WSP 2025c). The 90th percentile sediment concentrations of all samples collected from waterbodies within the LSA (Table A1-3, Attachment A) were used as the EPCs for wildlife for the purposes of the ERA (Table F1-1, Attachment F1).

2.3.4 SURFACE WATER

Surface water quality modelling was conducted by the Water Quality discipline (WSP 2025b) and the results are summarized in Attachment B. Surface water quality concentrations were provided for baseline,

and the Project phases (construction, operations, closure) and post-closure. The surface water quality modelling nodes used in the ERA are described in Attachment B. The selected EPCs for surface water were as follows:

- Maximum monthly average surface water concentrations predicted of all relevant surface water quality modelling nodes.
- Incremental Project Alone water quality concentrations were calculated from predicted concentrations by subtracting the baseline water quality concentrations from the predicted concentrations for each Project phase. If an incremental change was negative, a value of 0 was used as the EPC. The Project Alone concentrations were used to calculate incremental wild game tissue concentrations for meat consumed in the HHRA for carcinogenic POPCs.

The surface water EPCs can be found in Table F1-1 (Attachment F1).

2.3.5 TERRESTRIAL VEGETATION

2.3.5.1 PLANT SURFACE DEPOSITION MODELLING

Atmospheric deposition to plant surfaces was calculated using a procedure published by the US EPA (2005). The POPC concentration in plants from deposition was calculated using the following equation:

$$Plant_{dep} = \frac{Q \times Rp \times (1 - e^{-kp \times tp})}{Yp \times kp}$$

Where:

- Plant_{dep} = Concentration of POPC in plant tissue attributed to deposition from air (mg/kg dw)
- Q = Rate of airborne particle deposition (mg/m²/year)
- Rp = Intercept fraction of the edible portion of the plant (unitless)
- kp = Plant surface loss coefficient (year⁻¹)
- tp = Length of plant exposure to deposition per harvest of edible portion of plant (years)
- Yp = Yield or standing crop biomass of the edible portion of the plant (kg- dw/m²)

Inputs for calculating deposition to plant surfaces are provided in Table F1-1 and F1-17 (Attachment F1). The plant EPCs from deposition to plant surfaces can be found in Table F1-1 (Attachment F1). Sample calculations are provided below for berries, browse, and lichen.

Example 2-13: Deposition of Total Mercury to Berries (Operations)

$$Berries_{dep} = \frac{5.73 \times 10^{-4} \text{ mg/m}^2/\text{year} \times 0.053 \times (1 - e^{-18 \text{ years}^{-1} \times 0.16 \text{ years}})}{0.252 \text{ kg - dw/m}^2 \times 18 \text{ years}^{-1}}$$
$$Berries_{dep} = 6.32 \times 10^{-6} \text{ mg/kg dw}$$

Example 2-14: Deposition of Total Mercury to Browse (Operations)

$$Browse_{dep} = \frac{5.73 \times 10^{-4} \text{ mg/m}^2/\text{year} \times 0.5 \times (1 - e^{-18 \text{ years}^{-1} \times 0.12 \text{ years}})}{0.24 \text{ kg - dw/m}^2 \times 18 \text{ years}^{-1}}$$
$$Browse_{dep} = 5.87 \times 10^{-5} \text{ mg/kg dw}$$

Example 2-15: Deposition of Total Mercury to Lichen (Operations)

$$Lichen_{dep} = \frac{5.73 \times 10^{-4} \text{ mg/m}^2/\text{year} \times 0.5 \times (1 - e^{-18 \text{ years}^{-1} \times 0.58 \text{ years}})}{0.054 \text{ kg - dw/m}^2 \times 18 \text{ years}^{-1}}$$

$$Lichen_{dep} = 2.95 \times 10^{-4} mg/kg dw$$

2.3.5.2 PLANT UPTAKE FROM SOIL

Bioaccumulation factors and regression models (natural logarithmic relationships) were used to model uptake of POPCs from total sub-surface soil (i.e., measured baseline plus contribution from deposition to top 20cm soil depth) into plants as follows:

Bioaccumulation Factor:

$$Tissue_{soil} = C_s \times BAF$$

Where:

- Tissue_{soil} = Concentration of POPC in plant tissue attributed to soil uptake (mg/kg dw)
- C_s = Concentration of POPC in soil (mg/kg dw)
- BAF = Bioaccumulation factor (mg POPC/kg dw plant tissue) / (mg/kg dw soil)

Natural Logarithmic Relationship:

$$Tissue_{soil} = e^{slope \times \ln C_s + intercept}$$

Where:

- Tissue_{soil} = Concentration of POPC in plant tissue attributed to soil uptake (mg/kg dw)
- C_s = Concentration of POPC in soil (mg/kg dw)
- Slope = Rate of uptake of POPC into plant tissue from soil (unitless)
- Intercept = Plant tissue concentration when the soil concentration is zero (mg/kg dw)

Site-specific BAFs were calculated using the detected berry concentrations from the Baseline Soil and Traditional Foods Sampling Program, where available (i.e., baseline berry concentration divided by baseline soil concentrations). In instances where the baseline samples did not have any samples with detections of POPCs in berries, a literature BAF from Baes et al. (1984) was used. Natural logarithmic relationships from BJC (1998) were used to estimate browse POPC uptake from soil. For lichen, it was assumed that soil uptake was negligible (zero) and baseline tissue concentrations were used to calculate total lichen POPC concentrations. Baseline lichen concentrations can be found in Table A4-1-1 (Attachment A).

The BAFs and natural logarithmic relationships for berries and browse can be found in Table F1-11 (Attachment F1). The plant EPCs from soil uptake can be found in Table F1-1 (Attachment F1). Sample calculations are provided below for berries and browse.

Example 2-16: Accumulation of Total Mercury from Soil by Berries (Operations)

$$Berries_{soil} = 4.76 \times 10^{-2} mg/kg \times 0.2$$

$$Berries_{soil} = 9.53 \times 10^{-3} mg/kg dw$$

Example 2-17: Accumulation of Total Mercury from Soil by Browse (Operations)

$$Browse_{soil} = e^{0.544 \times \ln(4.76 \times 10^{-2} mg/kg) + (-0.996)}$$

$$Browse_{soil} = 7.05 \times 10^{-2} mg/kg dw$$

2.3.5.3 TOTAL PLANT CONCENTRATIONS

The total concentrations of POPCs in berries, browse, and lichen were calculated as follows:

$$Plant_{total} = Plant_{soil} + Plant_{dep}$$

Where:

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Plant_{total} = Total concentration of POPC in plant tissue (mg/kg dw)

Plant_{soil} = Concentration of POPC in plant tissue attributed to soil uptake (for lichen baseline was assumed) (mg/kg dw)

Plant_{dep} = Concentration of POPC in plant tissue attributed to deposition from air (mg/kg dw)

Example 2-18: Total Concentration of Total Mercury in Berries (Operations)

$$\begin{aligned} Berries_{tot} &= 9.53 \times 10^{-3} \text{ mg/kg} + 6.32 \times 10^{-6} \text{ mg/kg} \\ Berries_{tot} &= 9.54 \times 10^{-3} \text{ mg/kg dw} \end{aligned}$$

Example 2-19: Total Concentration of Total Mercury in Browse (Operations)

$$\begin{aligned} Browse_{tot} &= 7.05 \times 10^{-2} \text{ mg/kg} + 5.87 \times 10^{-5} \text{ mg/kg} \\ Browse_{tot} &= 7.06 \times 10^{-2} \text{ mg/kg dw} \end{aligned}$$

Example 2-20: Total Concentration of Total Mercury in Lichen (Operations)

$$\begin{aligned} Lichen_{tot} &= 1.40 \times 10^{-2} \text{ mg/kg} + 2.95 \times 10^{-4} \text{ mg/kg} \\ Lichen_{tot} &= 1.43 \times 10^{-2} \text{ mg/kg dw} \end{aligned}$$

The calculated total plant concentrations were used as the plant EPCs in the ERA (Table F1-1, Attachment F1).

2.3.6 TERRESTRIAL INVERTEBRATES AND SMALL MAMMALS

Bioaccumulation factors and natural logarithmic relationships for small mammals and natural logarithmic relationships for terrestrial invertebrates were used to model uptake of POPCs from total sub-surface soil (top 20 cm depth) into tissues as follows:

Bioaccumulation Factor:

$$Tissue_{soil} = C_s \times BAF$$

Where:

Tissue_{soil} = Concentration of POPC in tissue attributed to soil uptake (mg/kg dw)

C_s = Concentration of POPC in soil (mg/kg dw)

BAF = Bioaccumulation factor (mg POPC/kg dw tissue) / (mg/kg dw soil)

Natural Logarithmic Relationship:

$$Tissue_{soil} = e^{\text{slope} \times \ln C_s + \text{intercept}}$$

Where:

Tissue_{soil} = Concentration of POPC in tissue attributed to soil uptake (mg/kg dw)

C_s = Concentration of POPC in soil (mg/kg dw)

Slope = Rate of uptake of POPC into tissue from soil (unitless)

Intercept = Tissue concentration when the soil concentration is zero (mg/kg dw)

Natural logarithmic relationships from Sample et al. (1998a) and Beyer and Sample (2017) were used to estimate terrestrial invertebrate (i.e., arthropod and earthworm) POPC uptake from soil. Literature BAFs and natural logarithmic uptake relationships from Sample et al. (1998b) were used for small mammals in absence of site-specific data. The BAFs and natural logarithmic relationships can be found in Table F1-11

(Attachment F1). The terrestrial invertebrate and small mammal EPCs from soil accumulation can be found in Table F1-1 (Attachment F1).

Example 2-21: Accumulation of Total Mercury from Soil by Arthropods (Operations)

$$Arthropod_{soil} = e^{0.118 \times \ln(4.76 \times 10^{-2} \text{ mg/kg}) + (-0.684)}$$

$$Arthropod_{soil} = 3.52 \times 10^{-1} \text{ mg/kg dw}$$

Example 2-22: Accumulation of Total Mercury from Soil by Earthworms (Operations)

$$Earthworm_{soil} = e^{0.118 \times \ln(4.76 \times 10^{-2} \text{ mg/kg}) + (-0.684)}$$

$$Earthworm_{soil} = 3.52 \times 10^{-1} \text{ mg/kg dw}$$

Example 2-23: Accumulation of Total Mercury from Soil by Small Mammals (Operations)

$$Mammal_{soil} = 4.76 \times 10^{-2} \text{ mg/kg} \times 0.054$$

$$Mammal_{soil} = 2.59 \times 10^{-3} \text{ mg/kg dw}$$

2.3.7 AQUATIC FOOD ITEMS (FISH, INVERTEBRATES, PLANTS)

Site-specific and literature BCFs were used to model uptake of POPCs from surface water into fish, aquatic invertebrates, and aquatic plants as follows:

$$Tissue_{water} = C_w \times BCF$$

Where:

Tissue_{water} = Concentration of POPC in tissue attributed to uptake from surface water (mg/kg dw)

C_w = Concentration of POPC in surface water (mg/L)

BCF = Bioconcentration factor (L/kg dw)

Site-specific BCFs were derived for fish using measured baseline fish tissue data collected from the LSA and baseline surface water concentrations. Literature BCFs for aquatic plants and invertebrates from the US EPA (1999) and Argonne National Laboratory (2001) were used. The BCFs can be found in Table F1-11 (Attachment F1). The EPCs for aquatic food items can be found in Table F1-1 (Attachment F1).

Example 2-24: Accumulation of Total Mercury from Surface Water by Fish (Operations)

$$Fish_{water} = 3.68 \times 10^{-6} \text{ mg/L} \times 1.69 \times 10^5 \text{ L/kg}$$

$$Fish_{water} = 6.21 \times 10^{-1} \text{ mg/kg}$$

Example 2-25: Accumulation of Total Mercury from Surface Water by Aquatic Invertebrates (Operations)

$$Aquatic\ Invert_{water} = 3.68 \times 10^{-6} \text{ mg/L} \times 2.00 \times 10^4 \text{ L/kg}$$

$$Aquatic\ Invert_{water} = 7.36 \times 10^{-2} \text{ mg/kg}$$

Example 2-26: Accumulation of Total Mercury from Surface Water by Aquatic Plants (Operations)

$$Aquatic\ Plant_{water} = 3.68 \times 10^{-6} \text{ mg/L} \times 7.22 \times 10^4 \text{ L/kg}$$

$$Aquatic\ Plant_{water} = 2.66 \times 10^{-1} \text{ mg/kg}$$

2.4 WILDLIFE EXPOSURE ESTIMATES

Wildlife exposure estimates were determined using a multi-media (food chain) model (Attachment F1). The exposure estimates were then used to evaluate risks to wildlife in the LSA from the Project.

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Additionally, tissue POPC concentrations for wildlife species relevant to human consumption were estimated in the food chain model. The tissue concentrations were used in the human health multi-media model to estimate the potential risk to human health from the consumption of wild game in the LSA.

The following exposure pathways were included in the calculation of wildlife exposure estimates: soil contact (including incidental soil ingestion and dust inhalation), incidental sediment ingestion, surface water ingestion, and food ingestion. The exposure estimates were calculated based on receptor-specific parameters such as ingestion rates and dietary preferences (see Section 2.1), parameter speciation (applicable to mercury; see Section 2.2) and the EPCs of POPCs in environmental media (e.g., surface water, soil, sediment, terrestrial vegetation, terrestrial invertebrates, small mammals, aquatic plants, aquatic invertebrates and fish; see Section 2.3).

Further details on the calculation of wildlife exposure estimates are provided below and are based on CCME (2020). The wildlife exposure estimates expressed as estimated daily intakes (EDIs) of POPCs (mg/day) are provided in Table F1-2 (Attachment F1). Sample calculations are presented for the belted kingfisher exposed to methylmercury during the operations phase.

2.4.1 SOIL CONTACT

Exposure by wildlife from direct contact with soil was determined for the incidental ingestion and dust inhalation pathways.

2.4.1.1 SOIL INGESTION

Soil ingestion exposures were calculated from incidental soil ingestion rates and soil concentrations. For mercury, the proportion of methylmercury in soil was also applied in the calculation. The following equation was used:

$$EDI_{soil-ing} = C_s \times IR_s \times CA$$

Where:

$EDI_{soil-ing}$	= Estimated daily intake of POPC from soil ingestion (mg/day)
C_s	= POPC concentration in soil (mg/kg)
IR_s	= Soil ingestion rate (kg/day)
CA	= Parameter apportionment (unitless, applicable to mercury)

Example 2-27: Methylmercury Exposure from Soil Ingestion for the Belted Kingfisher (Operations)

$$EDI_{soil-ing} = 4.81 \times 10^{-2} \text{ mg/kg} \times 0.0 \text{ kg/day} \times 0.02$$

$$EDI_{soil-ing} = 0.0 \text{ mg/day}$$

For the belted kingfisher, the soil ingestion rate was assumed to be zero because it only feeds from the aquatic environment (Section 2.1).

2.4.1.2 DUST INHALATION

Dust inhalation exposures were calculated from inhalation rates and dust concentrations in air. For mercury, the proportion of methylmercury in dust (assumed to be the same as for soil) was also applied in the calculation. The following equation was used:

$$EDI_{dust-inh} = C_{dust} \times IR_A \times CA$$

Where:

$EDI_{dust-inh}$	= Estimated daily intake of POPC from dust inhalation (mg/day)
C_{dust}	= POPC concentration in dust (mg/m ³)

IR_A = Dust inhalation rate (m³/day)
CA = POPC apportionment (unitless, applicable to mercury)

Example 2-28: Methylmercury Exposure from Dust Inhalation for the Belted Kingfisher (Operations)

$$EDI_{dust-inh} = 3.65 \times 10^{-11} mg/m^3 \times 0.094 m^3/day \times 0.02$$

$$EDI_{dust-inh} = 6.86 \times 10^{-14} mg/day$$

2.4.2 SEDIMENT INGESTION

Incidental sediment ingestion exposures were estimated from sediment ingestion rates and baseline sediment concentrations. For mercury, the proportion of methylmercury in sediment was also applied in the calculation. The following equation was used:

$$EDI_{sed-ing} = C_{Sed} \times IR_{Sed} \times CA$$

Where:

EDI_{sed-ing} = Estimated daily intake of POPC from sediment ingestion (mg/day)
C_{Sed} = POPC concentration in sediment (mg/kg)
IR_{Sed} = sediment ingestion rate (kg/day)
CA = Parameter apportionment (unitless, applicable to mercury)

Example 2-29: Methylmercury Exposure from Sediment Ingestion for the Belted Kingfisher (Operations)

$$EDI_{sed-ing} = 1.21 \times 10^{-1} mg/kg \times 0.0 kg/day \times 0.05$$

$$EDI_{sed-ing} = 0.0 mg/day$$

2.4.3 SURFACE WATER INGESTION

Exposures from surface water ingestion were estimated from water ingestion rates and surface water concentrations. For mercury, the proportion of methylmercury in surface water was also applied in the calculation. The following equation was used.

$$EDI_{water-ing} = C_W \times IR_W \times CA$$

Where:

EDI_{water-ing} = Estimated daily intake of POPC from surface water ingestion (mg/day)
C_W = POPC concentration in surface water (mg/L)
IR_W = Water ingestion rate (L/day)
CA = Parameter apportionment (unitless, applicable to mercury)

Example 2-30: Methylmercury Exposure from Surface Water Ingestion for the Belted Kingfisher (Operations)

$$EDI_{water-ing} = 3.68 \times 10^{-6} mg/L \times 0.016 L/day \times 0.041$$

$$EDI_{water-ing} = 2.47 \times 10^{-9} mg/day$$

2.4.4 FOOD INGESTION

Food ingestion exposures were estimated from food ingestion rates, dietary proportions of each food item and tissue concentrations of each food item. For mercury, the proportion of methylmercury in each food item was also applied in the calculation. Food items included in the food chain model included browse, lichen, berries, aquatic invertebrates, arthropods, earthworms, small mammals, aquatic plants and fish. The following equation was used to calculate the estimated daily intake of POPCs from each individual food item:

$$EDI_{Food(i)} = C_{f(i)} \times P(i) \times FIR \times CA$$

The calculated estimated daily intakes from each individual food item were then summed to provide the estimated daily intake from total food ingestion, as follows:

$$EDI_{Food} = \sum EDI_{Food(i)}$$

Where:

EDI_{Food}	= Estimated daily intake of POPC from total food ingestion (mg dw/day)
$EDI_{Food(i)}$	= Estimated daily intake of POPC from ingestion of food item (i) (mg dw/day)
$C_{f(i)}$	= Concentration of POPC in food item (i) (mg dw/kg)
P_i	= Proportion of food item (i) in diet (unitless)
FIR	= Food ingestion rate (kg dw food/day)
CA	= Parameter apportionment (unitless, applicable to mercury)

Example 2-31: Methylmercury Exposure from Browse Ingestion for the Belted Kingfisher (Operations)

$$EDI_{browse} = 7.06 \times 10^{-2} \text{ mg/kg} \times 0.0 \times 0.017 \text{ kg dw/day} \times 0.019$$

$$EDI_{browse} = 0.0 \text{ mg dw/day}$$

Example 2-32: Methylmercury Exposure from Lichen Ingestion for the Belted Kingfisher (Operations)

$$EDI_{lichen} = 1.43 \times 10^{-2} \text{ mg/kg} \times 0.0 \times 0.017 \text{ kg dw/day} \times 0.017$$

$$EDI_{lichen} = 0.0 \text{ mg dw/day}$$

Example 2-33: Methylmercury Exposure from Berry Ingestion for the Belted Kingfisher (Operations)

$$EDI_{berry} = 9.54 \times 10^{-3} \text{ mg/kg} \times 0.0 \times 0.017 \text{ kg dw/day} \times 0.036$$

$$EDI_{berry} = 0.0 \text{ mg dw/day}$$

Example 2-34: Methylmercury Exposure from Aquatic Invertebrate Ingestion for the Belted Kingfisher (Operations)

$$EDI_{aquatic-invert} = 7.36 \times 10^{-2} \text{ mg/kg} \times 0.0 \times 0.017 \text{ kg dw/day} \times 0.576$$

$$EDI_{aquatic-invert} = 0.0 \text{ mg dw/day}$$

Example 2-35: Methylmercury Exposure from Arthropod Ingestion for the Belted Kingfisher (Operations)

$$EDI_{arthropod} = 3.52 \times 10^{-1} \text{ mg/kg} \times 0.0 \times 0.017 \text{ kg dw/day} \times 0.148$$

$$EDI_{arthropod} = 0.0 \text{ mg dw/day}$$

Example 2-36: Methylmercury Exposure from Earthworm Ingestion for the Belted Kingfisher (Operations)

$$EDI_{earthworm} = 3.52 \times 10^{-1} mg/kg \times 0.0 \times 0.017 kg \text{ dw/day} \times 0.148$$

$$EDI_{earthworm} = 0.0 \text{ mg dw/day}$$

Example 2-37: Methylmercury Exposure from Small Mammal Ingestion for the Belted Kingfisher (Operations)

$$EDI_{mammal} = 2.59 \times 10^{-3} mg/kg \times 0.0 \times 0.017 kg \text{ dw/day} \times 0.10$$

$$EDI_{mammal} = 0.0 \text{ mg dw/day}$$

Example 2-38: Methylmercury Exposure from Aquatic Plant Ingestion for the Belted Kingfisher (Operations)

$$EDI_{aquatic-plant} = 2.66 \times 10^{-1} mg/kg \times 0.0 \times 0.017 kg \text{ dw/day} \times 0.17$$

$$EDI_{aquatic-plant} = 0.0 \text{ mg dw/day}$$

Example 2-39: Methylmercury Exposure from Fish Ingestion for the Belted Kingfisher (Operations)

$$EDI_{fish} = 6.21 \times 10^{-1} mg/kg \times 1.0 \times 0.017 kg \text{ dw/day} \times 0.85$$

$$EDI_{fish} = 8.79 \times 10^{-3} mg \text{ dw/day}$$

Example 2-40: Total Methylmercury Exposure from Food Ingestion for the Belted Kingfisher (Operations)

$$EDI_{food} = 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 0.0 \frac{mg \text{ dw}}{day} + 8.79 \times 10^{-3} \frac{mg \text{ dw}}{day}$$

$$EDI_{food} = 8.79 \times 10^{-3} mg \text{ dw/day}$$

2.4.5 TOTAL DAILY INTAKE

Total estimated daily intake of POPCs by wildlife was calculated by summing the estimated daily intakes for each exposure pathway (i.e., soil ingestion, dust inhalation, sediment ingestion, water ingestion, food ingestion), as follows:

$$EDI_{total} = EDI_{soil-ing} + EDI_{dust-inh} + EDI_{sed-ing} + EDI_{water-ing} + EDI_{food}$$

Where:

- EDI_{Total} = Estimated total daily intake of POPC (mg dw/day)
- EDI_{soil-ing} = Estimated daily intake of POPC from incidental ingestion of soil (mg dw/day)
- EDI_{dust-inh} = Estimated daily intake of POPC from dust inhalation (mg dw/day)
- EDI_{sed-ing} = Estimated daily intake of POPC from incidental ingestion of sediment (mg dw/day)
- EDI_{water-ing} = Estimated daily intake of POPC from ingestion of water (mg dw/day)
- EDI_{food} = Estimated daily intake of POPC from total food ingestion (mg dw/day)

Example 2-41: Total Daily Intake of Methylmercury for the Belted Kingfisher (Operations)

$$EDI_{total} = 0.0 \text{ mg dw/day} + 6.85 \times 10^{-14} \text{ mg dw/day} + 0.0 \text{ mg dw/day} + 2.47 \times 10^{-9} \text{ mg dw/day}$$

$$+ 8.79 \times 10^{-3} \text{ mg dw/day}$$

$$EDI_{total} = 8.79 \times 10^{-3} mg dw/day$$

2.4.6 EXPOSURE DOSES

Wildlife exposure estimates must be normalized to body weight for comparison to TRVs (expressed in mg/kg-bw/day) in order to characterize risks. The estimated daily intakes (in mg dw/day) were converted to exposure doses (in mg/kg bw/day) based on the body weight of the wildlife receptor as follows:

$$Dose_{total} = \frac{EDI_{total}}{BW}$$

Where:

Dose_{total} = Total exposure dose (mg/kg-bw/day)

EDI_{total} = Total estimated daily intake of POPC for all media (mg dw/day)

BW = Body weight (kg)

Example 3-19: Total Methylmercury Exposure Dose for the Belted Kingfisher (Operations)

$$Dose_{total} = \frac{8.79 \times 10^{-3} mg/day}{0.148 kg}$$

$$Dose_{total} = 5.94 \times 10^{-2} mg/kg - bw/day$$

Exposure doses are provided in Table F1-5, Attachment F1.

2.5 WILD GAME TISSUE CONCENTRATIONS

Wild game tissue concentrations were used in the human health multi-media model to predict a daily dose for a human receptor. The wild game tissue concentrations (mg/kg of wet weight) were calculated in the wildlife food chain model by using biotransfer factors (BTFs) and the total daily intake of a POPC (mg/day) following guidance from the US EPA (2005). Full details on the BTFs and calculation of tissue concentrations are provided in Attachment E. Selected BTFs used to calculate tissue concentrations are presented in Table F1-15 and POPC concentrations in wild game tissues can be found in Table F1-4 (Attachment F1).

3 TOXICITY ASSESSMENT

Toxicity assessment involves the classification of the toxic effects and the identification of toxicity reference values (TRVs) for POPCs. A TRV is an estimate of the amount of a POPC that wildlife receptors can be exposed to over a given time without experiencing adverse health effects. A TRV is used as the effects threshold for evaluation of an exposure dose to quantitatively estimate wildlife health risks from the POPC.

Toxicity reference values were identified for mammals and birds for two different levels of protection:

- 1) **No-observed adverse effect level (NOAEL)-TRVs.** NOAEL-TRVs are more protective than lowest-observed adverse effect level (LOAEL)-TRVs (see below). NOAEL-TRVs were used for listed wildlife species or species at risk. NOAEL-TRVs were considered to represent minimal to low effect levels.
- 2) **LOAEL-TRVs.** LOAEL-TRVs were used for all non-listed (or common) wildlife species. LOAEL-TRVs were considered to represent low to moderate effects.

Only mercury was identified as a POPC for wildlife. The derivations of the NOAEL- and LOAEL-TRVs for inorganic and organic (methyl) mercury are summarized below.

The TRVs were adopted from federal (CCME and FCSAP), provincial (Ministry of the Environment Conservation and Parks [MECP]) regulatory agencies, and other sources commonly used in risk assessment (e.g., Sample et al. 1996) and the primary literature (e.g., Fuchsman et al. 2017). The CCME provides TRVs for mammals and birds for methylmercury but not for inorganic mercury. FCSAP provides TRVs for mammals and birds for inorganic mercury; however, the source of the selected TRVs (CEAEQ 2012) could not be obtained for review; therefore, these TRVs were not considered in the ERA. The MECP provides TRVs (LOAELs) for mammals and birds for both inorganic and methylmercury, which were adopted from Sample et al. (1996). The selected TRVs are based on survival, growth and reproduction endpoints because protection of these endpoints will establish population viability (CCME 2020).

Selected TRVs, including their derivations can be found in Table F-6.

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Table F-4 Toxicity Reference Values for Mammals and Birds

Receptor Group	POPC	NOAEL		LOAEL	
		TRV (mg/kg-bw/day)	Reference / Comment	TRV (mg/kg-bw/day)	Reference / Comment
Mammals	Inorganic Mercury	1.00	<p>A NOAEL of 1 mg Hg/kg bw/day was reported for effects on reproduction (i.e., kit weight, fertility, and kit survival) in mink that were exposed to 1.01 mg Hg/kg bw/day (as mercuric chloride) in their diet throughout gestation for six months (Aulerich et al. 1974; as cited in Sample et al. 1996).</p> <p>A significant reduction in kit body weight at birth was noted by Aulerich et al. (1974) at an exposure dose of 10 ppm mercuric chloride (1 mg Hg/kg bw/day); however, the authors indicated that “the reduction in kit weight at birth from mink fed mercuric chloride is without explanation at this time” and say that “10 parts per million of mercuric chloride in the diet for five months did not produce adverse effects”.</p> <p>The reduction in kit body weight at birth at the exposure dose of 1 mg Hg/kg bw/day was approximately 9% relative to controls. Because the effect was less than 10% and there was no significant difference in body weight from controls by 4 weeks of age, the 1 mg Hg/kg bw/day exposure dose was considered a NOAEL in the ERA.</p> <p>It is noted that the MECP (2011) used the effect level of 1 mg Hg/kg bw/day as a LOAEL in the development of the Ontario soil and groundwater standards. This approach was not taken in the ERA for the reasons described above.</p>	10.0	<p>The LOAEL was derived by applying a 10-fold uncertainty factor to the NOAEL based on LANL (2024) guidance.</p>

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Receptor Group	POPC	NOAEL		LOAEL	
		TRV (mg/kg-bw/day)	Reference / Comment	TRV (mg/kg-bw/day)	Reference / Comment
Mammals	Methylmercury	0.08	<p>NOAEL for survival of mink fed natural fish diets containing MeHg (Chamberland 1996 and Laperle et al. 1998; as cited in CCME 2000). There were no clinical signs of toxicity, neurological damage or reproductive effects in mink that consumed up to 80 µg/kg bw/day (0.08 mg/kg bw/day).</p> <p>The NOAEL is the same value used by the CCME (2000) in the derivation of the tissue-based guidelines for MeHg for mammals.</p>	0.14	<p>LOAEL for survival of mink fed natural fish diets containing MeHg (Chamberland 1996 and Laperle et al. 1998; as cited in CCME 2000). Mink fed 144 µg/kg bw/day (0.14 mg/kg bw/day) showed signs of neurotoxicity and died (over 50% of mink).</p> <p>The LOAEL is the same value used by the CCME (2000) in the derivation of the tissue-based guideline for MeHg for mammals.</p> <p>The LOAEL is similar to the LOAEL used by the MECP in the development of the Ontario soil and groundwater standards (2011; 0.16 mg/kg bw/day).</p>
Birds	Inorganic Mercury	0.45	<p>A NOAEL of 0.45 mg Hg/kg bw/day (4 mg Hg/kg) was reported for effects on reproduction (i.e., fertility, hatchability) in Japanese quail exposed to mercury (as mercuric chloride) in the diet at five dose levels (2, 4, 8, 16 and 32 mg Hg/kg) for one year (chronic) (Hill and Schaffner 1976; as cited in Sample et al 1996).</p>	0.90	<p>A LOAEL of 0.90 mg Hg/kg bw/day (8 mg Hg/kg) was reported for effects on reproduction (i.e., fertility, hatchability) in Japanese quail exposed to mercury (as mercuric chloride) in the diet at five dose levels (2, 4, 8, 16 and 32 mg Hg/kg) for one year (chronic) (Hill and Schaffner 1976; as cited in Sample et al 1996).</p> <p>The LOAEL is the same used by the MECP in the development of the Ontario soil and groundwater standards (2011; 0.9 mg/kg bw/day).</p>

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Receptor Group	POPC	NOAEL		LOAEL	
		TRV (mg/kg-bw/day)	Reference / Comment	TRV (mg/kg-bw/day)	Reference / Comment
Birds	Methylmercury	0.031	TDI used by the CCME (2000) in the derivation of the tissue-based guideline for MeHg for birds. The TDI is the geometric mean of the LOAEL (75 µg/kg bw/day) and NOAEL (13 µg/kg bw/day; calculated by dividing the LOAEL by 5.6) without application of an uncertainty factor. The CCME (2000) did not apply an uncertainty factor because the study that forms the basis of the effect levels was chronic (three generations) with a Canadian species (mallard) fed MeHg at doses found in wild fish. At a dose of 75 µg/kg bw/day, effects were seen on nesting behaviour of adults in the second generation, and growth and survival were decreased in their offspring. In the offspring of third generation ducks, behavioural effects that were ecologically relevant were observed.	0.050	Lowest EC20 / effects threshold / LOAEL for birds (Fuchsman et al. 2017). Fuchsman et al. (2017) conducted a comprehensive literature review of reproductive effects in birds from dietary exposure to MeHg. The review was conducted to identify effect thresholds for MeHg that could be used to support ecological risk assessments. Effect thresholds ranged from 0.05 to 0.5 mg/kg bw/day. The lowest value in the range (0.05 mg/kg bw/day) was selected as the LOAEL for the ERA.

Notes:

% = percent; µg/kg bw/day = micrograms per kilogram of body weight per day; bw = body weight; EC20 = effective concentration to induce a 20% effect; ERA = ecological risk assessment; Hg = mercury; LOAEL = lowest observed adverse effect level; MECP = Ministry of the Environment, Conservation and Parks; mg/kg-bw/day = milligrams per kilogram of body weight per day; MeHg = methylmercury; NOAEL = no observed adverse effect level; POPC = parameter of potential concern; TDI = tolerable daily intake; TRV = toxicity reference value.

4 RISK CHARACTERIZATION

Risk characterization combines the findings of the exposure assessment with the findings of the toxicity assessment to determine the potential for adverse effects, or risks, to ecological receptors using quantitative or qualitative methods. The characterization of risks also includes consideration of the uncertainty and conservatism in the ERA.

For mammals and birds, the risk characterization used a quantitative method to estimate overall risks from exposure to Project-influenced media by calculating a hazard quotient (HQ). The HQ is a unitless value, defined as the ratio of the exposure dose to the TRV. In general, if the HQ is less than 1.0, no unacceptable risks to ecological receptors would be expected, because concentrations are below levels known to cause adverse effects. Conversely, if the HQ is above 1.0, it may be inferred that adverse effects on individuals and/or populations, are possible. Further details on the interpretation of HQs are provided in the HHERA report .

The food chain model calculated HQs using both the NOAEL and LOAEL TRVs for all species. For species that are listed as species at risk, the HQ based on the NOAEL-TRV was used to characterize risks. For all other species, the HQ based on the LOAEL-TRV was used to characterize risks. Hazard quotients for POPCs were calculated by dividing the exposure dose by the TRV as follows:

$$HQ = \frac{Dose}{TRV}$$

Where:

HQ = Hazard quotient (unitless)

Dose = Exposure dose (mg/kg-bw/day)

TRV = Toxicity reference value (mg/kg-bw/day)

Example 3-20: Methylmercury Hazard Quotient (based on NOAEL TRV) for the Belted Kingfisher (Operations)

$$HQ = \frac{0.0594 \text{ mg/kg} - \text{bw/day}}{0.031 \text{ mg/kg} - \text{bw/day}}$$

$$HQ = 1.9$$

Example 3-21: Methylmercury Hazard Quotient (based on LOAEL TRV) for the Belted Kingfisher (Operations)

$$HQ = \frac{0.0594 \text{ mg/kg} - \text{bw/day}}{0.050 \text{ mg/kg} - \text{bw/day}}$$

$$HQ = 1.2$$

Hazard quotients are provided in Table F1-5 and Table F1-6 in Attachment F1.

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**Sub-Attachment F1
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and Food Chain Model Inputs,
Calculations, and Outputs**



ATTACHMENT F1: ECOLOGICAL RISK ASSESSMENT MODEL

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In the ERA model the assessment cases are represented by the following terms:

Base = baseline

Construction = baseline + incremental concentrations from construction phase

Project = baseline + incremental concentrations from operations phase

Closure = baseline + incremental concentrations from closure phase

Post Closure = baseline + incremental concentrations from post-closure phase

Construction-Base = incremental concentrations from construction phase alone

Project-Base = incremental concentrations from operations phase alone

Closure-Base = incremental concentrations from closure phase alone

Post Closure-Base = incremental concentrations from post-closure phase alone

Abbreviations:

% = Percent

µg/g = microgram per gram

AIR = Air inhalation rate

Aq_inverts = Aquatic invertebrates

Aq_Plant = Aquatic plant

BaBEEF = Biotransfer factor of beef

Bapoult = Biotransfer factor of poultry

BAF = Bioaccumulation factor

BCF = Bioconcentration factor

BTF = Biotransfer factor

BW = Body weight

day/kg WW = day per kilogram wet weight

DW = Dry weight

FIR = Food ingestion rate
FNFNES = First Nations Food, Nutrition, and Environment Study
HQ = Hazard quotient
kg-DW/m² = kilograms dry weight per square metre
kg-DW/m² = kilograms dry weight per square metre
kp = Plant surface loss coefficient
ks = Soil loss constant
LN = Natural logarithm
LOAEL = Lowest observed adverse effect level
m² = Square metre
MC = Moisture content
mg/day = Milligram per day
mg/kg = Milligram per kilogram
mg/kg-WW = Milligram per kilogram wet weight
mg/kg/day = Milligram per kilogram per day
mg/kg-BW/day = Milligram per kilogram of body weight
mg/kg-DW = milligram per kilogram dry weight
mg/L = milligram per litre
mg/m²/year = milligram per square meter per year
mg/m³ = milligram per cubic meter
NOAEL = No observed adverse effect level
P_SEDIR = Percent sediment ingestion as a proportion of aquatic food
P_SIR = Percent soil ingestion as a proportion of terrestrial food
POPC = Parameter of potential concern
Prop_Aq = Percentage of diet that is aquatic
Prop_Terr = Percentage of diet that is terrestrial
Rp = Intercept fraction
Sed&Soil = Total percentage of ingested sediment and soil
SEDIR = Sediment ingestion rate
SIR = Soil ingestion rate
Sm_Mammal = small mammal
T_Invert_Arthro = Terrestrial arthropod
T_Invert_Worm = Earthworm
tp = Length of time of plant exposure
TRV = Toxicity reference value
WIR = Water ingestion rate
WW = Wet weight
Yp = Yield of plant
yr = Years

Table F1-1: Exposure Point Concentrations Used to Predict Wildlife Exposure

Case	Parameter	Deposition			Soil			Surface Soil			Dust			Surface Water			Sediment	Browse			Lichen			Lichen	Aq. Inverts	T. Invert. Arthr	T. Invert. Worm	Sm. Mammal	Fish	Aq. Plant	Berries	Berries	Berries						
		Measured	Deposition	Soil	Soil	Surface Soil	Surface Soil	Surface Soil	Surface Soil	Total	Dust	Surface Water	Dust	Soil	Deposition	Total		Baseline	Deposition	Total	Soil	Soil	Soil											Soil	Soil	Soil	Soil	Soil	Soil
		(mg/m ² /year)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/m ³)	(mg/L)	(mg/m ³)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)		(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)											(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)	(mg/kg-DW)
Base	Arsenic	0.00E+00	1.46E+01	0.00E+00	0.00E+00	1.46E+01	0.00E+00	0.00E+00	0.00E+00	1.11E+08	1.19E-02	1.40E+01	6.19E-01	0.00E+00	6.19E-01	2.96E-01	0.00E+00	2.96E-01	0.00E+00	2.96E-01	3.57E+00	1.04E+00	7.05E-02	1.38E+00	1.62E+01	1.68E-01	0.00E+00	1.68E-01	0.00E+00	1.68E-01									
Base	Mercury	0.00E+00	4.76E-02	0.00E+00	0.00E+00	4.76E-02	0.00E+00	0.00E+00	0.00E+00	4.76E-02	3.62E-11	3.41E-06	1.21E-01	7.05E-02	0.00E+00	7.05E-02	1.40E-02	0.00E+00	1.40E-02	6.92E-02	3.52E-01	3.52E-01	2.59E-03	5.75E-01	2.46E-01	9.52E-03	0.00E+00	9.52E-03											
Base	Selenium	0.00E+00	2.20E-01	0.00E+00	0.00E+00	2.20E-01	0.00E+00	0.00E+00	0.00E+00	2.20E-01	1.67E-10	2.29E-04	1.21E+00	9.54E-02	0.00E+00	9.54E-02	9.80E-02	0.00E+00	9.80E-02	3.89E-02	3.08E-01	3.08E-01	3.73E-01	1.73E+00	1.23E+00	5.50E-03	0.00E+00	5.50E-03											
Construction	Arsenic	4.01E+00	1.46E+01	3.85E-02	3.85E-02	1.46E+01	1.46E+01	3.85E-01	3.85E-01	1.50E+01	1.14E-08	1.19E-02	1.40E+01	6.20E-01	4.10E-01	1.03E+00	2.96E-01	2.06E+00	2.36E+00	3.57E+00	1.61E+00	7.07E-02	1.38E+00	1.02E+01	1.69E-01	4.42E-02	2.13E-01	4.42E-02	2.13E-01										
Construction	Mercury	1.32E-03	4.76E-02	1.27E-05	1.27E-05	4.76E-02	1.27E-04	4.77E-02	3.63E-11	3.84E-06	1.21E-01	7.05E-02	1.35E-04	7.06E-02	1.40E-02	6.77E-04	1.47E-02	6.80E-02	3.08E-01	3.08E-01	3.52E-01	2.59E-03	6.48E-01	2.77E-01	9.52E-03	1.45E-05	9.54E-03												
Construction	Selenium	4.68E-02	2.20E-01	4.50E-04	4.50E-04	2.20E-01	4.50E-03	4.50E-03	2.24E-01	1.71E-10	2.31E-04	1.21E+00	9.58E-02	4.79E-03	1.00E-01	8.80E-02	2.41E-02	1.22E-01	3.93E-02	3.08E-01	3.08E-01	3.73E-01	1.75E+00	1.24E+00	5.51E-03	5.16E-04	6.03E-03												
Operations	Arsenic	1.75E+00	1.46E+01	1.09E-01	1.48E-01	1.47E+01	1.46E+01	1.09E+00	1.48E+00	1.61E+01	1.22E-08	1.19E-02	1.40E+01	6.22E-01	1.79E-01	8.01E-01	2.96E-01	8.98E-01	1.19E+00	3.57E+00	1.05E+00	1.61E+00	7.11E-02	1.38E+00	1.02E+01	1.70E-01	1.32E-02	1.89E-01											
Operations	Mercury	5.73E-04	4.76E-02	3.58E-05	4.85E-05	4.76E-02	3.58E-04	4.85E-04	4.81E-02	3.65E-11	3.68E-06	1.21E-01	7.05E-02	5.87E-05	7.06E-02	1.40E-02	2.96E-04	1.43E-02	7.36E-02	3.52E-01	3.52E-01	2.59E-03	6.21E-01	2.66E-01	9.53E-03	6.32E-06	9.54E-03												
Operations	Selenium	2.04E-02	2.20E-01	1.27E-03	1.72E-03	2.20E-01	1.27E-02	2.37E-01	1.80E-10	2.36E-04	1.21E+00	9.62E-02	2.09E-03	9.83E-02	8.80E-02	1.05E-02	1.08E-01	4.01E-02	3.08E-01	3.08E-01	3.74E-01	1.79E+00	1.27E+00	5.54E-03	2.25E-04	5.77E-03													
Closure	Arsenic	4.01E+00	1.46E+01	3.85E-02	3.85E-02	1.46E+01	1.46E+01	3.85E-01	3.85E-01	1.50E+01	1.14E-08	1.19E-02	1.40E+01	6.21E-01	4.10E-01	1.03E+00	2.96E-01	2.06E+00	2.36E+00	3.57E+00	1.05E+00	1.61E+00	7.08E-02	1.38E+00	1.02E+01	1.69E-01	4.42E-02	2.13E-01											
Closure	Mercury	1.32E-03	4.76E-02	1.27E-05	1.27E-05	4.76E-02	1.27E-04	4.82E-02	3.66E-11	3.40E-06	1.21E-01	7.05E-02	1.35E-04	7.06E-02	1.40E-02	6.77E-04	1.47E-02	6.80E-02	3.08E-01	3.08E-01	3.52E-01	2.59E-03	6.48E-01	2.77E-01	9.52E-03	1.45E-05	9.54E-03												
Closure	Selenium	4.68E-02	2.20E-01	4.50E-04	4.89E-04	2.24E-01	2.20E-01	4.50E-03	2.17E-02	2.42E-01	1.84E-10	2.48E-04	1.21E+00	9.58E-02	4.79E-03	1.01E-01	8.80E-02	2.41E-02	1.22E-01	4.22E-02	3.07E-01	3.07E-01	3.74E-01	1.88E+00	1.33E+00	5.52E-03	5.16E-04	6.04E-03											
Post Closure	Arsenic	0.00E+00	1.46E+01	0.00E+00	7.70E-02	1.47E+01	1.46E+01	0.00E+00	1.86E+00	1.65E-01	1.25E-08	1.19E-02	1.40E+01	6.21E-01	4.10E-01	1.03E+00	2.96E-01	0.00E+00	2.96E-01	3.57E+00	1.05E+00	1.61E+00	7.08E-02	1.38E+00	1.02E+01	1.69E-01	0.00E+00	1.69E-01											
Post Closure	Mercury	0.00E+00	4.76E-02	0.00E+00	2.53E-05	4.76E-02	0.00E+00	1.86E+00	1.65E-01	1.25E-08	1.19E-02	1.40E+01	6.21E-01	4.10E-01	1.03E+00	2.96E-01	0.00E+00	1.40E-02	6.52E-02	3.52E-01	2.59E-03	5.50E-01	2.35E-01	9.53E-03	0.00E+00	9.53E-03													
Post Closure	Selenium	0.00E+00	2.20E-01	0.00E+00	8.99E-04	2.21E-01	2.20E-01	0.00E+00	2.17E-02	2.42E-01	1.84E-10	2.74E-04	1.21E+00	9.58E-02	0.00E+00	9.58E-02	0.00E+00	8.80E-02	4.68E-02	3.07E-01	3.07E-01	3.74E-01	2.07E+00	1.47E+00	5.52E-03	0.00E+00	5.52E-03												
Construction-Base	Arsenic	4.01E+00	0.00E+00	3.85E-02	3.85E-02	0.00E+00	3.85E-01	3.85E-01	3.85E-01	2.93E-10	1.47E-03	0.00E+00	2.17E-02	4.10E-01	4.32E-01	2.96E-01	2.06E+00	2.36E+00	4.40E-01	4.17E-03	2.42E-02	5.45E-04	1.70E-01	1.25E+00	4.44E-04	4.42E-02	4.46E-02												
Construction-Base	Mercury	1.32E-03	0.00E+00	1.27E-05	1.27E-05	0.00E+00	1.27E-04	1.27E-04	1.27E-04	9.62E-14	4.36E-07	0.00E+00	8.00E-04	1.35E-04	1.35E-04	1.40E-02	6.77E-04	1.47E-02	6.71E-03	1.33E-01	1.33E-01	6.87E-07	7.35E-02	3.15E-02	2.53E-06	1.45E-05	1.71E-05												
Construction-Base	Selenium	4.68E-02	0.00E+00	4.50E-04	4.50E-04	0.00E+00	4.50E-03	4.50E-03	4.50E-03	3.42E-12	1.15E-05	0.00E+00	1.02E-04	4.79E-03	4.89E-03	9.80E-02	2.41E-02	1.22E-01	1.85E-03	3.27E-03	3.27E-03	3.63E-02	6.87E-02	6.19E-02	1.12E-06	5.16E-04	5.27E-04												
Operations-Base	Arsenic	1.75E+00	0.00E+00	0.00E+00	3.85E-02	1.09E+00	1.48E+00	1.48E+00	1.12E-09	1.34E-03	0.00E+00	2.17E-02	1.19E-01	2.00E-01	2.96E-01	8.98E-01	1.19E+00	4.01E-01	4.17E-03	2.42E-02	5.45E-04	1.54E-01	1.14E+00	4.44E-04	1.98E-02	1.97E-02													
Operations-Base	Mercury	5.73E-04	0.00E+00	0.00E+00	1.27E-05	1.27E-05	0.00E+00	3.58E-04	4.85E-04	3.68E-13	3.39E-07	0.00E+00	8.00E-04	5.87E-05	5.89E-04	1.40E-02	2.96E-01	1.43E-02	6.78E-03	1.33E-01	1.33E-01	6.87E-07	5.72E-02	2.45E-02	2.53E-06	6.32E-06	8.85E-06												
Operations-Base	Selenium	2.04E-02	0.00E+00	0.00E+00	4.50E-04	1.27E-02	1.72E-02	1.31E-11	2.60E-05	0.00E+00	1.02E-04	2.09E-03	2.19E-03	8.80E-02	1.05E-02	1.08E-01	4.42E-03	3.27E-03	3.27E-03	3.63E-02	1.97E-01	1.40E-01	1.12E-05	2.25E-04	2.36E-04														
Closure-Base	Arsenic	4.01E+00	0.00E+00	3.85E-02	7.70E-02	0.00E+00	3.85E-01	1.86E+00	1.86E+00	1.41E-09	3.09E-04	0.00E+00	3.21E-02	4.10E-01	4.42E-01	2.96E-01	2.06E+00	2.36E+00	9.27E-02	7.95E-03	3.95E-02	9.63E-04	3.57E-02	2.84E-01	6.88E-04	4.42E-02	4.51E-02												
Closure-Base	Mercury	1.32E-03	0.00E+00	1.27E-05	2.53E-05	0.00E+00	1.27E-04	6.11E-04	6.11E-04	6.65E-13	5.88E-07	0.00E+00	1.17E-03	1.35E-04	1.30E-03	1.40E-02	6.77E-04	1.47E-02	1.19E-02	1.45E-01	1.45E-01	1.37E-06	9.83E-02	4.25E-02	5.06E-06	1.45E-05	1.96E-05												
Closure-Base	Selenium	4.68E-02	0.00E+00	4.50E-04	8.99E-04	0.00E+00	4.50E-03	2.17E-02	2.17E-02	1.65E-11	2.77E-05	0.00E+00	2.20E-04	4.79E-03	5.01E-03	1.40E-02	2.41E-02	1.22E-01	4.70E-03	5.43E-03	5.43E-03	4.71E-02	2.09E-01	1.49E-01	2.25E-05	5.16E-04	5.39E-04												
Post Closure-Base	Arsenic	0.00E+00	0.00E+00	0.00E+00	7.70E-02	0.00E+00	0.00E+00	1.86E+00	1.86E+00	1.41E-09	2.56E-04	0.00E+00	3.21E-02	0.00E+00	3.21E-02	2.96E-01	0.00E+00	2.96E-01	7.88E-02	7.95E-03	3.95E-02	9.62E-04	2.96E-02	2.19E-01	8.88E-04	0.00E+00	8.88E-04												
Post Closure-Base	Mercury	0.00E+00	0.00E+00	0.00E+00	2.53E-05	0.00E+00	0.00E+00	6.11E-04	6.11E-04	4.65E-13	1.42E-06	0.00E+00	1.17E-03	0.00E+00	1.17E-03	1.40E-02	0.00E+00	1.40E-02	2.84E-02	1.45E-01	1.45E-01	1.37E-06	2.39E-01	1.02E-01	5.06E-06	0.00E+00	8.06E-06												
Post Closure-Base	Selenium	0.00E+00	0.00E+00	0.00E+00	8.99E-04	8.99E-04	0.00E+00	0.00E+00	2.17E-02	2.17E-02	1.65E-11	1.30E-04	0.00E+00	2.20E-04	0.00E+00	2.20E-04	9.80E-02	0.00E+00	9.80E-02	2.22E-02	5.43E-03	5.43E-03	4.71E-02	9.87E-01	7.01E-01	2.25E-05	0.00E+00	2.25E-05											

Table F1-3: Wildlife Estimated Daily Intakes as a Percentage of Total Exposure

Case	Parameter	Receptor	Speciation	Soil	Dust	Surface_water	Sediment	Browse	Lichen	A_inverts	T_invert_Arthro	T_invert_Worm	Sm_mammals	Fish	Aq_plants	Berries	Total	Total	Total	Total	Total	
				SIR	AIR	WIR	SEDIR	Soil	Air	A_inverts	T_invert_Arthro	T_invert_Worm	Sm_mammals	Surface Water	Surface Water	Soil	Soil	Sediment	Water	AIR	Diet	Total
				[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Base	Mercury	Beaver	Organic	0.01%	0.00%	0.00%	0.29%	1.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.64%	0.00%	0.01%	0.29%	0.00%	0.00%	99.70%	100.00%
Base	Selenium	Beaver	Total	0.11%	0.00%	0.22%	1.87%	2.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	95.34%	0.00%	0.11%	1.87%	0.22%	0.00%	97.80%	100.00%
Construction	Arsenic	Beaver	Total	0.91%	0.00%	1.35%	2.54%	3.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	92.09%	0.00%	0.91%	2.54%	1.35%	0.00%	95.20%	100.00%
Construction	Mercury	Beaver	Total	0.10%	0.00%	0.02%	0.80%	7.76%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	91.33%	0.00%	0.10%	0.80%	0.02%	0.00%	99.80%	100.00%
Construction	Mercury	Beaver	Inorganic	0.12%	0.00%	0.02%	0.93%	9.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	89.91%	0.00%	0.12%	0.93%	0.02%	0.00%	98.93%	100.00%
Construction	Mercury	Beaver	Organic	0.01%	0.00%	0.00%	0.25%	0.94%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.79%	0.00%	0.01%	0.25%	0.00%	0.00%	99.73%	100.00%
Construction	Selenium	Beaver	Total	0.11%	0.00%	0.22%	1.85%	2.57%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	95.25%	0.00%	0.11%	1.85%	0.22%	0.00%	97.81%	100.00%
Operations	Arsenic	Beaver	Total	0.98%	0.00%	1.36%	2.55%	2.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	92.67%	0.00%	0.98%	2.55%	1.36%	0.00%	95.11%	100.00%
Operations	Mercury	Beaver	Total	0.11%	0.00%	0.02%	0.83%	8.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	90.99%	0.00%	0.11%	0.83%	0.02%	0.00%	99.04%	100.00%
Operations	Mercury	Beaver	Inorganic	0.13%	0.00%	0.02%	0.97%	9.37%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	89.52%	0.00%	0.13%	0.97%	0.02%	0.00%	98.89%	100.00%
Operations	Mercury	Beaver	Organic	0.01%	0.00%	0.00%	0.26%	0.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.74%	0.00%	0.01%	0.26%	0.00%	0.00%	99.72%	100.00%
Operations	Selenium	Beaver	Total	0.12%	0.00%	0.22%	1.81%	2.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	95.38%	0.00%	0.12%	1.81%	0.22%	0.00%	97.85%	100.00%
Closure	Arsenic	Beaver	Total	0.99%	0.00%	1.35%	2.53%	3.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	92.01%	0.00%	0.99%	2.53%	1.35%	0.00%	95.12%	100.00%
Closure	Mercury	Beaver	Total	0.12%	0.00%	0.02%	0.89%	8.66%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	90.31%	0.00%	0.12%	0.89%	0.02%	0.00%	98.97%	100.00%
Closure	Mercury	Beaver	Inorganic	0.14%	0.00%	0.02%	1.04%	10.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	88.75%	0.00%	0.14%	1.04%	0.02%	0.00%	98.81%	100.00%
Closure	Mercury	Beaver	Organic	0.02%	0.00%	0.00%	0.29%	1.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.64%	0.00%	0.02%	0.29%	0.00%	0.00%	99.69%	100.00%
Closure	Selenium	Beaver	Total	0.12%	0.00%	0.22%	1.73%	2.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	95.53%	0.00%	0.12%	1.73%	0.22%	0.00%	97.93%	100.00%
Post Closure	Arsenic	Beaver	Total	1.01%	0.00%	1.37%	2.57%	1.90%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	93.16%	0.00%	1.01%	2.57%	1.37%	0.00%	95.06%	100.00%
Post Closure	Mercury	Beaver	Total	0.12%	0.00%	0.02%	0.93%	8.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	89.95%	0.00%	0.12%	0.93%	0.02%	0.00%	98.94%	100.00%
Post Closure	Mercury	Beaver	Inorganic	0.14%	0.00%	0.02%	1.08%	10.43%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	88.34%	0.00%	0.14%	1.08%	0.02%	0.00%	98.76%	100.00%
Post Closure	Mercury	Beaver	Organic	0.02%	0.00%	0.00%	0.30%	1.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.58%	0.00%	0.02%	0.30%	0.00%	0.00%	99.68%	100.00%
Post Closure	Selenium	Beaver	Total	0.10%	0.00%	0.22%	1.57%	2.08%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	96.02%	0.00%	0.10%	1.57%	0.22%	0.00%	98.10%	100.00%
Construction-Base	Arsenic	Beaver	Total	0.18%	0.00%	1.30%	0.00%	10.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	88.37%	0.00%	0.18%	0.00%	1.30%	0.00%	98.52%	100.00%
Construction-Base	Mercury	Beaver	Total	0.02%	0.00%	0.02%	0.00%	0.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.00%	0.00%	0.02%	0.00%	0.02%	0.00%	99.98%	100.00%
Construction-Base	Mercury	Beaver	Inorganic	0.00%	0.00%	0.02%	0.00%	1.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.82%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%
Construction-Base	Mercury	Beaver	Organic	0.00%	0.00%	0.00%	0.00%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.88%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
Construction-Base	Selenium	Beaver	Total	0.05%	0.00%	0.23%	0.00%	2.57%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.15%	0.00%	0.05%	0.00%	0.23%	0.00%	99.73%	100.00%
Operations-Base	Arsenic	Beaver	Total	0.80%	0.00%	1.36%	0.00%	5.41%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	92.43%	0.00%	0.80%	0.00%	1.36%	0.00%	97.84%	100.00%
Operations-Base	Mercury	Beaver	Total	0.01%	0.00%	0.02%	0.00%	1.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.81%	0.00%	0.01%	0.00%	0.02%	0.00%	99.97%	100.00%
Operations-Base	Mercury	Beaver	Inorganic	0.02%	0.00%	0.02%	0.00%	1.36%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.60%	0.00%	0.02%	0.00%	0.02%	0.00%	99.96%	100.00%
Operations-Base	Mercury	Beaver	Organic	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.86%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	100.00%
Operations-Base	Selenium	Beaver	Total	0.08%	0.00%	0.23%	0.00%	0.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.17%	0.00%	0.08%	0.00%	0.23%	0.00%	99.69%	100.00%
Closure-Base	Arsenic	Beaver	Total	2.90%	0.00%	0.91%	0.00%	34.48%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	61.71%	0.00%	2.90%	0.00%	0.91%	0.00%	98.19%	100.00%
Closure-Base	Mercury	Beaver	Total	0.01%	0.00%	0.02%	0.00%	1.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.96%	0.00%	0.01%	0.00%	0.02%	0.00%	99.97%	100.00%
Closure-Base	Mercury	Beaver	Inorganic	0.01%	0.00%	0.02%	0.00%	1.19%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.78%	0.00%	0.01%	0.00%	0.02%	0.00%	99.97%	100.00%
Closure-Base	Mercury	Beaver	Organic	0.00%	0.00%	0.00%	0.00%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.88%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	100.00%
Closure-Base	Selenium	Beaver	Total	0.10%	0.00%	0.23%	0.00%	1.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.57%	0.00%	0.10%	0.00%	0.23%	0.00%	99.67%	100.00%
Post Closure-Base	Arsenic	Beaver	Total	5.06%	0.00%	1.31%	0.00%	4.37%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	89.25%	0.00%	5.06%	0.00%	1.31%	0.00%	93.62%	100.00%
Post Closure-Base	Mercury	Beaver	Total	0.00%	0.00%	0.02%	0.00%	0.38%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.60%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%
Post Closure-Base	Mercury	Beaver	Inorganic	0.00%	0.00%	0.02%	0.00%	0.45%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.53%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%
Post Closure-Base	Mercury	Beaver	Organic	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.95%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
Post Closure-Base	Selenium	Beaver	Total	0.02%	0.00%	0.23%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.74%	0.00%	0.02%	0.00%	0.23%	0.00%	99.75%	100.00%
Base	Arsenic	Swan	Total	0.00%	0.00%	0.10%	5.95%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	93.95%	0.00%	0.00%	5.95%	0.10%	0.00%	93.95%	100.00%
Base	Mercury	Swan	Total	0.00%	0.00%	0.00%	2.21%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.78%	0.00%	0.00%	2.21%	0.00%	0.00%	97.78%	100.00%
Base	Mercury	Swan	Inorganic	0.00%	0.00%	0.00%	2.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.39%	0.00%	0.00%	2.61%	0.00%	0.00%	97.39%	100.00%
Base	Mercury	Swan	Organic	0.00%	0.00%	0.00%	0.66%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.34%	0.00%	0.00%	0.66%	0.00%	0.00%	99.34%	100.00%
Base	Selenium	Swan	Total	0.00%	0.00%	0.02%	4.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	95.68%	0.00%	0.00%	4.31%	0.02%	0.00%	95.68%	100.00%
Construction	Arsenic	Swan	Total	0.00%	0.00%	0.10%	5.95%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	93.95%	0.00%	0.00%	5.95%	0.10%	0.00%	93.95%	100.00%
Construction	Mercury	Swan	Total	0.00%	0.00%	0.00%	1.97%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	98.03%	0.00%	0.00%	1.97%	0.00%	0.00%	98.03%	100.00%
Construction	Mercury	Swan	Inorganic	0.00%	0.00%	0.00%	2.33%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.67%	0.00%	0.00%	2.33%	0.00%	0.00%	97.67%	100.00%
Construction	Mercury	Swan	Organic	0.00%	0.00%	0.00%	0.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.41%	0.00%	0.00%	0.59%	0.00%	0.00%	99.41%	100.00%

Table F1-3: Wildlife Estimated Daily Intakes as a Percentage of Total Exposure

Case	Parameter	Receptor	Speciation	Soil	Dust	Surface_water	Sediment	Browse	Lichen	A_inverts	T_invert_Arthro	T_invert_Worm	Sm_mammals	Fish	Aq_plants	Berries	Total	Total	Total	Total	Total	Total
				SIR	AIR	WIR	SEDIR	Soil	Air	Surface Water	Soil	Soil	Soil	Surface Water	Surface Water	Soil	Soil	Sediment	Water	AIR	Diet	Total
				[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Post Closure-Base	Mercury	Swan	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Mercury	Swan	Inorganic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Mercury	Swan	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Selenium	Swan	Total	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.98%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%
Base	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	0.96%	0.00%	0.00%	0.00%	88.47%	10.57%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.96%	0.00%	99.04%	100.00%	
Base	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	32.15%	67.84%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Base	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	19.99%	80.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Base	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	64.78%	35.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Base	Selenium	Little Brown Myotis	Total	0.00%	0.00%	0.45%	0.00%	0.00%	0.00%	23.65%	75.99%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.45%	0.00%	99.55%	100.00%	
Construction	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	0.96%	0.00%	0.00%	0.00%	88.44%	10.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.96%	0.00%	99.04%	100.00%	
Construction	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	34.80%	65.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Construction	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	20.99%	79.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Construction	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	67.44%	32.56%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Construction	Selenium	Little Brown Myotis	Total	0.00%	0.00%	0.46%	0.00%	0.00%	0.00%	23.78%	75.76%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.46%	0.00%	99.54%	100.00%	
Operations	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	0.96%	0.00%	0.00%	0.00%	88.38%	10.66%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.96%	0.00%	99.04%	100.00%	
Operations	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	33.84%	66.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Operations	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	20.29%	79.70%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Operations	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	66.50%	33.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations	Selenium	Little Brown Myotis	Total	0.00%	0.00%	0.46%	0.00%	0.00%	0.00%	24.10%	75.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.46%	0.00%	99.54%	100.00%	
Closure	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	0.96%	0.00%	0.00%	0.00%	88.42%	10.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.96%	0.00%	99.04%	100.00%	
Closure	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	32.09%	67.91%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Closure	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	19.04%	80.95%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Closure	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	64.72%	35.28%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure	Selenium	Little Brown Myotis	Total	0.00%	0.00%	0.48%	0.00%	0.00%	0.00%	25.06%	74.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.48%	0.00%	99.52%	100.00%	
Post Closure	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	0.96%	0.00%	0.00%	0.00%	88.42%	10.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.96%	0.00%	99.04%	100.00%	
Post Closure	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	31.18%	68.82%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Post Closure	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	18.41%	81.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Post Closure	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	63.75%	36.25%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure	Selenium	Little Brown Myotis	Total	0.00%	0.00%	0.52%	0.00%	0.00%	0.00%	26.96%	72.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.52%	0.00%	98.48%	100.00%	
Construction-Base	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	1.07%	0.00%	0.00%	0.00%	98.55%	0.38%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.07%	0.00%	98.53%	100.00%	
Construction-Base	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	13.79%	86.21%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Construction-Base	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	7.38%	92.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Construction-Base	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	38.31%	61.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Construction-Base	Selenium	Little Brown Myotis	Total	0.00%	0.00%	1.13%	0.00%	0.00%	0.00%	58.68%	40.19%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.13%	0.00%	98.87%	100.00%	
Operations-Base	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	1.07%	0.00%	0.00%	0.00%	98.51%	0.42%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.07%	0.00%	98.53%	100.00%	
Operations-Base	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	11.06%	88.94%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.83%	94.17%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	32.56%	67.44%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Selenium	Little Brown Myotis	Total	0.00%	0.00%	1.45%	0.00%	0.00%	0.00%	75.70%	22.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.45%	0.00%	98.55%	100.00%	
Closure-Base	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	1.04%	0.00%	0.00%	0.00%	95.61%	3.35%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.04%	0.00%	98.96%	100.00%	
Closure-Base	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	16.60%	83.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.02%	90.98%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	43.59%	56.41%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Selenium	Little Brown Myotis	Total	0.00%	0.00%	1.29%	0.00%	0.00%	0.00%	67.08%	31.64%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.29%	0.00%	98.71%	100.00%	
Post Closure-Base	Arsenic	Little Brown Myotis	Total	0.00%	0.00%	1.03%	0.00%	0.00%	0.00%	94.95%	4.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.03%	0.00%	98.97%	100.00%	
Post Closure-Base	Mercury	Little Brown Myotis	Total	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	32.45%	67.55%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Post Closure-Base	Mercury	Little Brown Myotis	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	19.30%	80.69%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Post Closure-Base	Mercury	Little Brown Myotis	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	65.09%	34.91%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Selenium	Little Brown Myotis	Total	0.00%	0.00%	1.72%	0.00%	0.00%	0.00%	89.34%	8.94%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.72%	0.00%	98.28%	100.00%	
Base	Arsenic	Sandpiper	Total	6.39%	0.00%	0.42%	4.09%	0.00%	0.00%	39.07%	11.43%	17.54%	0.00%	2.51%	18.54%	0.00%	6.39%	4.09%	0.42%	0.00%	89.10%	100.00%
Base	Mercury	Sandpiper	Total	0.21%	0.00%	0.00%	0.35%	0.00%	0.00%	7.45%	38.51%	38.51%	0.00%	10.48%	4.48%	0.00%	0.21%	0.35%	0.00%	0.00%	99.44%	100.00%
Base	Mercury	Sandpiper	Inorganic	0.27%	0.00%	0.00%	0.47%	0.00%	0.00%	4.24%	43.96%	43.96%	0.00%	2.11%	4.99%	0.00%	0.27%	0.47%	0.00%	0.00%	99.26%	100.00%
Base	Mercury	Sandpiper	Organic	0.02%	0.00%	0.00%	0.07%	0.00%	0.00%	16.90%	22.48%	22.48%	0.00%	35.05%	3.00%	0.00%	0.02%	0.07%	0.00%	0.00%	99.91%	100.00%
Base	Selenium	Sandpiper	Total	0.74%	0.00%	0.06%	2.71%	0.00%	0.00%	3.28%	25.78%	25.78%	0.00%	24.35%	17.30%	0.00%	0.74%	2.71%	0.06%	0.00%	98.49%	100.00%
Construction	Arsenic	Sandpiper	Total	6.55%	0.00%	0.42%	4.08%	0.00%	0.00%	38.99%	11.43%	17.54%	0.00%	2.50%	18.50%	0.00%	6.55%	4.08%	0.42%	0.00%	88.96%	100.00%
Construction	Mercury	Sandpiper	Total	0.20%	0.00%	0.00%	0.34%	0.00%	0.00%	8.16%	37.45%	37.45%	0.00%	11.48%	4.91%	0.00%	0.20%	0.34%	0.00%	0.00%	99.45%	100.00%
Construction	Mercury	Sandpiper	Inorganic	0.27%	0.00%	0.00%	0.46%	0.00%	0.00%	4.70%	43.34%	43.34%	0.00%	2.34%	5.54%	0.00%	0.27%	0.46%	0.00%	0.00%	99.27%	100.00%
Construction	Mercury	Sandpiper	Organic	0.02%	0.00%	0.00%	0.06%	0.00%	0.00%	17.79%	21.03%	21.03%	0.00%	36.91%	3.16%	0.00%	0.02%	0.06%	0.00%	0.00%	99.92%	100.00%
Construction	Selenium	Sandpiper	Total	0.75%	0.00%	0.06%	2.70%</															

Table F1-3: Wildlife Estimated Daily Intakes as a Percentage of Total Exposure

Case	Parameter	Receptor	Speciation	Soil	Dust	Surface_water	Sediment	Browse	Lichen	A_inverts	T_invert_Arthro	T_invert_Worm	Sm_mammals	Fish	Aq_plants	Berries	Total	Total	Total	Total	Total	Total	
				SIR	AIR	WIR	SEDIR	Soil	Air	Surface Water	Soil	Soil	Surface Water	Surface Water	Soil	Soil	Sediment	Water	AIR	Diet	Total	Total	Total
				[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]
Operations-Base	Selenium	Sandpiper	Total	1.02%	0.00%	0.12%	0.00%	0.00%	0.00%	6.52%	4.82%	4.82%	0.00%	48.35%	34.36%	0.00%	1.02%	0.00%	0.12%	0.00%	98.86%	100.00%	
Closure-Base	Arsenic	Sandpiper	Total	28.04%	0.00%	0.38%	0.00%	0.00%	0.00%	34.90%	2.99%	14.88%	0.00%	2.24%	16.65%	0.00%	28.04%	0.00%	0.38%	0.00%	71.58%	100.00%	
Closure-Base	Mercury	Sandpiper	Total	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	3.62%	44.55%	44.55%	0.00%	5.09%	2.18%	0.00%	0.01%	0.00%	0.00%	0.00%	99.99%	100.00%	
Closure-Base	Mercury	Sandpiper	Inorganic	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	1.92%	47.43%	47.43%	0.00%	0.95%	2.28%	0.00%	0.01%	0.00%	0.00%	0.00%	99.99%	100.00%	
Closure-Base	Mercury	Sandpiper	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.43%	33.04%	33.04%	0.00%	21.63%	1.85%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Selenium	Sandpiper	Total	1.14%	0.00%	0.12%	0.00%	0.00%	0.00%	6.17%	7.12%	7.12%	0.00%	45.78%	32.54%	0.00%	1.14%	0.00%	0.12%	0.00%	98.74%	100.00%	
Post Closure-Base	Arsenic	Sandpiper	Total	30.30%	0.00%	0.34%	0.00%	0.00%	0.00%	31.88%	3.30%	16.40%	0.00%	2.05%	15.13%	0.00%	30.30%	0.00%	0.34%	0.00%	68.75%	100.00%	
Post Closure-Base	Mercury	Sandpiper	Total	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	7.57%	38.61%	38.61%	0.00%	10.65%	4.58%	0.00%	0.01%	0.00%	0.00%	0.00%	99.98%	100.00%	
Post Closure-Base	Mercury	Sandpiper	Inorganic	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	4.32%	44.22%	44.22%	0.00%	2.15%	5.09%	0.00%	0.01%	0.00%	0.00%	0.00%	99.99%	100.00%	
Post Closure-Base	Mercury	Sandpiper	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	17.01%	22.34%	22.34%	0.00%	25.29%	3.02%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Selenium	Sandpiper	Total	0.28%	0.00%	0.13%	0.00%	0.00%	0.00%	7.02%	1.72%	1.72%	0.00%	52.10%	37.03%	0.00%	0.28%	0.00%	0.13%	0.00%	99.59%	100.00%	
Base	Arsenic	Oter	Total	0.75%	0.00%	1.64%	13.63%	0.00%	0.00%	27.44%	0.00%	0.00%	0.18%	56.36%	0.00%	0.00%	0.75%	13.63%	1.64%	0.00%	83.98%	100.00%	
Base	Mercury	Oter	Total	0.01%	0.00%	0.00%	0.49%	0.00%	0.00%	2.16%	0.00%	0.00%	0.03%	97.31%	0.00%	0.00%	0.01%	0.49%	0.00%	0.00%	99.50%	100.00%	
Base	Mercury	Oter	Inorganic	0.06%	0.00%	0.01%	2.99%	0.00%	0.00%	5.72%	0.00%	0.00%	0.15%	91.07%	0.00%	0.00%	0.06%	2.99%	0.01%	0.00%	96.94%	100.00%	
Base	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.48%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	99.97%	100.00%	
Base	Selenium	Oter	Total	0.02%	0.00%	0.04%	1.60%	0.00%	0.00%	0.41%	0.00%	0.00%	1.30%	96.64%	0.00%	0.00%	0.02%	1.60%	0.04%	0.00%	98.34%	100.00%	
Construction	Arsenic	Oter	Total	0.77%	0.00%	1.64%	13.63%	0.00%	0.00%	27.43%	0.00%	0.00%	0.18%	56.35%	0.00%	0.00%	0.77%	13.63%	1.64%	0.00%	83.96%	100.00%	
Construction	Mercury	Oter	Total	0.01%	0.00%	0.00%	0.43%	0.00%	0.00%	2.16%	0.00%	0.00%	0.02%	97.37%	0.00%	0.00%	0.01%	0.43%	0.00%	0.00%	99.56%	100.00%	
Construction	Mercury	Oter	Inorganic	0.05%	0.00%	0.01%	2.66%	0.00%	0.00%	5.74%	0.00%	0.00%	0.14%	91.39%	0.00%	0.00%	0.05%	2.66%	0.01%	0.00%	97.27%	100.00%	
Construction	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.49%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	99.97%	100.00%	
Construction	Selenium	Oter	Total	0.02%	0.00%	0.04%	1.58%	0.00%	0.00%	0.41%	0.00%	0.00%	1.29%	96.66%	0.00%	0.00%	0.02%	1.58%	0.04%	0.00%	98.36%	100.00%	
Operations	Arsenic	Oter	Total	0.82%	0.00%	1.64%	13.62%	0.00%	0.00%	27.42%	0.00%	0.00%	0.18%	56.32%	0.00%	0.00%	0.82%	13.62%	1.64%	0.00%	83.92%	100.00%	
Operations	Mercury	Oter	Total	0.01%	0.00%	0.00%	0.45%	0.00%	0.00%	2.16%	0.00%	0.00%	0.03%	97.35%	0.00%	0.00%	0.01%	0.45%	0.00%	0.00%	99.54%	100.00%	
Operations	Mercury	Oter	Inorganic	0.06%	0.00%	0.01%	2.77%	0.00%	0.00%	5.74%	0.00%	0.00%	0.14%	91.28%	0.00%	0.00%	0.06%	2.77%	0.01%	0.00%	97.16%	100.00%	
Operations	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.49%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	99.97%	100.00%	
Operations	Selenium	Oter	Total	0.02%	0.00%	0.04%	1.55%	0.00%	0.00%	0.41%	0.00%	0.00%	1.27%	96.72%	0.00%	0.00%	0.02%	1.55%	0.04%	0.00%	98.39%	100.00%	
Closure	Arsenic	Oter	Total	0.84%	0.00%	1.64%	13.62%	0.00%	0.00%	27.41%	0.00%	0.00%	0.18%	56.31%	0.00%	0.00%	0.84%	13.62%	1.64%	0.00%	83.90%	100.00%	
Closure	Mercury	Oter	Total	0.01%	0.00%	0.00%	0.49%	0.00%	0.00%	2.16%	0.00%	0.00%	0.03%	97.31%	0.00%	0.00%	0.01%	0.49%	0.00%	0.00%	99.50%	100.00%	
Closure	Mercury	Oter	Inorganic	0.06%	0.00%	0.01%	2.99%	0.00%	0.00%	5.72%	0.00%	0.00%	0.15%	91.06%	0.00%	0.00%	0.06%	2.99%	0.01%	0.00%	96.93%	100.00%	
Closure	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.48%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	99.97%	100.00%	
Closure	Selenium	Oter	Total	0.02%	0.00%	0.04%	1.48%	0.00%	0.00%	0.41%	0.00%	0.00%	1.21%	96.85%	0.00%	0.00%	0.02%	1.48%	0.04%	0.00%	98.48%	100.00%	
Post Closure	Arsenic	Oter	Total	0.84%	0.00%	1.64%	13.62%	0.00%	0.00%	27.41%	0.00%	0.00%	0.18%	56.31%	0.00%	0.00%	0.84%	13.62%	1.64%	0.00%	83.90%	100.00%	
Post Closure	Mercury	Oter	Total	0.01%	0.00%	0.00%	0.51%	0.00%	0.00%	2.16%	0.00%	0.00%	0.03%	97.29%	0.00%	0.00%	0.01%	0.51%	0.00%	0.00%	99.48%	100.00%	
Post Closure	Mercury	Oter	Inorganic	0.07%	0.00%	0.01%	3.12%	0.00%	0.00%	5.71%	0.00%	0.00%	0.16%	90.93%	0.00%	0.00%	0.07%	3.12%	0.01%	0.00%	96.80%	100.00%	
Post Closure	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.48%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	99.97%	100.00%	
Post Closure	Selenium	Oter	Total	0.01%	0.00%	0.04%	1.34%	0.00%	0.00%	0.41%	0.00%	0.00%	1.09%	97.10%	0.00%	0.00%	0.01%	1.34%	0.04%	0.00%	98.60%	100.00%	
Construction-Base	Arsenic	Oter	Total	0.19%	0.00%	0.92%	0.00%	0.00%	0.00%	32.05%	0.00%	0.00%	0.01%	65.83%	0.00%	0.00%	0.19%	0.00%	0.92%	0.00%	97.85%	100.00%	
Construction-Base	Mercury	Oter	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.17%	0.00%	0.00%	0.00%	97.82%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Construction-Base	Mercury	Oter	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	5.91%	0.00%	0.00%	0.00%	94.08%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Construction-Base	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Construction-Base	Selenium	Oter	Total	0.01%	0.00%	0.04%	0.00%	0.00%	0.00%	0.41%	0.00%	0.00%	2.54%	97.01%	0.00%	0.00%	0.01%	0.00%	0.04%	0.00%	99.95%	100.00%	
Operations-Base	Arsenic	Oter	Total	0.78%	0.00%	1.91%	0.00%	0.00%	0.00%	31.85%	0.00%	0.00%	0.01%	65.44%	0.00%	0.00%	0.78%	0.00%	1.91%	0.00%	97.31%	100.00%	
Operations-Base	Mercury	Oter	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.17%	0.00%	0.00%	0.00%	97.82%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Mercury	Oter	Inorganic	0.01%	0.00%	0.01%	0.00%	0.00%	0.00%	5.91%	0.00%	0.00%	0.00%	94.07%	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%	99.98%	100.00%	
Operations-Base	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Selenium	Oter	Total	0.01%	0.00%	0.04%	0.00%	0.00%	0.00%	0.41%	0.00%	0.00%	1.13%	98.40%	0.00%	0.00%	0.01%	0.00%	0.04%	0.00%	99.95%	100.00%	
Closure-Base	Arsenic	Oter	Total	4.12%	0.00%	1.84%	0.00%	0.00%	0.00%	30.75%	0.00%	0.00%	0.11%	63.18%	0.00%	0.00%	4.12%	0.00%	1.84%	0.00%	94.04%	100.00%	
Closure-Base	Mercury	Oter	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.17%	0.00%	0.00%	0.00%	97.82%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Mercury	Oter	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	5.91%	0.00%	0.00%	0.00%	94.07%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.98%	100.00%	
Closure-Base	Mercury	Oter	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%	0.00%	0.00%	0.00%	98.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Selenium	Oter	Total	0.01%	0.00%	0.04%	0.00%	0.00%	0.00%	0.41%	0.00%	0.00%	1.38%	98.15%	0.00%	0.00%	0.01%	0.00%	0				

Table F1-3: Wildlife Estimated Daily Intakes as a Percentage of Total Exposure

Case	Parameter	Receptor	Speciation	Soil	Dust	Surface_water	Sediment	Browse	Lichen	A_inverts	T_invert_Arthro	T_invert_Worm	Sm_mammals	Fish	Aq_plants	Berries	Total	Total	Total	Total	Total	Total	
				SIR [%]	AIR [%]	WIR [%]	SEDIR [%]	Soil [%]	Air [%]	Surface Water [%]	Soil [%]	Soil [%]	Soil [%]	Surface Water [%]	Surface Water [%]	Soil [%]	Soil [%]	Soil [%]	Soil [%]	Sediment [%]	Water [%]	AIR [%]	Surface Diet [%]
Post Closure	Arsenic	Eagle	Total	0.00%	0.00%	1.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.66%	95.75%	0.00%	0.00%	0.00%	0.00%	0.00%	1.59%	0.00%	98.41%	100.00%
Post Closure	Mercury	Eagle	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.25%	99.75%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
Post Closure	Mercury	Eagle	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.50%	98.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%
Post Closure	Mercury	Eagle	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	99.97%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
Post Closure	Selenium	Eagle	Total	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	8.84%	91.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%
Construction-Base	Arsenic	Eagle	Total	0.00%	0.00%	1.63%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.17%	98.20%	0.00%	0.00%	0.00%	0.00%	1.63%	0.00%	98.37%	100.00%	
Construction-Base	Mercury	Eagle	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%
Construction-Base	Mercury	Eagle	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Construction-Base	Mercury	Eagle	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	
Construction-Base	Selenium	Eagle	Total	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	18.38%	81.60%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%	
Operations-Base	Arsenic	Eagle	Total	0.00%	0.00%	1.63%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%	98.18%	0.00%	0.00%	0.00%	0.00%	1.63%	0.00%	98.37%	100.00%	
Operations-Base	Mercury	Eagle	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Mercury	Eagle	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Operations-Base	Mercury	Eagle	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Operations-Base	Selenium	Eagle	Total	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	9.03%	90.95%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%	
Closure-Base	Arsenic	Eagle	Total	0.00%	0.00%	1.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.41%	96.98%	0.00%	0.00%	0.00%	0.00%	1.61%	0.00%	98.39%	100.00%	
Closure-Base	Mercury	Eagle	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Mercury	Eagle	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Closure-Base	Mercury	Eagle	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Closure-Base	Selenium	Eagle	Total	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	10.80%	89.18%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%	
Post Closure-Base	Arsenic	Eagle	Total	0.00%	0.00%	1.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.69%	96.70%	0.00%	0.00%	0.00%	0.00%	1.61%	0.00%	98.39%	100.00%	
Post Closure-Base	Mercury	Eagle	Total	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Mercury	Eagle	Inorganic	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	99.99%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	99.99%	100.00%	
Post Closure-Base	Mercury	Eagle	Organic	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	100.00%	
Post Closure-Base	Selenium	Eagle	Total	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.51%	97.47%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	99.98%	100.00%	

Table F1-4: Summary of Game Meat Tissue Concentrations by Assessment Case

Receptor	Parameter	Speciation	Base	Construction	Operations	Closure	Post Closure	Construction-Base	Operations-Base	Closure-Base	Post Closure-Base
			[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]	[mg/kg-WW]
Caribou	Arsenic	Total	5.10E-03	1.58E-02	9.93E-03	1.60E-02	5.36E-03	1.21E-02	6.29E-03	1.23E-02	1.73E-03
Caribou	Mercury	Total	1.00E-02	1.01E-02	1.01E-02	1.02E-02	1.00E-02	3.00E-03	2.92E-03	3.04E-03	2.89E-03
Caribou	Selenium	Total	2.50E-01	2.94E-01	2.70E-01	2.95E-01	2.52E-01	2.04E-01	1.80E-01	2.05E-01	1.62E-01
CaribouLiver	Arsenic	Total	5.10E-03	1.58E-02	9.93E-03	1.60E-02	5.36E-03	1.21E-02	6.29E-03	1.23E-02	1.73E-03
CaribouLiver	Mercury	Total	2.00E-01	2.03E-01	2.01E-01	2.03E-01	2.00E-01	6.00E-02	5.84E-02	6.08E-02	5.79E-02
CaribouLiver	Selenium	Total	4.00E-01	4.70E-01	4.33E-01	4.72E-01	4.03E-01	3.26E-01	2.88E-01	3.28E-01	2.60E-01
Moose	Arsenic	Total	1.00E-02	1.12E-02	1.06E-02	1.13E-02	1.01E-02	2.13E-03	1.46E-03	1.53E-03	3.51E-04
Moose	Mercury	Total	3.00E-03	3.18E-03	3.11E-03	3.00E-03	2.94E-03	1.98E-04	1.57E-04	2.68E-04	6.02E-04
Moose	Selenium	Total	1.00E-01	1.02E-01	1.03E-01	1.08E-01	1.15E-01	4.93E-03	9.07E-03	1.03E-02	4.25E-02
MooseLiver	Arsenic	Total	2.00E-02	2.24E-02	2.12E-02	2.25E-02	2.02E-02	4.26E-03	2.92E-03	3.07E-03	7.01E-04
MooseLiver	Mercury	Total	1.00E-02	1.06E-02	1.04E-02	1.00E-02	9.80E-03	6.59E-04	5.23E-04	8.93E-04	2.01E-03
MooseLiver	Selenium	Total	3.50E-01	3.57E-01	3.61E-01	3.76E-01	4.02E-01	1.72E-02	3.17E-02	3.61E-02	1.49E-01
MooseKidney	Arsenic	Total	3.00E-02	3.35E-02	3.18E-02	3.38E-02	3.03E-02	6.38E-03	4.38E-03	4.60E-03	1.05E-03
MooseKidney	Mercury	Total	2.00E-02	2.12E-02	2.07E-02	2.00E-02	1.96E-02	1.32E-03	1.05E-03	1.79E-03	4.01E-03
MooseKidney	Selenium	Total	7.00E-01	7.13E-01	7.21E-01	7.53E-01	8.04E-01	3.45E-02	6.35E-02	7.22E-02	2.98E-01
Rabbit	Arsenic	Total	2.00E-02	2.52E-02	2.34E-02	2.64E-02	2.16E-02	5.51E-03	3.65E-03	6.79E-03	1.92E-03
Rabbit	Mercury	Total	4.00E-03	4.01E-03	4.01E-03	4.01E-03	4.00E-03	5.06E-05	4.78E-05	7.20E-05	6.49E-05
Rabbit	Selenium	Total	1.80E-01	1.89E-01	1.87E-01	1.91E-01	1.83E-01	8.51E-03	5.65E-03	1.07E-02	3.61E-03
Goose	Arsenic	Total	2.00E-02	2.48E-02	2.33E-02	2.61E-02	2.17E-02	5.04E-03	3.51E-03	6.46E-03	2.02E-03
Goose	Mercury	Total	2.00E-03	2.00E-03	2.00E-03	2.01E-03	2.00E-03	4.91E-05	4.78E-05	6.17E-05	5.82E-05
Goose	Selenium	Total	2.00E-01	2.09E-01	2.08E-01	2.12E-01	2.04E-01	9.14E-03	6.33E-03	1.19E-02	3.84E-03
Deer	Arsenic	Total	1.00E-02	1.45E-02	1.23E-02	1.48E-02	1.04E-02	4.77E-03	2.53E-03	5.18E-03	7.82E-04
Deer	Mercury	Total	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	3.04E-05	2.84E-05	4.08E-05	3.69E-05
Deer	Selenium	Total	1.50E-01	1.58E-01	1.55E-01	1.59E-01	1.52E-01	9.43E-03	5.68E-03	1.02E-02	3.11E-03
Grouse	Arsenic	Total	1.00E-02	1.36E-02	1.19E-02	1.39E-02	1.05E-02	3.75E-03	2.07E-03	4.19E-03	7.30E-04
Grouse	Mercury	Total	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.08E-03	1.08E-03	1.20E-03	1.19E-03
Grouse	Selenium	Total	2.20E-01	2.29E-01	2.26E-01	2.31E-01	2.22E-01	9.49E-03	5.34E-03	1.09E-02	2.60E-03
Duck	Arsenic	Total	7.00E-02	7.00E-02	7.01E-02	7.01E-02	7.01E-02	8.02E-03	7.33E-03	1.77E-03	1.46E-03
Duck	Mercury	Total	3.00E-02	3.33E-02	3.21E-02	2.99E-02	2.88E-02	4.51E-03	3.76E-03	5.78E-03	1.22E-02
Duck	Selenium	Total	5.00E-01	5.04E-01	5.14E-01	5.38E-01	5.91E-01	2.33E-02	5.26E-02	5.61E-02	2.63E-01

Table F1-5: Hazard Quotient Calculations for Ecological Receptors

Case	Parameter	Receptor	Speciation	Estimated Daily Intake	Dose	LOAEL-TRV	HQ (LOAEL)	NOAEL-TRV	HQ (NOAEL)
				[mg/day]	[mg/kg-BW day]	[mg/kg-BW day]	[unitless]	[mg/kg-BW day]	[unitless]
Base	Mercury	Moose	Inorganic	7.79E-01	1.95E-03	1.00E+01	1.95E-04	1.00E+00	1.95E-03
Base	Mercury	Moose	Organic	7.58E-02	1.90E-04	1.44E+01	1.32E-03	8.00E-02	2.37E-03
Construction	Mercury	Moose	Inorganic	8.21E-01	2.05E-03	1.00E+01	2.05E-04	1.00E+00	2.05E-03
Construction	Mercury	Moose	Organic	8.43E-02	2.11E-04	1.44E+01	1.46E-03	8.00E-02	2.63E-03
Operations	Mercury	Moose	Inorganic	8.06E-01	2.01E-03	1.00E+01	2.01E-04	1.00E+00	2.01E-03
Operations	Mercury	Moose	Organic	8.12E-02	2.03E-04	1.44E+01	1.41E-03	8.00E-02	2.54E-03
Closure	Mercury	Moose	Inorganic	7.79E-01	1.95E-03	1.00E+01	1.95E-04	1.00E+00	1.95E-03
Closure	Mercury	Moose	Organic	7.57E-02	1.89E-04	1.44E+01	1.31E-03	8.00E-02	2.36E-03
Post Closure	Mercury	Moose	Inorganic	7.65E-01	1.91E-03	1.00E+01	1.91E-04	1.00E+00	1.91E-03
Post Closure	Mercury	Moose	Organic	7.29E-02	1.82E-04	1.44E+01	1.27E-03	8.00E-02	2.28E-03
Construction-Base	Mercury	Moose	Inorganic	4.77E-02	1.19E-04	1.00E+01	1.19E-05	1.00E+00	1.19E-04
Construction-Base	Mercury	Moose	Organic	8.67E-03	2.17E-05	1.44E+01	1.51E-04	8.00E-02	2.71E-04
Operations-Base	Mercury	Moose	Inorganic	3.79E-02	9.48E-05	1.00E+01	9.48E-06	1.00E+00	9.48E-05
Operations-Base	Mercury	Moose	Organic	6.76E-03	1.69E-05	1.44E+01	1.17E-04	8.00E-02	2.11E-04
Closure-Base	Mercury	Moose	Inorganic	6.47E-02	1.62E-04	1.00E+01	1.62E-05	1.00E+00	1.62E-04
Closure-Base	Mercury	Moose	Organic	1.17E-02	2.93E-05	1.44E+01	2.03E-04	8.00E-02	3.66E-04
Post Closure-Base	Mercury	Moose	Inorganic	1.44E-01	3.59E-04	1.00E+01	3.59E-05	1.00E+00	3.59E-04
Post Closure-Base	Mercury	Moose	Organic	2.80E-02	7.01E-05	1.44E+01	4.86E-04	8.00E-02	8.76E-04
Base	Mercury	Grouse	Inorganic	2.67E-03	4.45E-03	9.00E-01	4.95E-03	4.50E-01	9.90E-03
Base	Mercury	Grouse	Organic	1.51E-04	2.52E-04	5.00E-02	5.05E-03	3.10E-02	8.14E-03
Construction	Mercury	Grouse	Inorganic	2.68E-03	4.46E-03	9.00E-01	4.96E-03	4.50E-01	9.91E-03
Construction	Mercury	Grouse	Organic	1.52E-04	2.53E-04	5.00E-02	5.05E-03	3.10E-02	8.15E-03
Operations	Mercury	Grouse	Inorganic	2.68E-03	4.46E-03	9.00E-01	4.96E-03	4.50E-01	9.91E-03
Operations	Mercury	Grouse	Organic	1.52E-04	2.53E-04	5.00E-02	5.05E-03	3.10E-02	8.15E-03
Closure	Mercury	Grouse	Inorganic	2.68E-03	4.46E-03	9.00E-01	4.96E-03	4.50E-01	9.92E-03
Closure	Mercury	Grouse	Organic	1.52E-04	2.53E-04	5.00E-02	5.05E-03	3.10E-02	8.15E-03
Post Closure	Mercury	Grouse	Inorganic	2.67E-03	4.46E-03	9.00E-01	4.95E-03	4.50E-01	9.90E-03
Post Closure	Mercury	Grouse	Organic	1.51E-04	2.52E-04	5.00E-02	5.05E-03	3.10E-02	8.15E-03
Construction-Base	Mercury	Grouse	Inorganic	2.64E-04	4.40E-04	9.00E-01	4.89E-04	4.50E-01	9.77E-04
Construction-Base	Mercury	Grouse	Organic	4.21E-05	7.01E-05	5.00E-02	1.40E-03	3.10E-02	2.26E-03
Operations-Base	Mercury	Grouse	Inorganic	2.62E-04	4.37E-04	9.00E-01	4.85E-04	4.50E-01	9.70E-04
Operations-Base	Mercury	Grouse	Organic	4.20E-05	7.00E-05	5.00E-02	1.40E-03	3.10E-02	2.26E-03
Closure-Base	Mercury	Grouse	Inorganic	2.94E-04	4.91E-04	9.00E-01	5.45E-04	4.50E-01	1.09E-03
Closure-Base	Mercury	Grouse	Organic	4.58E-05	7.63E-05	5.00E-02	1.53E-03	3.10E-02	2.46E-03
Post Closure-Base	Mercury	Grouse	Inorganic	2.91E-04	4.84E-04	9.00E-01	5.38E-04	4.50E-01	1.08E-03
Post Closure-Base	Mercury	Grouse	Organic	4.57E-05	7.62E-05	5.00E-02	1.52E-03	3.10E-02	2.46E-03
Base	Mercury	Duck	Inorganic	7.97E-03	6.64E-03	9.00E-01	7.38E-03	4.50E-01	1.48E-02
Base	Mercury	Duck	Organic	2.37E-03	1.97E-03	5.00E-02	3.95E-02	3.10E-02	6.36E-02
Construction	Mercury	Duck	Inorganic	8.83E-03	7.36E-03	9.00E-01	8.18E-03	4.50E-01	1.64E-02
Construction	Mercury	Duck	Organic	2.64E-03	2.20E-03	5.00E-02	4.41E-02	3.10E-02	7.11E-02
Operations	Mercury	Duck	Inorganic	8.51E-03	7.09E-03	9.00E-01	7.88E-03	4.50E-01	1.58E-02
Operations	Mercury	Duck	Organic	2.54E-03	2.12E-03	5.00E-02	4.24E-02	3.10E-02	6.83E-02
Closure	Mercury	Duck	Inorganic	7.95E-03	6.63E-03	9.00E-01	7.36E-03	4.50E-01	1.47E-02
Closure	Mercury	Duck	Organic	2.36E-03	1.97E-03	5.00E-02	3.93E-02	3.10E-02	6.35E-02
Post Closure	Mercury	Duck	Inorganic	7.67E-03	6.39E-03	9.00E-01	7.10E-03	4.50E-01	1.42E-02
Post Closure	Mercury	Duck	Organic	2.27E-03	1.89E-03	5.00E-02	3.78E-02	3.10E-02	6.10E-02
Construction-Base	Mercury	Duck	Inorganic	1.21E-03	1.01E-03	9.00E-01	1.12E-03	4.50E-01	2.25E-03
Construction-Base	Mercury	Duck	Organic	3.40E-04	2.84E-04	5.00E-02	5.67E-03	3.10E-02	9.15E-03
Operations-Base	Mercury	Duck	Inorganic	1.02E-03	8.49E-04	9.00E-01	9.43E-04	4.50E-01	1.89E-03
Operations-Base	Mercury	Duck	Organic	2.78E-04	2.31E-04	5.00E-02	4.63E-03	3.10E-02	7.47E-03
Closure-Base	Mercury	Duck	Inorganic	1.55E-03	1.29E-03	9.00E-01	1.43E-03	4.50E-01	2.87E-03
Closure-Base	Mercury	Duck	Organic	4.44E-04	3.70E-04	5.00E-02	7.40E-03	3.10E-02	1.19E-02
Post Closure-Base	Mercury	Duck	Inorganic	3.21E-03	2.68E-03	9.00E-01	2.97E-03	4.50E-01	5.95E-03
Post Closure-Base	Mercury	Duck	Organic	9.80E-04	8.16E-04	5.00E-02	1.63E-02	3.10E-02	2.63E-02
Base	Mercury	Muskrat	Inorganic	1.22E-02	1.22E-02	1.00E+01	1.22E-03	1.00E+00	1.22E-02
Base	Mercury	Muskrat	Organic	4.48E-03	4.48E-03	1.44E+01	3.11E-02	8.00E-02	5.59E-02
Construction	Mercury	Muskrat	Inorganic	1.37E-02	1.37E-02	1.00E+01	1.37E-03	1.00E+00	1.37E-02
Construction	Mercury	Muskrat	Organic	5.04E-03	5.04E-03	1.44E+01	3.50E-02	8.00E-02	6.30E-02
Operations	Mercury	Muskrat	Inorganic	1.32E-02	1.32E-02	1.00E+01	1.32E-03	1.00E+00	1.32E-02
Operations	Mercury	Muskrat	Organic	4.83E-03	4.83E-03	1.44E+01	3.35E-02	8.00E-02	6.04E-02
Closure	Mercury	Muskrat	Inorganic	1.22E-02	1.22E-02	1.00E+01	1.22E-03	1.00E+00	1.22E-02
Closure	Mercury	Muskrat	Organic	4.46E-03	4.46E-03	1.44E+01	3.10E-02	8.00E-02	5.58E-02
Post Closure	Mercury	Muskrat	Inorganic	1.17E-02	1.17E-02	1.00E+01	1.17E-03	1.00E+00	1.17E-02
Post Closure	Mercury	Muskrat	Organic	4.28E-03	4.28E-03	1.44E+01	2.97E-02	8.00E-02	5.35E-02
Construction-Base	Mercury	Muskrat	Inorganic	1.54E-03	1.54E-03	1.00E+01	1.54E-04	1.00E+00	1.54E-03
Construction-Base	Mercury	Muskrat	Organic	5.71E-04	5.71E-04	1.44E+01	3.96E-03	8.00E-02	7.14E-03
Operations-Base	Mercury	Muskrat	Inorganic	1.20E-03	1.20E-03	1.00E+01	1.20E-04	1.00E+00	1.20E-03
Operations-Base	Mercury	Muskrat	Organic	4.44E-04	4.44E-04	1.44E+01	3.08E-03	8.00E-02	5.55E-03
Closure-Base	Mercury	Muskrat	Inorganic	2.08E-03	2.08E-03	1.00E+01	2.08E-04	1.00E+00	2.08E-03
Closure-Base	Mercury	Muskrat	Organic	7.71E-04	7.71E-04	1.44E+01	5.35E-03	8.00E-02	9.64E-03
Post Closure-Base	Mercury	Muskrat	Inorganic	5.02E-03	5.02E-03	1.00E+01	5.02E-04	1.00E+00	5.02E-03
Post Closure-Base	Mercury	Muskrat	Organic	1.86E-03	1.86E-03	1.44E+01	1.29E-02	8.00E-02	2.32E-02
Base	Mercury	Beaver	Inorganic	3.17E-02	1.32E-03	1.00E+01	1.32E-04	1.00E+00	1.32E-03
Base	Mercury	Beaver	Organic	5.84E-03	2.43E-04	1.44E+01	1.69E-03	8.00E-02	3.04E-03
Construction	Mercury	Beaver	Inorganic	3.52E-02	1.47E-03	1.00E+01	1.47E-04	1.00E+00	1.47E-03
Construction	Mercury	Beaver	Organic	6.56E-03	2.73E-04	1.44E+01	1.90E-03	8.00E-02	3.42E-03
Operations	Mercury	Beaver	Inorganic	3.39E-02	1.41E-03	1.00E+01	1.41E-04	1.00E+00	1.41E-03
Operations	Mercury	Beaver	Organic	6.29E-03	2.62E-04	1.44E+01	1.82E-03	8.00E-02	3.28E-03

Table F1-5: Hazard Quotient Calculations for Ecological Receptors

Case	Parameter	Receptor	Speciation	Estimated Daily Intake	Dose	LOAEL-TRV	HQ (LOAEL)	NOAEL-TRV	HQ (NOAEL)
				[mg/day]	[mg/kg-BW day]	[mg/kg-BW day]	[unitless]	[mg/kg-BW day]	[unitless]
Closure	Mercury	Beaver	Inorganic	3.16E-02	1.32E-03	1.00E+01	1.32E-04	1.00E+00	1.32E-03
Closure	Mercury	Beaver	Organic	5.82E-03	2.43E-04	1.44E-01	1.68E-03	8.00E-02	3.03E-03
Post Closure	Mercury	Beaver	Inorganic	3.04E-02	1.27E-03	1.00E+01	1.27E-04	1.00E+00	1.27E-03
Post Closure	Mercury	Beaver	Organic	5.58E-03	2.33E-04	1.44E-01	1.62E-03	8.00E-02	2.91E-03
Construction-Base	Mercury	Beaver	Inorganic	3.64E-03	1.51E-04	1.00E+01	1.51E-05	1.00E+00	1.51E-04
Construction-Base	Mercury	Beaver	Organic	7.37E-04	3.07E-05	1.44E-01	2.13E-04	8.00E-02	3.84E-04
Operations-Base	Mercury	Beaver	Inorganic	2.83E-03	1.18E-04	1.00E+01	1.18E-05	1.00E+00	1.18E-04
Operations-Base	Mercury	Beaver	Organic	5.73E-04	2.39E-05	1.44E-01	1.66E-04	8.00E-02	2.98E-04
Closure-Base	Mercury	Beaver	Inorganic	4.91E-03	2.05E-04	1.00E+01	2.05E-05	1.00E+00	2.05E-04
Closure-Base	Mercury	Beaver	Organic	9.95E-04	4.14E-05	1.44E-01	2.88E-04	8.00E-02	5.18E-04
Post Closure-Base	Mercury	Beaver	Inorganic	1.18E-02	4.90E-04	1.00E+01	4.90E-05	1.00E+00	4.90E-04
Post Closure-Base	Mercury	Beaver	Organic	2.40E-03	9.99E-05	1.44E-01	6.94E-04	8.00E-02	1.25E-03
Base	Mercury	Swan	Inorganic	6.75E-02	6.25E-03	9.00E-01	6.95E-03	4.50E-01	1.39E-02
Base	Mercury	Swan	Organic	1.36E-02	1.26E-03	5.00E-02	2.51E-02	3.10E-02	4.05E-02
Construction	Mercury	Swan	Inorganic	7.58E-02	7.02E-03	9.00E-01	7.80E-03	4.50E-01	1.56E-02
Construction	Mercury	Swan	Organic	1.53E-02	1.41E-03	5.00E-02	2.83E-02	3.10E-02	4.56E-02
Operations	Mercury	Swan	Inorganic	7.27E-02	6.73E-03	9.00E-01	7.48E-03	4.50E-01	1.50E-02
Operations	Mercury	Swan	Organic	1.46E-02	1.35E-03	5.00E-02	2.71E-02	3.10E-02	4.37E-02
Closure	Mercury	Swan	Inorganic	6.73E-02	6.23E-03	9.00E-01	6.93E-03	4.50E-01	1.39E-02
Closure	Mercury	Swan	Organic	1.35E-02	1.25E-03	5.00E-02	2.50E-02	3.10E-02	4.04E-02
Post Closure	Mercury	Swan	Inorganic	6.46E-02	5.98E-03	9.00E-01	6.65E-03	4.50E-01	1.33E-02
Post Closure	Mercury	Swan	Organic	1.30E-02	1.20E-03	5.00E-02	2.40E-02	3.10E-02	3.87E-02
Construction-Base	Mercury	Swan	Inorganic	8.40E-03	7.78E-04	9.00E-01	8.65E-04	4.50E-01	1.73E-03
Construction-Base	Mercury	Swan	Organic	1.72E-03	1.59E-04	5.00E-02	3.19E-03	3.10E-02	5.14E-03
Operations-Base	Mercury	Swan	Inorganic	6.53E-03	6.05E-04	9.00E-01	6.72E-04	4.50E-01	1.34E-03
Operations-Base	Mercury	Swan	Organic	1.34E-03	1.24E-04	5.00E-02	2.48E-03	3.10E-02	4.00E-03
Closure-Base	Mercury	Swan	Inorganic	1.13E-02	1.05E-03	9.00E-01	1.17E-03	4.50E-01	2.33E-03
Closure-Base	Mercury	Swan	Organic	2.32E-03	2.15E-04	5.00E-02	4.30E-03	3.10E-02	6.94E-03
Post Closure-Base	Mercury	Swan	Inorganic	2.74E-02	2.54E-03	9.00E-01	2.82E-03	4.50E-01	5.63E-03
Post Closure-Base	Mercury	Swan	Organic	5.61E-03	5.19E-04	5.00E-02	1.04E-02	3.10E-02	1.67E-02
Base	Mercury	Little Brown Myotis	Inorganic	5.62E-05	7.49E-03	1.00E+01	7.49E-04	1.00E+00	7.49E-03
Base	Mercury	Little Brown Myotis	Organic	2.25E-05	3.00E-03	1.44E-01	2.08E-02	8.00E-02	3.75E-02
Construction	Mercury	Little Brown Myotis	Inorganic	5.75E-05	7.67E-03	1.00E+01	7.67E-04	1.00E+00	7.67E-03
Construction	Mercury	Little Brown Myotis	Organic	2.43E-05	3.24E-03	1.44E-01	2.25E-02	8.00E-02	4.06E-02
Operations	Mercury	Little Brown Myotis	Inorganic	5.70E-05	7.61E-03	1.00E+01	7.61E-04	1.00E+00	7.61E-03
Operations	Mercury	Little Brown Myotis	Organic	2.36E-05	3.15E-03	1.44E-01	2.19E-02	8.00E-02	3.94E-02
Closure	Mercury	Little Brown Myotis	Inorganic	5.62E-05	7.49E-03	1.00E+01	7.49E-04	1.00E+00	7.49E-03
Closure	Mercury	Little Brown Myotis	Organic	2.25E-05	2.99E-03	1.44E-01	2.08E-02	8.00E-02	3.74E-02
Post Closure	Mercury	Little Brown Myotis	Inorganic	5.57E-05	7.43E-03	1.00E+01	7.43E-04	1.00E+00	7.43E-03
Post Closure	Mercury	Little Brown Myotis	Organic	2.19E-05	2.91E-03	1.44E-01	2.02E-02	8.00E-02	3.64E-02
Construction-Base	Mercury	Little Brown Myotis	Inorganic	1.86E-05	2.48E-03	1.00E+01	2.48E-04	1.00E+00	2.48E-03
Construction-Base	Mercury	Little Brown Myotis	Organic	4.86E-06	6.48E-04	1.44E-01	4.50E-03	8.00E-02	8.10E-03
Operations-Base	Mercury	Little Brown Myotis	Inorganic	1.83E-05	2.44E-03	1.00E+01	2.44E-04	1.00E+00	2.44E-03
Operations-Base	Mercury	Little Brown Myotis	Organic	4.45E-06	5.93E-04	1.44E-01	4.12E-03	8.00E-02	7.41E-03
Closure-Base	Mercury	Little Brown Myotis	Inorganic	2.05E-05	2.74E-03	1.00E+01	2.74E-04	1.00E+00	2.74E-03
Closure-Base	Mercury	Little Brown Myotis	Organic	5.77E-06	7.69E-04	1.44E-01	5.34E-03	8.00E-02	9.61E-03
Post Closure-Base	Mercury	Little Brown Myotis	Inorganic	2.31E-05	3.09E-03	1.00E+01	3.09E-04	1.00E+00	3.09E-03
Post Closure-Base	Mercury	Little Brown Myotis	Organic	9.32E-06	1.24E-03	1.44E-01	8.63E-03	8.00E-02	1.55E-02
Base	Mercury	Sandpiper	Inorganic	1.38E-03	3.69E-02	9.00E-01	4.09E-02	4.50E-01	8.19E-02
Base	Mercury	Sandpiper	Organic	4.71E-04	1.26E-02	5.00E-02	2.51E-01	3.10E-02	4.05E-01
Construction	Mercury	Sandpiper	Inorganic	1.40E-03	3.74E-02	9.00E-01	4.15E-02	4.50E-01	8.31E-02
Construction	Mercury	Sandpiper	Organic	5.03E-04	1.34E-02	5.00E-02	2.69E-01	3.10E-02	4.33E-01
Operations	Mercury	Sandpiper	Inorganic	1.39E-03	3.72E-02	9.00E-01	4.13E-02	4.50E-01	8.26E-02
Operations	Mercury	Sandpiper	Organic	4.91E-04	1.31E-02	5.00E-02	2.62E-01	3.10E-02	4.23E-01
Closure	Mercury	Sandpiper	Inorganic	1.38E-03	3.68E-02	9.00E-01	4.09E-02	4.50E-01	8.19E-02
Closure	Mercury	Sandpiper	Organic	4.70E-04	1.25E-02	5.00E-02	2.51E-01	3.10E-02	4.04E-01
Post Closure	Mercury	Sandpiper	Inorganic	1.38E-03	3.67E-02	9.00E-01	4.07E-02	4.50E-01	8.15E-02
Post Closure	Mercury	Sandpiper	Organic	4.59E-04	1.23E-02	5.00E-02	2.45E-01	3.10E-02	3.95E-01
Construction-Base	Mercury	Sandpiper	Inorganic	4.80E-04	1.28E-02	9.00E-01	1.42E-02	4.50E-01	2.84E-02
Construction-Base	Mercury	Sandpiper	Organic	1.13E-04	3.02E-03	5.00E-02	6.04E-02	3.10E-02	9.74E-02
Operations-Base	Mercury	Sandpiper	Inorganic	4.76E-04	1.27E-02	9.00E-01	1.41E-02	4.50E-01	2.82E-02
Operations-Base	Mercury	Sandpiper	Organic	1.06E-04	2.82E-03	5.00E-02	5.65E-02	3.10E-02	9.11E-02
Closure-Base	Mercury	Sandpiper	Inorganic	5.26E-04	1.40E-02	9.00E-01	1.56E-02	4.50E-01	3.12E-02
Closure-Base	Mercury	Sandpiper	Organic	1.32E-04	3.51E-03	5.00E-02	7.02E-02	3.10E-02	1.13E-01
Post Closure-Base	Mercury	Sandpiper	Inorganic	5.64E-04	1.51E-02	9.00E-01	1.67E-02	4.50E-01	3.34E-02
Post Closure-Base	Mercury	Sandpiper	Organic	1.95E-04	5.19E-03	5.00E-02	1.04E-01	3.10E-02	1.67E-01
Base	Mercury	Otter	Inorganic	1.71E-02	2.27E-03	1.00E+01	2.27E-04	1.00E+00	2.27E-03
Base	Mercury	Otter	Organic	8.94E-02	1.19E-02	1.44E-01	8.27E-02	8.00E-02	1.49E-01
Construction	Mercury	Otter	Inorganic	1.91E-02	2.55E-03	1.00E+01	2.55E-04	1.00E+00	2.55E-03
Construction	Mercury	Otter	Organic	1.01E-01	1.34E-02	1.44E-01	9.32E-02	8.00E-02	1.68E-01
Operations	Mercury	Otter	Inorganic	1.84E-02	2.45E-03	1.00E+01	2.45E-04	1.00E+00	2.45E-03
Operations	Mercury	Otter	Organic	9.64E-02	1.29E-02	1.44E-01	8.93E-02	8.00E-02	1.61E-01
Closure	Mercury	Otter	Inorganic	1.70E-02	2.27E-03	1.00E+01	2.27E-04	1.00E+00	2.27E-03
Closure	Mercury	Otter	Organic	8.91E-02	1.19E-02	1.44E-01	8.25E-02	8.00E-02	1.49E-01
Post Closure	Mercury	Otter	Inorganic	1.63E-02	2.18E-03	1.00E+01	2.18E-04	1.00E+00	2.18E-03
Post Closure	Mercury	Otter	Organic	8.54E-02	1.14E-02	1.44E-01	7.91E-02	8.00E-02	1.42E-01
Construction-Base	Mercury	Otter	Inorganic	2.11E-03	2.81E-04	1.00E+01	2.81E-05	1.00E+00	2.81E-04
Construction-Base	Mercury	Otter	Organic	1.14E-02	1.52E-03	1.44E-01	1.06E-02	8.00E-02	1.90E-02

Table F1-5: Hazard Quotient Calculations for Ecological Receptors

Case	Parameter	Receptor	Speciation	Estimated Daily Intake	Dose	LOAEL-TRV	HQ (LOAEL)	NOAEL-TRV	HQ (NOAEL)
				[mg/day]	[mg/kg-BW day]	[mg/kg-BW day]	[unitless]	[mg/kg-BW day]	[unitless]
Operations-Base	Mercury	Otter	Inorganic	1.64E-03	2.19E-04	1.00E+01	2.19E-05	1.00E+00	2.19E-04
Operations-Base	Mercury	Otter	Organic	8.88E-03	1.18E-03	1.44E+01	8.22E-03	8.00E-02	1.48E-02
Closure-Base	Mercury	Otter	Inorganic	2.85E-03	3.80E-04	1.00E+01	3.80E-05	1.00E+00	3.80E-04
Closure-Base	Mercury	Otter	Organic	1.54E-02	2.06E-03	1.44E+01	1.43E-02	8.00E-02	2.57E-02
Post Closure-Base	Mercury	Otter	Inorganic	6.87E-03	9.16E-04	1.00E+01	9.16E-05	1.00E+00	9.16E-04
Post Closure-Base	Mercury	Otter	Organic	3.72E-02	4.96E-03	1.44E+01	3.44E-02	8.00E-02	6.20E-02
Base	Mercury	Kingfisher	Inorganic	1.44E-03	9.71E-03	9.00E-01	1.08E-02	4.50E-01	2.16E-02
Base	Mercury	Kingfisher	Organic	8.14E-03	5.50E-02	5.00E-02	1.10E+00	3.10E-02	1.77E+00
Construction	Mercury	Kingfisher	Inorganic	1.62E-03	1.09E-02	9.00E-01	1.21E-02	4.50E-01	2.43E-02
Construction	Mercury	Kingfisher	Organic	9.17E-03	6.19E-02	5.00E-02	1.24E+00	3.10E-02	2.00E+00
Operations	Mercury	Kingfisher	Inorganic	1.55E-03	1.05E-02	9.00E-01	1.16E-02	4.50E-01	2.33E-02
Operations	Mercury	Kingfisher	Organic	8.79E-03	5.94E-02	5.00E-02	1.19E+00	3.10E-02	1.91E+00
Closure	Mercury	Kingfisher	Inorganic	1.43E-03	9.68E-03	9.00E-01	1.08E-02	4.50E-01	2.15E-02
Closure	Mercury	Kingfisher	Organic	8.12E-03	5.48E-02	5.00E-02	1.10E+00	3.10E-02	1.77E+00
Post Closure	Mercury	Kingfisher	Inorganic	1.37E-03	9.28E-03	9.00E-01	1.03E-02	4.50E-01	2.06E-02
Post Closure	Mercury	Kingfisher	Organic	7.78E-03	5.26E-02	5.00E-02	1.05E+00	3.10E-02	1.70E+00
Construction-Base	Mercury	Kingfisher	Inorganic	1.84E-04	1.24E-03	9.00E-01	1.38E-03	4.50E-01	2.76E-03
Construction-Base	Mercury	Kingfisher	Organic	1.04E-03	7.03E-03	5.00E-02	1.41E-01	3.10E-02	2.27E-01
Operations-Base	Mercury	Kingfisher	Inorganic	1.43E-04	9.64E-04	9.00E-01	1.07E-03	4.50E-01	2.14E-03
Operations-Base	Mercury	Kingfisher	Organic	8.09E-04	5.47E-03	5.00E-02	1.09E-01	3.10E-02	1.76E-01
Closure-Base	Mercury	Kingfisher	Inorganic	2.48E-04	1.68E-03	9.00E-01	1.86E-03	4.50E-01	3.72E-03
Closure-Base	Mercury	Kingfisher	Organic	1.40E-03	9.49E-03	5.00E-02	1.90E-01	3.10E-02	3.06E-01
Post Closure-Base	Mercury	Kingfisher	Inorganic	5.98E-04	4.04E-03	9.00E-01	4.49E-03	4.50E-01	8.98E-03
Post Closure-Base	Mercury	Kingfisher	Organic	3.39E-03	2.29E-02	5.00E-02	4.58E-01	3.10E-02	7.39E-01
Base	Mercury	Merganser	Inorganic	6.48E-03	4.32E-03	9.00E-01	4.80E-03	4.50E-01	9.60E-03
Base	Mercury	Merganser	Organic	3.33E-02	2.22E-02	5.00E-02	4.44E-01	3.10E-02	7.16E-01
Construction	Mercury	Merganser	Inorganic	7.28E-03	4.85E-03	9.00E-01	5.39E-03	4.50E-01	1.08E-02
Construction	Mercury	Merganser	Organic	3.75E-02	2.50E-02	5.00E-02	5.00E-01	3.10E-02	8.07E-01
Operations	Mercury	Merganser	Inorganic	6.98E-03	4.66E-03	9.00E-01	5.17E-03	4.50E-01	1.03E-02
Operations	Mercury	Merganser	Organic	3.59E-02	2.40E-02	5.00E-02	4.79E-01	3.10E-02	7.73E-01
Closure	Mercury	Merganser	Inorganic	6.46E-03	4.31E-03	9.00E-01	4.79E-03	4.50E-01	9.58E-03
Closure	Mercury	Merganser	Organic	3.32E-02	2.21E-02	5.00E-02	4.43E-01	3.10E-02	7.14E-01
Post Closure	Mercury	Merganser	Inorganic	6.21E-03	4.14E-03	9.00E-01	4.60E-03	4.50E-01	9.19E-03
Post Closure	Mercury	Merganser	Organic	3.18E-02	2.12E-02	5.00E-02	4.25E-01	3.10E-02	6.85E-01
Construction-Base	Mercury	Merganser	Inorganic	8.06E-04	5.37E-04	9.00E-01	5.97E-04	4.50E-01	1.19E-03
Construction-Base	Mercury	Merganser	Organic	4.26E-03	2.84E-03	5.00E-02	5.67E-02	3.10E-02	9.15E-02
Operations-Base	Mercury	Merganser	Inorganic	6.26E-04	4.18E-04	9.00E-01	4.64E-04	4.50E-01	9.28E-04
Operations-Base	Mercury	Merganser	Organic	3.31E-03	2.21E-03	5.00E-02	4.41E-02	3.10E-02	7.12E-02
Closure-Base	Mercury	Merganser	Inorganic	1.09E-03	7.25E-04	9.00E-01	8.06E-04	4.50E-01	1.61E-03
Closure-Base	Mercury	Merganser	Organic	5.75E-03	3.83E-03	5.00E-02	7.66E-02	3.10E-02	1.24E-01
Post Closure-Base	Mercury	Merganser	Inorganic	2.62E-03	1.75E-03	9.00E-01	1.94E-03	4.50E-01	3.89E-03
Post Closure-Base	Mercury	Merganser	Organic	1.39E-02	9.24E-03	5.00E-02	1.85E-01	3.10E-02	2.98E-01
Base	Mercury	Eagle	Inorganic	7.57E-03	1.61E-03	9.00E-01	1.79E-03	4.50E-01	3.58E-03
Base	Mercury	Eagle	Organic	4.23E-02	9.00E-03	5.00E-02	1.80E-01	3.10E-02	2.90E-01
Construction	Mercury	Eagle	Inorganic	8.52E-03	1.81E-03	9.00E-01	2.01E-03	4.50E-01	4.03E-03
Construction	Mercury	Eagle	Organic	4.77E-02	1.01E-02	5.00E-02	2.03E-01	3.10E-02	3.27E-01
Operations	Mercury	Eagle	Inorganic	8.17E-03	1.74E-03	9.00E-01	1.93E-03	4.50E-01	3.86E-03
Operations	Mercury	Eagle	Organic	4.57E-02	9.72E-03	5.00E-02	1.94E-01	3.10E-02	3.13E-01
Closure	Mercury	Eagle	Inorganic	7.55E-03	1.61E-03	9.00E-01	1.79E-03	4.50E-01	3.57E-03
Closure	Mercury	Eagle	Organic	4.22E-02	8.98E-03	5.00E-02	1.80E-01	3.10E-02	2.90E-01
Post Closure	Mercury	Eagle	Inorganic	7.25E-03	1.54E-03	9.00E-01	1.71E-03	4.50E-01	3.43E-03
Post Closure	Mercury	Eagle	Organic	4.05E-02	8.61E-03	5.00E-02	1.72E-01	3.10E-02	2.78E-01
Construction-Base	Mercury	Eagle	Inorganic	9.54E-04	2.03E-04	9.00E-01	2.26E-04	4.50E-01	4.51E-04
Construction-Base	Mercury	Eagle	Organic	5.41E-03	1.15E-03	5.00E-02	2.30E-02	3.10E-02	3.71E-02
Operations-Base	Mercury	Eagle	Inorganic	7.42E-04	1.58E-04	9.00E-01	1.75E-04	4.50E-01	3.51E-04
Operations-Base	Mercury	Eagle	Organic	4.20E-03	8.94E-04	5.00E-02	1.79E-02	3.10E-02	2.88E-02
Closure-Base	Mercury	Eagle	Inorganic	1.29E-03	2.74E-04	9.00E-01	3.05E-04	4.50E-01	6.09E-04
Closure-Base	Mercury	Eagle	Organic	7.30E-03	1.55E-03	5.00E-02	3.11E-02	3.10E-02	5.01E-02
Post Closure-Base	Mercury	Eagle	Inorganic	3.11E-03	6.61E-04	9.00E-01	7.35E-04	4.50E-01	1.47E-03
Post Closure-Base	Mercury	Eagle	Organic	1.76E-02	3.75E-03	5.00E-02	7.49E-02	3.10E-02	1.21E-01

Table F1-6: Hazard Quotient Summary for Ecological Receptors for Each Assessment Case

Mammal HQs using NOAEL-TRVs			
Receptor	Phase	Mercury	MethylMercury
Moose	Base	1.95E-03	2.37E-03
Moose	Construction	2.05E-03	2.63E-03
Moose	Operations	2.01E-03	2.54E-03
Moose	Closure	1.95E-03	2.36E-03
Moose	Post closure	1.91E-03	2.28E-03
Muskrat	Base	1.22E-02	5.59E-02
Muskrat	Construction	1.37E-02	6.30E-02
Muskrat	Operations	1.32E-02	6.04E-02
Muskrat	Closure	1.22E-02	5.58E-02
Muskrat	Post closure	1.17E-02	5.35E-02
Beaver	Base	1.32E-03	3.04E-03
Beaver	Construction	1.47E-03	3.42E-03
Beaver	Operations	1.41E-03	3.28E-03
Beaver	Closure	1.32E-03	3.03E-03
Beaver	Post closure	1.27E-03	2.91E-03
Little Brown Myotis	Base	7.49E-03	3.75E-02
Little Brown Myotis	Construction	7.67E-03	4.06E-02
Little Brown Myotis	Operations	7.61E-03	3.94E-02
Little Brown Myotis	Closure	7.49E-03	3.74E-02
Little Brown Myotis	Post closure	7.43E-03	3.64E-02
Otter	Base	2.27E-03	1.49E-01
Otter	Construction	2.55E-03	1.68E-01
Otter	Operations	2.45E-03	1.61E-01
Otter	Closure	2.27E-03	1.49E-01
Otter	Post closure	2.18E-03	1.42E-01
Mammal HQs using LOAEL-TRVs			
Moose	Base	1.95E-04	1.32E-03
Moose	Construction	2.05E-04	1.46E-03
Moose	Operations	2.01E-04	1.41E-03
Moose	Closure	1.95E-04	1.31E-03
Moose	Post closure	1.91E-04	1.27E-03
Muskrat	Base	1.22E-03	3.11E-02
Muskrat	Construction	1.37E-03	3.50E-02
Muskrat	Operations	1.32E-03	3.35E-02
Muskrat	Closure	1.22E-03	3.10E-02
Muskrat	Post closure	1.17E-03	2.97E-02
Beaver	Base	1.32E-04	1.69E-03

Receptor	Phase	Mercury	MethylMercury
Beaver	Construction	1.47E-04	1.90E-03
Beaver	Operations	1.41E-04	1.82E-03
Beaver	Closure	1.32E-04	1.68E-03
Beaver	Post closure	1.27E-04	1.62E-03
Little Brown Myotis	Base	7.49E-04	2.08E-02
Little Brown Myotis	Construction	7.67E-04	2.25E-02
Little Brown Myotis	Operations	7.61E-04	2.19E-02
Little Brown Myotis	Closure	7.49E-04	2.08E-02
Little Brown Myotis	Post closure	7.43E-04	2.02E-02
Otter	Base	2.27E-04	8.27E-02
Otter	Construction	2.55E-04	9.32E-02
Otter	Operations	2.45E-04	8.93E-02
Otter	Closure	2.27E-04	8.25E-02
Otter	Post closure	2.18E-04	7.91E-02
Bird HQs using NOAEL-TRVs			
Grouse	Base	9.90E-03	8.14E-03
Grouse	Construction	9.91E-03	8.15E-03
Grouse	Operations	9.91E-03	8.15E-03
Grouse	Closure	9.92E-03	8.15E-03
Grouse	Post closure	9.90E-03	8.15E-03
Duck	Base	1.48E-02	6.36E-02
Duck	Construction	1.64E-02	7.11E-02
Duck	Operations	1.58E-02	6.83E-02
Duck	Closure	1.47E-02	6.35E-02
Duck	Post closure	1.42E-02	6.10E-02
Swan	Base	1.39E-02	4.05E-02
Swan	Construction	1.56E-02	4.56E-02
Swan	Operations	1.50E-02	4.37E-02
Swan	Closure	1.39E-02	4.04E-02
Swan	Post closure	1.33E-02	3.87E-02
Sandpiper	Base	8.19E-02	4.05E-01
Sandpiper	Construction	8.31E-02	4.33E-01
Sandpiper	Operations	8.26E-02	4.23E-01
Sandpiper	Closure	8.19E-02	4.04E-01
Sandpiper	Post closure	8.15E-02	3.95E-01
Kingfisher	Base	2.16E-02	1.77E+00
Kingfisher	Construction	2.43E-02	2.00E+00
Kingfisher	Operations	2.33E-02	1.91E+00
Kingfisher	Closure	2.15E-02	1.77E+00
Kingfisher	Post closure	2.06E-02	1.70E+00
Merganser	Base	9.60E-03	7.16E-01

Receptor	Phase	Mercury	MethylMercury
Merganser	Construction	1.08E-02	8.07E-01
Merganser	Operations	1.03E-02	7.73E-01
Merganser	Closure	9.58E-03	7.14E-01
Merganser	Post closure	9.19E-03	6.85E-01
Eagle	Base	3.58E-03	2.90E-01
Eagle	Construction	4.03E-03	3.27E-01
Eagle	Operations	3.86E-03	3.13E-01
Eagle	Closure	3.57E-03	2.90E-01
Eagle	Post closure	3.43E-03	2.78E-01
Bird HQs using LOAEL-TRVs			
Grouse	Base	4.95E-03	5.05E-03
Grouse	Construction	4.96E-03	5.05E-03
Grouse	Operations	4.96E-03	5.05E-03
Grouse	Closure	4.96E-03	5.05E-03
Grouse	Post closure	4.95E-03	5.05E-03
Duck	Base	7.38E-03	3.95E-02
Duck	Construction	8.18E-03	4.41E-02
Duck	Operations	7.88E-03	4.24E-02
Duck	Closure	7.36E-03	3.93E-02
Duck	Post closure	7.10E-03	3.78E-02
Swan	Base	6.95E-03	2.51E-02
Swan	Construction	7.80E-03	2.83E-02
Swan	Operations	7.48E-03	2.71E-02
Swan	Closure	6.93E-03	2.50E-02
Swan	Post closure	6.65E-03	2.40E-02
Sandpiper	Base	4.09E-02	2.51E-01
Sandpiper	Construction	4.15E-02	2.69E-01
Sandpiper	Operations	4.13E-02	2.62E-01
Sandpiper	Closure	4.09E-02	2.51E-01
Sandpiper	Post closure	4.07E-02	2.45E-01
Kingfisher	Base	1.08E-02	1.10E+00
Kingfisher	Construction	1.21E-02	1.24E+00
Kingfisher	Operations	1.16E-02	1.19E+00
Kingfisher	Closure	1.08E-02	1.10E+00
Kingfisher	Post closure	1.03E-02	1.05E+00
Merganser	Base	4.80E-03	4.44E-01
Merganser	Construction	5.39E-03	5.00E-01
Merganser	Operations	5.17E-03	4.79E-01
Merganser	Closure	4.79E-03	4.43E-01
Merganser	Post closure	4.60E-03	4.25E-01
Eagle	Base	1.79E-03	1.80E-01

Receptor	Phase	Mercury	MethylMercury
Eagle	Construction	2.01E-03	2.03E-01
Eagle	Operations	1.93E-03	1.94E-01
Eagle	Closure	1.79E-03	1.80E-01
Eagle	Post closure	1.71E-03	1.72E-01

Shaded and Bold = HQ > 1.0

Table F1-7: Parameter Speciation Assumptions [%]

Media	Parameter	Speciation	Value	Reference
Soil	Arsenic	Inorganic	100%	Assumed
Dust	Arsenic	Inorganic	100%	Assumed
Surface_water	Arsenic	Inorganic	100%	Assumed
Sediment	Arsenic	Inorganic	100%	Assumed
Browse	Arsenic	Inorganic	100%	Assumed
Lichen	Arsenic	Inorganic	100%	Assumed
A_inverts	Arsenic	Inorganic	100%	Assumed
T_Invert_Arthro	Arsenic	Inorganic	100%	Assumed
T_Invert_Worm	Arsenic	Inorganic	100%	Assumed
Sm_mammals	Arsenic	Inorganic	100%	Assumed
Fish	Arsenic	Inorganic	100%	Assumed
Aq_plants	Arsenic	Inorganic	100%	Assumed
Berries	Arsenic	Inorganic	100%	Assumed
Soil	Selenium	Inorganic	100%	Assumed
Dust	Selenium	Inorganic	100%	Assumed
Surface_water	Selenium	Inorganic	100%	Assumed
Sediment	Selenium	Inorganic	100%	Assumed
Browse	Selenium	Inorganic	100%	Assumed
Lichen	Selenium	Inorganic	100%	Assumed
A_inverts	Selenium	Inorganic	100%	Assumed
T_Invert_Arthro	Selenium	Inorganic	100%	Assumed
T_Invert_Worm	Selenium	Inorganic	100%	Assumed
Sm_mammals	Selenium	Inorganic	100%	Assumed
Fish	Selenium	Inorganic	100%	Assumed
Aq_plants	Selenium	Inorganic	100%	Assumed
Berries	Selenium	Inorganic	100%	Assumed
Soil	Mercury	Inorganic	98.0%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Dust	Mercury	Inorganic	98.0%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Surface_water	Mercury	Inorganic	95.9%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Sediment	Mercury	Inorganic	98.3%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Browse	Mercury	Inorganic	98.1%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Lichen	Mercury	Inorganic	98.3%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
A_inverts	Mercury	Inorganic	42.4%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
T_Invert_Arthro	Mercury	Inorganic	85.2%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
T_Invert_Worm	Mercury	Inorganic	85.2%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Sm_mammals	Mercury	Inorganic	90.0%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Fish	Mercury	Inorganic	15.0%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Aq_plants	Mercury	Inorganic	83.0%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Berries	Mercury	Inorganic	96.4%	Assumed; proportion inorganic mercury (%) = 100% - proportion methylmercury (%)
Soil	Mercury	Organic	2.0%	US EPA 2005; HHRAP Appendix B
Dust	Mercury	Organic	2.0%	US EPA 2005; Assumed same as soil
Surface_water	Mercury	Organic	4.1%	Site-specific, average (all stations all years); WSP 2025 Mercury Study Report; Table 5-1
Sediment	Mercury	Organic	5.0%	CCME 1999; Canadian Sediment Quality Guidelines for the Protection of Aquatic Life; Midpoint of range (0.1-10%)
Browse	Mercury	Organic	1.9%	Mailman and Bodaly 2005 (Labrador tea)
Lichen	Mercury	Organic	1.7%	Hall 2004
A_inverts	Mercury	Organic	57.6%	Tremblay et al. 1996; Average across locations and species from lakes in Quebec
T_Invert_Arthro	Mercury	Organic	14.8%	Zheng 2008; Average across species and sampling locations
T_Invert_Worm	Mercury	Organic	14.8%	Assumed same as arthropod
Sm_mammals	Mercury	Organic	10.0%	US EPA 1997; Assumed same as raw beef tissue
Fish	Mercury	Organic	85.0%	Canuel et al. 2006
Aq_plants	Mercury	Organic	17.0%	Mauro et al. 2002; Percent mercury methylation of cultivated macrophytes
Berries	Mercury	Organic	3.6%	Mailman and Bodaly 2005 (blueberry)
Soil	Arsenic	Total	100%	Assumed
Dust	Arsenic	Total	100%	Assumed
Surface_water	Arsenic	Total	100%	Assumed
Sediment	Arsenic	Total	100%	Assumed
Browse	Arsenic	Total	100%	Assumed
Lichen	Arsenic	Total	100%	Assumed
A_inverts	Arsenic	Total	100%	Assumed
T_Invert_Arthro	Arsenic	Total	100%	Assumed
T_Invert_Worm	Arsenic	Total	100%	Assumed
Sm_mammals	Arsenic	Total	100%	Assumed
Fish	Arsenic	Total	100%	Assumed
Aq_plants	Arsenic	Total	100%	Assumed
Berries	Arsenic	Total	100%	Assumed
Soil	Selenium	Total	100%	Assumed
Dust	Selenium	Total	100%	Assumed
Surface_water	Selenium	Total	100%	Assumed
Sediment	Selenium	Total	100%	Assumed
Browse	Selenium	Total	100%	Assumed
Lichen	Selenium	Total	100%	Assumed
A_inverts	Selenium	Total	100%	Assumed
T_Invert_Arthro	Selenium	Total	100%	Assumed
T_Invert_Worm	Selenium	Total	100%	Assumed
Sm_mammals	Selenium	Total	100%	Assumed
Fish	Selenium	Total	100%	Assumed
Aq_plants	Selenium	Total	100%	Assumed
Berries	Selenium	Total	100%	Assumed
Soil	Mercury	Total	100%	Assumed
Dust	Mercury	Total	100%	Assumed
Surface_water	Mercury	Total	100%	Assumed

Table F1-7: Parameter Speciation Assumptions [%]				
Media	Parameter	Speciation	Value	Reference
Sediment	Mercury	Total	100%	Assumed
Browse	Mercury	Total	100%	Assumed
Lichen	Mercury	Total	100%	Assumed
A_inverts	Mercury	Total	100%	Assumed
T_Invert_Arthro	Mercury	Total	100%	Assumed
T_Invert_Worm	Mercury	Total	100%	Assumed
Sm_mammals	Mercury	Total	100%	Assumed
Fish	Mercury	Total	100%	Assumed
Aq_plants	Mercury	Total	100%	Assumed
Berries	Mercury	Total	100%	Assumed

Table F1-8: Toxicity Reference Values Used for the ERA						
Type	Parameter	Speciation	TRV [mg/kg-BW/day]		Reference / Comment	
			NOAEL	LOAEL	NOAEL	LOAEL
Mammal	Mercury	Inorganic	1.00	10.0	A NOAEL of 1 mg Hg/kg bw/day was reported for effects on reproduction (i.e., kit weight, fertility, and kit survival) in laboratory mink that were exposed to 1.01 mg Hg/kg bw/day (as mercuric chloride) in their diet throughout gestation for six months (Aulerich et al. 1974; as cited in Sample et al. 1996).	The LOAEL was derived by applying a 10-fold uncertainty factor to the NOAEL.
Mammal	Mercury	Organic	0.08	0.14	NOAEL for survival of mink (Chamberland 1996; Laperle et al. 1998) as cited in CCME 2000.	LOAEL for survival of mink (Chamberland 1996; Laperle et al. 1998) as cited in CCME 2000.
Bird	Mercury	Inorganic	0.45	0.90	A NOAEL of 0.45 mg Hg/kg bw/day was reported for effects on reproduction (i.e., fertility, hatchability) in laboratory Japanese quail that were exposed to 4 mg/kg (as mercuric chloride) in their diet over one year (Hill and Schaffner 1976; as cited in Sample et al 1996).	A LOAEL of 0.90 mg Hg/kg bw/day was reported for effects on reproduction (i.e., fertility, hatchability) in laboratory Japanese quail that were exposed to 8 mg/kg (as mercuric chloride) in their diet over one year (Hill and Schaffner 1976; as cited in Sample et al 1996).
Bird	Mercury	Organic	0.031	0.050	Tolerable daily intake used by CCME in the derivation of the tissue-based guideline for MeHg for birds. Geometric mean of the LOAEL and NOAEL without application of an uncertainty factor (CCME 2000).	Lowest EC20/effects threshold/LOAEL for birds (Fuchsman et al. 2017).

Table F1-9: Input Parameters Used for Predicting Soil Concentrations from Deposition Based on Project and Site Characteristics		
Variable	Value	Reference / Comment
Time_Construction	3	t; Assumed equal to duration of project construction (3)
Time_Operations	26	t; Assumed equal to duration of project operations (26)
Time_Closure	3	t; Assumed equal to duration of active closure (3)
Time_PostClosure	2	t; Assumed equal to duration of passive and final closure (~2)
Time_Total	34	t; Assumed equal to duration of all phases
Surface Soil Mixing Depth [metres] = Depth1	0.02	Z1; US EPA 2005
Soil Mixing Depth for Plants and Invertebrates[metres] = Depth2	0.2	Z2; US EPA 2005
Soil Bulk Density [kg/m3]	1500	BD; US EPA 2005

Parameter	Value	Half-life [days]	Reference / Comment
Arsenic	0.026659507	9490	Assumed life of project
Mercury	0.026659507	9490	Assumed life of project
Selenium	0.026659507	9490	Assumed life of project

Table F1-11: Bioaccumulation Models Used to Predict Tissue Concentrations										
Media	Parameter	Slope	Intercept	BAF DW	Model	Media	Site-Specific/ Literature	Units	Comment	Reference
Browse	Arsenic	0.564	-1.992	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 7	BJC 1998
Browse	Mercury	0.544	-0.996	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 7	BJC 1998
Browse	Selenium	1.104	-0.678	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 7	BJC 1998
T_Invert_Arthro	Arsenic	0.93	-2.45	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)		Beyer & Sample 2017
T_Invert_Arthro	Mercury	0.118	-0.684	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	No arthropod factor available. Assumed same as earthworm	Sample et al. 1998a
T_Invert_Arthro	Selenium	0.733	-0.075	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	No arthropod factor available. Assumed same as earthworm	Sample et al. 1998a
T_Invert_Worm	Arsenic	0.706	-1.421	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 12	Sample et al. 1998a
T_Invert_Worm	Mercury	0.118	-0.684	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 12	Sample et al. 1998a
T_Invert_Worm	Selenium	0.733	-0.075	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 12; Se (w/o outlier)	Sample et al. 1998a
Aq_Plant	Arsenic	-	-	854.23	BCF	Surface Water	Literature	(mg POPC / kg dry tissue) / (mg dissolved POPC / L water)	Table C-4; Converted to dry weight using 65.7% moisture (algae).	US EPA 1999
Aq_Plant	Mercury	-	-	72192.42	BCF	Surface Water	Literature	(mg POPC / kg dry tissue) / (mg dissolved POPC / L water)	Table C-4; Mercury chloride; Converted to dry weight using 65.7% moisture	US EPA 1999
Aq_Plant	Selenium	-	-	5379.01	BCF	Surface Water	Literature	(mg POPC / kg dry tissue) / (mg dissolved POPC / L water)	Table C-4; Converted to dry weight using 65.7% moisture (algae).	US EPA 1999
Sm_Mammal	Arsenic	0.8188	-4.8471	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 8; general group	Sample et al. 1998b
Sm_Mammal	Mercury	-	-	0.05	BAF	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 7; Median uptake factor	Sample et al. 1998b
Sm_Mammal	Selenium	0.3764	-0.4158	-	LN	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Table 8; general group	Sample et al. 1998b
Aq_Inverts	Arsenic	-	-	300.00	BCF	Surface Water	Literature	(mg POPC/kg dry tissue) / (mg/L)	Table D.5; BAF for crustacea and mollusks; Assumed dry weight tissue	Argonne National Laboratory 2001
Aq_Inverts	Mercury	-	-	20000.00	BCF	Surface Water	Literature	(mg POPC/kg dry tissue) / (mg/L)	Table D.5; BAF for crustacea and mollusks; Assumed dry weight tissue	Argonne National Laboratory 2001
Aq_Inverts	Selenium	-	-	170.00	BCF	Surface Water	Literature	(mg POPC/kg dry tissue) / (mg/L)	Table D.5; BAF for crustacea and mollusks; Assumed dry weight tissue	Argonne National Laboratory 2001
Berries	Arsenic	-	-	0.01	BAF	Soil	Site-Specific	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Calculated based on 90th percentile baseline soil and berry concentrations. Converted to dry weight using 86% moisture	--
Berries	Mercury	-	-	0.20	BAF	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Soil to plant concentration factor, Br (reproductive part of plant). Figure 2.2	Baes et al 1984
Berries	Selenium	-	-	0.03	BAF	Soil	Literature	(mg POPC/kg dry tissue) / (mg/kg dry soil)	Soil to plant concentration factor, Br (reproductive part of plant). Figure 2.2	Baes et al 1984
Fish	Arsenic	-	-	115.55	BCF	Surface Water	Site-Specific	(mg POPC/kg dry tissue) / (mg/L surface water)	Calculated based on 90th percentile small fish concentrations in each sampled year and Model Baseline maximum monthly average surface water concentrations. Maximum year BAF selected; BAF for 2022.	--
Fish	Mercury	-	-	168694.17	BCF	Surface Water	Site-Specific	(mg POPC/kg dry tissue) / (mg/L surface water)	Calculated based on 90th percentile small fish concentrations in each sampled year and Model Baseline maximum monthly average surface water concentrations. Maximum year BAF selected; BAF for 2022	--
Fish	Selenium	-	-	7568.20	BCF	Surface Water	Site-Specific	(mg POPC/kg dry tissue) / (mg/L surface water)	Calculated based on 90th percentile small fish concentrations in each sampled year and Model Baseline maximum monthly average surface water concentrations. Maximum year BAF selected; BAF for 2023	--

Table F1-12: Wildlife Exposure Variables						
Receptor	Parameter	Value	Units	Reference / Comment	Description	
Moose	Sed&Soil	2%	%	FCSAP 2012; Moose	Total percentage of ingested sediment and soil	
Moose	SIR	0.13	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Moose	P_SIR	1.6%	%	Calculated from proportion of terrestrial food	percent SIR	
Moose	BW	400	kg	FCSAP 2012; Moose, average	Body Weight	
Moose	WIR	22	L/day	FCSAP (2012) (based on US EPA (1993); Calculated based on allometric equation 3-17 for mammals)	Water Ingestion Rate	
Moose	FIR	8.0	kg dry food/day	FCSAP 2012; Moose, 0.02 kg dry food/kg wet body weight/day	Food Ingestion Rate	
Moose	SEDIR	0.032	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate	
Moose	P_SEDIR	0.4%	%	Calculated from proportion of aquatic food	percent SEDIR	
Moose	AIR	66	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Deer	Sed&Soil	2%	%	FCSAP 2012; White-tailed Deer	Total soil and sediment ingestion proportion	
Deer	SIR	0.045	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Deer	P_SIR	2%	%	Calculated from proportion of terrestrial food	percent SIR	
Deer	BW	75	kg	FCSAP 2012; White-Tailed Deer, average	Body Weight	
Deer	WIR	4.8	L/day	FCSAP (2012) (based on US EPA (1993); Calculated based on allometric equation 3-17 for mammals)	Water Ingestion Rate	
Deer	FIR	2.3	kg dry food/day	FCSAP 2012; White-Tailed Deer, 0.03 kg dry food/kg wet body weight/day	Food Ingestion Rate	
Deer	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
Deer	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Deer	AIR	17	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Snowshoe Hare	Sed&Soil	6.3%	%	FCSAP 2012; Snowshoe Hare	Total soil and sediment ingestion proportion	
Snowshoe Hare	SIR	0.0049	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Snowshoe Hare	P_SIR	6.3%	%	Calculated from proportion of terrestrial food	percent SIR	
Snowshoe Hare	BW	1.30	kg	FCSAP 2012; Snowshoe Hare, average	Body Weight	
Snowshoe Hare	WIR	0.13	L/day	FCSAP (2012) (based on US EPA (1993); Calculated based on allometric equation 3-17 for mammals)	Water Ingestion Rate	
Snowshoe Hare	FIR	0.078	kg dry food/day	FCSAP 2012; Snowshoe Hare, 0.06 kg dry food/kg wet body weight/day	Food Ingestion Rate	
Snowshoe Hare	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
Snowshoe Hare	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Snowshoe Hare	AIR	0.67	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Rabbit	Sed&Soil	6.3%	%	FCSAP 2012; Assumed same as Snowshoe Hare	Total soil and sediment ingestion proportion	
Rabbit	SIR	0.0022	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Rabbit	P_SIR	6.3%	%	Calculated from proportion of terrestrial food	percent SIR	
Rabbit	BW	1.25	kg	US EPA 1993; Eastern Cottontail; Value is mid-point of reported size range (0.7-1.8 kg)	Body Weight	
Rabbit	WIR	0.12	L/day	US EPA (1993); Calculated based on allometric equation 3-17 for mammals	Water Ingestion Rate	
Rabbit	FIR	0.035	kg dry food/day	US EPA (1993); Calculated based on allometric equation 3-8 for rodents	Food Ingestion Rate	
Rabbit	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
Rabbit	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Rabbit	AIR	0.65	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
MooseLiver	Sed&Soil	2%	%	FCSAP 2012; Moose	Total soil and sediment ingestion proportion	
MooseLiver	SIR	0.13	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
MooseLiver	P_SIR	1.6%	%	Calculated from proportion of terrestrial food	percent SIR	
MooseLiver	BW	400	kg	FCSAP 2012; Moose, average	Body Weight	
MooseLiver	WIR	22	L/day	FCSAP (2012) (based on US EPA (1993); Calculated based on allometric equation 3-17 for mammals)	Water Ingestion Rate	
MooseLiver	FIR	8.0	kg dry food/day	FCSAP 2012; Moose, 0.02 kg dry food/kg wet body weight/day	Food Ingestion Rate	
MooseLiver	SEDIR	0.032	kg sed/day	Calculated	Sediment Ingestion Rate	
MooseLiver	P_SEDIR	0.4%	%	Calculated from proportion of aquatic food	percent SEDIR	
MooseLiver	AIR	66	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
MooseKidney	Sed&Soil	2%	%	FCSAP 2012; Moose	Total soil and sediment ingestion proportion	
MooseKidney	SIR	0.13	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
MooseKidney	P_SIR	1.6%	%	Calculated from proportion of terrestrial food	percent SIR	
MooseKidney	BW	400	kg	FCSAP 2012; Moose, average	Body Weight	
MooseKidney	WIR	22	L/day	FCSAP (2012) (based on US EPA (1993); Calculated based on allometric equation 3-17 for mammals)	Water Ingestion Rate	
MooseKidney	FIR	8.0	kg dry food/day	FCSAP 2012; Moose, 0.02 kg dry food/kg wet body weight/day	Food Ingestion Rate	
MooseKidney	SEDIR	0.032	kg sed/day	Calculated	Sediment Ingestion Rate	
MooseKidney	P_SEDIR	0.4%	%	Calculated from proportion of aquatic food	percent SEDIR	
MooseKidney	AIR	66	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Partridge	Sed&Soil	2%	%	FCSAP 2012; assumed same as Spruce Grouse	Total soil and sediment ingestion proportion	
Partridge	SIR	0.00084	kg soil/day	Assumed same as Spruce Grouse	Soil Ingestion Rate	
Partridge	P_SIR	2%	%	Calculated from proportion of terrestrial food	percent SIR; Assumed same as spruce grouse	
Partridge	BW	0.60	kg	FCSAP 2012; assumed same as Spruce Grouse	Body Weight	
Partridge	WIR	0.042	L/day	grouse	Water Ingestion Rate	
Partridge	FIR	0.042	kg dry food/day	FCSAP 2012; assumed same as Spruce Grouse	Food Ingestion Rate	
Partridge	SEDIR	0	kg sed/day	Assumed same as Spruce Grouse	Sediment Ingestion Rate	

Table F1-12: Wildlife Exposure Variables						
Receptor	Parameter	Value	Units	Reference / Comment	Description	
Partridge	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR; Assumed same as spruce grouse	
Partridge	AIR	0.28	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust ; Assumed same as spruce grouse	
Grouse	Sed&Soil	2%	%	FCSAP 2012; Spruce Grouse; No rate provided. Assumed generic rate.	Total percentage of ingested sediment and soil	
Grouse	SIR	0.00084	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Grouse	P_SIR	2%	%	Calculated from proportion of terrestrial food	percent SIR	
Grouse	BW	0.60	kg	FCSAP 2012; Spruce Grouse, average	Body Weight	
Grouse	WIR	0.042	L/day	FCSAP (2012) (based on US EPA (1993)); Calculated based on allometric equation 3-15 for birds)	Water Ingestion Rate	
Grouse	FIR	0.042	kg dry food/day	FCSAP 2012; Spruce Grouse, 0.07 kg dry food/kg wet body weight/day	Food Ingestion Rate	
Grouse	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
Grouse	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Grouse	AIR	0.28	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust	
Duck	Sed&Soil	3.3%	%	FCSAP 2012; Mallard	Total percentage of ingested sediment and soil	
Duck	SIR	0.00020	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Duck	P_SIR	0.3%	%	Calculated from proportion of terrestrial food	percent SIR	
Duck	BW	1.2	kg	FCSAP 2012; Mallard, average	Body Weight	
Duck	WIR	0.067	L/day	FCSAP (2012) (based on US EPA (1993)); Calculated based on allometric equation 3-15 for birds)	Water Ingestion Rate	
Duck	FIR	0.060	kg dry food/day	FCSAP 2012; Mallard, 0.05 kg dry food/kg wet body weight/day	Food Ingestion Rate	
Duck	SEDIR	0.0018	kg sed/day	Calculated	Sediment Ingestion Rate	
Duck	P_SEDIR	3.0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Duck	AIR	0.47	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust	
Goose	Sed&Soil	8.2%	%	US EPA 1993; Canada Goose	Total soil and sediment ingestion proportion	
Goose	SIR	0.0083	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Goose	P_SIR	8.2%	%	Calculated from proportion of terrestrial food	percent SIR	
Goose	BW	3.45	kg	US EPA 1993; Canada Goose Adult female, Nova Scotia	Body Weight	
Goose	WIR	0.14	L/day	US EPA (1993); Calculated based on allometric equation 3-15 for birds	Water Ingestion Rate	
Goose	FIR	0.10	kg dry food/day	US EPA 1993; Canada Goose; Female winter ingestion rate; Converted to DW using 11% MC of diet (US EPA 1993)	Food Ingestion Rate	
Goose	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
Goose	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Goose	AIR	1.1	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust	
CaribouLiver	Sed&Soil	2%	%	Beyer et al. 1994; Assumed same as deer, elk, and moose	Total soil and sediment ingestion proportion	
CaribouLiver	SIR	0.070	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
CaribouLiver	P_SIR	2%	%	Does not consume aquatic foods	percent SIR	
CaribouLiver	BW	160	kg	Calculated from proportion of terrestrial food	Body Weight	
CaribouLiver	WIR	9.5	L/day	US EPA (1993); Calculated based on allometric equation 3-17 for mammals	Water Ingestion Rate	
CaribouLiver	FIR	3.5	kg dry food/day	US EPA (1993); Calculated based on allometric equation 3-9 for herbivore mammals	Food Ingestion Rate	
CaribouLiver	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
CaribouLiver	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
CaribouLiver	AIR	32	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Caribou	Sed&Soil	2%	%	Beyer et al. 1994; Assumed same as deer, elk, and moose	Total soil and sediment ingestion proportion	
Caribou	SIR	0.070	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Caribou	P_SIR	2%	%	Calculated from proportion of terrestrial food	percent SIR	
Caribou	BW	160	kg	MECP (2025); Caribou, average of range	Body Weight	
Caribou	WIR	9.5	L/day	US EPA (1993); Calculated based on allometric equation 3-17 for mammals	Water Ingestion Rate	
Caribou	FIR	3.5	kg dry food/day	US EPA (1993); Calculated based on allometric equation 3-9 for herbivore mammals	Food Ingestion Rate	
Caribou	SEDIR	0	kg sed/day	Does not consume aquatic foods	Sediment Ingestion Rate	
Caribou	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR	
Caribou	AIR	32	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Muskrat	Sed&Soil	2%	%	FCSAP 2012; Muskrat; No rate provided. Assumed generic rate.	Total percentage of ingested sediment and soil	
Muskrat	SIR	0	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Muskrat	P_SIR	0%	%	Calculated from proportion of terrestrial food	percent SIR	
Muskrat	BW	1	kg	FCSAP 2012; Muskrat, average	Body Weight	
Muskrat	WIR	0.10	L/day	FCSAP (2012) (based on US EPA (1993)); Calculated based on allometric equation 3-17 for mammals)	Water Ingestion Rate	
Muskrat	FIR	0.070	kg dry food/day	FCSAP 2012; Muskrat, 0.07 kg dry food/kg wet body weight/day	Food Ingestion Rate	
Muskrat	SEDIR	0.0014	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate	
Muskrat	P_SEDIR	2%	%	Calculated from proportion of aquatic food	percent SEDIR	
Muskrat	AIR	0.55	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust	
Beaver	Sed&Soil	2%	%	No rate provided. Assumed generic rate (FCSAP 2012)	Total percentage of ingested sediment and soil	
Beaver	SIR	0.00092	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate	
Beaver	P_SIR	0.5%	%	Calculated from proportion of terrestrial food	percent SIR	
Beaver	BW	24	kg	CWS and CWF (2017), average (range 16-32 kg)	Body Weight	
Beaver	WIR	1.7	L/day	US EPA (1993); Calculated based on allometric equation 3-17 for mammals	Water Ingestion Rate	

Table F1-12: Wildlife Exposure Variables

Receptor	Parameter	Value	Units	Reference / Comment	Description
Beaver	FIR	0.18	kg dry food/day	US EPA (1993); Calculated based on allometric equation 3-8 for rodents	Food Ingestion Rate
Beaver	SEDIR	0.0028	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Beaver	P_SEDIR	1.5%	%	Calculated from proportion of aquatic food	percent SEDIR
Beaver	AIR	6.9	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust
Swan	Sed&Soil	4.6%	%	Beyer et al. 2008; used Mute swan as a surrogate	Total percentage of ingested sediment and soil
Swan	SIR	0	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate
Swan	P_SIR	0%	%	Calculated from proportion of terrestrial food	percent SIR
Swan	BW	10.8	kg	Mitchell and Eichholz 2020. Birds of the World - Trumpeter Swan; Maximum of female range (First year birds)	Body Weight
Swan	WIR	0.29	L/day	US EPA (1993); Calculated based on allometric equation 3-15 for birds	Water Ingestion Rate
Swan	FIR	0.32	kg dry food/day	US EPA (1993); Calculated based on allometric equation 3-5 for non-passerines	Food Ingestion Rate
Swan	SEDIR	0.015	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Swan	P_SEDIR	4.6%	%	Calculated from proportion of aquatic food	percent SEDIR
Swan	AIR	2.6	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust
Little Brown Myotis	Sed&Soil	0%	%	Sample and Suter 1994; Assumed to be negligible for aerial insectivore	Total percentage of ingested sediment and soil
Little Brown Myotis	SIR	0	kg soil/day	Assumed to be negligible for aerial insectivore	Soil Ingestion Rate
Little Brown Myotis	P_SIR	0%	%	Calculated from proportion of terrestrial food	percent SIR
Little Brown Myotis	BW	0.0075	kg	Sample and Suter 1994; Little Brown Myotis	Body Weight
Little Brown Myotis	WIR	0.0012	L/day	US EPA (1993); Calculated based on allometric equation 3-17 for mammals	Water Ingestion Rate
Little Brown Myotis	FIR	0.00052	kg dry food/day	Sample and Suter 1994; Little Brown Myotis; pregnant female; Converted to DW with a weighted average MC 79.1% moisture in food.	Food Ingestion Rate
Little Brown Myotis	SEDIR	0	kg sed/day	Assumed to be negligible for aerial insectivore	Sediment Ingestion Rate
Little Brown Myotis	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR
Little Brown Myotis	AIR	0.011	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust
Sandpiper	Sed&Soil	2%	%	FCSAP 2012; Spotted Sandpiper; No rate provided. Assumed generic rate.	Total percentage of ingested sediment and soil
Sandpiper	SIR	0.000081	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate
Sandpiper	P_SIR	1.2%	%	Calculated from proportion of terrestrial food	percent SIR
Sandpiper	BW	0.0375	kg	FCSAP 2012; Spotted Sandpiper, average	Body Weight
Sandpiper	WIR	0.0065	L/day	FCSAP (2012) (based on US EPA (1993)); Calculated based on allometric equation 3-15 for birds	Water Ingestion Rate
Sandpiper	FIR	0.0068	kg dry food/day	FCSAP 2012; Spotted Sandpiper, 0.18 kg dry food/kg wet body weight/day	Food Ingestion Rate
Sandpiper	SEDIR	0.000054	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Sandpiper	P_SEDIR	0.8%	%	Calculated from proportion of aquatic food	percent SEDIR
Sandpiper	AIR	0.033	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust
Otter	Sed&Soil	2%	%	FCSAP 2012; Northern River Otter; No rate provided. Assumed generic rate.	Total percentage of ingested sediment and soil
Otter	SIR	0.00023	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate
Otter	P_SIR	0.1%	%	Calculated from proportion of terrestrial food	percent SIR
Otter	BW	7.5	kg	FCSAP 2012; Northern River Otter, average	Body Weight
Otter	WIR	0.61	L/day	FCSAP (2012) (based on US EPA (1993)); Calculated based on allometric equation 3-17 for mammals	Water Ingestion Rate
Otter	FIR	0.23	kg dry food/day	FCSAP 2012; Northern River Otter, 0.03 kg dry food/kg wet body weight/day	Food Ingestion Rate
Otter	SEDIR	0.0043	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Otter	P_SEDIR	1.9%	%	Calculated from proportion of aquatic food	percent SEDIR
Otter	AIR	2.7	m3/day	US EPA (1993); Calculated based on allometric equation 3-20 for mammals	Air inhalation rate / ingestion of dust
Kingfisher	Sed&Soil	0%	%	Assumed no soil and sediment exposure to piscivorous predator	Total percentage of ingested sediment and soil
Kingfisher	SIR	0	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate
Kingfisher	P_SIR	0%	%	Calculated from proportion of terrestrial food	percent SIR
Kingfisher	BW	0.148	kg	Sample and Suter 1994; Belted Kingfisher	Body Weight
Kingfisher	WIR	0.016	L/day	US EPA (1993); Calculated based on allometric equation 3-15 for birds	Water Ingestion Rate
Kingfisher	FIR	0.017	kg dry food/day	Sample and Suter 1994; Belted Kingfisher; Converted to DW with a weighted average MC of 77.8%	Food Ingestion Rate
Kingfisher	SEDIR	0	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Kingfisher	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR
Kingfisher	AIR	0.094	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust
Merganser	Sed&Soil	2%	%	FCSAP 2012; Common Merganser; No rate provided. Assumed generic rate.	Total percentage of ingested sediment and soil
Merganser	SIR	0	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate
Merganser	P_SIR	0%	%	Calculated from proportion of terrestrial food	percent SIR
Merganser	BW	1.5	kg	FCSAP 2012; Common Merganser, average	Body Weight
Merganser	WIR	0.077	L/day	FCSAP (2012) (based on US EPA (1993)); Calculated based on allometric equation 3-15 for birds	Water Ingestion Rate
Merganser	FIR	0.075	kg dry food/day	FCSAP 2012; Common Merganser, 0.05 kg dry food/kg wet body weight/day	Food Ingestion Rate
Merganser	SEDIR	0.0015	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Merganser	P_SEDIR	2%	%	Calculated from proportion of aquatic food	percent SEDIR
Merganser	AIR	0.56	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust
Eagle	Sed&Soil	0%	%	Assumed no soil and sediment exposure to carnivorous predator	Total percentage of ingested sediment and soil
Eagle	SIR	0	kg soil/day	Calculated as FIR x P_SIR	Soil Ingestion Rate

Table F1-12: Wildlife Exposure Variables					
Receptor	Parameter	Value	Units	Reference / Comment	Description
Eagle	P_SIR	0%	%	Calculated from proportion of terrestrial food	percent SIR
Eagle	BW	4.7	kg	FCSAP 2012; Bald Eagle, average	Body Weight
Eagle	WIR	0.17	L/day	FCSAP (2012) (based on US EPA (1993); Calculated based on allometric equation 3-15 for birds)	Water Ingestion Rate
Eagle	FIR	0.13	kg dry food/day	FCSAP 2012; Bald Eagle, 0.12 kg wet food/kg wet body weight/day; Converted to DW with a weighted average MC of 76.4%	Food Ingestion Rate
Eagle	SEDIR	0	kg sed/day	Calculated as FIR x P_SEDIR	Sediment Ingestion Rate
Eagle	P_SEDIR	0%	%	Calculated from proportion of aquatic food	percent SEDIR
Eagle	AIR	1.3	m3/day	US EPA (1993); Calculated based on allometric equation 3-19 for birds	Air inhalation rate / ingestion of dust

Table F1-13: Receptor Dietary Composition (Media % of Diet)

Receptor	Media	Value	Reference
Beaver	Browse	25%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	Aq_plants	75%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	A_Inverts	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	T_Invert_Arthro	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	T_Invert_Worm	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	Sm_mammals	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	Lichen	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	Fish	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	Berries	0%	Milligan and Humphries 2010; Autumn diet composition of beavers in stream habitats
Beaver	Prop_Terr	25%	Percentage of diet that is terrestrial; Calculated
Beaver	Prop_Aq	75%	Percentage of diet that is aquatic; Calculated
Caribou	Browse	33%	Thompson et al. 2015; Remaining portion of diet other than lichen
Caribou	Aq_plants	0%	Thompson et al. 2015
Caribou	A_Inverts	0%	Thompson et al. 2015
Caribou	T_Invert_Arthro	0%	Thompson et al. 2015
Caribou	T_Invert_Worm	0%	Thompson et al. 2015
Caribou	Sm_mammals	0%	Thompson et al. 2015
Caribou	Lichen	67%	Thompson et al. 2015; Average lichen consumption across all seasons in Ontario
Caribou	Fish	0%	Thompson et al. 2015
Caribou	Berries	0%	Thompson et al. 2015
Caribou	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Caribou	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
CaribouLiver	Browse	33%	Assumed same as caribou
CaribouLiver	Aq_plants	0%	Assumed same as caribou
CaribouLiver	A_Inverts	0%	Assumed same as caribou
CaribouLiver	T_Invert_Arthro	0%	Assumed same as caribou
CaribouLiver	T_Invert_Worm	0%	Assumed same as caribou
CaribouLiver	Sm_mammals	0%	Assumed same as caribou
CaribouLiver	Lichen	67%	Assumed same as caribou
CaribouLiver	Fish	0%	Assumed same as caribou
CaribouLiver	Berries	0%	Assumed same as caribou
CaribouLiver	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
CaribouLiver	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Deer	Browse	89%	FCSAP 2012; White-tailed deer
Deer	Aq_plants	0%	FCSAP 2012; White-tailed deer
Deer	A_Inverts	0%	FCSAP 2012; White-tailed deer
Deer	T_Invert_Arthro	0%	FCSAP 2012; White-tailed deer
Deer	T_Invert_Worm	0%	FCSAP 2012; White-tailed deer
Deer	Sm_mammals	0%	FCSAP 2012; White-tailed deer
Deer	Lichen	1%	FCSAP 2012; White-tailed deer
Deer	Fish	0%	FCSAP 2012; White-tailed deer
Deer	Berries	10%	FCSAP 2012; White-tailed deer
Deer	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Deer	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Duck	Browse	0%	FCSAP 2012; Mallard
Duck	Aq_plants	50%	FCSAP 2012; Mallard
Duck	A_Inverts	40%	FCSAP 2012; Mallard
Duck	T_Invert_Arthro	5%	FCSAP 2012; Mallard
Duck	T_Invert_Worm	0%	FCSAP 2012; Mallard
Duck	Sm_mammals	0%	FCSAP 2012; Mallard
Duck	Lichen	0%	FCSAP 2012; Mallard
Duck	Fish	0%	FCSAP 2012; Mallard
Duck	Berries	5%	FCSAP 2012; Mallard
Duck	Prop_Terr	10%	Percentage of diet that is terrestrial; Calculated
Duck	Prop_Aq	90%	Percentage of diet that is aquatic; Calculated
Eagle	Browse	0%	FCSAP 2012; Bald eagle
Eagle	Aq_plants	0%	FCSAP 2012; Bald eagle
Eagle	A_Inverts	0%	FCSAP 2012; Bald eagle
Eagle	T_Invert_Arthro	0%	FCSAP 2012; Bald eagle

Table F1-13: Receptor Dietary Composition (Media % of Diet)

Receptor	Media	Value	Reference
Eagle	T_Invert_Worm	0%	FCSAP 2012; Bald eagle
Eagle	Sm_mammals	35%	FCSAP 2012; Bald eagle; Small mammals and birds
Eagle	Lichen	0%	FCSAP 2012; Bald eagle
Eagle	Fish	65%	FCSAP 2012; Bald eagle
Eagle	Berries	0%	FCSAP 2012; Bald eagle
Eagle	Prop_Terr	35%	Percentage of diet that is terrestrial; Calculated
Eagle	Prop_Aq	65%	Percentage of diet that is aquatic; Calculated
Goose	Browse	99%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	Aq_plants	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	A_Inverts	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	T_Invert_Arthro	1%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	T_Invert_Worm	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	Sm_mammals	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	Lichen	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	Fish	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	Berries	0%	US EPA 1993; Diet of Canada goose in Ontario during Spring
Goose	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Goose	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Grouse	Browse	65%	FCSAP 2012; Spruce Grouse
Grouse	Aq_plants	0%	FCSAP 2012; Spruce Grouse
Grouse	A_Inverts	0%	FCSAP 2012; Spruce Grouse
Grouse	T_Invert_Arthro	5.0%	FCSAP 2012; Spruce Grouse
Grouse	T_Invert_Worm	0.0%	FCSAP 2012; Spruce Grouse
Grouse	Sm_mammals	0%	FCSAP 2012; Spruce Grouse
Grouse	Lichen	0%	FCSAP 2012; Spruce Grouse
Grouse	Fish	0%	FCSAP 2012; Spruce Grouse
Grouse	Berries	30%	FCSAP 2012; Spruce Grouse
Grouse	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Grouse	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Kingfisher	Browse	0%	Sample and Suter 1994
Kingfisher	Aq_plants	0%	Sample and Suter 1994
Kingfisher	A_Inverts	0%	Sample and Suter 1994
Kingfisher	T_Invert_Arthro	0%	Sample and Suter 1994
Kingfisher	T_Invert_Worm	0%	Sample and Suter 1994
Kingfisher	Sm_mammals	0%	Sample and Suter 1994
Kingfisher	Lichen	0%	Sample and Suter 1994
Kingfisher	Fish	100%	Sample and Suter 1994
Kingfisher	Berries	0%	Sample and Suter 1994
Kingfisher	Prop_Terr	0%	Percentage of diet that is terrestrial; Calculated
Kingfisher	Prop_Aq	100%	Percentage of diet that is aquatic; Calculated
Little Brown Myotis	Browse	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	Aq_plants	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	A_Inverts	71%	Sample and Suter 1994; Little brown bat; Chironomidae and trichoptera
Little Brown Myotis	T_Invert_Arthro	29%	Sample and Suter 1994; Little brown bat; Lepidoptera, misc. insects, coleoptera, and neuroptera
Little Brown Myotis	T_Invert_Worm	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	Sm_mammals	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	Lichen	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	Fish	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	Berries	0%	Sample and Suter 1994; Little brown bat
Little Brown Myotis	Prop_Terr	29%	Percentage of diet that is terrestrial; Calculated
Little Brown Myotis	Prop_Aq	71%	Percentage of diet that is aquatic; Calculated
Merganser	Browse	0%	FCSAP 2012; Common merganser
Merganser	Aq_plants	2%	FCSAP 2012; Common merganser
Merganser	A_Inverts	8%	FCSAP 2012; Common merganser
Merganser	T_Invert_Arthro	0%	FCSAP 2012; Common merganser
Merganser	T_Invert_Worm	0%	FCSAP 2012; Common merganser
Merganser	Sm_mammals	0%	FCSAP 2012; Common merganser
Merganser	Lichen	0%	FCSAP 2012; Common merganser
Merganser	Fish	90%	FCSAP 2012; Common merganser

Table F1-13: Receptor Dietary Composition (Media % of Diet)

Receptor	Media	Value	Reference
Merganser	Berries	0%	FCSAP 2012; Common merganser
Merganser	Prop_Terr	0%	Percentage of diet that is terrestrial; Calculated
Merganser	Prop_Aq	100%	Percentage of diet that is aquatic; Calculated
Moose	Browse	80%	FCSAP 2012; Moose
Moose	Aq_plants	20%	FCSAP 2012; Moose
Moose	A_Inverts	0%	FCSAP 2012; Moose
Moose	T_Invert_Arthro	0%	FCSAP 2012; Moose
Moose	T_Invert_Worm	0%	FCSAP 2012; Moose
Moose	Sm_mammals	0%	FCSAP 2012; Moose
Moose	Lichen	0%	FCSAP 2012; Moose
Moose	Fish	0%	FCSAP 2012; Moose
Moose	Berries	0%	FCSAP 2012; Moose
Moose	Prop_Terr	80%	Percentage of diet that is terrestrial; Calculated
Moose	Prop_Aq	20%	Percentage of diet that is aquatic; Calculated
MooseKidney	Browse	80%	FCSAP 2012; Assumed same as moose
MooseKidney	Aq_plants	20%	FCSAP 2012; Assumed same as moose
MooseKidney	A_Inverts	0%	FCSAP 2012; Assumed same as moose
MooseKidney	T_Invert_Arthro	0%	FCSAP 2012; Assumed same as moose
MooseKidney	T_Invert_Worm	0%	FCSAP 2012; Assumed same as moose
MooseKidney	Sm_mammals	0%	FCSAP 2012; Assumed same as moose
MooseKidney	Lichen	0%	FCSAP 2012; Assumed same as moose
MooseKidney	Fish	0%	FCSAP 2012; Assumed same as moose
MooseKidney	Berries	0%	FCSAP 2012; Assumed same as moose
MooseKidney	Prop_Terr	80%	Percentage of diet that is terrestrial; Calculated
MooseKidney	Prop_Aq	20%	Percentage of diet that is aquatic; Calculated
MooseLiver	Browse	80%	FCSAP 2012; Assumed same as moose
MooseLiver	Aq_plants	20%	FCSAP 2012; Assumed same as moose
MooseLiver	A_Inverts	0%	FCSAP 2012; Assumed same as moose
MooseLiver	T_Invert_Arthro	0%	FCSAP 2012; Assumed same as moose
MooseLiver	T_Invert_Worm	0%	FCSAP 2012; Assumed same as moose
MooseLiver	Sm_mammals	0%	FCSAP 2012; Assumed same as moose
MooseLiver	Lichen	0%	FCSAP 2012; Assumed same as moose
MooseLiver	Fish	0%	FCSAP 2012; Assumed same as moose
MooseLiver	Berries	0%	FCSAP 2012; Assumed same as moose
MooseLiver	Prop_Terr	80%	Percentage of diet that is terrestrial; Calculated
MooseLiver	Prop_Aq	20%	Percentage of diet that is aquatic; Calculated
Mouse	Browse	15%	FCSAP 2012; Deer mouse
Mouse	Aq_plants	0%	FCSAP 2012; Deer mouse
Mouse	A_Inverts	0%	FCSAP 2012; Deer mouse
Mouse	T_Invert_Arthro	45%	FCSAP 2012; Deer mouse
Mouse	T_Invert_Worm	5%	FCSAP 2012; Deer mouse
Mouse	Sm_mammals	0%	FCSAP 2012; Deer mouse
Mouse	Lichen	0%	FCSAP 2012; Deer mouse
Mouse	Fish	0%	FCSAP 2012; Deer mouse
Mouse	Berries	35%	FCSAP 2012; Deer mouse; Berries, seeds, and mushrooms
Mouse	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Mouse	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Muskrat	Browse	0%	FCSAP 2012; Muskrat
Muskrat	Aq_plants	80%	FCSAP 2012; Muskrat
Muskrat	A_Inverts	15%	FCSAP 2012; Muskrat
Muskrat	T_Invert_Arthro	0%	FCSAP 2012; Muskrat
Muskrat	T_Invert_Worm	0%	FCSAP 2012; Muskrat
Muskrat	Sm_mammals	0%	FCSAP 2012; Muskrat
Muskrat	Lichen	0%	FCSAP 2012; Muskrat
Muskrat	Fish	5%	FCSAP 2012; Muskrat
Muskrat	Berries	0%	FCSAP 2012; Muskrat
Muskrat	Prop_Terr	0%	Percentage of diet that is terrestrial; Calculated
Muskrat	Prop_Aq	100%	Percentage of diet that is aquatic; Calculated
Otter	Browse	0%	FCSAP 2012; Northern river otter

Table F1-13: Receptor Dietary Composition (Media % of Diet)

Receptor	Media	Value	Reference
Otter	Aq_plants	0%	FCSAP 2012; Northern river otter
Otter	A_Inverts	15%	FCSAP 2012; Northern river otter
Otter	T_Invert_Arthro	0%	FCSAP 2012; Northern river otter
Otter	T_Invert_Worm	0%	FCSAP 2012; Northern river otter
Otter	Sm_mammals	5%	FCSAP 2012; Northern river otter
Otter	Lichen	0%	FCSAP 2012; Northern river otter
Otter	Fish	80%	FCSAP 2012; Northern river otter
Otter	Berries	0%	FCSAP 2012; Northern river otter
Otter	Prop_Terr	5%	Percentage of diet that is terrestrial; Calculated
Otter	Prop_Aq	95%	Percentage of diet that is aquatic; Calculated
Partridge	Browse	65%	Assumed same as spruce grouse
Partridge	Aq_plants	0%	Assumed same as spruce grouse
Partridge	A_Inverts	0%	Assumed same as spruce grouse
Partridge	T_Invert_Arthro	5.0%	Assumed same as spruce grouse
Partridge	T_Invert_Worm	0%	Assumed same as spruce grouse
Partridge	Sm_mammals	0%	Assumed same as spruce grouse
Partridge	Lichen	0%	Assumed same as spruce grouse
Partridge	Fish	0%	Assumed same as spruce grouse
Partridge	Berries	30%	Assumed same as spruce grouse
Partridge	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Partridge	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Rabbit	Browse	90%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	Aq_plants	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	A_Inverts	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	T_Invert_Arthro	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	T_Invert_Worm	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	Sm_mammals	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	Lichen	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	Fish	0%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	Berries	10%	FCSAP 2012; Assumed same as snowshoe hare
Rabbit	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Rabbit	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Sandpiper	Browse	0%	FCSAP 2012; Spotted sandpiper
Sandpiper	Aq_plants	5%	FCSAP 2012; Spotted sandpiper
Sandpiper	A_Inverts	30%	FCSAP 2012; Spotted sandpiper
Sandpiper	T_Invert_Arthro	30%	FCSAP 2012; Spotted sandpiper; Assumed equal proportions of ground insects and flying insects
Sandpiper	T_Invert_Worm	30%	FCSAP 2012; Spotted sandpiper; Assumed equal proportions of ground insects and flying insects
Sandpiper	Sm_mammals	0%	FCSAP 2012; Spotted sandpiper
Sandpiper	Lichen	0%	FCSAP 2012; Spotted sandpiper
Sandpiper	Fish	5%	FCSAP 2012; Spotted sandpiper; Amphibians/fish
Sandpiper	Berries	0%	FCSAP 2012; Spotted sandpiper
Sandpiper	Prop_Terr	60%	Percentage of diet that is terrestrial; Calculated
Sandpiper	Prop_Aq	40%	Percentage of diet that is aquatic; Calculated
Snowshoe Hare	Browse	90%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	Aq_plants	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	A_Inverts	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	T_Invert_Arthro	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	T_Invert_Worm	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	Sm_mammals	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	Lichen	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	Fish	0%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	Berries	10%	FCSAP 2012; Snowshoe Hare
Snowshoe Hare	Prop_Terr	100%	Percentage of diet that is terrestrial; Calculated
Snowshoe Hare	Prop_Aq	0%	Percentage of diet that is aquatic; Calculated
Swan	Browse	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	Aq_plants	100%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	A_Inverts	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	T_Invert_Arthro	0%	Mitchel and Eichholz 2020; Trumpeter Swan

Table F1-13: Receptor Dietary Composition (Media % of Diet)			
Receptor	Media	Value	Reference
Swan	T_Invert_Worm	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	Sm_mammals	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	Lichen	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	Fish	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	Berries	0%	Mitchel and Eichholz 2020; Trumpeter Swan
Swan	Prop_Terr	0%	Percentage of diet that is terrestrial; Calculated
Swan	Prop_Aq	100%	Percentage of diet that is aquatic; Calculated

Table F1-14: Measured Baseline Game Meat Concentrations from Chan et al (2021)				
Receptor	Parameter	Value	Unit	Reference / Comment
Caribou	Arsenic	0.02	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Caribou	Mercury	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Caribou	Selenium	0.25	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
CaribouLiver	Arsenic	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
CaribouLiver	Mercury	0.2	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
CaribouLiver	Selenium	0.4	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Goose	Arsenic	0.02	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Goose	Mercury	0.002	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Goose	Selenium	0.2	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Duck	Arsenic	0.07	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Duck	Mercury	0.03	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Duck	Selenium	0.5	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Moose	Arsenic	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Moose	Mercury	0.003	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Moose	Selenium	0.1	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Deer	Arsenic	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Deer	Mercury	0.002	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Deer	Selenium	0.15	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
MooseKidney	Arsenic	0.03	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
MooseKidney	Mercury	0.02	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
MooseKidney	Selenium	0.7	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
MooseLiver	Arsenic	0.02	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
MooseLiver	Mercury	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
MooseLiver	Selenium	0.35	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Grouse	Arsenic	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Grouse	Mercury	0.01	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Grouse	Selenium	0.22	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Rabbit	Arsenic	0.02	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Rabbit	Mercury	0.004	µg/g WW	Chan et al 2021; Boreal Shield Ecozone
Rabbit	Selenium	0.18	µg/g WW	Chan et al 2021; Boreal Shield Ecozone

Table F1-15: Biotransfer Factors Used to Predict Game Meat Concentrations (day/ kg WW)						
Receptor	Parameter	Site Specific	Literature	Literature	Literature	Selected BTF
		Value	Value	BTF Type	Reference / Comment	
Caribou	Arsenic	0.0078	0.002	BaBEEF	US EPA 2004 (ChemData)	0.002
Caribou	Mercury	0.085	0.25	BaBEEF	Baes et al 1984	0.085
Caribou	Selenium	0.70	0.002265	BaBEEF	US EPA 2004 (ChemData)	0.70
CaribouLiver	Arsenic	0.0039	0.002	BaBEEF	US EPA 2004 (ChemData)	0.002
CaribouLiver	Mercury	1.7	0.25	BaBEEF	Baes et al 1984	1.7
CaribouLiver	Selenium	1.1	0.002265	BaBEEF	US EPA 2004 (ChemData)	1.1
Grouse	Arsenic	0.29	0.002	BaBEEF	US EPA 2004 (ChemData)	0.29
Grouse	Mercury	3.5	0.25	BaBEEF	Baes et al 1984	3.5
Grouse	Selenium	63	1.12625	Bapoult	US EPA 2004 (ChemData)	63
Rabbit	Arsenic	0.38	0.002	BaBEEF	US EPA 2004 (ChemData)	0.38
Rabbit	Mercury	1.7	0.25	BaBEEF	Baes et al 1984	1.7
Rabbit	Selenium	51	0.002265	BaBEEF	US EPA 2004 (ChemData)	51
Goose	Arsenic	0.11	0.002	BaBEEF	US EPA 2004 (ChemData)	0.11
Goose	Mercury	0.26	0.25	BaBEEF	Baes et al 1984	0.26
Goose	Selenium	17	1.12625	Bapoult	US EPA 2004 (ChemData)	17
Duck	Arsenic	0.17	0.002	BaBEEF	US EPA 2004 (ChemData)	0.17
Duck	Mercury	2.9	0.25	BaBEEF	Baes et al 1984	2.9
Duck	Selenium	12	1.12625	Bapoult	US EPA 2004 (ChemData)	12
Deer	Arsenic	0.0050	0.002	BaBEEF	US EPA 2004 (ChemData)	0.0050
Deer	Mercury	0.014	0.25	BaBEEF	Baes et al 1984	0.014
Deer	Selenium	0.73	0.002265	BaBEEF	US EPA 2004 (ChemData)	0.73
Moose	Arsenic	0.00044	0.002	BaBEEF	US EPA 2004 (ChemData)	0.00044
Moose	Mercury	0.0035	0.25	BaBEEF	Baes et al 1984	0.0035
Moose	Selenium	0.038	0.002265	BaBEEF	US EPA 2004 (ChemData)	0.038
MooseKidney	Arsenic	0.0013	0.002	BaBEEF	US EPA 2004 (ChemData)	0.0013
MooseKidney	Mercury	0.023	0.25	BaBEEF	Baes et al 1984	0.023
MooseKidney	Selenium	0.26	0.002265	BaBEEF	US EPA 2004 (ChemData)	0.26
MooseLiver	Arsenic	0.00088	0.002	BaBEEF	US EPA 2004 (ChemData)	0.00088
MooseLiver	Mercury	0.012	0.25	BaBEEF	Baes et al 1984	0.012
MooseLiver	Selenium	0.13	0.002265	BaBEEF	US EPA 2004 (ChemData)	0.13

Table F1-16: Calculation of Diet Moisture Content

Species	Food	Diet Proportion	Diet Proportion Source/Comment	Moisture Content	Moisture Content Source	Weighted Average Moisture Content	Total Diet Moisture Content
Eagle	Browse	0	FCSAP 2012; Bald eagle	0.551	Site-specific; Attachment A, Table A1-6	0.000	0.764
Eagle	Aq_plants	0	FCSAP 2012; Bald eagle	0.657	US EPA 1999; moisture content of algae	0.000	
Eagle	A_inverts	0	FCSAP 2012; Bald eagle	0.833	US EPA 1999	0.000	
Eagle	T_Invert_Arthro	0	FCSAP 2012; Bald eagle	0.688	Hadley 1994	0.000	
Eagle	T_Invert_Worm	0	FCSAP 2012; Bald eagle	0.833	US EPA 1999	0.000	
Eagle	Sm_mammals	0.35	FCSAP 2012; Bald eagle; Small mammals and birds	0.737	US EPA 1993; mice, voles, rabbits	0.258	
Eagle	Lichen	0	FCSAP 2012; Bald eagle	0.153	Ardea Biological Consulting 2015	0.000	
Eagle	Fish	0.65	FCSAP 2012; Bald eagle	0.778	Site-specific; average for 2022 fish sampling program. Attachment A, Table A1-8	0.506	
Eagle	Berries	0	FCSAP 2012; Bald eagle	0.749	Site-specific; average. Attachment A, Table A1-5	0.000	
Caribou	Browse	0.5	Thompson et al. 2015; Remaining portion of diet other than lichen	0.551	Site-specific; Attachment A, Table A1-6	0.275	0.352
Caribou	Aq_plants	0	Thompson et al. 2015	0.657	US EPA 1999; moisture content of algae	0.000	
Caribou	A_inverts	0	Thompson et al. 2015	0.833	US EPA 1999	0.000	
Caribou	T_Invert_Arthro	0	Thompson et al. 2015	0.688	Hadley 1994	0.000	
Caribou	T_Invert_Worm	0	Thompson et al. 2015	0.833	US EPA 1999	0.000	
Caribou	Sm_mammals	0	Thompson et al. 2015	0.737	US EPA 1993; mice, voles, rabbits	0.000	
Caribou	Lichen	0.5	Thompson et al. 2015; Average lichen consumption across all seasons in Ontario	0.153	Ardea Biological Consulting 2015	0.077	
Caribou	Fish	0	Thompson et al. 2015	0.778	Site-specific; average for 2022 fish sampling program. Attachment A, Table A1-8	0.000	
Caribou	Berries	0	Thompson et al. 2015	0.749	Site-specific; average. Attachment A, Table A1-5	0.000	
Kingfisher	Browse	0	Sample and Suter 1994	0.551	Site-specific; Attachment A, Table A1-6	0.000	0.778
Kingfisher	Aq_plants	0	Sample and Suter 1994	0.657	US EPA 1999; moisture content of algae	0.000	
Kingfisher	A_inverts	0	Sample and Suter 1994	0.833	US EPA 1999	0.000	
Kingfisher	T_Invert_Arthro	0	Sample and Suter 1994	0.688	Hadley 1994	0.000	
Kingfisher	T_Invert_Worm	0	Sample and Suter 1994	0.833	US EPA 1999	0.000	
Kingfisher	Sm_mammals	0	Sample and Suter 1994	0.737	US EPA 1993; mice, voles, rabbits	0.000	
Kingfisher	Lichen	0	Sample and Suter 1994	0.153	Ardea Biological Consulting 2015	0.000	
Kingfisher	Fish	1	Sample and Suter 1994	0.778	Site-specific; average for 2022 fish sampling program. Attachment A, Table A1-8	0.778	
Kingfisher	Berries	0	Sample and Suter 1994	0.749	Site-specific; average. Attachment A, Table A1-5	0.000	
Little Brown Myotis	Browse	0	Sample and Suter 1994	0.551	Site-specific; Attachment A, Table A1-6	0.000	0.791
Little Brown Myotis	Aq_plants	0	Sample and Suter 1994	0.657	US EPA 1999; moisture content of algae	0.000	
Little Brown Myotis	A_inverts	0.71	Sample and Suter 1994; Chironomidae and trichoptera	0.833	US EPA 1999	0.591	
Little Brown Myotis	T_Invert_Arthro	0.29	Sample and Suter 1994; Lepidoptera, misc. insects, coleoptera, and neuroptera	0.688	Hadley 1994	0.200	
Little Brown Myotis	T_Invert_Worm	0	Sample and Suter 1994	0.833	US EPA 1999	0.000	
Little Brown Myotis	Sm_mammals	0	Sample and Suter 1994	0.737	US EPA 1993; mice, voles, rabbits	0.000	
Little Brown Myotis	Lichen	0	Sample and Suter 1994	0.153	Ardea Biological Consulting 2015	0.000	
Little Brown Myotis	Fish	0	Sample and Suter 1994	0.778	Site-specific; average for 2022 fish sampling program. Attachment A, Table A1-8	0.000	
Little Brown Myotis	Berries	0	Sample and Suter 1994	0.749	Site-specific; average. Attachment A, Table A1-5	0.000	

Table F1-17: Input Parameters for Predicting Plant Concentrations from Deposition

Plant Type	Parameter	Variable	Browse / Forage	Comment/Reference
Browse	Intercept Fraction [Unitless]	Rp_Browse	0.5	US EPA 2005; Forage
Browse	Plant Surface Loss Coefficient [yr-1]	kp_Browse	18	US EPA 2005; Forage
Browse	Length of Plant Exposure [year]	tp_Browse	0.12	US EPA 2005; Forage
Browse	Yield or Productivity [kg-DW/m2]	Yp_Browse	0.24	US EPA 2005; Forage
Browse	Moisture Content [Unitless]	MC_Browse	55.05%	Site specific; average
Lichen	Intercept Fraction [Unitless]	Rp_Lichen	0.5	US EPA 2005; Forage
Lichen	Plant Surface Loss Coefficient [yr-1]	kp_Lichen	18	US EPA 2005; Forage
Lichen	Length of Plant Exposure [year]	tp_Lichen	0.583333333	Government of Canada 2025; Canadian climate normals for Red Lake. 7/12 months of the year average temperatures above 0C.
Lichen	Yield or Productivity [kg-DW/m2]	Yp_Lichen	0.054	Errington et al. 2022
Lichen	Moisture Content	MC_Lichen	15%	Ardea Biological Consulting Ltd. 2015. Kemess Underground Project: Ecosystems and Vegetation Baseline Report. Prepared for AuRico Metals Inc. by Ardea Biological Consulting Ltd.: Smithers, British Columbia.
Berries	Intercept Fraction [Unitless]	Rp_Berries	0.053	US EPA 2005; Exposed fruits
Berries	Plant Surface Loss Coefficient [yr-1]	kp_Berries	18	US EPA 2005; Generic above ground produce
Berries	Length of Plant Exposure [year]	tp_Berries	0.16	US EPA 2005; Generic above ground produce
Berries	Yield or Productivity [kg-DW/m2]	Yp_Berries	0.252	US EPA 2005; Exposed fruits
Berries	Moisture Content	MC_Berries	74.91%	Site specific; average