Update of Figures for Section 6 of the Revised EIS			
Figure Number	Description	Page	Actions
Figure 6.1.4.1-1	General LSA and RSA	6-60	Figure resolution increased
Figure 6.1.4.4-1	Noise LSA	6-62	Resolution unchanged
Figure 6.1.4.4-2	Location of Sensitive Noise Receptors	6-64	Resolution unchanged
Figure 6.1.4.4-3	Noise RSA	6-65	Resolution unchanged
Figure 6.1.4.5-1	Location of Light Receptors and the Light LSA	6-67	Resolution unchanged
Figure 6.1.4.6-1	Air Quality LSA	6-68	Resolution unchanged
Figure 6.1.4.6-2	Location of Sensitive Air Receptors	6-69	Resolution unchanged
Figure 6.1.4.6-3	Air Quality RSA	6-71	Resolution unchanged
Figure 6.1.4.8-1	Surface Water Quality RSA and LSA	6-74	Figure resolution increased
Figure 6.1.4.8-2	Surface Water Quality Modelling Nodes	6-75	Figure resolution increased
Figure 6.1.4.9-1	Surface Water Quantity Study Areas	6-77	Figure resolution increased
Figure 6.1.4.9-2	Surface Water Quantity Modelling Nodes	6-78	Figure resolution increased
Figure 6.1.4.10-1	Effects Assessment LSA and RSA for Hydrogeology	6-80	Figure resolution increased
Figure 6.1.4.11-1	Private Water Wells within the Hydrogeological LSA	6-81	Figure resolution increased
Figure 6.1.4.12-1	Wildlife and Wildlife Habitat Study Areas	6-83	Figure resolution increased
Figure 6.1.4.14-1	Fish and Fish Habitat Study Areas	6-85	Figure resolution increased
Figure 6.1.4.16 1	Land and Resource Use (Terrestrial) Study Area	6-87	Figure resolution increased
Figure 6.1.4.16-2	Land and Resource Use (Aquatic) Study Area	6-88	Figure resolution increased
Figure 6.1.4.17-1	Socio-economic Study Area	6-89	Figure resolution increased
Figure 6.1.4.20-1	Heritage Resources Local Study Area (LSA)	6-92	Resolution unchanged
Figure 6.2.1-1	Terrain and Soils Linkage Diagram	6-101	Resolution unchanged
Figure 6.2.4.1-1	Cross Section from South Hoffstrom's Bay, Showing Relative Height of WRSA	6-105	Resolution unchanged
Figure 6.2.4.1-2	Cross Section from North of Hoffstrom's Bay, Showing Relative Height of WRSA	6-106	Resolution unchanged
Figure 6.2.6-1	Spatial Extent of Effects for Terrain and Soils	6-110	Figure resolution increased
Figure 6.3.1-1	Geology and Geochemistry Linkage Diagram	6-113	Resolution unchanged
Figure 6.4.1-1	Noise Linkage Diagram	6-129	Resolution unchanged
Figure 6.4.4.1-1	Predicted 50 dBA Contour, Site Preparation and Construction	6-133	Resolution unchanged
Figure 6.4.4.2-1	Predicted 50 dBA Contour, Operations	6-136	Resolution unchanged
Figure 6.4.4.3-1	Predicted 50 dBA Contour, Closure	6-138	Resolution unchanged

Update of Figures for Section 6 of the Revised EIS			
Figure Number	Description	Page	Actions
Figure 6.4.6-1	Spatial Extents of Predicted Noise Effects	6-142	Figure resolution increased
Figure 6.5.1-1	Light Linkage Diagram	6-145	Resolution unchanged
Figure 6.5.2-1	Process Plant and Mine Infrastructure, Lighting Plan	6-148	Figure resolution increased
Figure 6.5.4-1	Process Plant and Infrastructure, Lux Plot	6-152	Figure resolution increased
Figure 6.5.4-2	Process Plant and Infrastructure, Rendered Plan View	6-153	Figure resolution increased
Figure 6.5.6-1	Spatial Extent of Residual Light Effects	6-157	Figure resolution increased
Figure 6.6.1-1	Air Quality Linkage Diagram	6-160	Resolution unchanged
Figure 6.6.2.2-1	Modelled Source Configuration, Operations	6-167	Resolution unchanged
Figure 6.6.2.2-2	Wind Rose for Dispersion Meteorological Data	6-168	Resolution unchanged
Figure 6.6.6-1	Spatial Distribution of Residual Air Quality Effects	6-176	Figure resolution increased
Figure 6.7.1-1	Climate Linkage Diagram	6-180	Resolution unchanged
Figure 6.8.1-1	Surface Water Quality Linkage Diagram	6-194	Resolution unchanged
Figure 6.8.2.1-1	Locations of Background Water Quality Sampling Locations	6-196	Figure resolution increased
Figure 6.8.2.2-1	Locations of Water Quality Modelling Node	6-198	Figure resolution increased
Figure 6.8.2.2-2	Surface Water Quality Model Schematic, Existing Conditions	6-199	Resolution unchanged
Figure 6.8.2.4-2	Surface Water Quality Model Operations Phase	6-202	Resolution unchanged
Figure 6.8.2.6-1	Surface Water Quality Model Post-Closure Phase	6-208	Resolution unchanged
Figure 6.9.1-1	Surface Water Quantity Linkage Diagram	6-233	Resolution unchanged
Figure 6.9.2.3-1	Overlay of Project on Local Watersheds	6-237	Figure resolution increased
Figure 6.9.2.5-1	Post-closure Watersheds and Land Use	6-239	Figure resolution increased
Figure 6.9.6-1	Spatial Extent Surface Water Quantity Effects	6-260	Figure resolution increased
Figure 6.10.1-1	Groundwater Quality Linkage Diagram	6-263	Resolution unchanged
Figure 6.11.1-1	Groundwater Quantity Linkage Diagram	6-270	Resolution unchanged
Figure 6.11.4.2-1	Predicted Groundwater Drawdown during Operations	6-277	Figure resolution increased
Figure 6.12.1-1	Wildlife and Wildlife Habitat Linkage Diagram	6-286	Resolution unchanged
Figure 6.12.1-2	Wildlife and Wildlife Habitat Linkage Diagram (continued)	6-287	Resolution unchanged
Figure 6.12.6-1	Spatial Extent Wildlife and Wildlife Habitat Residual Effects	6-307	Figure resolution increased
Figure 6.13.1-1	Migratory Birds Linkage Diagram	6-311	Resolution unchanged
Figure 6.13.6-1	Spatial Extent Migratory Birds Residual Effects	6-318	Figure resolution increased

Update of Figures for Section 6 of the Revised EIS			
Figure Number	Description	Page	Actions
Figure 6.14.1-1	Fish and Fish Habitat Linkage Diagram	6-323	Resolution unchanged
Figure 6.14.6-1	Spatial Extent Fish and Fish Habitat Effects	6-337	Figure resolution increased
Figure 6.15.1-1	Wetlands and Vegetation Linkage Diagram	6-340	Resolution unchanged
Figure 6.15.6-1	Spatial Extent of Residual Wetland Effects	6-347	Figure resolution increased
Figure 6.15.6-2	Spatial Extent of Residual Vegetation Effects	6-348	Figure resolution increased
Figure 6.16.1-1	Land and Resource Use Linkage Diagram	6-353	Resolution unchanged
Figure 6.16.1-2	Land and Resource Use Linkage Diagram (continued)	6-354	Resolution unchanged
Figure 6.16.6-1	Spatial Extent for Residual Effects on Harvesting	6-368	Figure resolution increased
Figure 6.17.1-1	Social Linkage Diagram	6-377	Resolution unchanged
Figure 6.18.1-1	Economic Linkage Diagram	6-391	Resolution unchanged
Figure 6.19.1-1	Human Health Linkage Diagram	6-413	Resolution unchanged
Figure 6.19.1-2	Conceptual Risk Model for Operations	6-416	Figure resolution increased
Figure 6.19.1-3	Conceptual Risk Model for Post-closure	6-417	Figure resolution increased
Figure 6.20.1-1	Heritage Resources Linkage Diagram	6-438	Resolution unchanged
Figure 6.21.1-1	Aboriginal Peoples Linkage Diagram	6-444	Resolution unchanged
Figure 6.21.6-1	Spatial Extent for Residual Effects on Traditional Land Use	6-457	Figure resolution increased

1.0 Introduction

2.0 Alternatives

3.0 Project Description

4.0 Accidents

5.0 Baseline Conditions

6.0 Description of Project Effects

6.1 Methods Used in the Assessment of Project Effects

6.1.1 Integration of Public and Aboriginal Feedback

Throughout the process of preparing the EIS for the Project, Treasury Metals undertook to engage potentially affected parties and individuals. The engagement with First Nations and Aboriginal peoples regarding the Project were outlined in Section 8 of the original EIS, and detailed in Aboriginal Consultation Report included as Appendix DD to the original EIS.

As part of the Round 1 information requests, the Agency requested that Treasury Metals revise and update Appendix DD. The resulting Aboriginal Engagement Report has been prepared and is included as Appendix DD to the revised EIS. The Aboriginal Engagement Report sets out how Treasury Metals has addressed the issues raised by Aboriginal peoples during the EIS process, as well as subsequent to the submission of the EIS. The report also provides information regarding the disaggregated comments from individual First Nations and Aboriginal communities.

6.1.2 Integration of Responses to Round 1 Information Requests

As part of the Round 1 information request process, there were some 859 individual information requests, to which Treasury Metals has provided individual, specific responses. Of those requests, 440 questions were identified by the Agency as coming from Aboriginal peoples, while 90 were identified as coming from other interested stakeholders. In total, there were 329 questions from the Agency and other regulators.

All of these questions have been responded to individually. Where it was not practical to respond to the answer individually (e.g., requests for re-organization of how the information was presented in the EIS), the response refers to the relevant sections of the revised EIS. In preparing the revised EIS, every effort was made to incorporate the responses provided to the individual Round 1 information requests from Aboriginal peoples, stakeholders and regulators. Where there are specific questions that influenced sections of this report, those questions have been listed to provide a concordance back to the individual responses themselves.

6.1.3 Selection of Valued Components (VCs) and Indicators

The use of valued components (VCs) in the environmental assessment process is important as they provide structure and focus for the assessment, as well as ensuring that the likely effects of a Project are considered. Since VCs are used as assessment endpoints, it is important that the selected VCs can be used to meaningfully describe the effects of the Project. The concept of VCs has become integral to the environmental assessment process in Canada since it was first introduced by Beanlands and Duinker (1983).

The Canadian Environmental Assessment Agency (the Agency) describes VCs as an "…environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Aboriginal peoples or the public." (CEAA, 2015b). The EIS Guidelines for the Project (CEAA 2013) go on to indicate that the "…proponent will identify the VCs deemed appropriate to ensure the full consideration of the factors listed in subsection 19(1) of CEAA, 2012 as well as the 2012 amendment to section 79 of the Species at Risk Act." Although not explicitly identified in the EIS Guidelines (CEAA 2013), Section 9.1 the guidelines do list the areas that should be addressed in the EIS.

From an ecological perspective, a VCs can be any of the following:

- An aspect of the physical environment (e.g., air quality or surface water quality);
- An individual plant or animal species (e.g., walleye or northern pike);
- A range of species that serve as a surrogate for species that interact similarly with the environment (e.g., upland birds); or
- A complex feature or element of the natural environment (e.g., a local wetland or stream) considered to be culturally or scientifically important.

From a socio-economic perspective, VCs could represent an aspect of community well-being, such as housing or employment.

In selecting the VCs used to assess the effects of the Project were selected with consideration for the above, but also with consideration those VCs, processes, and interactions that "…were identified to be of concern during any workshops or meetings held by the proponent or that the proponent considers likely to be affected by the project." However, the Round 1 IRs also include questions related to the VCs selected, or justification for elements of the environment not selected for use as VCs in the EIS. The following sections describe the VCs used in the EIS, organized by component of the environment. Where specific concerns or issues were raised that help identify the VCs used, this has been identified in each section. Additionally, the individual component sections include information to reflect the responses to the Round 1 IR questions. To help the Agency reviewers, Section 2.1.20 has been included to summarize the questions raised regarding the VCs used and provide a cross reference to where the specific information to respond to the questions is located in this report.

6.1.3.1 Terrain and Soils

Section 6.3.1.1 of the original EIS introduced the VCs used by Treasury Metals for evaluating the effects of the Project on terrain and soils. Specifically the following three terrain and soils VCs were in the EIS:

- Natural landscape;
- Overburden; and
- Soil chemistry.

The natural landscape was selected as a VC to capture concerns raised regarding whether the Project would materially alter the topography and landscape of the surrounding area. The Project area is relatively flat, with only 140 m vertical variability within 20 km of the site.n Surface features such as the waste rock storage area (WRSA), the tailings storage facility (TSF), the overburden storage area and the low-grade ore (LGO) stockpile could be visible, and present a contrast with the natural terrain. Although the changes in topography associated with Project could be visible to nearby residents (e.g., residents and cottagers on Thunder Lake) and other individuals in the area, the effects of the Project on views is also discussed within the land use component.

The overburden was selected as a VC because the overburden acts as a medium to sustain plant growth, it helps to filter and retain precipitation, and is part of the wildlife habitat. The overburden will also need to be preserved to support the reclamation and closure activities at the end of the Project life. Overburden stripping will occur over the ore body, while cut-and-fill of overburden will occur in the vicinity of facilities requiring a leveled surface. As a result, the overburden could be susceptible to wind and water erosion due to the disruption of the stable state of the soils (removal of vegetation and alteration of consolidated materials).

Soil chemistry was also selected as a VC in the EIS. Once disturbed the soil may undergo erosion or be chemically altered. Additionally, stored mine waste and low-grade stockpile could potentially affect the chemistry or disturbed and undisturbed soils.

The bedrock in the area was not selected as a VC because it is mostly covered by overburden or relatively flat where exposed. Due to its inconspicuous or buried state, the bedrock in the Project area is not expected to provide a significant habitat opportunities, or has not been identified as a component of the environment valued by stakeholders.

There were no questions in the Round 1 IRs that were specifically directed at the VCs selected for terrain and soils, therefore the terrain and soils VCs remain unchanged from the EIS. A listing of the VCs to be used in evaluating the effects of the Project on terrain and soils is provided in Table 6.1.3.1-1, along with the corresponding indicators and measures.

Table 6.1.3.1-1: Terrain and Soil VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Natural Landscapes	Uniqueness of surface features from surrounding terrain	Are surface features different in shape or appearance from natural features
Overburden	Erosion of disturbed overburden	Amount of erosion of disturbed overburden occur
Soil chemistry	Changes in soil chemistry	Extent of changes in the soil chemistry

6.1.3.2 Geology and Geochemistry

Although geology and geochemistry would not normally be considered assessment endpoints; they are important for understanding how the Project could affect the environment. For example, geology and geochemistry describe the potential for acid rock drainage (ARD) and the associated metals leaching (ML). Both ARD and ML are important parameters of geology and geochemistry that could influence other components (e.g., surface water quality). Specifically, geology and geochemistry will influence the quality of seepage from the tailings storage facility (TSF) and the waste rock storage area (WRSA), as well as dictating the quality of the water in the pit lake that is allowed to form following closure.

Although there were no questions in the Round 1 IRs specifically directed at the choice to not identify any VCs for geology and geochemistry, one VC has been added for geology and geochemistry in order to capture the effects of ARD and ML on the quality of water in the pit lake following closure. This VC addresses the request in TMI_134-FH(1)-13 to assess the quality of the water within the pit lake. Geology and geochemistry are also important for determining the quality of seepage from the TSF and WRSA. These were not selected as a VC because the effects of this seepage on the receiving environment has been explicitly addressed as part of the surface water quality and groundwater quality VC discussed in Sections 6.1.3.7 and 6.1.3.9, respectively.

Table 6.1.3.2-1 summarizes the VC, indicators and measures used for evaluating the potential effects of the Project on geology and geochemistry. The indicators and measures are consistent with those defined for surface water quality (Section 6.1.3.7).

Table 6.1.3.2-1: Geology and Geochemistry VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Pit Lake Water Quality	Aluminum (Al)	Concentrations (mg/L)
	Antimony (Sb)	Concentrations (mg/L)
	Arsenic (As)	Concentrations (mg/L)
	Beryllium (Be)	Concentrations (mg/L)
	Boron (B)	Concentrations (mg/L)
	Cadmium (Cd)	Concentrations (mg/L)
	Chromium (Cr)	Concentrations (mg/L)
	Cobalt (Co)	Concentrations (mg/L)
	Copper (Cu)	Concentrations (mg/L)
	Iron (Fe)	Concentrations (mg/L)
	Lead (Pb)	Concentrations (mg/L)
	Mercury (Hg)	Concentrations (mg/L)
	Molybdenum (Mo)	Concentrations (mg/L)
	Nickel (Ni)	Concentrations (mg/L)
	Selenium (Se)	Concentrations (mg/L)
	Silver (Ag)	Concentrations (mg/L)

Table 6.1.3.2-1: Geology and Geochemistry VCs, Indicators and Measures (continued)

Valued Components (VCs)	Indicators	Measures
	Thallium (Tl)	Concentrations (mg/L)
	Uranium (U)	Concentrations (mg/L)
	Vanadium (V)	Concentrations (mg/L)
	Zinc (Zn)	Concentrations (mg/L)

6.1.3.3 Noise

Section 6.3.1.3 of the original EIS introduced the following two VCs used by Treasury Metals for evaluating the effects of the Project on noise:

- Ambient noise levels; and
- Noise disturbance of wildlife.

In Ontario, ambient noise levels are regulated by the Ministry of Environment and Climate Change. The Ministry of Environment and Climate Change has established “Stationary Source” guidelines set out in MOE Publication NPC-300 (MOECC, 2013). These guidelines state that one-hour sound exposures (A-weighted hourly LEQ values) from stationary noise source shall not exceed that the established limits or background levels. Under the guidelines, background is defined as the sound level present in the environment produced by noise sources other than those associated with the Project. The MOE Publication NPC-300 establishes sound level limits at the façade (or plane of window) for the following three different times of the day, which were used as indicators for the ambient noise level VC:

- Daytime hours (0700 to 1900h);
- Evening hours (1900 to 2300h); and
- Night-time hours (2300 to 0700h).

High levels of environmental noise can also affect wildlife, including species at risk (SAR), causing changes in behaviour or avoidance of affected areas, for at least temporary periods of time. For the “noise effects to wildlife” VC, it was necessary to turn to literature to identify suitable criteria for use in the noise assessment. The assessment of effects of the Project on the “noise effects to wildlife” VC focused on determining whether the predicted noise levels were above the identified criteria or not. An evaluation of how the predicted noise levels could affect wildlife is provided in in the wildlife and wildlife habitat assessment provided in Section 6.12 of the revised EIS.

One criteria that was considered for evaluating the effects of noise on wildlife was the criteria suggested in the Round 1 IRs, specifically TMI_192-AE-(1)-30. The IR indicates that Environment

Canada's 'Incidental Take of Migratory Birds in Canada' website (EC, 2016: website) identifies that migratory birds are typically disturbed by sound levels exceeding 50 dBA. Such disturbance could contribute to adverse effects on migratory birds and SAR. However, this is not the only literature relevant to the subject, with recent projects evaluated by the Agency having also considered the subject.

The recent Rainy River Project EIS (Newgold, 2013) described the types of effects noise could have on wildlife particularly birds. The most common effect they identified was masking of important communication signals. The EIS went on to indicate that "…sound masking has been shown to occur at sound emissions levels of 50 to 60 dBA (Dooling and Popper 2007)". A threshold of 50 dBA was used to determining areas that could potentially represent reductions in habitat suitability.

An extensive literature search was also made as part of the recent regulatory process for the Deep Geologic Repository (DGR) project. The findings (OPG, 2013) identified 27 separate publicly available studies and reports dealing with issues related to noise effects on livestock and wildlife, but found that "…species-specific information on the response to increases in background noise for SAR in Ontario was not readily available." The findings (OPG, 2013) went on to indicate that "the literature review relied on information regarding species that can be considered comparable to the SAR of interest". Some other findings include the following:

- Exposure to constant noise has been documented to lead to habituation even if the levels are high (54 dB);
- Birds adapt to relatively noisy environments by changing their vocalization (Brumm 2004);
- Birds can acclimatize to relatively high background noise (54 dB) (GOLDER 2012);
- Birds are often more disturbed by sporadic activities than continuous noise (GOLDER 2012);
- American bullfrog have been documented to modify their call structure by altering the call frequency level and increasing call bandwidth (Wilson 2012); and
- Literature suggests that species respond to increased noise either through avoidance and/or habituation.

Based on the above, the 50 dBA value represents a threshold for evaluating the "noise effects on wildlife" VC, which was also recommended in the Round 1 IRs (TMI_192-AE-(1)-30). The potential effects of noise on wildlife are described as displacement. To describe the potential displacement of wildlife, the predicted effects of the Project to the noise effects on wildlife VC, are described using the areal extent with predicted noise levels in excess of the 50 dBA threshold. However, while it is possible to predict, and describe the areas where noise levels as a result of the Project

are expected to exceed 50 dBA, what this means to individual wildlife VCs or species requires consideration with other factors and effects of the Project. Therefore, the consideration of the potential effects of noise from the Project on wildlife will be considered as a component of the wildlife and wildlife habitat assessment described in Section 6.12 of the revised EIS.

The following questions, raised as part of the Round 1 IRs, specifically asked about the selection of the noise VCs used in the EIS:

- TMI_184-AE(1)-16: Blasting vibration;
- TMI_194-HE(1)-01: Linkages between noise and Aboriginal health;
- TMI_515- AC(1)-189: Noise associated with blasting; and
- TMI_526-AC(1)-200: Noise associated with blasting.

To address specific noise questions in the Round 1 IRs, two additional noise VCs (blasting noise and vibration, and noise related health effects) have been added. All of the technical work necessary to address these two additional VCs was already presented in Appendix H of the original EIS, and has been re-issued as Appendix H to the revised EIS. Table 6.1.3.3-1 lists the noise VCs, along with the corresponding indicators and measures.

Table 6.1.3.3-1: Noise VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Ambient noise levels	Equivalent noise levels, L_{EQ}	A-weighted decibels (dBA)
Noise disturbance to wildlife (including SAR)	Area predicted L_{EQ} above 50 dBA	Area (ha)
Blasting noise and vibration	Peak sound pressure level	Decibels (dB)
	Peak particle velocity	Centimetres per second (cm/s)
Noise related health effects	Absolute sound pressure, L_{DN}	A-weighted decibels (dBA)
	Percent highly annoyed, %HA	Change in %HA

6.1.3.4 Light

The development of the Project will require the use of artificial, exterior lighting in order for activities at the Project to proceed safely, and to ensure security. However, artificial lighting can also represent an effect on the environment. To capture these effects, the original EIS identified (Section 6.3.1.4) the following two VCs for evaluating the effects of the Project on light:

- Light trespass; and
- Wildlife attraction.

The development of the Project will require the use of exterior lighting for operations, safety and security. Treasury Metals also ensured that the nuisance factor of potential light trespass from the Project to neighboring residences was evaluated by identifying light trespass as a VC.

In addition, night-time lighting of structures (e.g., work lights) has been shown to act as an attractant to wildlife, thereby increasing the probability of Project-wildlife interactions. Although wildlife attraction to novel light sources was selected as a VC in the EIS, there are no specific criteria or thresholds or criteria that can be used from the perspective of light to evaluate these effects. Therefore, the assessment of the effects of light on wildlife has been addressed as part of the wildlife assessment (Section 6.12 of the revised EIS). Therefore, the "wildlife attraction" VC for light has been dropped, and the effects of light on wildlife incorporated when evaluating the effects of the Project on the wildlife VCs, described in Section 6.12.

There were no questions in the Round 1 IRs that specifically asked about the selection of the light VCs used in the EIS.

Table 6.1.3.4-1 lists the light VC, along with the corresponding indicators and measures.

Table 6.1.3.4-1: Light VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Light trespass	Ambient light levels	Lux

6.1.3.5 Air Quality

Project activities during the site preparation and construction phase, operations phase, and decommissioning and abandonment phase are expected to result in air emissions that can affect air quality. These air emissions can be broadly grouped as either gaseous or particulate emissions. However, both categories of emissions can be effectively with a single Valued Component (VC), namely air quality.

Both gaseous and particulate emissions are comprised of a number of compounds, often referred to as air contaminants. Those air contaminants expected to be released in amounts to result in measurable air concentrations beyond the Project were selected as indicators for air quality.

The following gaseous compounds were used as air quality indicators for assessing the effects of the Project on the air quality VC (RWDI, 2014e: Section 2.1.1, included as Appendix J-1):

- Sulphur Dioxide (SO_2);
- Nitrogen Dioxide (NO_2); and
- Carbon Monoxide (CO).

The following particulate compounds are used as air quality indicators for assessing the effects of the Project on the air quality VC (RWDI, 2014e: Section 2.1.2 and 2.1.3, included as part of Appendix J):

- Total Suspended Particulate (TSP), or dust, which includes nearly all of the airborne particles likely to be emitted by the Project.
- Inhalable particulate matter (PM_{10}), which, includes airborne particles with an aerodynamic diameters less than 10 microns.
- Respirable particulate matter ($PM_{2.5}$), which includes airborne particles aerodynamic diameters less than 2.5 microns.
- Metals present in the airborne particulate matter. The specific compounds selected are those for which relevant ambient air criteria were available (i.e., silver, copper, iron, lead, zinc aluminium, arsenic, barium, calcium, cadmium, cobalt, chromium, potassium, lithium, magnesium, manganese, molybdenum, nickel, phosphorous, antimony, selenium, tin, strontium, titanium, thallium, vanadium, tungsten, yttrium, sulphur, uranium, platinum, palladium, rhodium, sodium).
- Deposition of airborne particles as a result of gravitational settling and other influences. The deposited particulates are often referred to as dustfall, and are measured as deposition on a mass per area per time basis (g/m²/30 days).

Gaseous compounds potentially associated with projects of this nature, but not chosen as air quality indicators for this assessment are ammonia (NH_3), Volatile Organic Compounds (VOC) and ozone (O_3). Ammonia emissions were excluded as air quality indicators because the emissions of ammonia to air are minimal from the Project (RWDI, 2014e: Section 2.1.1, included as part of Appendix J). The heavy equipment at the mine will be diesel-fired, which will minimize the emissions of VOC to the point where the Project will result in no measurable change in the VOC concentrations. Although O_3 can form in the atmosphere through photochemical reactions with oxides of nitrogen (NO_X) and VOC emissions, the magnitude of these emissions from the Project is viewed as negligible from the perspective of O_3 formation (RWDI, 2014e, included as part of Appendix J). In fact, the NO_X emissions from the Project are likely to result in a local decrease in O_3 due to scavenging (as detailed in the response to TMI_165-AE(1)-03. Finally, the climate is the area is not conducive to ozone formation. Overall, the Project is expected to have little or no lasting effect on ground-level ozone concentrations in the region.

There are other metals likely to be present in the dust emitted from the Project, including beryllium, bismuth, gallium, gold, lanthanum, scandium, and thorium. Air quality criteria are not available for these compounds, so they will not be used in evaluating the effects of the Project on the air quality VC. Predictions of these compounds will be used provided as inputs to the human health risk assessment.

The following questions, raised as part of the Round 1 IRs, specifically asked about the selection of the air quality VCs used in the EIS:

- TMI_165-AE(1)-03: expected direction of ozone (O_3) formation;
- TMI_465-AC(1)-139: VOC and O_3 as indicators; and
- TMI_529-AC(1)-203: air quality as the VC, and O_3 as an indicator.

Table 6.1.3.5-1 summarizes the VCs, indicators and measures used for evaluating the potential effects of the Project on air quality, which considers the response to the Round 1 IR listed above.

Table 6.1.3.5-1: Air Quality VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Air Quality	Sulphur Dioxide (SO_2)	Concentrations (µg/m³)
	Nitrogen Dioxide (NO_2)	Concentrations (µg/m³)
	Carbon Monoxide (CO)	Concentrations (µg/m³)
	Total Suspended particulate (TSP)	Concentrations (µg/m³)
	Inhalable particulate (PM_{10})	Concentrations (µg/m³)
	Respirable particulate ($PM_{2.5}$)	Concentrations (µg/m³)
	Airborne metals	Concentrations (µg/m³)
	Particulate deposition (dustfall)	Deposition (g/m²/30 days)

6.1.3.6 Climate

Throughout the operating life of the Project, there will be equipment operating on the site that will be equipped with internal combustion engines, and will thus result in greenhouse gas (GHG) emissions. One aspect of the Project that will not materially contribute to the direct GHG emissions from the Project is the power supply. Treasury Metals intends on relying on the HydroOne 115 kV transmission line that runs through the Project, in the vicinity of the proposed plant site [Mit_047]. The Project GHG emissions are a potential concern as they could contribute to climate change. Additionally, both the federal and provincial governments have implemented initiatives to manage and mitigate the GHG emissions.

The following questions, raised as part of the Round 1 IRs, specifically asked about the selection of the climate VCs used in the EIS:

- TMI_263-EE(1)-06: climate projections for the region;
- TMI_439-AC(1)-114: consideration of changing climate;
- TMI_530-AC(1)-204: typo in VC section;

- TMI_586-AC(1)-260: consideration of changing climate; and
- TMI_738-PC(1)-71: GHG emissions comparison

In order to capture the potential effects of the Project on climate, the following to VCs will be used:

- Project GHG emissions, and
- Changes in climate due to the Project.

While these VC are slightly different from the single VC identified in the EIS (i.e., GHG emission compliance with CEAA and MOECC climate change guidelines), it is felt they more fully describe the potential effects of the Project, and address issues raised in the Round 1 information requests. They are also consistent with the current federal guidance document (FPTCCCEA 2003) for addressing climate change considerations in environmental assessments. This guidance document talks about the need to address both the potential effects of the Project, as well as potential effects on the Project. Both of the VCs identified are used for assessing the effects of the Project on the environment related to climate.

Table 6.1.3.6-1 summarizes the VCs, indicators and measures used for evaluating the potential effects of the Project on climate.

Table 6.1.3.6-1: Climate VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Project GHG emissions	Annual equivalent carbon dioxide emissions (eCO_2)	Mt/year
Changes in climate due to the Project	Changes in annual temperature	°C
	Changes in annual precipitation	Percent change from current precipitation levels

The evaluation of the potential effects of the environment on the Project, specifically the effects of changing climate on the Project are set out in the federal guidance (FPTCCCEA 2003), as well as described in Section 7.1.3 of the EIS Guidelines. Since the operating life of the Project will be relatively short, lasting approximately 15 years from site preparation and construction phase through the active closure phase, climate conditions during the operating life of the Project were expected to be comparable to the current levels. Therefore, the effects of climate change on the Project are expected to be relatively minimal during the operating life.

Although climate change is not expected to have a noticeable effect on the Project over its operating life, longer-term conditions extending into post-closure are projected to be different from those experienced today. The implications of these changes were specifically addressed in the response to TMI_263-EE(1)-06.

6.1.3.7 Surface Water Quality

During the engagement process for the Project, regulators, Aboriginal peoples and stakeholders all stressed the importance of protecting surface water quality from potential adverse effects related to the Project. Activities during the various phases of the Project life are expected to result in releases to receiving waters that have the potential to affect surface water quality. These effects can be effectively evaluated using a single Valued Component (VC), namely surface water quality.

Based on the EIS and understanding of the Project design, the compounds likely to be released by the Project will be used as indicators. The following parameters were used as indicators for the surface water quality VC:

- Aluminum (Al);
- Antimony (Sb);
- Arsenic (As);
- Beryllium (Be);
- Boron (B);
- Cadmium (Cd);
- Chloride (Cl);
- Chromium (Cr);
- Cobalt (Co);
- Copper (Cu);
- Cyanide (CN);
- Iron (Fe);
- Lead (Pb);
- Mercury (Hg);
- Molybdenum (Mo);
- Nickel (Ni);
- Nitrate (NO_3);
- Phosphorus (P);
- Selenium (Se);
- Silver (Ag);
- Thallium (Tl);
- Uranium (U);
- Vanadium (V); and
- Zinc (Zn).

The above indicators are described using concentrations in units of milligrams per litre (mg/L), which will be used as the “measures” in the assessment.

Table 6.1.3.7-1 summarizes the VCs, indicators and measures used for evaluating the potential effects of the Project on surface water quality.

Table 6.1.3.7-1: Surface Water Quality VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Surface water quality	Aluminum (Al)	Concentrations (mg/L)
	Antimony (Sb)	Concentrations (mg/L)
	Arsenic (As)	Concentrations (mg/L)
	Beryllium (Be)	Concentrations (mg/L)
	Boron (B)	Concentrations (mg/L)
	Cadmium (Cd)	Concentrations (mg/L)
	Chloride (Cl)	Concentrations (mg/L)
	Chromium (Cr)	Concentrations (mg/L)
	Cobalt (Co)	Concentrations (mg/L)
Surface water quality	Copper (Cu)	Concentrations (mg/L)
	Cyanide (CN)	Concentrations (mg/L)

Table 6.1.3.7-1: Surface Water Quality VCs, Indicators and Measures (continued)

Valued Components (VCs)	Indicators	Measures
	Iron (Fe)	Concentrations (mg/L)
	Lead (Pb)	Concentrations (mg/L)
	Mercury (Hg)	Concentrations (mg/L)
	Molybdenum (Mo)	Concentrations (mg/L)
	Nickel (Ni)	Concentrations (mg/L)
	Nitrate (NO_3)	Concentrations (mg/L)
	Phosphorus (P)	Concentrations (mg/L)
	Selenium (Se)	Concentrations (mg/L)
	Silver (Ag)	Concentrations (mg/L)
	Thallium (Tl)	Concentrations (mg/L)
	Uranium (U)	Concentrations (mg/L)
	Vanadium (V)	Concentrations (mg/L)
	Zinc (Zn)	Concentrations (mg/L)

The following question, raised as part of the Round 1 IRs, specifically asked about the selection of the water quality VC used in the EIS. The response to this question was considered in identifying the VCs, indicators and measures presented in the table above.

- TMI_531-AC(1)-205: water quality as the VC;

6.1.3.8 Surface Water Quantity

During the engagement process for the Project, regulators, Aboriginal peoples and stakeholders all stressed the importance of protecting surface water from potential adverse effects related to the Project. Activities during the various phases of the Project life will have the potential to affect the quantity of water in the receiving environment. To address these effects, a single Valued Component (VC), surface water quantity has been selected. This single VC is considered to be more inclusive than the pair of VCs identified in the EIS (i.e., alteration of flow rates in Blackwater Creek throughout Project operations and closure; and, alteration of flow rates in the Hoffstrom's Bay Tributary during operations) as it does not limit the assessment to a specific watercourse, or a specific period during the Project life. The watercourses and waterbodies evaluated in the assessments are described in Section 6.3.9.

Table 6.1.3.8-1 summarizes the VCs, indicators and measures used for evaluating the potential effects of the Project on surface water quantity.

Table 6.1.3.8-1: Surface Water Quantity VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Surface water quantity	Increase in surface water flows	Change in annual flow (%)
	Decrease in surface water flows	Change in monthly flow (%)
	Change in lake levels	Change in annual inflow (%)

Although there were no specific questions raised as part of the Round 1 IRs regarding the VC used in the EIS for evaluating surface water quantities, the following questions support the decision to select more inclusive VCs that consider potential effects beyond just Blackwater Creek and Hoffstrom's Bay Tributary:

- TMI_700-PC(1)-15: water levels of Thunder Lake and Wabigoon Lake; and
- TMI_719-PC(1)-34: water quality and water quantity in Thunder Lake.

6.1.3.9 Groundwater Quality

There are records for about 140 private water wells in the general area, mostly to the south and west, the majority of which are assumed to be providing private sources of drinking water for residents. Existing water quality in those areas is also expected to be generally compliant with Ontario Drinking Water Quality Standards, although some private in home water treatment equipment (e.g., filters, softeners, chlorinators) may be necessary (and is currently being used), based on the assumption that the closest wells in the area, which are located to the south and west of the Project, access the groundwater from both the overburden and bedrock aquifers for domestic use. This is supported by measurements of existing groundwater quality information that shows that groundwater in the basal sand and silt water bearing units are generally in compliance with the Provincial Water Quality Objectives (PWQO), which are more stringent than drinking water criteria and are established to protect sensitive aquatic receptors. Some compounds, however, have naturally occurring elevated metals (i.e., aluminum, arsenic, chromium, cobalt, copper, iron, tungsten, vanadium and zinc).

A single Valued Component (VC), groundwater quality was identified in the EIS for evaluating the effects of the Project. There were no specific questions related to the choice of this VC in the Round 1 information requests, therefore, this VC has been retained for evaluating the effects of the Project on groundwater quality. Table 6.1.3.9-1 summarizes the VC, indicators and measures used for evaluating the potential effects of the Project on groundwater quality. The indicators and measures are consistent with those defined for geology and geochemistry (Section 6.1.3.2).

Table 6.1.3.9-1: Groundwater Quality VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Groundwater Quality	Aluminum (Al)	Concentrations (mg/L)
	Antimony (Sb)	Concentrations (mg/L)
	Arsenic (As)	Concentrations (mg/L)
	Beryllium (Be)	Concentrations (mg/L)
	Boron (B)	Concentrations (mg/L)
	Cadmium (Cd)	Concentrations (mg/L)
	Chromium (Cr)	Concentrations (mg/L)
	Cobalt (Co)	Concentrations (mg/L)
	Copper (Cu)	Concentrations (mg/L)
	Cyanide (CN)	Concentrations (mg/L)

Table 6.1.3.9-1: Groundwater Quality VCs, Indicators and Measures (continued)

Valued Components (VCs)	Indicators	Measures
	Iron (Fe)	Concentrations (mg/L)
	Lead (Pb)	Concentrations (mg/L)
	Mercury (Hg)	Concentrations (mg/L)
	Molybdenum (Mo)	Concentrations (mg/L)
	Nickel (Ni)	Concentrations (mg/L)
	Selenium (Se)	Concentrations (mg/L)
	Silver (Ag)	Concentrations (mg/L)
	Thallium (Tl)	Concentrations (mg/L)
	Uranium (U)	Concentrations (mg/L)
	Vanadium (V)	Concentrations (mg/L)
	Zinc (Zn)	Concentrations (mg/L)

6.1.3.10 Groundwater Quantity

There are records for about 140 private water wells in the general area, mostly to the south and west, the majority of which are assumed to be providing private sources of drinking water for residents. Stakeholders and residents living in the vicinity of the Project have identified concerns related to the effects of the dewatering associated with the Project will have on the availability of water from existing water wells. Additionally, regulators, Aboriginal peoples and stakeholders have identified potential concerns that the dewatering of the open pit and underground mine could also have an effect on the water in nearby watercourses and waterbodies. To evaluate these potential effects, the EIS identified the following two Valued Components (VC) for groundwater quantity:

- Groundwater elevations in private wells; and
- Groundwater contributions to surface flow patterns.

The two VC used in the EIS have been combined into a single VC, groundwater quantity. Groundwater elevations in private wells and groundwater contributions to surface flow patterns are now used as indicators for the groundwater quantity VC. Table 6.1.3.10-1 summarizes the VC, indicators and measures used for evaluating the potential effects of the Project on groundwater quantity.

Table 6.1.3.10-1: Groundwater Quantity VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Groundwater quantity	Decreasing elevations in private water wells	Estimated decrease in well elevations (m)
	Decreasing contributions to surface flow pattern	Decrease in annual flow (%)

Although there were no specific questions in the Round 1 information requests regarding groundwater quantity VC, the following IRs were identified as supporting both of the indicators selected for the groundwater quantity VC:

- TMI_126-FH(1)-05: groundwater drawdown effects on surface water;
- TMI_341-AC(1)-15: water levels in local wells;
- TMI_632.3-AC(1)-305: contribution of groundwater to surface water flows;
- TMI_634-AC(1)-307: contribution of groundwater to surface water flows; and
- TMI_767-PC(1)-82: effects on water wells.

6.1.3.11 Wildlife and Wildlife Habitat

The importance of wildlife to Aboriginal peoples and other stakeholders was highlighted through the engagement process undertaken by Treasury Metals in support of the Project. To address these concerns, the following five VCs that were used for assessment of the effects of the Project on wildlife and wildlife habitat in the original EIS (Section 6.3.1.11):

- Wildlife Species at Risk (especially bats);
- Ungulates;
- Furbearers;
- Upland birds; and
- Wetland birds.

In addition to the above VCs, reptiles and amphibians, as well as small terrestrial mammals were considered as potential VCs, but were discarded for the following reasons:

- Reptiles and amphibians were not retained as a VC in the EIS on the basis of the low probability of a reptile or amphibian SAR occurring in the areas and the assumption that any mitigation implemented for wetlands would benefit reptiles and amphibians.
- Small mammals were not retained as a VC in the EIS due to the low probability of a small mammal SAR occurring in the area and the assumption that mitigation strategies for other mammals and birds would benefit small mammals.

As part of the Round 1 information request process, there were a number of questions asking for clarification or justification for the VCs selected or discarded with respect to wildlife. In response to this feedback, the list of VCs, indicators and measures used for assessing the effects on wildlife and wildlife habitat has been modified. Table 6.1.3.11-1 lists the indicators and measures that have been used for assessing the effects of the Project on wildlife and wildlife habitat in this report.

Table 6.1.3.11-1: Wildlife and Wildlife Habitat VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Wildlife Species at Risk	Common Nighthawk	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
	Northern Myotis/Little Brown Myotis	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
	Barn Swallow	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Ungulates	Moose	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Furbearers	American Marten	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Upland birds	Upland birds	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Wetland birds	Marsh birds	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Small mammals	Small mammals	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Reptiles and amphibians	Reptiles and amphibians	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Invertebrates	Terrestrial invertebrates	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality

In choosing the VCs, indicators and measures to be used for evaluating the potential effects of the Project on wildlife and wildlife health, consideration was given to the purpose, concept and intent of VCs, described in Section 6.3.1. From an ecological perspective, VCs can be a range of species that serve as a surrogate for individual species that interact similarly with the environment (e.g., upland birds). It is not necessary to assess every individual species within the group when the effects are can be described effectively for a surrogate. Table 6.1.3.11-2 provides the justification for the VCs used in the Revised EIS for evaluating the effects of the Project on wildlife

and wildlife habitat. A decision was made by Treasury Metals to select VCs from a holistic perspective of assessing some broad ecosystem components and species groups rather than focusing on more specific ecosystem components and species (with the exception of SAR and economically and culturally important species – where individual species were assessed).

Table 6.1.3.11-2: Justification for the Selection of Wildlife and Wildlife Habitat VCs, Indicators and Measures

Valued Components (VCs)	Justification
Wildlife Species at Risk	• Species at risk must be afforded special consideration given their status and vulnerability • Important component to the function of the ecosystem • Educational, scientific, or aesthetic interest • Provincial, national or international significance.
Ungulates	• Significant habitat for locally important species • Component is of economic or cultural significance
Furbearers	• Significant habitat for locally important species • Component is of economic or cultural significance
Upland birds	• Significant habitat for locally important species • Significant habitat for uncommon, rare or unusual species • Notable species or species groups • Component is of provincial, national or international significance
Wetland birds	• Significant habitat for locally important species • Significant habitat for uncommon, rare or unusual species • Notable species or species groups • Indicator of environmental health • Component is of economic or cultural significance • Component is of provincial, national or international significance
Small mammals	• Significant habitat for locally important species • Indicators of general ecosystem biodiversity and health • Important component of food webs for higher level predators
Reptiles and amphibians	• Indicators of general ecosystem biodiversity and health (particularly wetlands and aquatic habitats) • Important component of food webs
Invertebrates	• Important components of food webs • Important component to the function of healthy ecosystems

Four SAR VCs have been selected: Common Nighthawk, Northern Myotis, Little Brown Myotis, and Barn Swallow. These have been selected due to their occurrence with in the LSA and as a result of the legislative requirements surrounding any potential effects to the species or their habitats. Marten are important, not only for their relevance to ecosystem biodiversity, but also because of their economic and cultural significance.

Ungulates present in the LSA and the RSA include White-tailed deer and Moose. Both are relatively common throughout the LSA, however, Moose were chosen as a VC based on the fact that the project lies within MNRFs Cervid Ecological Zone C1, which emphasis management for higher moose populations and lower White-tailed deer populations.

The remaining VCs (upland birds, wetland birds, small mammals, reptiles and amphibians and invertebrates) were chosen based on the fact that each group of species has individual members with a variety of disturbance tolerances and habitat requirements. As such, an effects assessment on these groups will provide insights into the effects of the ecosystem as a whole as opposed to the effects on a single species.

The importance of wildlife and wildlife habitat in the region was reflected in the number of Round 1 information requests from regulators, Aboriginal peoples and stakeholders on the subject. The following information requests relate specifically to the selection of valued components, indicators and measures for wildlife and wildlife habitat:

- TMI_153-WL(1)-10: include VCs for reptiles and amphibians, terrestrial invertebrates, and small mammals;
- TMI_153-WL(1)-10 (revised): additional SAR species;
- TMI_156-WL(1)-13: bird SAR as a separate VC;
- TMI_336-AC(1)-10: presence of owls, wild turkeys and robins near Project site;
- TMI_358-AC(1)-32: presence of fox and bear near Project site;
- TMI_359-AC(1)-33: potential effects on moose, furbearers (e.g., beaver and muskrat), aquatic animals and small terrestrial mammals ;
- TMI_532-AC(1)-206: need to provide indicators and measures;
- TMI_542-AC(1)-216: need to identify specific SAR for assessment of effects; and
- TMI_748-PC(1)-63: presence of wolves near the Project site.

In the Round 1 information requests, specifically TMI_153-WL(1)-10 (revised), the Agency asked for specific justification for not explicitly evaluating the potential effects of the Project on the following VCs, which were discussed in Appendix G to the original EIS:

- Mammals: American Badger (Taxidea taxus), Grey Fox (Urocyon cinereoargenteus), Eastern Timber Wolf (Canis lupus lycaon)
- Reptiles: Snapping Turtle (Chelydra serpentina)
- Arthropods: Monarch (Danaus plexippus)

While these species were discussed original EIS baseline work, and were included in the baseline surveys, the results of the baseline work confirmed that they were not present in the areas likely to be affected by the Project and thus would not be suitable for identification as VCs for evaluating the effects of the Project on the environment. Each of these species is discussed more fully below.

Gray Fox

Gray Fox distribution is closely associated with the presence of deciduous forest, with denning usually occurring in shrublands close to water. Recent (i.e., within the last 20 years) observations in the Wabigoon Ecoregion were located near the US and Manitoba borders, roughly 150–170 km from Dryden. This represents the northern extent of this species' global range. The primary threats to Gray Fox in northern Ontario are trapping and road mortality. Although this species was captured in the RSA and habitat capable of supporting Gray Foxes exists within the LSA, the Project footprint does not include sufficient shrubland to support a denning family unit. The Project effects will not impact existing populations. Therefore there would be no potential effects on this species and the exclusion from the list of VCs and associated indicators is justified.

Eastern Wolf

The Eastern Wolf (Canis lycaon; listed as Threatened federally)—formerly assessed as Eastern Timber Wolf (C. lupus lycaon), recently listed as provincially Threatened by COSSARO under Algonquin Wolf (Canis sp.)—was included in Section 4.7.4.1 as a statement to illustrate that they were not present in the study area.

Eastern wolves exploit a relatively narrow ecological niche, inhabiting mixedwood forests with low levels of human disturbance, and requiring larger prey (e.g., White-tailed Deer [Odocoileus virginianus] and American Beaver [Castor canadensis]) to meet their energy requirements. Eastern Wolf distribution is limited to southeastern Ontario, the nearest record occurring in Killarney Provincial Park, over 900 km from Dryden. Although Eastern Wolf-Grey Wolf hybrids—the Great Lakes-Boreal Wolf (C. lupus x C. sp. cf. lycaon)—may extend further into central and northern Ontario, the hybrids are ecological analogues of Grey Wolves (Canis Lupus). Although the Great Lakes-Boreal Wolf range extends over the Project area, they are not afforded the same protection as the Eastern Wolf proper.

Eastern Wolves do not occur within the local or regional study areas. Therefore there would be no potential effects on this species and the exclusion from the list of VCs and associated indicators is justified.

American Badger

There has only been one documented American Badger sighting in the Kenora and Dryden areas since 1979, roughly 40 km west of Dryden. The estimated mature population in northwestern Ontario may be as few as 5 individuals. Though they are not expected to occur within the Project

area, American Badgers are considered below because of the scarcity of the species in northern Ontario and the relative proximity of the Project to a reported sighting.

The northwestern population of American Badger is small but supported by consistent sightings in the province, primarily in a 3000 km2 area of agricultural land between Rainy River and Fort Francis. Further north in Kenora/Dryden areas, they are seldom observed, with only one record since 1979. These observations represent the northern extent of this species' global range.

Primary American Badger habitat consists of grasslands, open forest, hedgerows and agricultural field edges, but recent work suggests they may also use areas within forested environments opened by disturbance (e.g., road right-of-way). Their primary habitat requirements appear to be soil conditions suitable for digging and the availability of prey. This species does not appear to use defined movement corridors and does not exhibit seasonal migrations. The major threats to American Badger are habitat loss and road mortality, although they are also susceptible to hunting pressure, disease, loss of prey and secondary poisoning.

Mammal encounter surveys were conducted in 2011. Transects were established in habitats specifically targeting American Badgers (i.e., grasslands and open areas) throughout the LSA. There were no sightings or signs of American Badger activity from these surveys.

Project activities that compact soil (e.g., drilling) may disturb suitable American Badger habitat, but other activities like line clearing or road construction in forested areas may open new habitat as a secondary effect. The Project footprint covers roughly 427 ha characterized by 28% coniferous, 18% deciduous and 24% successional forests, 8% wetlands, and the remaining area developed. Although there are undoubtedly some open areas, the Project area does not constitute high quality American Badger habitat. Combined with the historical records in northwestern Ontario, Project activity is unlikely to impact American Badgers. As a result it was concluded that the exclusion from the list of VCs and associated indicators is justified.

It should be noted that the Wildlife Management Plan (section 12.9 of the revised EIS) will incorporate procedures to be followed, including the implementation of mitigation measures, in the event American Badger are identified in the Project area.

Snapping Turtle

Extensive aquatic, wetland and terrestrial surveys were conducted in the LSA, all of which failed to detect Snapping Turtles (Chelydra serpentine; listed as Special Concern in Ontario). The nearest reported occurrences roughly 40 km west of Dryden, representing the northern-most extent of this species' global range. As a result it was concluded that the exclusion from the list of VCs and associated indicators is justified.

Although Snapping Turtles are not expected to occur in the Project area and species of "Special Concern" are not afforded additional protection in Ontario, Snapping Turtles have been identified

in the Wildlife Management Plan (section 12.9 of the revised EIS) because of the presence of potential nesting habitat and the relative proximity of historical sightings.

Monarch

The range of Monarch butterflies (Danaus plexippus; listed as Special Concern in Ontario) extends across the Project area. Monarchs require four distinct habitats for different parts of their life history, including overwintering, breeding, staging and nectar (feeding) habitats. Monarchs overwinter in Mexico, and the Project area does not appear to be an important migratory staging area or exist within a high volume migratory corridor. The Project area could potentially be used for breeding and nectar habitats.

Breeding habitat is confined to where milkweed (Asclepias sp.) grows, since this serves as the sole food for their caterpillars. Although Swamp Milkweed (Asclepias incarnata) was identified in the LSA, it was not abundant enough to provide high quality Monarch breeding habitat. Monarchs breeding activity within the Project area is expected to be negligible.

Several flowering plants occur within the LSA, so adults may feed throughout Project area. However, adult Monarch abundance is considered very low because there were no observations during three years of fieldwork and the lack of abundant breeding habitat.

Generally, species listed as “Special Concern” in Ontario are not afforded any additional protection. Nevertheless, Project effects are not expected to impact Monarchs. As a result it was concluded that the exclusion from the list of VCs and associated indicators is justified.

6.1.3.12 Migratory Birds

Migratory birds were not identified as a separate discipline in the original EIS, but have been added in the revised EIS at the request of the Agency to facilitate their review process. The information regarding the on migratory birds uses the following VCs:

- Upland birds; and
- Wetland birds.

Table 6.1.3.12-1 lists the valued components, indicators and measures used for describing the effects of the Project on migratory wildlife and wildlife habitat in this report.

Table 6.1.3.12-1: Migratory Birds VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Upland birds	Upland birds	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality
Wetland birds	Marsh birds	Habitat loss (ha)
		Habitat alteration or displacement (ha)
		Potential for mortality

6.1.3.13 Fish and Fish Habitat

Project activities during the site preparation and construction phase, operations phase, closure phase and post-closure phase will all have the potential to effect fish and fish habitat. The importance of these potential effects to Aboriginal peoples and other stakeholders was highlighted through the engagement process undertaken by Treasury Metals in support of the Project. To address these concerns, the following two VCs were identified in Section 6.3.1.12 of the original EIS for evaluating he effects of fish and fish habitat:

- Fish; and
- Fish Habitat Conditions for all activities and fish life stages (spawning, incubating, rearing, feeding, respiration, migration, refuge, overwintering).

Based on a review of the questions raised as part of the Round 1 information request, the list of valued components has been changed to include stream-resident fish populations, migratory fish populations, lake-resident fish populations, and fish species at risk. Stream-resident fish populations are species that complete their entire life cycle (spawning, nursery, foraging, overwintering) in the habitats that are present within the local watercourses. In streams such as those affected by the project these are typically small-bodied fishes. Migratory fish populations are populations that migrate into streams to complete a portion of their life cycle, usually spawning. In some cases the streams also provide nursery habitat. Lake-resident populations are populations that complete their entire life cycle in lakes. Fish species-at-risk are species that have status under the federal *Species at Risk Act* or the *Ontario Endangered Species Act*.

Two indicators have been identified for each of the VCs, namely the habitat lost or adversely affected as a result of the Project, and fish mortality. Fish habitat can be affected by a range of factors that result in either the loss or degradation of fish habitat. The loss of habitat occurs when watercourses or waterbodies are overprinted by the construction of Project elements (e.g., the tailings storage facility, or TSF, will overprint portions of Blackwater Creek Tributary 2). Degradation can result from factors such as changes in surface water quality, changes in surface water flow, or alteration of the habitat that makes it less suitable (e.g., changes in substrate). Fish mortality can occur if fish cannot be relocated prior to the loss of habitat or if fish are subjected to

lethal pressure changes due to blasting. Mortality could also occur should the surface quality be degraded to a point where fish can no longer survive.

Table 6.1.3.13-1 lists the VCs, indicators and measures to be used in evaluating the effects of the Project on fish and fish habitat.

Table 6.1.3.13-1: Fish and Fish Habitat VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Stream-resident fish population	Habitat lost	Length (km) or area (m^2)
	Habitat adversely affected	Length (km) or area (m^2)
	Fish mortality	Fish mortality proportion (%)
Migratory fish populations	Habitat lost	Length (km) or area (m^2)
	Habitat adversely affected	Length (km) or area (m^2)
	Fish mortality	Fish mortality proportion (%)
Lake-resident fish populations	Habitat lost	Length (km) or area (m^2)
	Habitat adversely affected	Length (km) or area (m^2)
	Fish mortality	Fish mortality proportion (%)
Fish species-at-risk	Habitat lost	Length (km) or area (m^2)
	Habitat adversely affected	Length (km) or area (m^2)
	Fish mortality	Fish mortality proportion (%)

The following Round 1 information requests commented on the VCs for fish and fish habitat, specifically the selection of Fish Species of Management Concern:

- TMI_142-FH(1)-21: selection of valued components, indicators and measures;
- TMI_143-FH(1)-22: identification of Fish Species of Management Concern; and
- TMI_475-AC(1)-149: identification of Fish Species of Management Concern.

6.1.3.14 Wetlands and Vegetation

Wetlands are important habitat for many wildlife species including moose, birds, amphibians, and fish. They may also provide key hydrological functions such as groundwater recharge and water quality improvement. Wetlands may also serve a cultural and social function – for example, as sites where wild rice may grow, or where recreational fisheries may occur. To address any concerns the Project may have on wetlands and vegetation, two VCs were identified in Section 6.3.1.13 of the original EIS:

- Wetland extent; and
- Vegetation communities and species.

Although additional VCs that may be associated with wetlands were identified, they were more directly related to other resource topics such as water quality, fish and fish habitat, and wildlife and wildlife habitat, and are discussed in those sections. Based on a review of the questions raised as part of the Round 1 information request, the list of valued components for wetlands and vegetation has been retained for consideration (Table 6.1.3.14-1)

Table 6.1.3.14-1: Wetlands and Vegetation VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Wetland extent	Wetland extent	Wetland area (ha)
Vegetation communities and species	Floating Marsh Marigold (*Caltha natans*)	Area of potential habitat (ha)

Wetland extent was chosen as a VC due to the fact that wetlands are an integral component of the watersheds. Wetland functions including water storage and delay, contribute to year-round flows of streams that are connected by surface or sub-surface flow. These flows in turn support year-round habitat for aquatic species. Intact, functional wetlands help to ensure that downstream flow rates are moderated.

The only provincially listed plant species detected within the LSA is the floating marsh marigold (provincially rare). This species is considered a VC as it is found only in wetlands, and its presence serves as an indicator of wetland health. Also, it is considered a rare species, both regionally and in the ecosystem type in which it is found.

Wetlands are abundant in the region. Baseline studies found swamps dominated by tall shrubs, to be the most dominant type of wetland in the LSA. Small areas of fens and marshes dominated by emergent vegetation and shrubs are also common. The Lola Lake wetland is a very large (1,487 ha) wetland complex adjacent to the LSA. It is within a provincial nature reserve designed to protect the unique geology of the area. Baseline studies did not identify any other wetland within the LSA as being provincially significant according to the Ontario Wetland Evaluation System (OWES). The Lola Lake wetland has not been evaluated.

The following information requests relate specifically to the selection of valued components, indicators and measures for wetlands and vegetation:

- TMI_153-WL(1)-10 (revised): additional SAR species;
- TMI_282-RG(1)-17: hydrology of Lola Lake;
- TMI_283-RG(1)-18: fen inventories, vegetation, and SAR surveys;
- TMI_333-AC(1)-07: water quality impacts to Lola Lake;

- TMI_478-AC(1)-152: define spatial boundary for wetlands; and
- TMI_534-AC(1)-208: better identification of wetland and vegetation VCs.

In the Round 1 information requests, specifically TMI_153-WL(1)-10 (revised), the Agency asked for specific justification for not explicitely evaluating the potential effects of the Project on Western Silvery Aster (Symphyotrichum sericeum), which were discussed in Appendix G to the original EIS. Western Silvery Aster (Symphyotrichum sericeum; listed as Endangered in Ontario) occurs in only two areas in Ontario, roughly 130–150 km from Dryden. In the northern Ontario portion of its range, this species is only found in Bur Oak (Quercus macrocarpa) savannah on shallow soil over mafic (i.e., basic) bedrock. This habitat is very uncommon, with most bedrock across the Boreal Shield composed of acidic (usually granite) rock. These observations represent the north-eastern extent of the species' global range. Although Western Silvery Aster was captured in the RSA, suitable habitat does not occur within the LSA. Project effects will not impact the existing populations. Therefore there would be no potential effects on this species and the exclusion from the list of VCs and associated indicators is justified.

6.1.3.15 Land Use

The EIS previously this section Land Use has been expanded to consider the resource uses and thus renamed this section to Land and Resource Use. Considering the review of the existing information related to land and resource use, review of the IRs and knowledge of similar land and resource assessments, the VCs for land and resource use used in this report suggested a more extensive list of land and resource use VCs would be appropriate. The land and resource use VCs used in this report are:

- Land Use Planning and Policies;
- Aggregate Operations;
- Forestry;
- Mineral Exploration;
- Fishing - Recreational and Commercial;
- Hunting;
- Trapping;
- Cottagers and Outfitters; and
- Other Recreational Uses.

Following a review of the Round 1 information requests, the following revision was made to the VCs:

- Transportation has been incorporated into a new VC titled Transportation and Traffic. Within the original EIS, Transportation was assessed as a part of the land use assessment. However, transportation issues have been relocated to the social component (Seciton 6.17) of the revised EIS.

The land and resource uses VCs, indicators and measures are listed in Table 6.1.3.15-1.

Table 6.1.3.15-1: Land and Resource Use VCs, Indicators, and Measures

Valued Components (VCs)	Indicators	Measures
Land Use Planning and Policies	Conflict with accepted land uses as stipulated in approved land use plans.	• Conflict with policies
	Overlap with protected areas.	• Overlap of Project with protected areas
Aggregate Operations	Change in access to aggregate resources.	• Change in access
	Change in demand of aggregate resources extraction.	• Change in aggregate demand
Forestry	Change in access to forestry resources for management.	• Change in access
Mineral Exploration	Change in access to mineral claims for exploration and production.	• Change in access
Fishing - Recreational and Commercial	Change in access to fisheries resources, affecting the ability to fish.	• Change in access
	Change in the abundance of fisheries resources, affecting the ability to fish.	• Change in fish habitat and populations
	Change in contaminant levels in fish, affecting the suitability for harvesting.	• Change in surface water quality
Hunting	Change in access to wildlife resources, affecting the ability to hunt.	• Change in access
	Change in abundance of wildlife resources, affecting the ability to hunt.	• Change in available wildlife habitat and populations
	Diminished experience of being on the land and conducting hunting activities.	• Changes in noise • Changes in light trespass • Changes in air quality (dust) • Changes in viewscapes
Trapping	Change in access to wildlife resources, affecting the ability to trap.	• Change in access
	Change in abundance of wildlife resources, affecting the ability to trap.	• Change in available wildlife habitat and populations
	Diminished experience of being on the land and conducting trapping activities.	• Changes in noise • Changes in light trespass • Changes in air quality (dust) • Changes in viewscapes
Cottagers and Outfitters	Diminished experience of being on the land and conducting trapping activities.	• Change in traffic volumes • Changes in noise and vibration • Changes in air quality (dust) • Changes in viewscapes

Table 6.1.3.15-1: Land and Resource Use VCs, Indicators, and Measures (continued)

Valued Components (VCs)	Indicators	Measures
	Change in access to cottage and/or outfitter areas.	• Change in access
	Changes in clientele for outfitters with lodges located near the Project.	• Change in clientele
Other Recreational Uses	Change in access for residents and visitors to public lands for non-consumptive purposes (e.g., motorized recreational vehicles, canoeing, wildlife viewing, walking and hiking).	• Change in access
	Change in access for residents and visitors to pick berries and/or mushrooms and/or other vegetation for consumptive purposes.	• Change in access
	Change in abundance of berries and/or mushrooms and/or other vegetation used for consumptive purposes.	• Change in abundance of vegetation

The rationale for selection of land and resource use valued components is presented in Table 6.1.3.15-2.

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
Land use planning and policies	**NA**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** • Project could overlap with conservation areas where the Project conflicts with the use of the land. **Aboriginal:** • Project could overlap land use planning and policies where the Project conflicts with the intended use of the land or associated policies. **Other Stakeholder:** • Project could overlap land use planning and policies where the	• This VC is recommended due to the potential Project effects associated with Ontario's Living Legacy Land Use Strategy (1999), Dryden District Land Use Guidelines (1983) and potential policies from the local services board (designated place – Wabigoon). • The Project may overlap with planning or policies that have not been detailed in the EIS. Potential effects on land use plans and policies may include overlapping of land use policy area where the use would not be allowed and creating land use conflicts. • The Project site footprint overlaps the Crown Land Use area G2531, Dryden, Vermilion Bay and Area, General Use Area by less than 1% (414.25 ha). The Project is consistent with the intent of this land use policy area. • The LSA overlaps portions of P2552, Aaron Provincial Park and P2591, Lola Lake Provincial Park by 29.5% (34.48

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		Project conflicts with the intended use of the land or associated policies.	ha) and 27.4% (1,682.96 ha), respectively. • Project may conflict with Dryden District Land Use Guidelines (1983) or if the local services board has guidelines or policies with which the Project may conflict.
Aggregate operations	**NA**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** • Not applicable **Aboriginal:** NA **Other Stakeholder:** • The Project may overlap and/or change access to existing aggregate operations. The Project may increase the demand on aggregate resources in the LSA.	• This VC is recommended due to the potential Project effects on aggregates that may include the overlapping aggregate areas; the long-term removal of aggregate (at the Project site footprint); and changes to access at the Project site. The Project may also increase the demand for aggregates in LSA. • There are three aggregate operations in close proximity to the LSA but not within it. There are two active and one MTO aggregate pit within the LSA. The two aggregate pits are located on Maggrah and Johnsons roads south of Anderson Road. The MTO pit is located on the north side of Anderson Road, east of Johnsons Road. • No effects on aggregate operation are anticipated as the Project site footprint does not overlap with any existing aggregate operations. • There is the potential for increased demand of aggregate resources during to the construction of the Project, which are generally addressed in the socio-economic component.
Forestry	**NA**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** NA **Aboriginal:** NA **Other Stakeholder:** • The Project may overlap and/or change access to FMUs.	• This VC is recommended due to the potential Project effects on forestry that may include the overlapping, and therefore, loss of Forest Management Units (FMUs) area; the long-term removal of forest resources (at the Project site footprint); and changes to access at the Project site. • The Project Site Footprint overlaps FMU 535, Dryden Forest by less than 1% (415.34 ha). The LSA overlaps FMU 535, Dryden Forest and FMU 130, Wabigoon Forest by 1.23%

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
			(3,832.51 ha) and less than 1% (1,171.01 ha), respectively. • Treasury Metals may be required to obtain a forestry license from the MNRF to clear forest resources for Project construction, the applicable Sustainable Forest License Holder will be given first right of refusal to harvest.
Mineral exploration	**1.2.3 Land Ownership**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** NA **Aboriginal:** NA **Other Stakeholder:** • Project could overlap and/or change access to land that is associated with ownership and/or mineral claims to parties other than Treasury. Project could overlap or change access to Crown land.	• This VC is recommended due to the potential Project effects that may either create improved access to mineral claims through the development of new access roads or limit access by removing previously used access roads.
Fishing - recreational and commercial	**5.11.5.3 Fishing** **6.2.1.12 Fish and Fish Habitat** **6.4.1.12 Fish and Fish Habitat** **Appendix EE: Country Foods Assessment**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific**: NA **Aboriginal**: • Potential Project effects on fishing include loss of recreational or commercial fishing areas, changes to access to these areas, and changes to abundance and distribution of fish. **Other Stakeholder**: • Potential Project effects on fishing include loss of	• This VC is recommended due to the potential Project effects on Fisheries Management Zones (FMZs), bait harvest areas or other important management areas from the Project that may include the loss of bait harvest areas, commercial fishing areas, or recreational fishing areas; changes to access to fishing areas; and changes to the abundance and distribution of fish that could affect fishing success rates, and therefore, any commercial fishing income (such as for bait fish harvesters) due to changes in biophysical or anthropogenic conditions. • The EIS identifies fish and fish habitat effects from the Project, including alteration of existing watercourses that will result in the loss of 6 ha of fish habitat. Potential impacts to fish also include direct mortality due to physical

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		recreational or commercial fishing areas, changes to access to these areas, and changes to abundance and distribution of fish.	disturbances and/or release of a deleterious substance. • The Project overlaps FMZ 5 by less than 1% (415.34 ha) and bait harvest areas DR0031 by 1.66% (415.34 ha). The LSA overlaps these areas and bait harvest area DR0030. • From Crown Use designations (Ontario's Living Legacy Land Use Strategy (1999)): Thunder Lake is a designated the lake for natural trout management. See Inland Ontario Lakes Designated for Lake Trout Management (2015). • There is a designated provincial fish sanctuary at the mouth of Nugget Creek at Wabigoon Lake. • Commercial fishing licences are held for Thunder and Wabigoon lakes.
Hunting	**5.11.5.2 Hunting and Trapping** **6.2.1.11; 6.4.1.11 Wildlife and Wildlife Habitat** **Appendix EE: Country Foods Assessment**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** NA **Aboriginal:** • Potential Project effects on hunting include changes to access. Potential Project effects on hunting include changes to abundance and distribution of wildlife that could affect hunting success rates. **Other Stakeholder:** • Potential Project effects on hunting include changes to access WMUs or BMAs. Potential Project effects on hunting include changes to abundance and distribution of wildlife that could affect hunting success rates.	• This VC is recommended due to the potential Project effects on hunting that relate to Wildlife Management Units (WMUs) and Bear Management Areas (BMAs), where the Project may overlap, and therefore, limit use and access to WMUs and BMAs, increase access along corridors, and change the abundance and distribution of wildlife that could affect hunting success rates. • These effects can be experienced by the residential or non-residential (tourist) hunter as well as tourism outfitters. • The EIS identifies that habitat will be lost as a result of the Project, as well as there bing the potential of direct mortality from intereactions with Project vehicles • The Project Site Footprint overlaps WMU 8, BMAs DR-08-050 and DR-05-067. The Project Site Footprint also overlaps the Cervid Ecological Zone C1. The LSA also overlaps with WMU 5.
Trapping	**5.11.5.2 Hunting and Trapping**	**Regulator:**	• This VC is recommended due to the potential Project effects on trapping that

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
	6.2.1.11; 6.4.1.11 Wildlife and Wildlife Habitat **6.2.1.12;6.4.1.12 Fish and Fish Habitat** **Appendix EE: Country Foods Assessment**	• EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** NA **Aboriginal:** • Potential Project effects on trapping include loss of trapline areas or trapping cabins and access to trapline areas or cabins. • Potential Project effects on trapping include changes to abundance and distribution of furbearers that could affect trapping success rates, and therefore, trapping income due to changes in biophysical or anthropogenic conditions. **Other Stakeholder**: • Potential Project effects on trapping include loss of trapline areas or trapping cabins and access to trapline areas or cabins. • Potential Project effects on trapping include changes to abundance and distribution of furbearers that could affect trapping success rates, and therefore, trapping income due to changes in biophysical or anthropogenic conditions.	may include the loss of trapline areas or trap cabins; changes to access to trapline areas or trapping cabins; and changes to the abundance and distribution of furbearers that could affect trapping success rates, and therefore, trapping income due to changes in biophysical or anthropogenic conditions. • These potential effects could be experienced by licenced trappers. • The EIS identifies that habitat will be lost as a result of the Project, as well as there bing the potential of direct mortality from intereactions with Project vehicles • The Project site footprint overlaps trapline area DR026, and D027 by. Trapline areas DR021 is also within the LSA.
Cottagers and outfitters	**5.2 Air Quality; 5.3 Acoustic and Light Environment** **6.2.1.1; 6.3.1.1; 6.4.1.1 Terrain and Soils** **6.2.1.3; 6.3.1.3; 6.4.1.3 Noise**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** NA **Aboriginal:**	• This VC is recommended due to the potential Project effects for residential cottage areas located near the Project site. Potential effects on the cottagers may include decreased enjoyment and leisure lifestyle associated with cottaging due to noise and dust; perceived effects to water quality, quantity and area aesthetics); and increased vehicle traffic.

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
	6.2.1.4; 6.3.1.4; 6.4.1.4 Light **6.2.1.5; 6.3.1.5; 6.4.1.5 Air Quality**	• Potential Project effects to the cottagers and rural residential properties include decreased enjoyment and leisure lifestyle associated due to noise and dust, perceived effect to water quality and quantity, and area aesthetics. • Potential Project effects to the outfitters may include decreased areas recommended by outfitters to clientele, perception of the area is not pristine or natural which could deter clientele, and increase local clientele due to increased workforce in the area. **Other Stakeholder:** • Potential Project effects to the cottagers and rural residential properties include decreased enjoyment and leisure lifestyle associated due to noise and dust, perceived effect to water quality and quantity, and area aesthetics. • Potential Project effects to the outfitters may include decreased areas recommended by outfitters to clientele, perception of the area is no pristine or natural which could detract clientele, and increase local clientele due to increased workforce in the area.	• Tourist outfitters are likely to be situated in the area and/or use the area for their clientele. The potential effects of the Project on the outfitters may include decrease in areas recommended by outfitters to clientele (related to effects on BMAs); perception that the area is not pristine or natural which could detract clientele; and increased local clientele due to increased workforce in area (staying or hunting, etc). • The LSA overlaps the Thunder Lake Lodge.
Other recreational uses	**5.11.5.1 Vegetation** **Appendix EE: Country Foods Assessment** **Appendix W: Screening Level Risk Assessment**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. Land use context (e.g., hunting, fishing, outdoor recreation, use of seasonal cabins, existing land development). • EIS Guideline 10.3 – Public concerns **Conservation / Scientific:** NA **Aboriginal:** • Potential Project effects on other recreational uses include changes to access, changes to abundance and distribution of	• This VC is recommended due to the potential Project effects on other recreational uses (including the use of motorized and non-motorized recreational vehicles, canoeing, hiking, mushroom and berry picking, wild rice harvesting and wood gathering). The potential effects on other recreational uses may include the temporary disruption of the snowmobile trails; changes to access to the Project area that may have previously been used for other recreation uses; and changes in the natural aesthetic of the area which may detract some recreational users from using the Project area.

Table 6.1.3.15-2: Rationale for Land and Resource Use VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		harvested foods, and changes to the natural aesthetic. **Other Stakeholder:** • Potential Project effects on other recreational uses include changes to access, changes to abundance and distribution of harvested foods, and changes to the natural aesthetic.	• The LSA overlaps the Thunder Lake Lodge and a portion of the Thunder Lakes Trails.

There were a range of questions asked as part of the Round 1 information request process related to land and resource use. The following lists those specific questions that relate to the selection of VCs, indicators and measures for the land and resource use component:

Land Use Planning and Policies

- Government Agency - CEA Agency:
  - TMI_194-HE(1)-01 – Land use
- Métis Nation of Ontario:
  - TMI_535-AC(1)-209 – Land use
  - TMI_536-AC(1)-210 – Land use
  - TMI_582-AC(1)-256 – Crown land
  - TMI_583-AC(1)-257 – Crown land, trapping
  - TMI_584-AC(1)-258 – Crown land, hunting, trapping
- Wabigoon Lake Ojibway Nation:
  - TMI_360-AC(1)-34 – Land use

Forestry

- Government Agency - CEA Agency:
  - TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping

- Wabigoon Lake Ojibway Nation:
    - TMI_360-AC(1)-34 – Land use, fishing, hunting, trapping, other recreational uses

Mineral Exploration

- Thunder Lake residents:
    - TMI_715-PC(1)-30 – Surface mining rights

Fishing - Recreational and Commercial

- Government Agency - CEA Agency:
    - TMI_194-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
    - TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping
- Métis Nation of Ontario:
    - TMI_505-AC(1)-179 – Fishing, fish sanctuary
- Eagle Lake First Nation:
    - TMI_349-AC(1)-23 – Fish
    - TMI_362-AC(1)-36 – Fishing, other recreational uses
- Naotkamegwanning First Nation:
    - TMI_349-AC(1)-23 – Commercial fishing
- Wabigoon Lake Ojibway Nation:
    - TMI_360-AC(1)-34 – Baitfishing
    - TMI_348-AC(1)-22 – Fishing, hunting, trapping, other recreational uses, and outfitters

Hunting

- Government Agency - CEA Agency:

- TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping , Bear Management Area
- TMI_194-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters

- Métis Nation of Ontario
  - TMI_584-AC(1)-258 – Crown land, hunting, trapping

Trapping

- Government Agency - CEA Agency:
  - TMI_194-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters

- Métis Nation of Ontario
  - TMI_581-AC(1)-255 – Hunting, trapping
  - TMI_583-AC(1)-257 - Crown land, trapping
  - TMI_584-AC(1)-258 – Crown land, hunting, trapping

Cottagers and Outfitters

- Government Agency - CEA Agency:
  - TMI_194-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
  - TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping , Bear Management Area

- Thunder Lake residents:
  - TMI_715-PC(1)-30 – Cottage

Other Recreational Uses

- Government Agency - CEA Agency:
  - TMI_194-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters

- City of Dryden residents:
  - TMI_731-PC(1)-46 – Mushroom
  - TMI_732-PC(1)-47 – Wild rice
- Member of the public:
  - TMI_745-PC(1)-60 – Berry
- Eagle Lake First Nation:
  - TMI_362-AC(1)-36 – Fishing, other recreational uses
- Wabigoon Lake Ojibway Nation:
  - TMI_360-AC(1)-34 – Harvest

6.1.3.16 Social

The following social VCs were identified and assessed in the original EIS:

- Population demographics;
- Education;
- Regional infrastructure and services;
- Housing; and
- Crime.

Following a review of the Round 1 information requests, the following revisions were made to the VCs:

- Crime has been incorporated into a large VC titled Public Safety. This new VC includes Crime as an indicator; and
- Transportation has been incorporated into a new VC titled Transportation and Traffic. Within the EIS, Transportation was previously assessed as a land use VC and has been relocated to the social component for assessment purposes as it is more closely tied to social factors than land use.

Table 6.1.3.16-1 contains a listing of the social factor VCs, their indicators and measures.

Table 6.1.3.16-1: Social VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Population demographics	Population change	Population size
		Age and gender of population
		In- and out-migration
Education	Capacity of education services	Enrollment
	Education attainment	Highest level of education achieved
	Project-specific Training	Training type and number of trainees
Infrastructure and services	Municipal Services	Landfill availability and capacity
	Community services such as recreation, health and social services	To be determined in conjunction with affected communities
Housing and property values	Housing availability	Quantity of available accommodations, including temporary accommodations
		Number of building lots available in Dryden and Village of Wabigoon
	Property values	Real estate prices
		Property conditions
Public safety	Crime rate	Types / categories of crime
	Capacity of emergency services	Traffic accident rate
	Requests for emergency services initiated by the Project	Number and type of requests
Transportation and traffic	Road network capacity and conditions	Traffic volumes
		Traffic accident rate

The rationale for selection of social valued components is presented in Table 6.1.3.16-2.

Table 6.1.3.16-2 Rationale for Social VC Selection

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
Population demographics	**6.3.2.2; 6.4.2.2 Social Factors**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation / Scientific**: NA **Aboriginal:** • Changes in population demographics as a result of Project economic activities could place strain on existing social conditions and community infrastructure, affect housing availability and affordability and	• Unlike remote mining projects, the Project is in an area surrounded by several communities which are within reasonable commuting distance (100 km or less). Consequently, the Project design does not include a camp and it is anticipated that potential changes to population demographics could occur because of economic opportunities (direct and indirect employment, supply of goods and services) associated with the Project. • Speculative in-migration could occur as people look for work with the Project,

Table 6.1.3.16-2 Rationale for Social VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		influence other social value components. **Other Stakeholders:** • Changes in population demographics as a result of Project economic activities could place strain on existing social conditions and community infrastructure, affect housing availability and affordability and influence other social value components.	which could be both positive and negative. Employment opportunities associated with the Project may also positively support retention of existing population and stem the current outmigration trend of young adults within the socio-economic study area. • Project-related changes to the regional demographics may affect other social VCs.
Education	**6.3.2.2; 6.4.2.2 Social Factors**	**Regulator:** NA **Conservation / Scientific**: NA **Aboriginal:** • Changes in population demographics as a result of Project economic activities could affect existing education services. Opportunities for employment could affect education levels. **Other Stakeholders:** • Changes in population demographics as a result of Project economic activities could affect existing education services. Opportunities for employment could affect education levels.	• In-migration of workers to the area with their families may have a potential effect on education enrollments. • The Project's commitment to provide industry training for workers may result in an increased demand for post-secondary education and training. • The prospect of Project-related employment could have a positive effect, acting as motivation to stay in school or have a negative effect, acting as a motivation to discontinue education and pursue employment.
Infrastructure and services	**6.3.2.2; 6.4.2.2 Social Factors**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation / Scientific**: NA **Aboriginal:** • Changes in population demographics could place strain on existing community infrastructure and services. **Other Stakeholders:** • Changes in population demographics could place strain on existing community infrastructure and services.	• Potential changes within the population may affect the demand on existing infrastructure and services such as utilities, municipal infrastructure, communication services and recreation facilities.
Housing	**6.2.2.2; 6.3.2.2; 6.4.2.2 Social Factors**	**Regulator:**	• Short-term demand for housing during site preparation and construction may

Table 6.1.3.16-2 Rationale for Social VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		• EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation / Scientific**: NA **Aboriginal:** • Changes in population demographics could affect housing availability and affordability. **Other Stakeholders:** • Changes in population demographics could affect housing availability and affordability. Project-related activities (e.g., blasting) could affect property values and cause damage to housing.	strain availability of permanent and temporary accommodations. • Potential for increased demands for accommodation because of in-migration during site preparation and construction and operations may affect local real estate values. • No on-site camp is proposed for housing workers during site preparation and construction and operations. Non-resident workers are expected to stay in rental houses and temporary accommodation within the local area during site preparation and construction and may choose to move permanently during mine operations. This has the potential to affect community services and infrastructure, cost of living and real estate. It is anticipated that sufficient housing capacity exists within the socio-economic study area to house in-migrants who choose to live in the area to participate in Project-related employment and business opportunities. • The proximity of the Project may affect property values of some housing.
Public safety	**New – previously captured within Crime VC; 6.2.2.2; 6.3.2.2; 6.4.2.2 Social Factors**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation / Scientific**: NA **Aboriginal:** • Changes in population demographics could increase demand for emergency services. Individual lifestyle choices may be positively or negatively affected by income from Project-related employment. **Other Stakeholders:** • Changes in population demographics could increase demand for emergency services. Individual lifestyle choices may be positively or negatively affected by income from Project-related employment.	• There is a potential for increased demand for public safety services due to increased traffic volumes as a result of the Project. • Potential changes within the population may increase pressure and demand on fire protection services, emergency services and police services. • There are potential effects on crime rate related to the behavior of a non-local labour force and increased income / spending levels as a result of Project-related employment.

Table 6.1.3.16-2 Rationale for Social VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
Transportation and traffic	**6.2.2.1; 6.3.2.1; 6.4.2.1 Land Use**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation / Scientific**: NA **Aboriginal:** • Project-related traffic and changes in population demographics could increase current traffic volumes. **Other Stakeholders:** • Project-related traffic and changes in population demographics could increase current traffic volumes.	• Potential impact on transportation infrastructure due to potential population changes and transportation of goods and services throughout the life of the Project. • Potential increase of traffic on roads in the vicinity of the Project site. • Potential impact on traffic safety and accidents / road collision particularly during the site preparation and construction phase.

There were a range of questions asked as part of the Round 1 information request process related to the social factors component. The following lists those specific questions that relate to the selection of VCs, indicators and measures for social factors:

Population Demographics

- Government Agencies:
  - TMI_227-HE(1)-34: Potential for population increases.

Housing

- Métis Nation of Ontario:
  - TMI_590- AC(1)-264: Property values.
- Eagle Lake First Nation:
  - TMI_611-AC(1)-284: Property damage.
- Other Stakeholders:
  - TMI_708-PC(1)-23: Property values.
  - TMI_715-PC(1)-30: Noise.

- TMI_716-PC(1)-31: Noise and vibration.
- TMI_716-PC(1)-31: Noise and vibration / property damage.
- TMI_722-PC(1)-37: Property values.
- TMI_724-PC(1)-39: Property values.

Public Safety

- Métis Nation of Ontario:
  - TMI_492-AC(1)-166: Inadequate baseline to determine crime effects.
- Other Stakeholders:
  - TMI_735-PC(1)-50: Fire services.

Transportation and Traffic

- Government Agencies:
  - TMI_227-HE(1)-34: Potential for increased traffic.
  - TMI_17-PD(1)-04: Redirection of Tree Nursery Road.
  - TMI_186-AE(1)-24: Noise from vehicle traffic.

6.1.3.17 Economic

The economic valued components (VCs) considered in the original EIS (Section 6.3.2.3) were:

- Employment;
- Income; and
- Economic development.

A review of Round 1 information requests has resulted in expanding the economic valued components used in this report to correspond to the available baseline information considered in the EIS (Appendix T). The economic valued components used in this revised EIS are:

- Labour Force, Labour Participation and Employment;

- Income Levels;
- Cost of Living;
- Real Estate;
- Economic Development;
- Existing Businesses; and
- Government Revenues.

Public comments and input regarding the Project have been received though engagement and consultation activities such as public and special interest group meetings. Comments include those reflecting employment, business and training. The region has experienced significant local regional declines in employment and population. Employment has largely decreased due to downsizing and permanent closure of paper machines and sawmilling capacity in the forestry industry. Appendix CC of the EIS provides further details on regional declines of employment and localized employment shifts.

The construction and operations of the Project will have a positive effect on the local economy. Employment opportunities arising from the Project may also allow skilled trade workers who left the City of Dryden after downsizing of the Weyerhaeuser/Domtar pulp and paper facilities to find employment at the Project. Job opportunities created at the Project will provide an opportunity for youth to stay in the region, and attract new working age migrants. The overall economic effects of the Project will be felt most within commuting distance from the site (estimated 100 km).

The economic valued components, indicators, and measures are presented in Table 6.1.3.17-1.

Table 6.1.3.17-1: Economic VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Labour force, labour participation and employment	Labour income employment	• Direct impacts on employment, labour compensation and Gross Domestic Product (GDP). • Indirect impacts on employment, labour compensation and GDP. • Induced impacts on employment, labour compensation and GDP • Employment by skill category.
Income levels	Income levels and categories	• Project contribution to additional labour income through employment creation.
Cost of living	Current prevailing cost of living	• Changes in cost of living and inflation.
Real estate	Housing prices and affordability	• Changes in housing prices and affordability.
Economic development	Municipal taxes and contribution to economic development projects	• Changes in municipal taxes and contribution to economic development projects.

Valued Components (VCs)	Indicators	Measures
Existing businesses	Local business availability	• Local economic effects. • Potential for growth.
Government revenues	Taxes and revenues	• Changes in government revenues.

The rationale for selection of economic valued components is presented in Table 6.1.3.17-2.

Table 6.1.3.17-2: Rationale for Economic VC Selection

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
Labour force, labour participation and employment	**5.11.3; 6.4.2**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation/Scientific:** • Assessment of economic conditions provides useful information to government decision makers on the size of the proposed Project's economic contribution to the provincial economy, and the proposed Project's potential economic benefits and costs. It also increase government revenues and thus contribute to economic development in the region. **Aboriginal:** • For Aboriginal people and businesses, participation by Aboriginal people in the Project will improve their participation in wage economy and improve their labour income. **Other Stakeholders:** • The Project could provide employment and business opportunities for local and regional residents/businesses.	• The Project will provide short term and long term demand for local staff providing employment opportunity for local residents. It could also encourage people to migrate to the area for employment. In-migration of workers could have positive or negative effects on the population of the region. Positive if it is within the design capacity of community services and infrastructure and negative if it is not since it could create competition and raises inflation. • Project employment will affect the population of the socio-economic study area either temporarily during the construction phase or permanently during operations. • Closure and Post Closure of the Project will create short term employment but will reduce the local Project-related employment, the demand for local goods and services, and government tax revenues. This could slow the economic development in the region. • Economic effects of major projects are of interest to all levels of government, Aboriginal peoples and the general public. • The construction and operations expenditures of the Project will create direct, indirect and induced economic effects on GDP, labour income and employment. The economic effects could bring economic benefits to the region.
Income levels	**5.11.3; 6.4.2**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions.	• The Project will provide employment and business opportunities for local and regional residents/businesses and improve labour income.

Table 6.1.3.17-2: Rationale for Economic VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		Conservation/Scientific: • The Project demand for labour, goods and services could lead to competition with other industries in the area and increase wage rates and cost of living. **Aboriginal:** • The Project will improve labour income in the region through employment and contacting opportunities. **Other Stakeholders:** **N**The Project will improve labour income in the region through employment and contacting opportunities.	• Additional labour income could have positive or negative effects. Positive if used to improve style of living and overall investment in local economy and negative if it is used as a disposable income and increases substance abuse.
Cost of living	**5.11.3; 6.4.2**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Conservation/Scientific:** • The Project demand for labour, goods and services could lead to competition with other industries in the area and increase wage rates and cost of living. **Aboriginal:** • Demand for labour could encourage in-migration of new residents. Arrival of new residents could create higher demand for housing which in turn, could create inflation and affect cost of living in local communities. **Other Stakeholders:** • Demand for labour could encourage influx of new residents. Arrival of new residents could create higher demand for housing which in turn, could create inflation and affect cost of living in local communities.	• Economic effects will be experienced through increased employment, income, and the associated demand for local goods and services. Additional demands for local goods and services could have positive and negative effects on local businesses. Positive effects when additional demand creates additional supply and contribute to the growth of local businesses and negative effects when local businesses are unable to increase supply which results in higher cost of goods and services.
Real estate	**5.11.3; 6.4.2**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions.	• Temporary or permanent demand for housing, created by the arrival of workers from outside the region, could

Table 6.1.3.17-2: Rationale for Economic VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		Aboriginal • In-migration of workers from outside the region could affect the real estate market within the socio-economic study area. **Other Stakeholders:** • In-migration of workers from outside the region could affect the real estate market within the socio-economic study area.	affect the real estate market either positively or negatively. • Positively, when the market is able to expand and cover the additional demand and negatively if the market is unable to increase the supply which would result in competition for housing and higher inflation rate.
Economic development	**5.11.3; 6.4.2**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Aboriginal:** • Assessment of economic conditions provides useful information to government decision makers on the size of the proposed Project's economic contribution to the provincial economy, and the proposed Project's potential economic benefits and costs. It also increases government revenues and thus contributes to economic development in the region. **Other Stakeholders:** • Assessment of economic conditions provides useful information to government decision makers on the size of the proposed Project's economic contribution to the provincial economy, and the proposed Project's potential economic benefits and costs. It also increases government revenues and thus contributes to economic development in the region.	• The Project will generate government revenues at three levels, Federal, Provincial and local government, through both income and corporate tax generated during the construction and operations phases of the Project. • Government revenues could be used to develop community infrastructure in the socio-economic study area and contribute to the economic development of the region.
Existing businesses	**5.11.3; 6.4.2**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Aboriginal:** • The Project will create additional demands for local goods and services during the construction	• Economic effects will be experienced through increased employment, income, and associated demand for local goods and services. Additional demands for local goods and services could have positive and negative effects on local businesses.

Table 6.1.3.17-2: Rationale for Economic VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		and operations phase. This has the potential to improve existing local businesses and contribute to their growth. **Other Stakeholders:** • The Project will create additional demands for local goods and services during the construction and operations phase. This has the potential to improve existing local businesses and contribute to their growth.	• Positive effects when local business are able to expand and improve to meet the new and additional demands and negative if local businesses are unable to compete in the new market.
Government revenues	**5.11.3**	**Regulator:** • NEIS Guideline 9.1.3 – Human Environment – socio-economic conditions. **Aboriginal:** • Assessment of economic conditions provides useful information to government decision makers on the size of the proposed Project's economic contribution to the provincial economy, and the proposed Project's potential economic benefits and costs. It also increases government revenues and thus contributes to economic development in the region. **Other Stakeholders:** • Assessment of economic conditions provides useful information to government decision makers on the size of the proposed Project's economic contribution to the provincial economy, and the proposed Project's potential economic benefits and costs. It also increases government revenues and thus contributes to economic development in the region.	• Economic effects of major projects are of interest to all levels of government, Aboriginal peoples and the general public. • The Project will generate government revenues at three levels Federal, Provincial and local government through both income and corporate tax generated during the construction and operations phases of the Project. • Generated revenues could be used to develop community infrastructure in the socio-economic study area and contribute to the economic development of the region.

The Round 1 information requests related to **economic effects** are:

- CEA Agency

- TMI_3-EA(1)-03: General VC and Assessment Criteria
- TMI_227-PC(1) 42: Socio-economic Effects
- TMI_230-HE(1)-37: General TML

- Métis Nation of Ontario
  - TMI_507-AC(1)-181: Socio-economic VC
- City of Dryden, Thunder Lake, and Village of Wabigoon residents
  - TMI_228-PC(1)-43: Socio-economic Effects
- Wabigoon Lake Ojibway Nation
  - TMI_348-AC(1)-22: Socio-economic Effects
  - TMI_728-PC(1)-43: Socio-economic Effects

6.1.3.18 Human Health

Although the original EIS included a fulsome evaluation of the risks to human health from the Project (presented in Appendix W to the EIS), no specific Valued Components (VC) were identified for human health in the EIS. The need to add a VC that deals with human health was identified by regulators and Aboriginal peoples as part of the Round 1 information request process. To address this, a single VC, human health was added. The Round 1 information requests also identified the need to distinguish between the potential health effects for Aboriginal peoples and non-Aboriginals. This was addressed using indicators of Aboriginal health and non-Aboriginal health. Table 6.1.3.18-1 lists the VC, indicators and measures to be used in evaluating the effects of the Project on human health.

Table 6.1.3.18-1: Human Health VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Human health	Aboriginal health	Carcinogenic effects
		Non-carcinogenic effects
	Non-Aboriginal health	Carcinogenic effects
		Non-carcinogenic effects

The following questions, raised as part of the Round 1 IRs, specifically asked about the need to describe the potential effects of the Project on human health:

- TMI_194-HE(1)-01: Aboriginal human health;
- TMI_257-CE(1)-07: cumulative human health;
- TMI_338-AC(1)-12: human health effects of air quality;
- TMI_373-AC(1)-47: impacts to human health;
- TMI_611-AC(1)-284: human health concerns;
- TMI_617-AC(1)-290: risk of health issues;
- TMI_620-AC(1)-293: human health and dissolved mercury;
- TMI_643-AC(1)-316: impact on health;
- TMI_709-PC(1)-24: potential health effects;
- TMI_710-PC(1)-25: health and air quality; and
- TMI_719-PC(1)-34: health and water quality health.

6.1.3.19 Heritage Resources

The heritage resources component of the assessment refers specifically to those components of the environment regulated under the *Ontario Heritage Act*. The two Valued Components (VC) identified for heritage resources in the original EIS were as follows:

- Archaeological sites; and
- Historic heritage sites.

As part of the Round 1 information requests, there were several questions raised regarding cultural activities by Aboriginal peoples and the absence of this as part of the heritage resources component. In preparing this revised EIS, consideration was given to addressing these questions, which has been done as part of the Aboriginal peoples component and VCs discussed in Section 6.1.3.20. For addressing the heritage resource components relevant to the *Ontario heritage Act*, the valued Components, indicators and measures identified in Table 6.1.3.19-1 are used.

Table 6.1.3.19-1: Heritage Resources VCs, Indicators and Measures

Valued Components (VCs)	Indicators	Measures
Archaeological sites	Presence of a site	Distance from the Project
	Disturbance of a site	Level of disturbance
Historic heritage sites	Presence of a site	Distance from the Project
	Disturbance of a site	Level of disturbance

6.1.3.20 Aboriginal Peoples

As described in Section 6.1.2 of the original EIS, efforts by Treasury Metals to have traditional knowledge or traditional land use studies completed for the Project have been unsuccessful. Consequently, detailed knowledge of traditional land use in the Project and surrounding areas has not been available in deriving valued components for effects on Aboriginal people. Aboriginal concerns were made available to Treasury Metals via letters to Treasury Metals, letters to government agencies, and in direct meetings with the company and government agencies. The issues and concerns raised were incorporated into the development of Project valued components. Aboriginal concerns relating to the development of the Project were discussed in detail in the EIS Aboriginal Consultation Report (included as Appendix DD to the original EIS) and have been restated in the Aboriginal Engagement Report, included as Appendix DD to the revised EIS.

The following valued components regarding effects on Aboriginal people were identified and assessed in the EIS:

- Health effects;
- Gathering of country foods and plant material; and
- Hunting, trapping, fishing.

Review of the Round 1 information requests identified a number of questions that stated that the Project could potentially impact Aboriginal and treaty rights. While Aboriginal and treaty rights is challenging to consider as a valued component; what can be assessed are those aspects of Aboriginal and treaty rights that consider the use of lands and resources for traditional purposes. This includes gathering, harvesting and cultural activities. The Round 1 information requests also indicated interests in the socio-economic effects on Aboriginal people. The Aboriginal people valued components have been revised to include the following:

- Health Effects – no change from the EIS;
- Gathering of Plant Materials – changed from gathering of country foods and plant materials;

- Hunting, Trapping, Fishing – no change from EIS;
- Cultural Activities – new valued component; and
- Socio-economic Effects – new valued component.

Table 6.1.3.20-1 provides a listing of the valued components, indicators and measures used for the assessment of the effects of the Project on Aboriginal peoples.

Table 6.1.3.20-1: Aboriginal People VCs, Indicators, and Measures

Valued Components (VCs)	Indicators	Measures
Health effects	Changes in water quality downstream of the Project site	Water quality guidelines
	Changes in quality of harvested plants, animals, or fish	Food quality guidelines
	Changes in health due to noise and vibration	Noise and vibration levels
Gathering of plant material	Removal of locations of traditionally harvested vegetation	Area of traditional resource removed
	Restricted access to areas of previous traditional plant harvesting	Area of harvesting area restricted from access
	Change in plant quality	Contaminant levels in plants
	Diminished on-the-land experience	Frequency and duration of on-the-land activities
Hunting, trapping, fishing	Changes in populations of harvested animals or fish	Harvesting statistics
	Change in access to areas previously used for traditional hunting, trapping, or fishing activities	Area of harvesting area restricted from access
	Change in amount of habitat	Area of habitat removed
	Change in quality of fish	Contaminant levels in fish
	Diminished on-the-land experience	Frequency and duration of on-the-land activities
Cultural activities	Removal of cultural sites or restricted access to cultural sites	Cultural sites affected by project activities
	Reduction in traditional activities	Changes in traditional activities
Socio-economic effects	Economic effects	Project-related employment of Aboriginal people
		Project purchases from Aboriginal businesses
		Increased training opportunities
	Social effects	Impacts on social valued components applicable to Aboriginal people or communities

The rationale for selection of Aboriginal people valued components is presented in Table 6.1.3.20-2. The process considered the results of the engagement process conducted with

Aboriginal peoples (as detailed in the Aboriginal Engagement Report, Appendix DD to the revised EIS), as well as the responses to the various questions raised as part of the Round 1 information request process.

Table 6.1.3.20-2: Rationale for Aboriginal People VC Selection

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
Health effects	**6.3.2.5; 6.4.2.5 Aboriginal People**	**Regulator:** • EIS Guideline 10.1.3 – Effects of changes to the environment on Aboriginal peoples **Conservation / Scientific**: NA **Aboriginal:** • Aboriginal communities have expressed concerns about impacts on water quality that could impact drinking water quality and fish and fish habitat. Aboriginal people also expressed concern regarding air quality and exposure by people, wildlife, and birds to tailings. **Other Stakeholder:** NA	• The traditional land uses of Aboriginal people in the study area includes harvesting of fish, wildlife, birds, and plants. If any of those traditional resources are contaminated, there could be adverse impacts on Aboriginal health.
Gathering of plant materials (previously gathering of country foods and plant materials)	**6.32.5; 6.4.2.5 Aboriginal People**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. The current use of land and resources for traditional purposes by Aboriginal persons is to be considered. • EIS Guideline 10.2 – Adverse Impacts on Aboriginal and Treaty Rights and Related Interests • EIS Guideline 11.2 – Measures to address impacts on Aboriginal rights **Conservation / Scientific**: NA **Aboriginal:** • Aboriginal traditional land use includes the gathering of plants and berries, including blueberries, chanterelles, and wild rice. **Other Stakeholder:** NA	• Removal of traditionally used plant resources or restricting access to existing resources would reduce the areas available to Aboriginal people to exercise their traditional gathering activities, including the gathering of plant materials for food, medicinal, spiritual, and other uses. • Real or perceived contamination of plant materials may reduce gathering activities.
Hunting, trapping, fishing	**6.32.5; 6.4.2.5 Aboriginal People**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. The current use of land and resources for traditional purposes by aboriginal persons is to be considered.	• Impacts on resources that are hunted, trapped or fished or reduced access to areas of previous hunting, trapping, or fishing could adversely the ability of Aboriginal people to participate in traditional activities.

Table 6.1.3.20-2: Rationale for Aboriginal People VC Selection (continued)

Valued Component	EIS Section	Conservation / Scientific Importance	Rationale for Inclusion
		• EIS Guideline 10.2 – Adverse Impacts on Aboriginal and Treaty Rights and Related Interests • EIS Guideline 11.2 – Measures to address impacts on Aboriginal rights **Conservation / Scientific**: NA **Aboriginal:** • Aboriginal traditional land use activities include hunting, trapping, and fishing. **Other Stakeholder:** NA	• Real or perceived contamination of animals, birds or fish may reduce harvesting activities.
Cultural activities	**New valued component**	**Regulator:** • EIS Guideline 9.1.3 – Human Environment. The current use of land and resources for traditional purposes by Aboriginal persons is to be considered. • EIS Guideline 10.2 – Adverse Impacts on Aboriginal and Treaty Rights and Related Interests • EIS Guideline 11.2 – Measures to address impacts on Aboriginal rights **Conservation / Scientific**: NA **Aboriginal:** • Aboriginal cultural activities and cultural teachings can occur in specific locations or while practicing traditional activities. Changes to the ability to practice traditional activities to access to culturally important sights could adversely impact the ability to participate in cultural activities. **Other Stakeholder:** NA	• A restriction in the ability to access culturally important sites would reduce the ability to practice traditional cultural, spiritual or ceremonial activities. • A reduction in the ability to conduct traditional practices could reduce the ability to share cultural practices within an Aboriginal group which could adversely affect the culture.
Socio-economic effects	**New valued component**	**Regulator:** • EIS Guideline 10.1.3 – Effects of changes to the environment on Aboriginal peoples **Conservation / Scientific**: NA **Aboriginal:** • Aboriginal communities have expressed concerns that there may be Project-related social and economic effects. **Other Stakeholder:** NA	• The Project spending on labour and goods and services could have positive economic effects on Aboriginal people and businesses. • Impacts on social valued components could be experienced by Aboriginal people.

There were a range of questions asked as part of the Round 1 information request process related to the potential effects on Aboriginal peoples. The following lists those specific questions that relate to the selection of VCs, indicators and measures for Aboriginal peoples:

Health Effects

- Government Agencies
    - TMI_194-HE(1)-01 Aboriginal health

Gathering Plant Materials, and Hunting, Trapping and Fishing

- Métis Nation of Ontario
    - TMI_426-AC(1)-101 Traditional land use study
    - TMI_500-AC(1)-174 Traditional harvesting

Cultural Activities

- Government agencies
    - TMI_240-HE(1)-47 Cultural resources
- Wabigoon Lake Ojibway Nation
    - TMI_354-AC(1)-28 Cultural resources

S**ocio-economic Effects**

- Government Agencies
    - TMI_226-HE(1)-33 Aboriginal socio-economic study area
    - TMI_228-HE(1)-35 Aboriginal socio-economic effects
- Métis Nation of Ontario
    - TMI_446-AC(1)-120 Aboriginal socio-economic effects

6.1.3.21 Summary of Valued Components (VCs)

As detailed in the preceding sections, the VCs used for assessing the effects of the Project on the environment have been refined to reflect the feedback received as part of the Round 1 information request process. Table 6.1.3.21-1 provides a comparison of the VC identified in the EIS and those used in this revised EIS. Where additional BC have been added, they are show in bold-face type in the table. The primary changes related to the VC include the following:

- **Geology and Geochemistry**: Addition of “pit lake quality” as a VC.
- **Noise**: Addition of two VCs, namely “blasting noise and vibration” and “noise related health effects”.
- **Light**: Move the “wildlife attraction” VC from light. This is now considered as part of the effects on wildlife and wildlife habitat.
- **Climate**: Addition of “changes in climate due to the Project” as a VC.
- **Surface Water Quantity**: Discard the previous VCs (“alteration of flow rates in Blackwater Creek” and “alteration of flow rates in Hoffstrom’s Bay tributary”) to be replaced by a single, more inclusive VC “surface water quantity”.
- **Groundwater Quantity**: The previous VCs (“groundwater contributions to surface water patterns” and “groundwater elevations in private water wells”) are now used as indicators for a single VC, namely “groundwater quantity”.
- **Wildlife and Wildlife Habitat**: Three additional VCs have been added, namely “small mammals”, “reptiles and amphibians”, and “invertebrates”.
- **Migratory Birds**: Addition of “upland birds” and “wetland birds” as VCs.
- **Fish and Fish Habitat**: The VCs used in the EIS have been replaced with four new VCs, namely; stream-resident fish population, migratory fish populations, lake-resident fish populations, and Fish species-at-risk.
- **Wetlands and Vegetation**: The VCs used in the EIS have been replaced with two new VCs, namely; wetland extent, and vegetation communities and species.
- **Land Use**: The previous VCs (“land and resource use” and “transportation”) have been replaced by the following:
    - Land Use Planning and Policies

- Aggregate Operations
- Forestry
- Mineral Exploration
- Fishing — Recreational and Commercial
- Hunting
- Trapping
- Cottagers and Outfitters
- Other Recreational Uses

- **Social**: “Transportation and traffic” has been added as a new VC, while the VCs “housing” and “crime” have been re-defined as “housing and property values” and “public safety”, respectively. A new VC

- **Economic**: The VCs “employment” and “income” have been re-defined as “labour force, labour participation and employment” and “income levels”, respectively. The “economic development” VC was retained, and the following VCs were added:
  - Cost of living
  - Real estate
  - Existing businesses
  - Government revenues

- **Human Health**: Two new VCs were added, namely “aboriginal health” and “non-Aboriginal health”.

- **Aboriginal Peoples**: The VCs “Aboriginal health effects”, “gathering of country foods”, and “hunting, trapping and fishing conditions” were re-defined as “health effects”, “gathering of plant material”, and “hunting, trapping, fishing”. “Cultural Activities” and “socio-economic effects” were added as VCs.

Table 6.1.3.21-1: Summary of Valued Components

Discipline/Component	Valued Components (VCs) used in Original EIS	Valued Components (VCs) in Revised EIS
Terrain and soils	Natural landscapes	Natural landscapes
	Overburden	Overburden
	Soil chemistry	Soil chemistry
Geology and Geochemistry	No VCs identified for geology and geochemistry	**Pit lake water quality**
Noise	Ambient noise levels	Ambient noise levels
	Noise disturbance to wildlife (including SAR)	Noise disturbance to wildlife (including SAR)
	Blasting noise and vibration	**Blasting noise and vibration**
	Noise related health effects	**Noise related health effects**
Light	Light trespass	Light trespass
	Wildlife attraction	—
Air quality	Air quality	Air quality
Climate	GHG emissions	GHG emissions
	—	**Changes in climate due to the Project**
Surface water quality	Surface water quality	Surface water quality
Surface water quantity	Alteration of flow rates in Blackwater Creek	Surface water quantity
	Alteration of flow rates in Hoffstrom's Bay tributary	—
Groundwater quality	Groundwater quality	Groundwater quality
Groundwater quantity	Groundwater contributions to surface water patterns	Groundwater quantity
	Groundwater elevations in private water wells	—
Wildlife and wildlife habitat	Wildlife Species at Risk	Wildlife Species at Risk
	Ungulates	Ungulates
	Furbearers	Furbearers
	Upland birds	Upland birds
	Wetland birds	Wetland birds
	—	**Small mammals**
	—	**Reptiles and amphibians**
	—	**Invertebrates**
Migratory Birds	—	**Upland birds**
	—	**Wetland birds**
Fish and fish habitat	Fish	**Stream-resident fish population**
	Fish habitat	**Migratory fish populations**
	—	**Lake-resident fish populations**
	—	**Fish species at risk**
Wetlands and vegetation	Wetlands	**Wetland extent**
	Vegetation Species at Risk (SAR)	**Vegetation communities and species**
Land use	Land and resource use	**Land Use Planning and Policies**

Discipline/Component	Valued Components (VCs) used in Original EIS	Valued Components (VCs) in Revised EIS
	Transportation	**Aggregate Operations**
	—	**Forestry**
	—	**Mineral Exploration**
	—	**Fishing — Recreational and Commercial**
	—	**Hunting**
	—	**Trapping**
	—	**Cottagers and Outfitters**
	—	**Other Recreational Uses**
Social	Population demographics	Population demographics
	Education	Education
	Regional infrastructure and services	Infrastructure and services
	Housing	**Housing and property values**
	Crime	**Public safety**
	—	**Transportation and traffic**
Economic	Employment	**Labour force, labour participation and employment**
	Income	**Income levels**
	Economic development	**Cost of living**
	—	**Real estate**
	—	Economic development
	—	**Existing businesses**
	—	**Government revenues**
Human health	—	**Aboriginal health**
	—	**Non-Aboriginal health**
Heritage resources	Archaeological sites	Archaeological sites
	Historic heritage sites	Historic heritage sites
Aboriginal Peoples	Aboriginal health effects	Health effects
	Gathering of country foods	Gathering of plant material
	Hunting, trapping and fishing conditions	Hunting, trapping, fishing
	—	**Cultural activities**
	—	**Socio-economic effects**

6.1.4 Selection of Study Areas

6.1.4.1 General Study Areas Used in EIS

In 2010, Treasury Metals retained Klohn Crippen Berger to undertake environmental baseline studies to support the environmental assessment process for the Project, the findings of which were summarized into a report included as Appendix G to the original EIS (Klohn Crippen Berger, 2012). As part of the baseline studies, both a general local study area (LSA) and general regional study area (RSA) were established. The study areas were selected to encompass the local and

regional environmental features in proximity to the Project, based on Project information available at that time. For continuity with the baseline work, the original LSA and RSA definitions were retained for use in the original EIS, except for those disciplines where discipline, or VC specific study areas were selected.

The general LSA was defined by a 5 km radius area, centered on the proposed mine portal location. The LSA was established to study the ecological relationships in the local area in which the Project was proposed, and was large enough to encompass the physical Project footprint. It was noted that there are a number notable ecological and social features contained within the LSA, including one recreational Provincial Park (Aaron Provincial Park), one Nature Reserve (Lola Lake Peatland), a lake trout fishery (Thunder Lake), a locally important walleye and sport fishery (Lake Wabigoon), and the Village of Wabigoon.

The general RSA defined in the EIS incorporated the watersheds in which the Project was located in the north, east and south and by the boundary of the LSA in the west. The RSA was selected to cover the regional ecological context in which the Project exists. Using the watershed boundary to delineate this RSA was done to allow for a holistic approach to studying ecological relationships in proximity to the proposed Project.

The location of the general LSA and RSA is shown in Figure 6.1.4.1-1.

As part of the Round 1 information request process, there were several questions that made mention of the general study areas, however, those questions were primarily related to the specific use of the general study areas for specific components of the EIS. Those information requests are discussed as part of the discussions for the component specific study areas. The following question was raised about study areas in general as part of the Round 1 information requests:

- TMI_470-AC(1)-144: study areas and property boundary

Specifically, the above information request asks why the local study areas (LSAs) used in the EIS did not incorporate the entire property boundary. The reason, described in the individual response to this questions, was that the component specific LSA and RSA were established to capture the areas potentially affected by the Project. Generally, the LSA for each component was established so as to capture the direct effects of the Project, while the RSA for each component were established to include other effects that may be wider reaching.

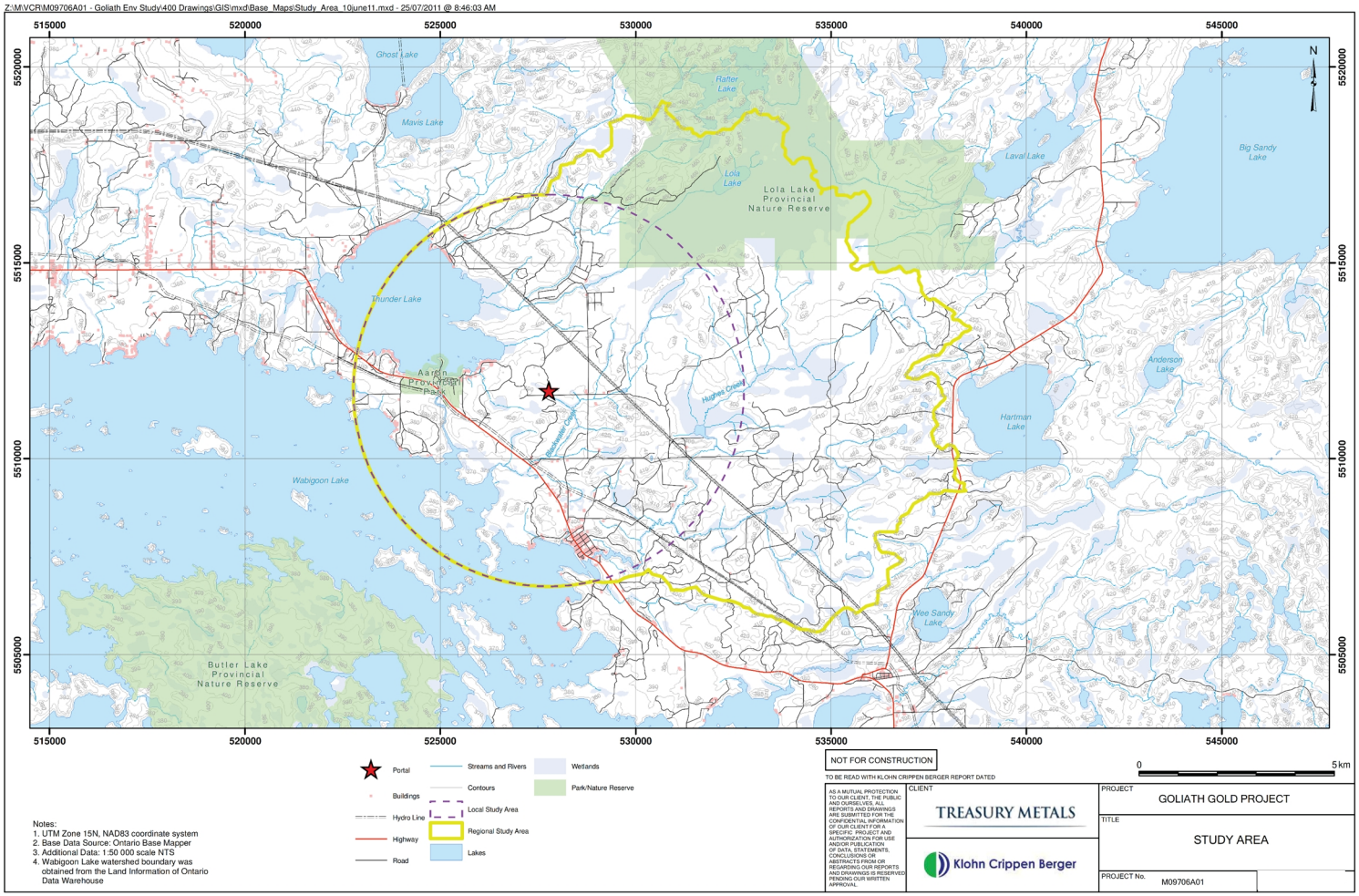


Figure 6.1.4.1-1: General LSA and RSA

(Source: Klohn Crippen Berger, 2012: Figure 1.1)

In contract, the property boundary referenced in the EIS corresponds to the limits of claims and dispositions associated with the Goliath Gold Project. However, these claims and dispositions do not correspond to the Project footprint, or the areas potentially affected by the Project. The Project footprint is located towards the western end of the claims and dispositions area (property line). If the local study areas had been increased in size to enclose the extent of the claims and dispositions, no additional Project effects would have been captured. However, expanding the size of the local study areas could have diminished the relative importance of the predicted effects of the Project, as they would have represented a much smaller percentage of the expanded study areas.

6.1.4.2 Terrain and Soils

As described in Section 5.5 of the revised EIS, terrain and soils made use of the general LSA and RSA described in Section 6.1.4.1. The general LSA and RSA includes all of the areas that will be physically impacted by the Project and are thus sufficiently large to capture all of the potential effects of the Project on terrain and soils. There were no specific questions regarding the study areas for terrain and soils raised as part of the Round 1 information requests.

6.1.4.3 Geology and Geochemistry

As described in Section 6.1.3.2, a single VC (pit lake water quality) was defined for evaluating the effects of the Project on geochemistry. Secondary effects of geochemistry, such as the effects of seepage from on-site facilities on surface water quality and groundwater quality, are addresses as a component of those disciplines. There were no assessment endpioints identified for geology.

The existing regional geologic setting was described over an area spanning from Thunder Bay in the east, to Kenora in the west, and from the US-Canadian border in the south to Lac Seul in the north (Figure 5.4.2-1 of the revised EIS). The local bedrock geology was described over a smaller area, enclosing the entire property line for the Project, and extending from the west end of Thunder Lake in the West, to the east of Wee Sandy Lake in the East (Figure 5.4.2.3-1 of the revised EIS). Geology was also described in the vertical extend, spanning from the surface to approximately 450 metres below the Project site (Figure 5.4.2.3-2 of the revised EIS).

The geochemistry of the rocks associated with the Project was not described on any spatial scale, rather it was described using the specific materials to be mined as part of the Project. The understanding of how these rocks will undergo chemical changes once exposed to the elements is important for understanding the effects of the Project on components of the receiving environment (such as surface water quality). The spatial extent of the assessment of the effects of the Project on geochemistry are limited to the physical footprint of the Project. While the effects of geochemical reactions on the receiving environment over time may extend beyond the Project site, these effects will be captured as part of other components (e.g., surface water quality).

There was a single question related to the geochemical study areas (TMI_44-MW(1)-06), which was looking for specific information regarding justification for the geochemical study areas based on the surface water bodies potentially affected by long-term seepage from the Project. As noted in discussion on geology and geochemistry VCs (Section 6.1.3.2), seepage from the on-site features (e.g., TSF and WRSA) were not identified as VCs, in themselves. However, the potential effects of seepage from these on-site were incorporated into the considerations for the study areas for surface water quality (Section 6.1.4.8) and groundwater quality (6.1.4.10).

6.1.4.4 Noise

For the purposes of the noise assessment, an area that corresponds with the noise modelling domain was selected as the LSA. This area encloses a rectangle approximately 5 by 3 km in size, and sufficiently large to capture all of measurable noise effects associated with the Project. The LSA for noise is illustrated on Figure 6.1.4.4-1.

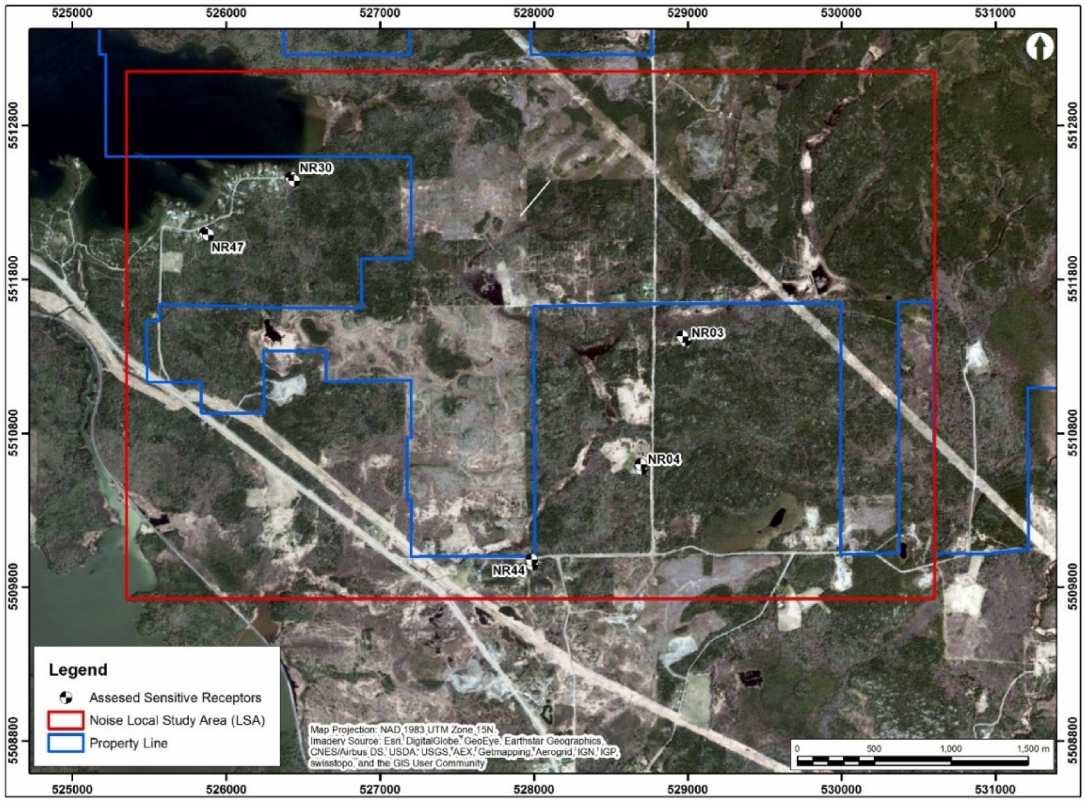


Figure 6.1.4.4-1: Noise LSA

However, noise is managed in Ontario at points of reception (PORs), located on noise-sensitive land uses. Noise-sensitive land uses are defined in the MOECC's environmental noise guideline, publication NPC-300 (MOE, 2013), as:

- A property of a person that accommodates a dwelling and includes a legal nonconforming residential use; or
- A property of a person that accommodates a building used for a noise sensitive commercial purpose; or
- A property of a person that accommodates a building used for a noise sensitive institutional purpose.

A noise-sensitive land use may have one or more receptors. The PORs used in an acoustic assessment are those locations where sound from the facility is received and assessed against the applicable limits. Sound levels may be assessed at the façade of the building and/or outdoor areas, depending on the type of sensitive land use assessed. Outdoor PORs are only assessed for dwellings and are not assessed for commercial and institutional noise-sensitive land uses.

Residential receptors include houses, cottages, and the like, whether continuously occupied or seasonal. For existing residential properties, sound levels are assessed at the façade of the building at a height of 4.5 m above local grade and an outdoor POR at a height of 1.5 m. The point of assessment for the outdoor receptors is a point 30 m from the building façade, or the property line in cases where the 30 m setback would exceed the size of the property.

Commercial and institutional receptors include hotels, churches, daycares, schools, clinics, and the like. The point of assessment for these types of receptors is at the façade of the building only; Outdoor receptors are not assessed for commercial and institutional noise-sensitive land uses.

Properties that are zoned to permit a noise-sensitive land use, but are currently vacant need to be assessed as if a noise-sensitive land use exists at that location. For these noise sensitive areas, the receptors are typically considered in a location consistent with typical local building patterns, at a height of 4.5 m above local grade. In the case of unincorporated land without a minister's zoning order, the land is generally understood to allow noise-sensitive uses, and would be assessed in the same way as land that is zoned for a noise sensitive use. All land within the vicinity of the Project is either crown land, or unincorporated land. No zoning information is available for these areas.

There is currently a house located to the West of the low grade ore (LGO) stockpile, which is owned by Treasury Metals, and will not be occupied during the life of the Project. A house located on the northwest corner of Normans Road and Nursery Road is also owned by Treasury Metals and will not be occupied during the life of the Project. The house located approximately 400 m

east of the intersection of Normans Road and Nursery Road, on the North side of Normans Road is currently occupied, and will be vacated prior to the commencement of the Project.

Vacant land on the south side of Normans Road, immediately to the south of the low grade stockpile is apparently accessible by road as judged from aerial photographs. This section of Normans Road, west of Nursery Road, is controlled by Treasury Metals, and will result in this land being inaccessible for the life of the Project.

Forty-four individual noise-sensitive receptors were identified within the LSA. Where the surface mining rights have been secured by Treasury Metals, land use was assumed not to be noise-sensitive, and no receptors were identified. All other vacant lands in the vicinity of the Project that were found to be inaccessible (except by a rough cut-in through the forest) were not considered as receptors. Forty-two of the receptors were identified as houses. One was identified as the campground at Aaron Provincial Park. One receptor is a trailer located on otherwise vacant land. There are no receptors identified roughly within 2 km to the north or 8 km to the east. Access is limited, and Treasury Metals has exploration claims to the majority of the land in those directions. The location of the 44 sensitive noise receptors considered in the noise assessment are shown on Figure 6.1.4.4-2.

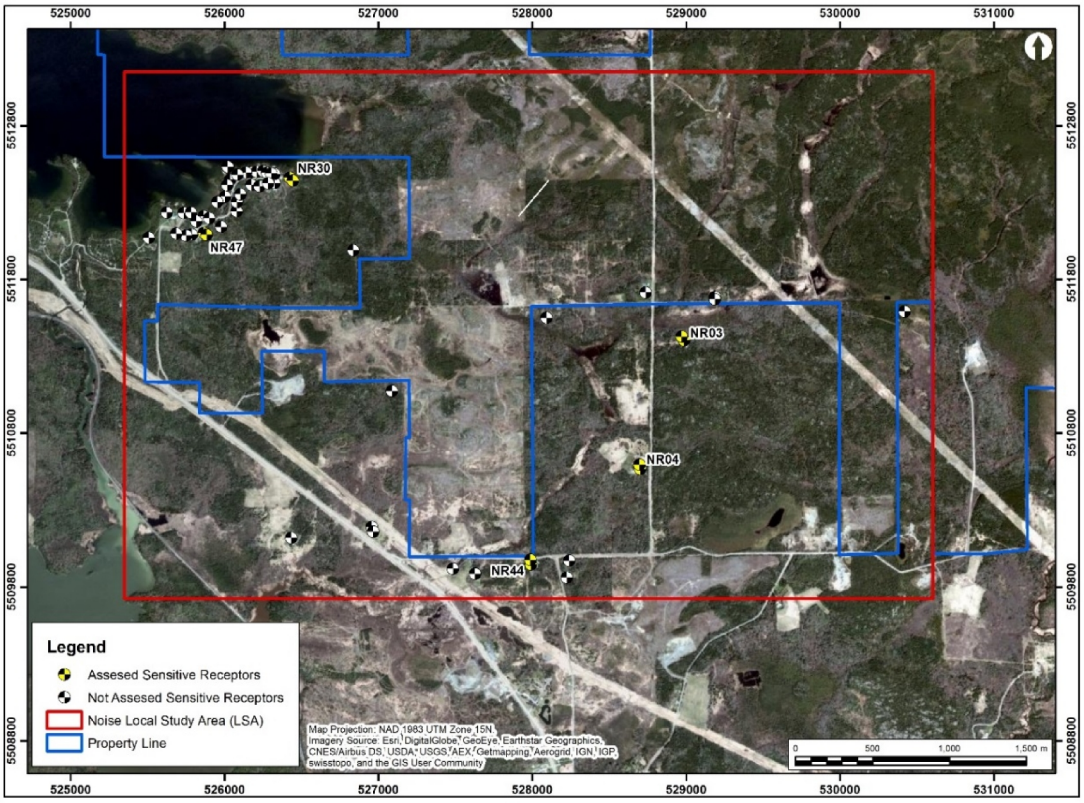


Figure 6.1.4.4-2: Location of Sensitive Noise Receptors

Since noise effects decrease with distance from the source, the nearest receptors to the Project are considered the worst-case, and are evaluated explicitly. Other receptors are not evaluated explicitly, but effects would be comparable to, or less than those for the worst-case receptors. None of these worst-case noise receptors were specifically identified as being Aboriginal receptors. However, any of these locations could be Aboriginal receptors. If the closest Aboriginal receptor is further from the Project than these worst case receptors then the resulting noise effects would be less than experienced at the worst case receptors.

Areas and land uses that do not meet the definitions provided by MOECC were not explicitly evaluated as part of the noise assessment. However, predicted noise levels have been used elsewhere in this report to determine the potential effects of noise from the Project on other receivers, such as wildlife (Section 6.12) and Aboriginal people practicing traditional uses of the land (Section 6.21).

Although the assessment of potential noise effects focussed on the sensitive receptors, a regional study area (RSA) could be defined as a rectangular area enclosing the LSA and the areas around the LSA where information regarding the existing noise conditions were collected. Figure 6.1.4.4-3 provides an illustration of the area corresponding to the RSA for noise.

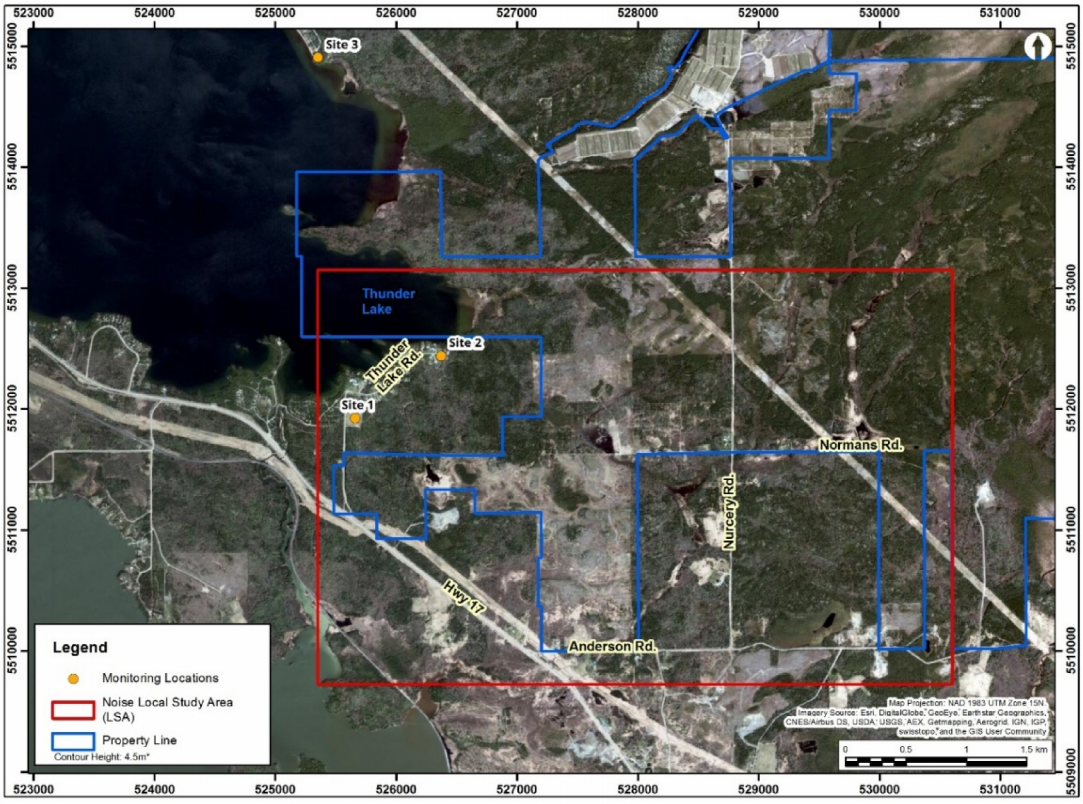


Figure 6.1.4.4-3: Noise RSA

The following questions, raised as part of the Round 1 IRs, referred to the noise study areas used in the EIS:

- TMI_183-AE(1)-21: Study area definitions;
- TMI_188-AE(1)-26: Receptors for traditional land uses;
- TMI_194-HE(1)-01: Identification of Aboriginal receptors;
- TMI_466-AC(1)-140: Extent of baseline noise measurements; and
- TMI_715-PC(1)-30: Consideration of a specific residence as a receptor.

None of the information presented in the EIS, or questions raised as part of the Round 1 IRs indicated the need to modify of expand the study areas used to evaluate the effects of the Project on noise. The noise prediction results presented in the Environmental Noise Assessment (RWDI, 2014c), included as part of Appendix H to the EIS, confirm that the LSA selected for use in the EIS was suitable to capture all of the direct noise effects associated with of the Project. The only potential additional receptor identified in the Round 1 IRs (TMI_755-PC(1)-30) is located further from the Project noise sources that the worst case noise receptors. Therefore any effects at this potential receptor location would be less than those characterized in the revised EIS.

6.1.4.5 Light

For the light assessment, an LSA extending 1 km from the Project property boundaries was identified. The reason for selecting this LSA was that light effects beyond 1 km are typically comparable to general lighting (Section 5.3.2.1 of the revised EIS). In addition to the LSA, the light assessment also focussed on specific receptor locations. A total of 12 receptor locations were identified for use in the light assessment, and were used in the collection of baseline light conditions against which the light effects of the Project were compared. The location of the receptors used for evaluating light, and the portions of the light LSA near where receptors were identified was shown in Figure 2 of Appendix I-1 to the revised EIS, and is reproduced as Figure 6.1.4.5-1. It should be noted that receptors R1 and R2 are located within the operations area for the Project, and would not represent light receptors once construction activities commence. Receptor R3 is a residence on Tree Nursery Road. Receptors R4 through R8 and R12 are neighbouring residences or cottages within 1 km of the property boundary on the shoreline of Thunder Lake. Receptors R9 through R11 are the representative receptors for clusters of cottages located on the far (west) shoreline of Thunder Lake from the Project Site, and were grouped for reasons of sharing similar viewscapes and topographic features.

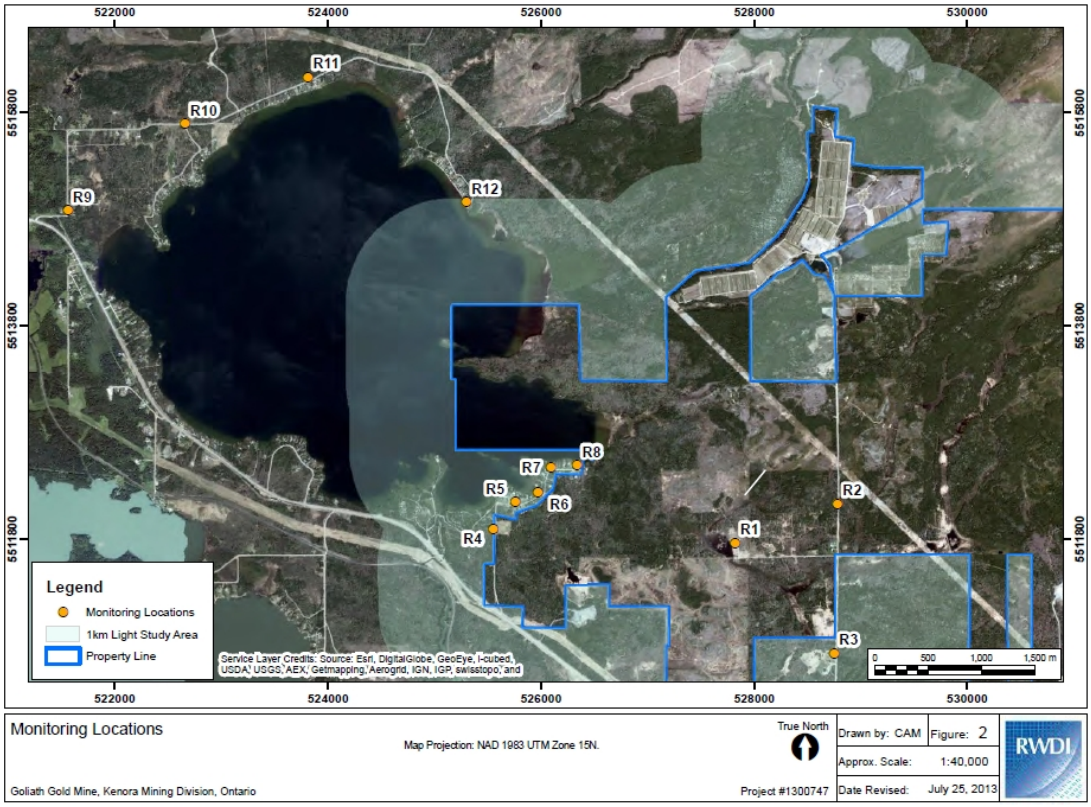


Figure 6.1.4.5-1: Location of Light Receptors and the Light LSA

6.1.4.6 Air Quality

The Local Study Area (LSA) for air quality was chosen to enclose the dispersion modelling domain used for evaluating air quality effects associated with the Project. The LSA for air quality was a rectangular area 20 km by 20 km generally centred on the main mine features (e.g., open pit mine, mill, underground vent raise). The section for this size for the LSA was based on the understanding that air quality effects from a Project would be indistinguishable from background air quality at a distance of 10 km (response to TMI_174-AE(1)-12). The LSA for air quality is shown in Figure 6.1.4.6-1. The figure illustrates the area of air modelling coverage, which responds with the LSA, showing the gridded receptor locations where air quality predictions were made. The area of modelling coverage was designed to meet the requirements outlined in Section 14 of the Ontario air regulations (O.Reg. 419/05). The receptor grid, which provides suitable receptor coverage for this assessment, includes a multi-tiered receptor grid consistent with the Ontario Air Dispersion Modelling Guidelines (MOECC, 2009b). In accordance with the Ontario guidance (MOECC, 2009a), modelling receptors are not placed within the property boundary, which is also shown on Figure 6.1.4.6-1. The highest predicted concentrations at the property boundary are referred to as Maximum Point of Impingement (MPOI) predictions. This is because the concentrations at the property line will be higher than concentrations at greater distances from the Project.

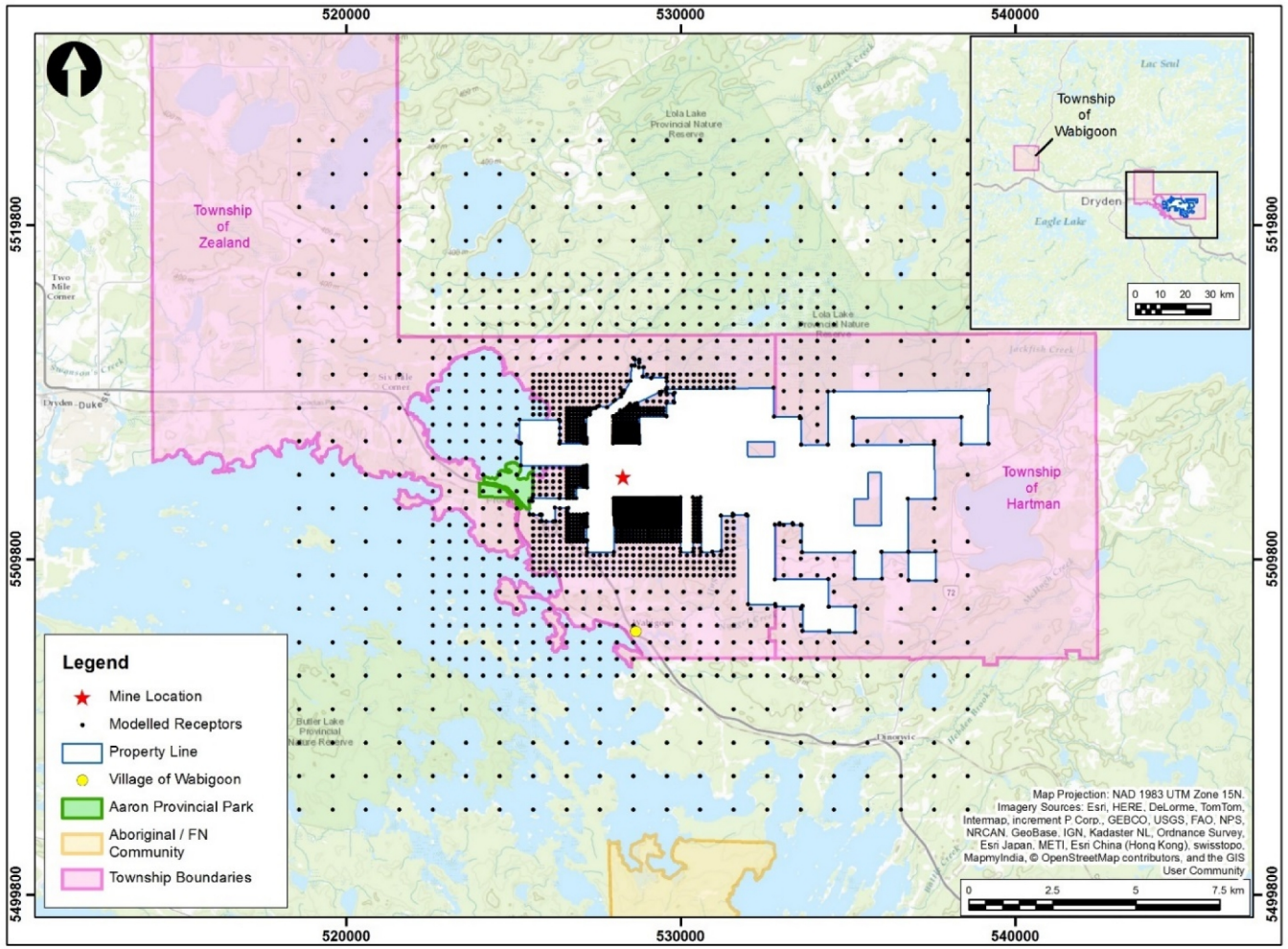


Figure 6.1.4.6-1: Air Quality LSA

(Source: TMI_172-AE(1)-10)

In addition to the gridded receptors, 44 sensitive receptors were identified in the LSA. These sensitive receptors represent the closest community-oriented locations to the air emission sources, and include: a campground within Aaron Provincial Park; a trailer on otherwise vacant land; and 42 residences, mostly in the developments along the shores of Thunder Lake. Sensitive receptor locations, from an air quality perspective, were defined based on any inhabited location that would be used for residential or other purposes. This is consistent with the authors of the Canada-Wide Standards acknowledge that achievement of the standards were to be based on "community-oriented locations" (CCME, 2000), with an emphasis on areas "where people live, work and play" (CCME, 2000). For the purpose of the air quality assessment, the definition of sensitive receptors is appropriate when comparing predictions to criteria, as described by the CCME (2000). The locations of these sensitive receptors are illustrated on Figure 6.1.4.6-2.

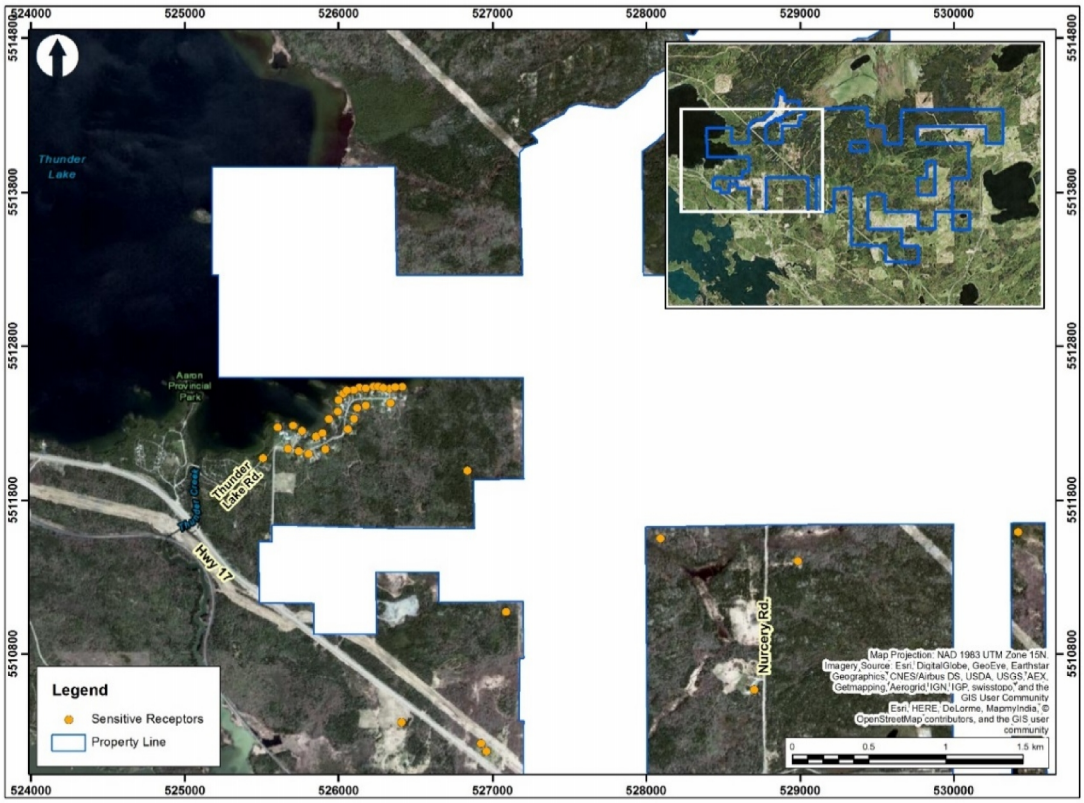


Figure 6.1.4.6-2: Location of Sensitive Air Receptors

The highest predicted concentrations at the property boundary are referred to as Maximum Point of Impingement (MPOI) predictions. This is because the concentrations at the property line will be higher than concentrations at greater distances from the Project. During the site preparation and construction, operations, closure, and portions of the post-closure phases, access to the active Project areas will be restricted for safety and security reasons. The active Project areas

correspond to the property boundary in the areas with the most densely spaced receptors shown in Figure 6.1.4.6-1. Therefore, the MPOI concentrations predicted in the air quality assessment represent the highest concentrations that members of the public could be exposed to during the life of the Project. Treasury Metals recognizes Aboriginal rights to conduct traditional land uses, such as gathering and hunting, on Crown lands not occupied by the Project. Such locations would be further from the sources of air emissions, and thus would experience lower air concentrations than the MPOI predictions.

The air quality assessment was completed at receptors across the LSA (Figure 6.1.4.5-1), which cover most of the Township of Hartman, portions of the Township of Zealand, Aaron Provincial Park and the Village of Wabigoon. However, the maximum predicted concentrations at 44 sensitive receptors represent the highest concentrations at any "community-oriented locations" (CCME, 2000) and the maximum concentrations predicted at the property line represent the highest concentrations beyond the active mining area. Predicted concentrations and resulting effects at more distant receptor locations (e.g., the Village of Wabigoon) would be lower than the maximum values presented in the assessment. Additionally, the town of Dryden is located approximately 15 km west of the Project, beyond the LSA. At those distances the predicted effects of the Project would not be distinguishable from background values.

Although the effects of the Project on air quality would be indistinguishable from background levels at distances of 10 km (RWDI, 2014e: Section 1.4), a larger Regional Study Area (RSA) is used when describing the existing air quality conditions in the region. Specifically, background air quality concentrations were derived from ambient air monitoring data from the MOE monitoring stations in Thunder Bay (Section 5.2.1). In addition, meteorological data from the stations at International Falls and Thunder Bay were used in the dispersion modelling (Appendix J-1: Section 3.2; Section 3.5.4). The resulting RSA, and the relative location of these stations to the Project is shown on Figure 6.1.4.6-3.

The following questions, raised as part of the Round 1 IRs, specifically asked about the study areas and receptors used for assessing air quality:

- TMI_172-AE(1)-10: Identification of sensitive receptors;
- TMI_174-AE(1)-12: City of Dryden and Village of Wabigoon as receptors;
- TMI_1941-HE(1)-01: Aboriginal receptors;
- TMI_339-AC(1)-13: Nearby residents and the Village of Wabigoon;
- TMI_470-AC(1)-144: Size of local study area;
- TMI_539-AC(1)-213: Definition of spatial boundaries; and
- TMI_597-AC(1)-271: Receptors for traditional uses of the land.



Figure 6.1.4.6-3: Air Quality RSA

6.1.4.7 Climate

When considering the potential effects of the Project with respect to climate, the study areas need to relate to the potential effects of the Project and the VCs used to describe those effects (i.e., “Project GHG emissions”, “changes in climate due to the Project”). For the Project GHG emissions VC, the study areas would need to consider the scope of the management initiatives related to GHG emissions (i.e., LSA: provincial, RSA: national). For changes on climate due to the Project, the scale would need to be global, as the contribution of GHG emissions from the Project would need to be put into the perspective of the emissions driving the predicted changes in climate.

6.1.4.8 Surface Water Quality

The Local Study Area (LSA) for surface water quality was selected to include those watercourses and catchment areas that could be directly affected by Project activities. Specifically, the LSA includes the following catchment areas: Thunder Lake Tributary 2 and Tributary 3, Hoffstrom’s Bay Tributary, Little Creek, and Blackwater Creek. The reasons for including these catchment areas are as follows:

- Thunder Lake Tributary 2 and Tributary 3: It is anticipated there will be surface water runoff or seepage during the site preparation and construction, operations, or closure phase, however but there will be water withdrawals during operations which will affect the flow. Also, seepage from the TSF during the post-closure phase may reach Thunder Lake Tributary 3.

- Hoffstrom’s Bay Tributary: During the post-closure phase, seepage from the TSF may reach this watercourse.

- Little Creek: It is anticipated there will be no discharges to this creek (i.e., surface water runoff or seepage) during the life of the Project but there will be a reduction in catchment area as a result of the Project footprint and therefore a reduction of flow.

- Blackwater Creek: During the operations phase, surface water runoff from the Project site will be treated and discharged to Blackwater Creek. Additionally, seepage from the TSF during the post-closure phase may also reach this watercourse.

In addition to the direct effects, there is the possibility that changes in surface water quality within the LSA could have effects on downstream waterbodies. To capture this, a regional study area (RSA) has been selected to include the downstream waterbodies of Thunder Lake and Wabigoon Lake. Additionally, the RSA includes baseline surface water quality stations that were located beyond the areas likely to be directly affected by the Project activities (i.e., SW1 located in Hughes Creek and SW3 in McHughes Creek). The LSA and RSA for surface water quality is shown in Figure 6.1.4.8-1.

In determining the potential surface water quality effects from the Project, it was necessary to identify locations for which surface water quality in the receiving environment was evaluated. Surface water quality was evaluated at nine locations in the surrounding waterbodies of the Project site. The location of all the nodes for which receiver surface water quality has been evaluated for is shown on Figure 6.1.4.8-2. These nine locations (also referred to as "nodes" in the model) are listed below (in order of upstream to downstream location) along with a brief description for each node:

- **Node TL1**: Thunder Lake Tributary 2, downstream of irrigation pond;
- **Node TL2**: Thunder Lake Tributary 3, downstream of the Tree Nursery Ponds;
- **Node TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **Node HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **Node LC1**: Little Creek at Thunder Lake;
- **Node BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location;
- **Node BW2**: Blackwater Creek, upstream of Wabigoon Lake;
- **Node TL**: Thunder Lake; and
- **Node WL**: Wabigoon Lake.

Of these nodes, the first seven are located within the LSA, while Thunder Lake (TL) and Wabigoon Lake (WL) are within the RSA for surface water quality. Five of the stream nodes (i.e., HB1, TL1, TL2, TL3 and LC1) are within the Thunder Lake watershed area, along with the node for Thunder Lake (TL). The remaining two stream are located within the Blackwater Creek sub-watershed, which drains into Wabigoon Lake. Ultimately, all of the nodes evaluated, including Wabigoon Lake (WL) fall within the Wabigoon Lake watershed area.

Only the following question from the Round 1 information requests specifically commented on the study areas for surface water quality:

- TMI_686-AC(1)-358: RSA must be revised as current RSA only includes a small portion of Wabigoon Lake.

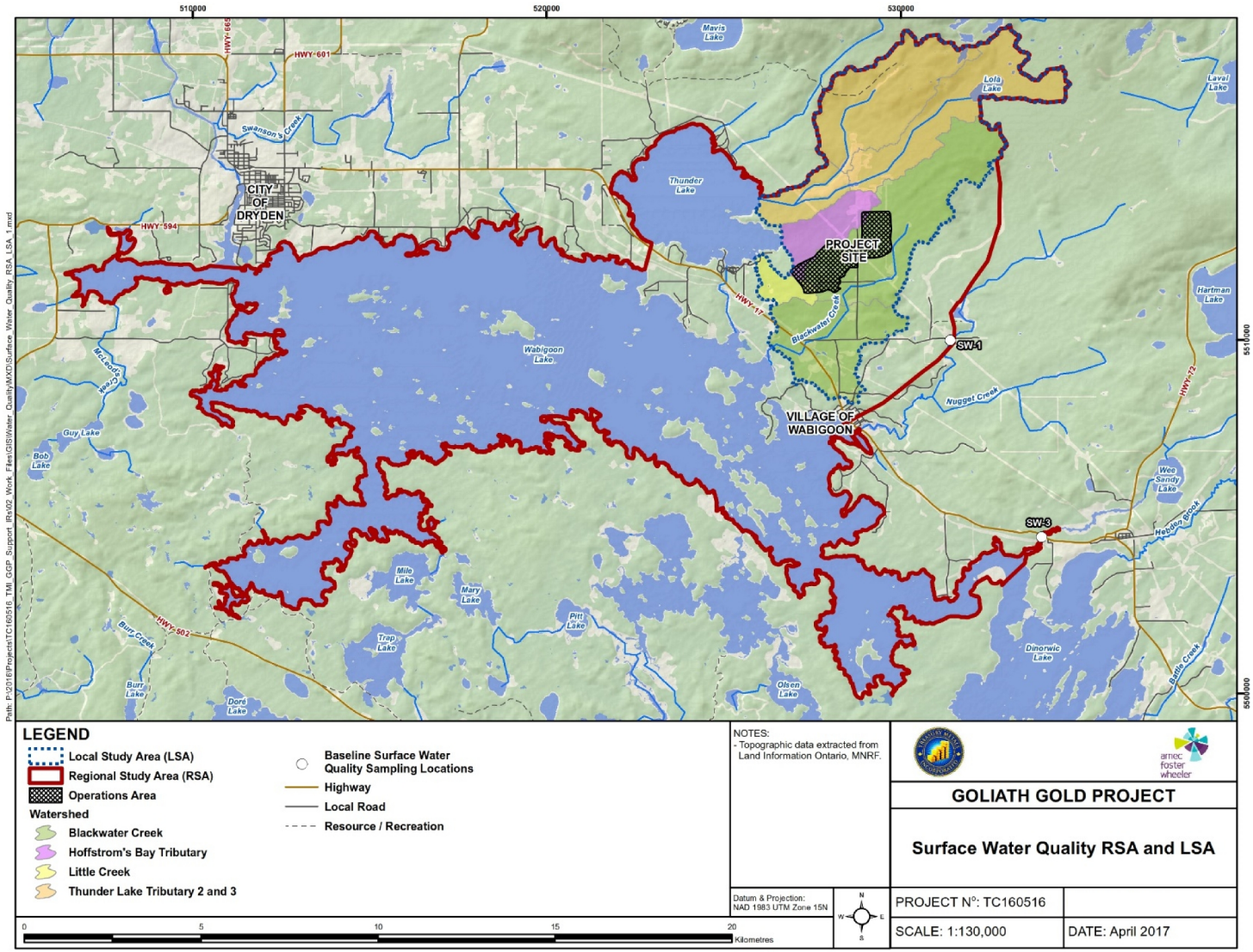


Figure 6.1.4.8-1: Surface Water Quality RSA and LSA

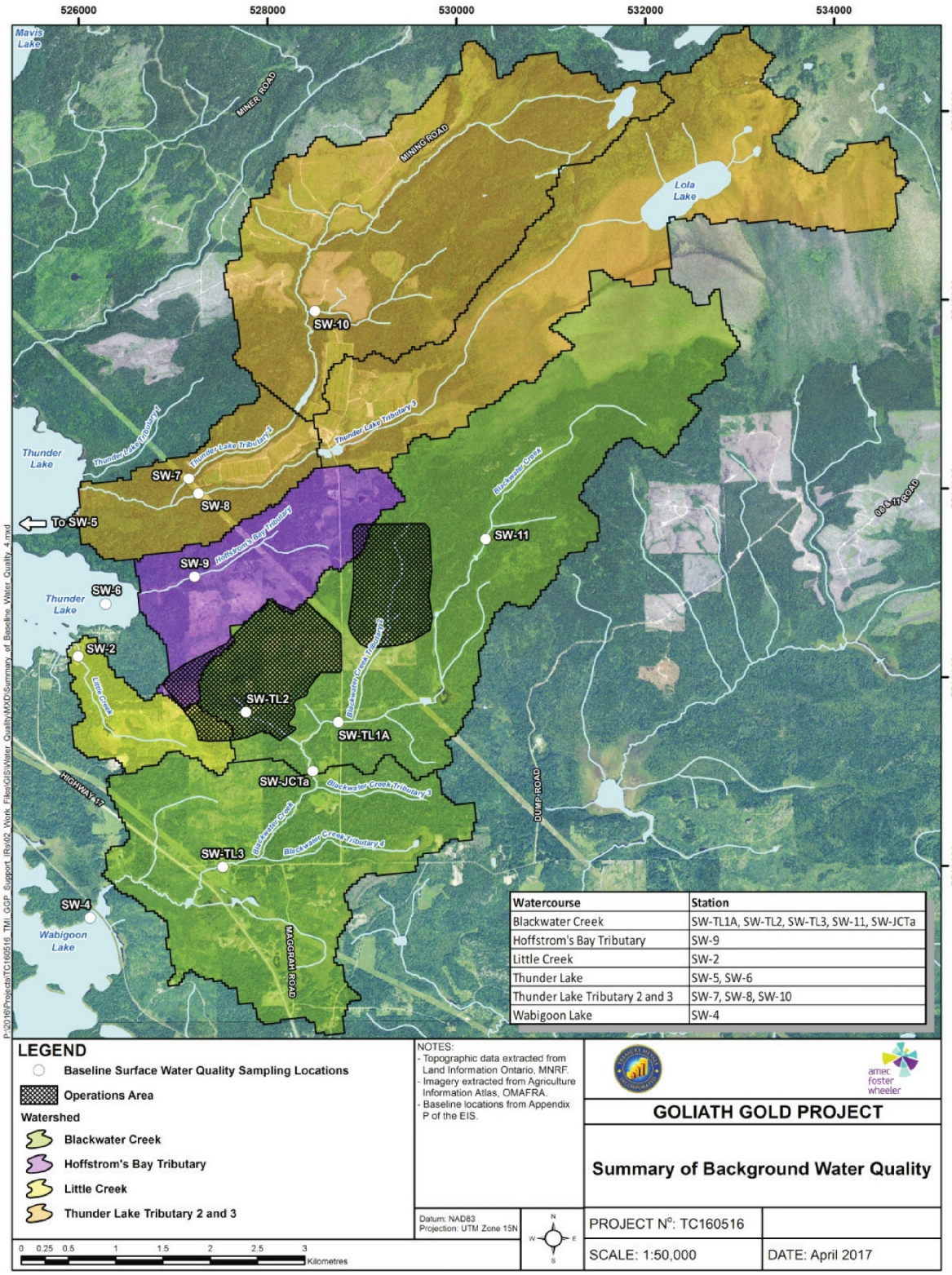


Figure 6.1.4.8-2: Surface Water Quality Modelling Nodes

6.1.4.9 Surface Water Quantity

The Project is located east of Thunder Lake and north-east of Wabigoon Lake. The regional study area (RSA) for the Project comprises watersheds which drain to either Thunder Lake or Wabigoon Lake. Thunder Lake ultimately discharges to Wabigoon Lake via Thunder Creek. The RSA, which is illustrated in Figure 6.1.4.9-1, incorporates those areas where the potential effects of the Project on surface water hydrology are anticipated.

On a local scale, the sub-watersheds surrounding the Project Site include Thunder Lake Tributaries 2 and 3, Hoffstrom's Bay Tributary, and Little Creek in the Thunder Lake watershed, and Blackwater Creek in the Wabigoon Lake watershed are considered to comprise the local study are (LSA), which is illustrated in Figure 6.1.4.9-2. These are the areas where the Project water management activities are likely to affect surface water hydrology (quantity). Within the LSA, surface water quantity predictions were made at the following seven locations (illustrated in Figure 6.1.4.9-2), which also correspond to the stream-based nodes discussed in the surface water quality (Section 6.1.4.9):

- **Node TL1**: Thunder Lake Tributary 2, downstream of irrigation pond;
- **Node TL2**: Thunder Lake Tributary 3, downstream of the Tree Nursery Ponds;
- **Node TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **Node HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **Node LC1**: Little Creek at Thunder Lake
- **Node BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location;
- **Node BW2**: Blackwater Creek, upstream of Wabigoon Lake;

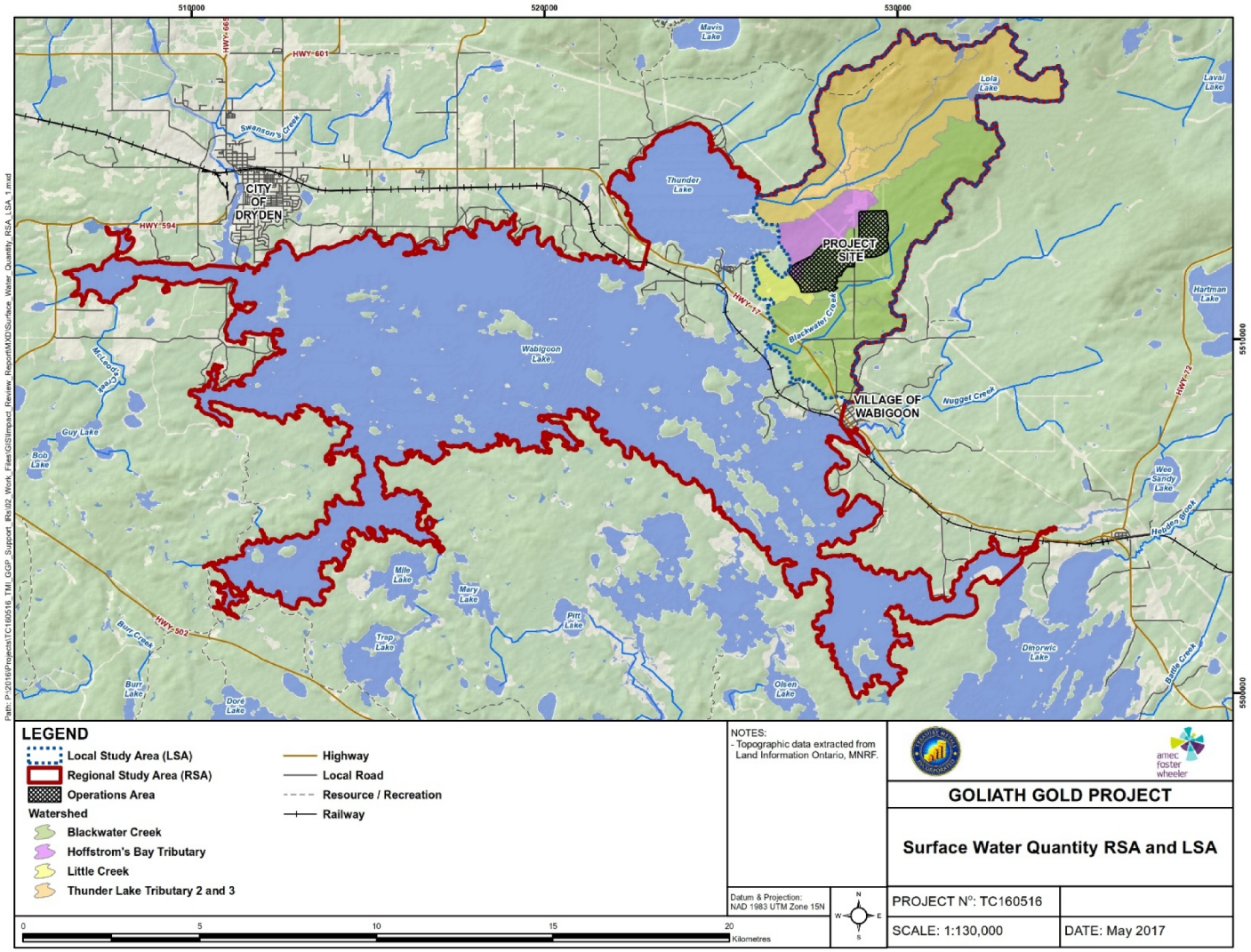


Figure 6.1.4.9-1: Surface Water Quantity Study Areas

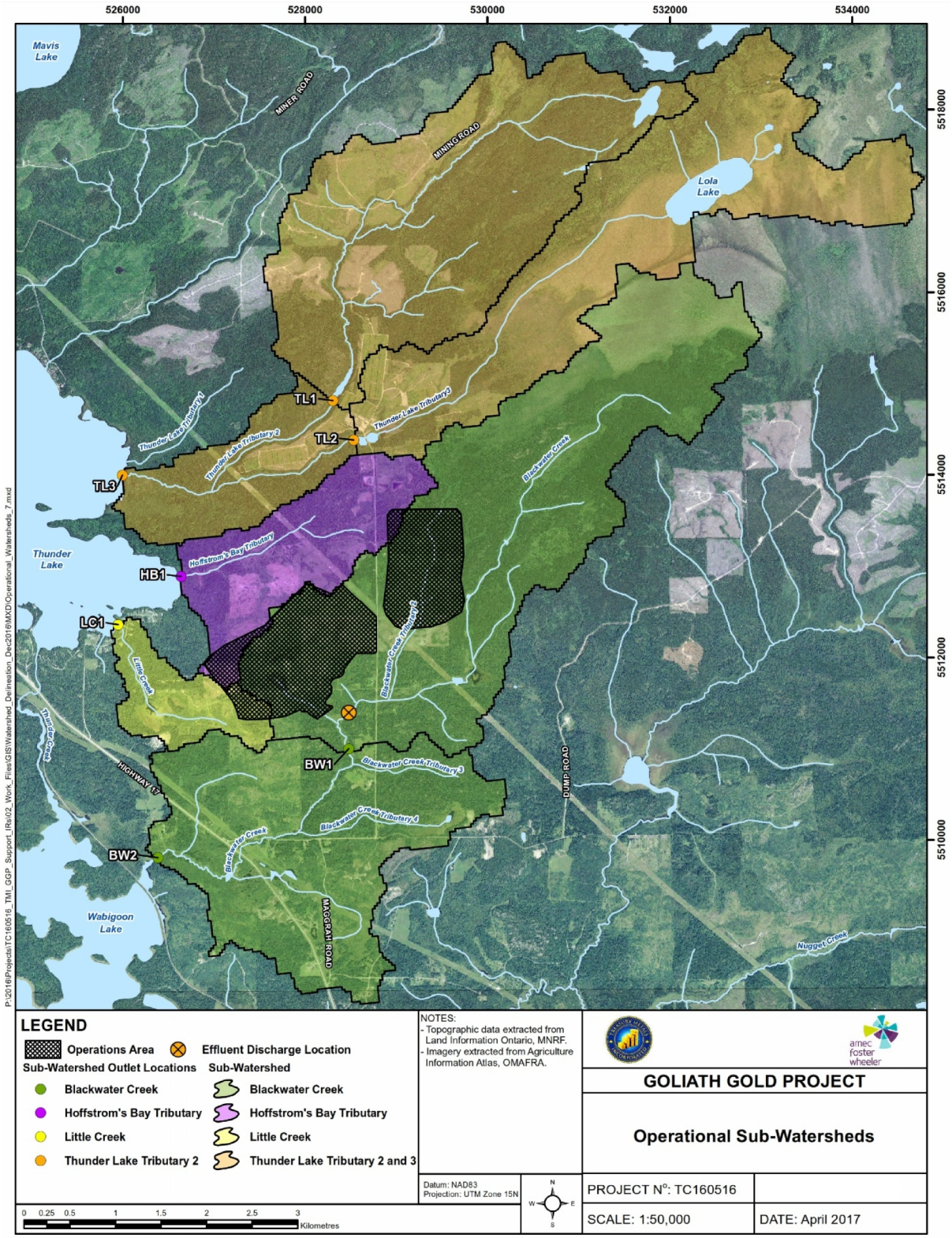


Figure 6.1.4.9-2: Surface Water Quantity Modelling Nodes

6.1.4.10 Groundwater Quality

The LSA for the groundwater quality component corresponds with the hydrogeological modelling domain described in Appendix M to the revised EIS. The LSA enclosed a hydrological basin containing low to moderate relief topographic features, including low lying marsh type lands and exposed bedrock ridges. This basin has been defined by inferred groundwater divides associated with topographic watersheds, and is bordered by upland areas to the east, in the vicinity of Hartman Lake, and to the north, part of which is occupied by a significant wetland area; the Thunder Lake Tributary drainage basin to the west; and Wabigoon Lake to the south. This basin contains the Thunder Lake drainage area to the west, Blackwater Creek drainage area through the central region, and the Hughes and Nugget Creek drainage areas in the east. Blackwater Creek and Hughes Creek both drain southerly into Wabigoon Lake. The extent of the LSAis shown on Figure 6.1.4.10-1. No RSA was used for groundwater data as the effects would be restricted to the LSA used for the modelling.

6.1.4.11 Groundwater Quantity

As described in Section 6.1.4.10, the LSA for groundwater corresponds to the modelling domain used for the hydrogeological modelling presented in Appendix M to the EIS. The same LSA applies for both groundwater quantity and quality. No RSA was used for groundwater as the expected effects of the Project are restricted to the LSA.

In addition to the LSA used for groundwater quality and quantity are a number of discrete receptor locations that correspond with private water wells. The location of the wells within the hydrogeological LSA are shown on Figure 6.1.4.11-1. These wells are identified by the Ontario Ministry of Environment and Climate Change (MOECC), however, the MOECC does not provide details on the owners of the wells, or whether the wells represent drinking water sources for either Aboriginal peoples or non-Aboriginals (response to TMI_197-HE(1)-04).

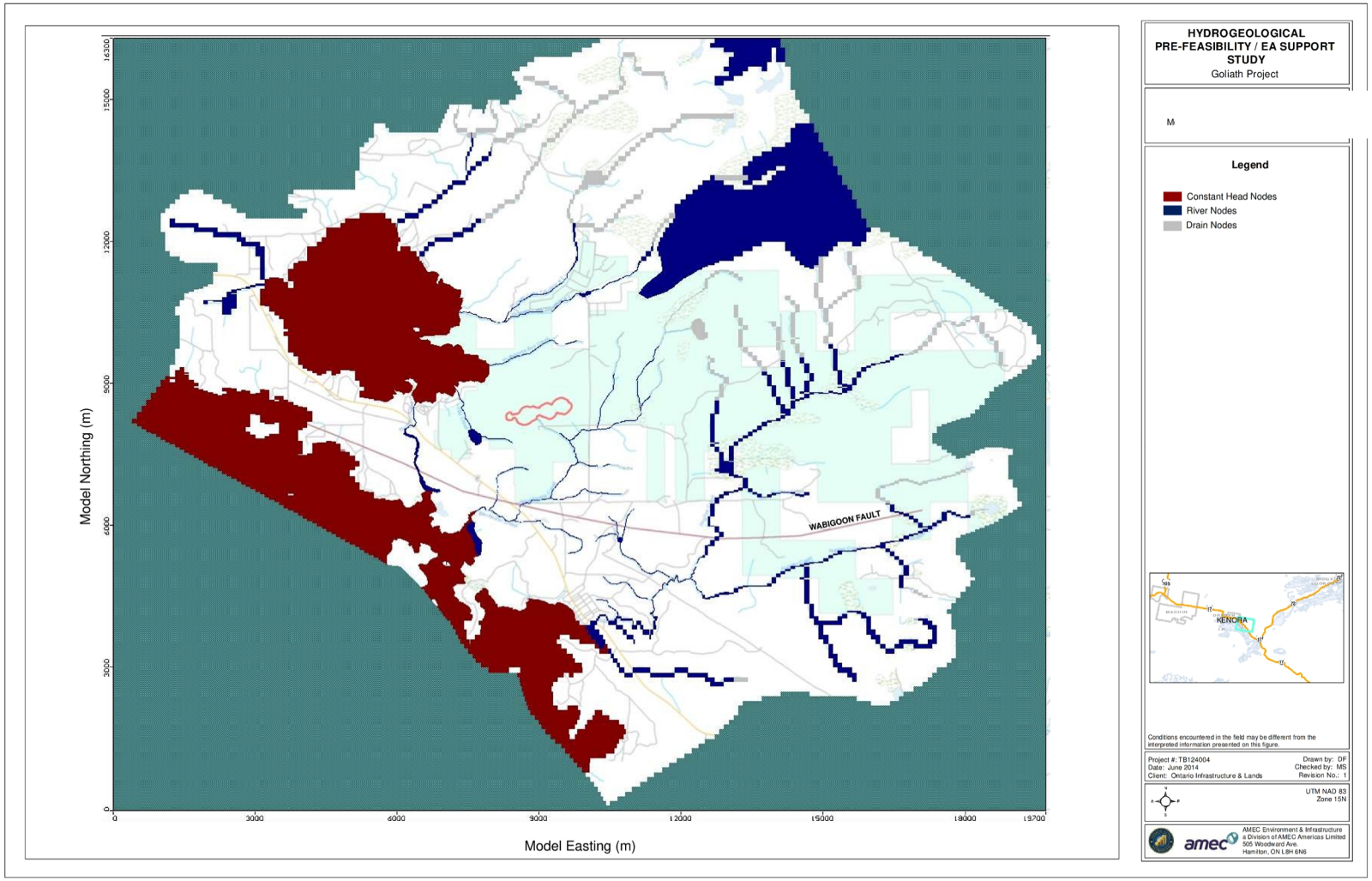


Figure 6.1.4.10-1: Effects Assessment LSA and RSA for Hydrogeology

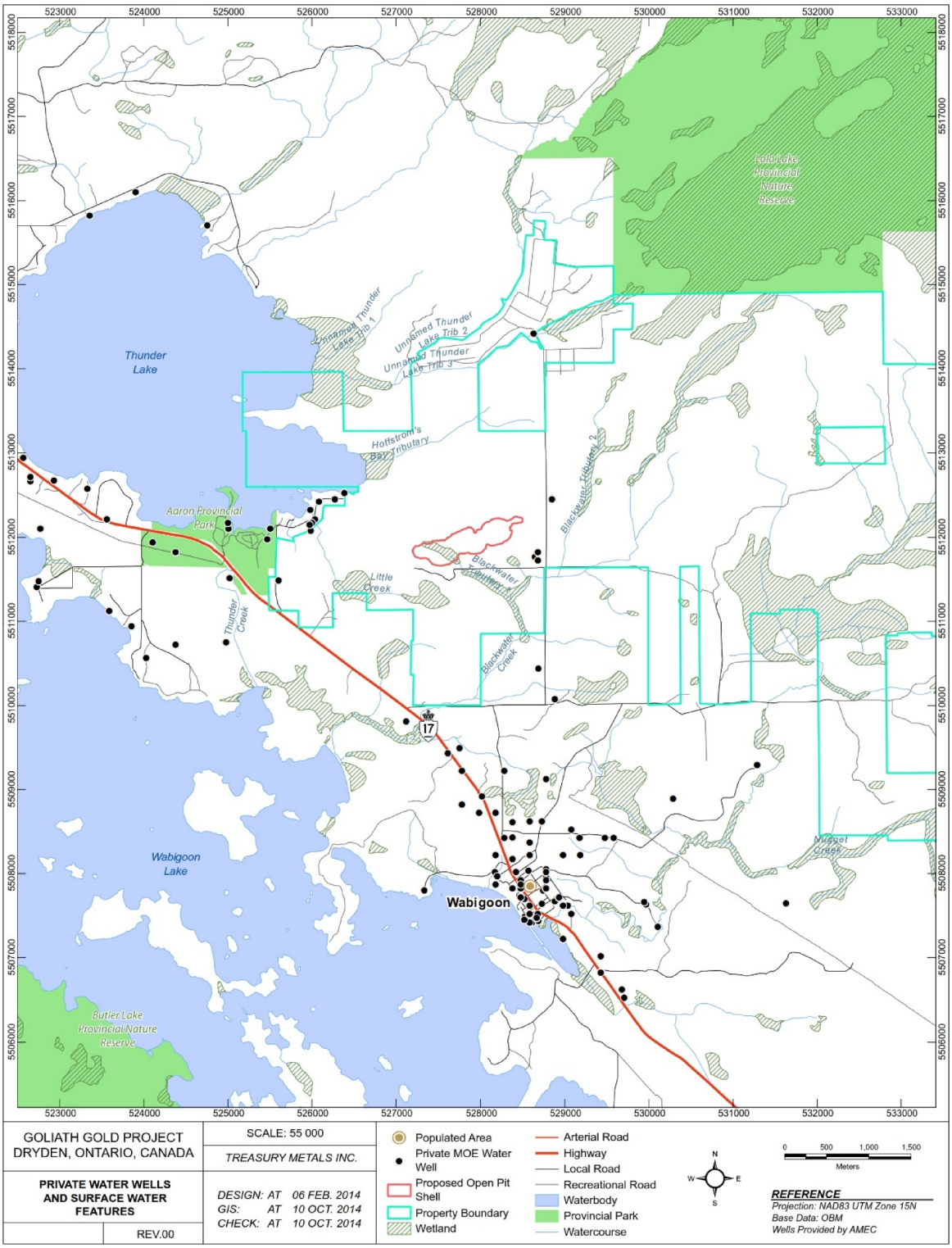


Figure 6.1.4.11-1: Private Water Wells within the Hydrogeological LSA

6.1.4.12 Wildlife and Wildlife Habitat

For evaluating the potential effects of the project on wildlife and wildlife habitat, a local study area (LSA) was defined as the lands and waters of the watersheds in which the proposed development footprint. The wildlife RSA is defined by the Wabigoon Ecoregion. An Ontario Ecoregion is defined as “A unique area of land and water nested within an ecozone that is defined by a characteristic range and pattern in climatic variables, including temperature, precipitation, and humidity. The climate within an ecoregion has a profound influence on the vegetation types, substrate formation, and other ecosystem processes, and associated biota that live there.” (Crins 2009). The LSA and RSA used for evaluating the potential effects of the Project on wildlife and wildlife habitat are illustrated on Figure 6.1.4.12-1.

The following specific questions regarding the studies for wildlife and wildlife habitat were raised as part of the Round 1 information requests:

- TMI_12-AC(1)-03: study areas for SAR;
- TMI_144-WL(1)-01: study areas for wildlife and wildlife habitat;
- TMI_145-WL(1)-02: study areas for wildlife and wildlife habitat;
- TMI_479-AC(1)-153: study areas for mammals;
- TMI_480-AC(1)-154: study areas for birds;
- TMI_481-AC(1)-155: study areas for significant wildlife habitat; and
- TMI_484-AC(1)-158: study areas for Species at Risk (SAR).

6.1.4.13 Migratory Birds

The inclusion of migratory birds as a distinct discipline in the revised EIS at the request of the Agency to facilitate their review process. Migratory birds uses the same study areas as were used for wildlife and wildlife habitat, as described in Section 6.1.4.12.

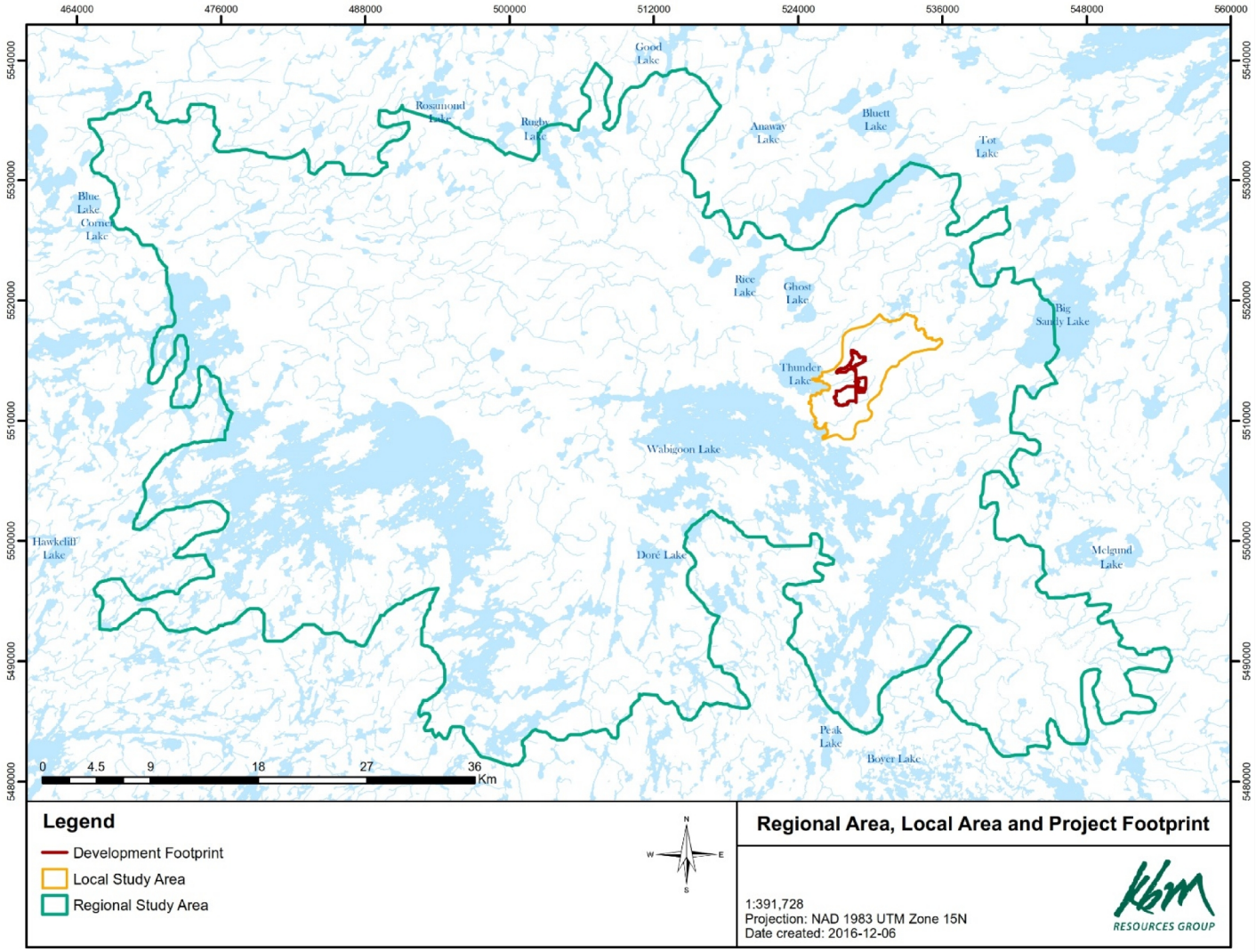


Figure 6.1.4.12-1: Wildlife and Wildlife Habitat Study Areas

6.1.4.14 Fish and Fish Habitat

For fish and fish habitat, the Local Study Area (LSA) includes the watercourses where direct effects associated with the Project could potentially occur and the lake habitats in the immediate vicinity of the mouths of these creeks. The Project design has taken a watershed approach and the Project activities are now confined to the watersheds of Blackwater Creek and four tributaries to Thunder Lake. These include Hoffsrtom's Bay tributary, Little Creek, Thunder Lake Tributary 2 and Thunder Lake Tributary 3. Thunder Lake Tributary 3 is the south branch of Thunder Lake Tributary 2, which drains from Lola Lake into Thunder Lake. Hughes Creek, which was included in the LSA in the EIS, is no longer considered part of the LSA as no activities will take place in the watershed, and no effects are expected to occur. The Regional Study Area includes Wabigoon Lake and Thunder Lake to which the watercourse in the LSA are tributaries. The LSA and LSA for fish and fish habitat are shown on Figure 6.1.4.14-1.

The following specific questions regarding the study areas for fish and fish habitat were raised as part of the Round 1 information requests:

- TMI_129-FH(1)-20: LSA and RSA selection
- TMI_141-FH(1)-20: study areas for fish and fish habitat
- TMI_472-AC(1)-146: study areas for fish and fish habitat

6.1.4.15 Wetlands and Vegetation

For evaluating the potential effects of the Project on wetlands and vegetation, a local study area (LSA) was defined as the lands and waters of the watersheds in which the proposed development footprint is located. The wetlands and vegetation LSA is the same as the LSA for wildlife and wildlife habitat (Section 6.1.4.12). The wetlands and vegetation RSA is also the same as the wildlife RSA, which corresponds to the Wabigoon Ecoregion. The wildlife and wildlife habitat LSA and RSA, which are the same as the study areas used for wetlands and vegetation, are illustrated in Figure 6.1.4.1-1.

The following specific questions regarding the study areas for wetlands and vegetation were raised as part of the Round 1 information requests:

- TMI_476-AC(1)-150: study areas for vegetation
- TMI_478-AC(1)-152: study areas for wetlands

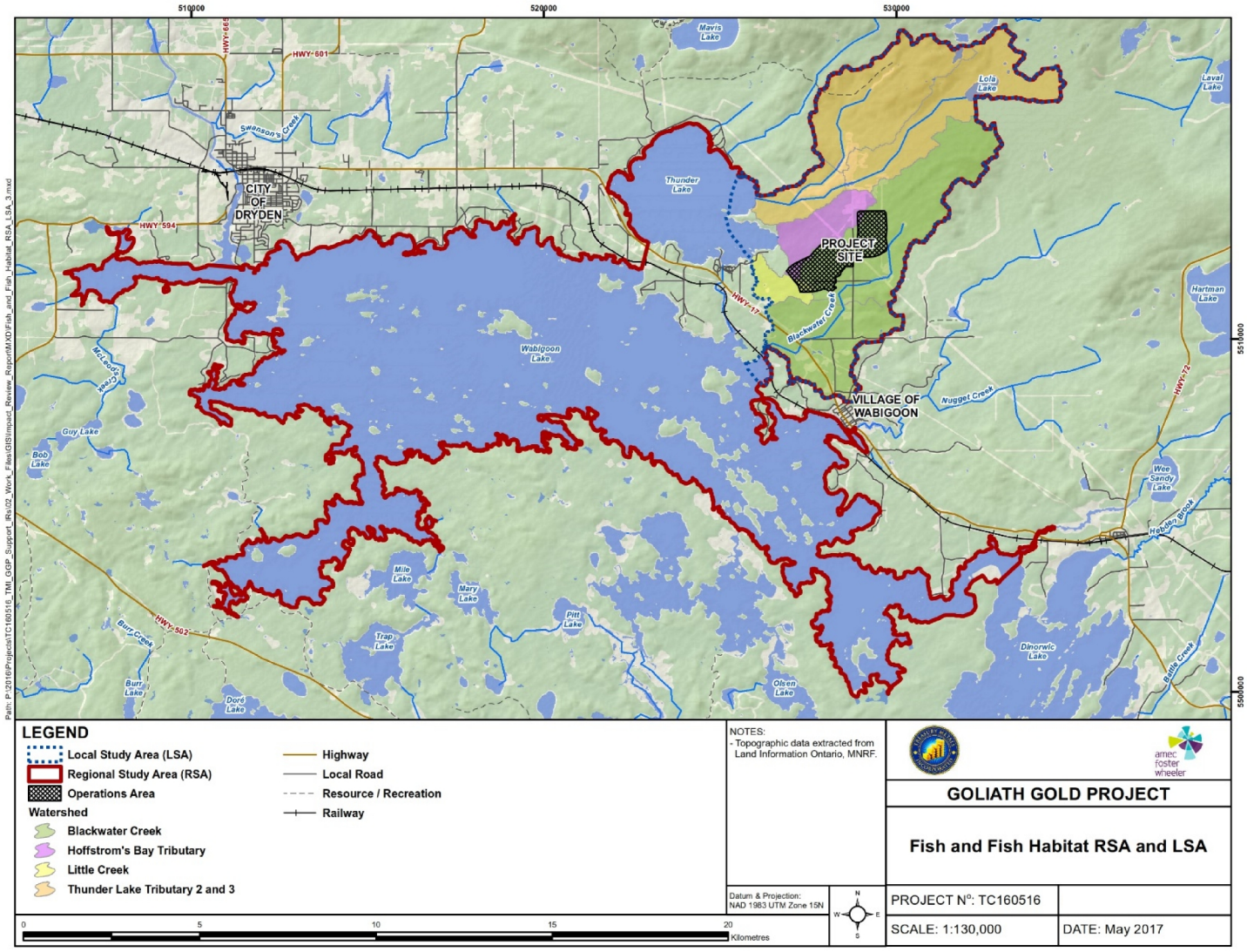


Figure 6.1.4.14-1: Fish and Fish Habitat Study Areas

6.1.4.16 Land Use

Depending on the type of land and resource use, the local and regional study areas for terrestrial or aquatic biology disciplines were used to set parameters for land and resource uses. For example, potential effects on recreational and commercial fishing are predicted in the regional study area (RSA) and local study area (LSA) for the aquatic biology disciplines, while the terrestrial biology RSA and LSA are used to predict the potential effects on recreational hunting.

The LSA and RSA for terrestrial-based land and resource uses is defined using the same study areas used for wildlife and wildlife habitat (Section 6.1.4.12) and wetlands and vegetation (6.1.4.15) disciplines. The LSA and RSA used for evaluating terrestrial land and resource use effects is illustrated on Figure 6.1.4.16-1.

The local study area for the aquatic-based land and resource uses (fishing and bait fish harvesting) includes areas where there is potential for measurable effects as a result of Project activities on waterbodies, as well as downstream waterbodies that may receive water discharged from the Project, or may be affected by watercourse realignments. The extent of the water bodies included in the assessment was based on the currently defined Project, the expected extents of potential changes to the aquatic ecosystems and the expected changes associated with the Project. The proposed fish and fish habitat LSA, which is defined in Section 6.1.4.14, includes those catchments directly affected by the Project through either discharges, alterations to flow or physical alterations. The aquatic LSA also includes portions of Thunder Lake and Wabigoon Lake at the mouths of the watercourses affected by the Project. The RSA for aquatics (Section 6.1.4.14) includes the remainder of both Thunder Lake and Wabigoon Lake, as well as being extended to the east to incorporate the baseline fisheries would Hughes Creek and McHughes Creek. The LSA and RSA used for the aquatic-based land and resource use is illustrated in Figure 6.1.4.16-2.

6.1.4.17 Social

For the assessment of potential Project-related social, economic and Aboriginal people effects, a single study area is appropriate. Distinguishing between a local study area (LSA) and a regional study area (RSA) is not practical for the assessment of socio-economic VCs. The socio-economic study area report includes a more complete list of communities and Aboriginal communities than was included in the original EIS. The Project and the major local population centres, Dryden (15 km from the Project) and Kenora (150 km from the Project) are within the Kenora District and the Kenora census district. The Kenora District covers an extensive territory from near the Canada – United States border in the south to James Bay in the north. The communities in the southernmost portion the District which could experience direct and indirect project socio-economic effects and provide labour, goods and services to the Project, are identified in the list below. Effects may be most noticeable in the Dryden area, including the Village of Wabigoon, and in the nearby Aboriginal communities but may extend throughout the study area, including to Kenora which has a larger population and is relatively close to the Project site. A map of the socio-economic study area is presented in Figure 6.1.4.17-1.

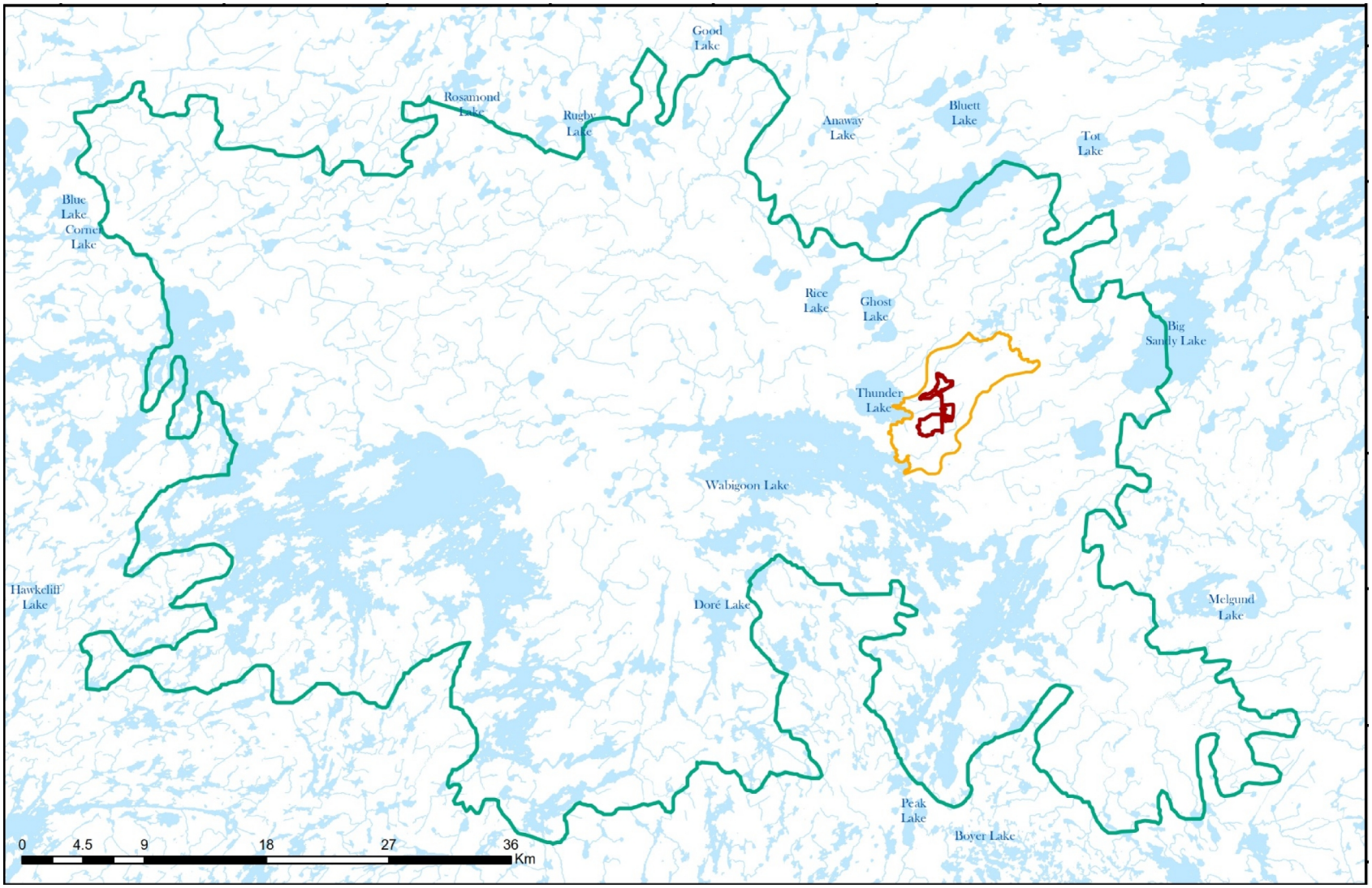


Figure 6.1.4.16-1: Land and Resource Use (Terrestrial) Study Area

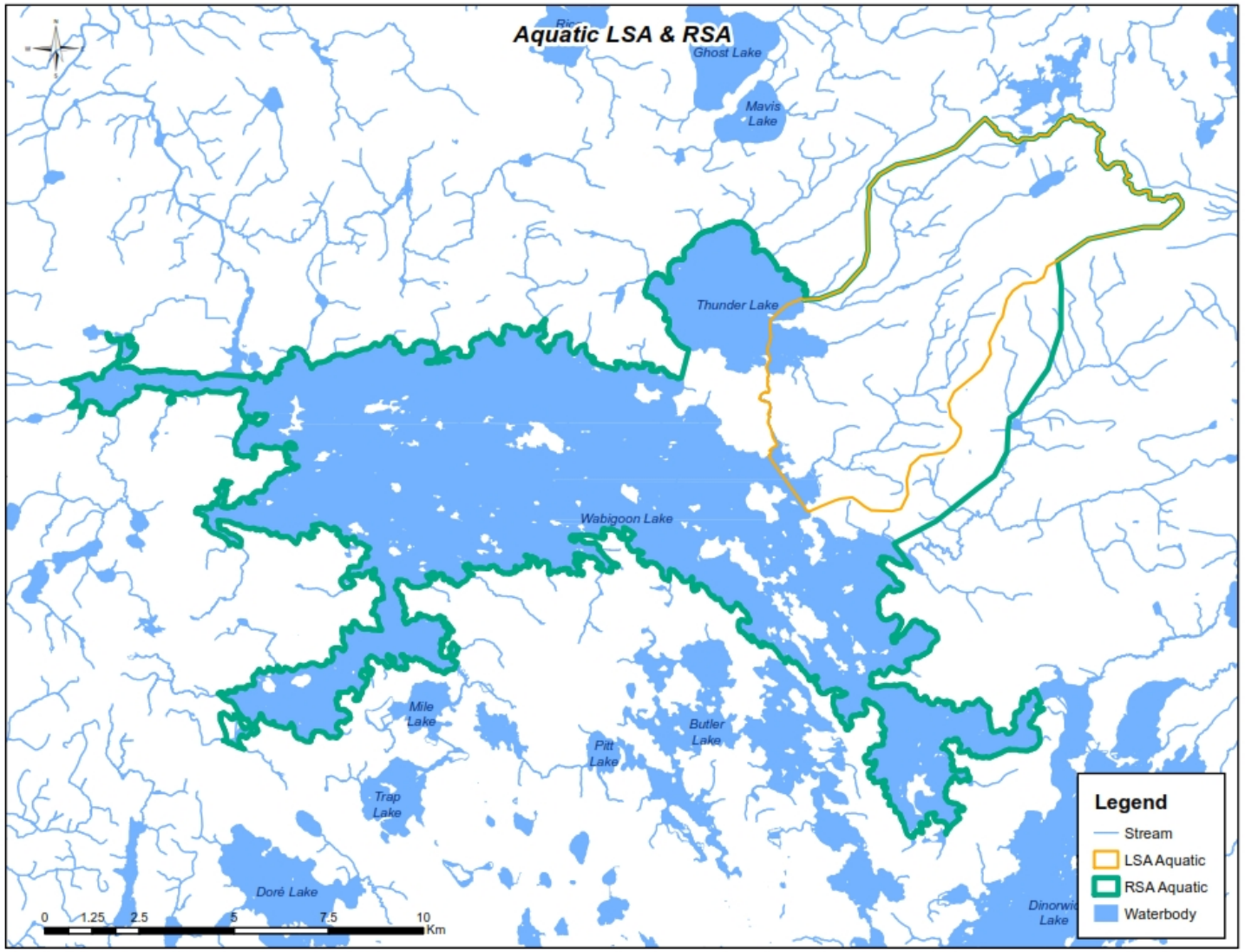


Figure 6.1.4.16-2: Land and Resource Use (Aquatic) Study Area

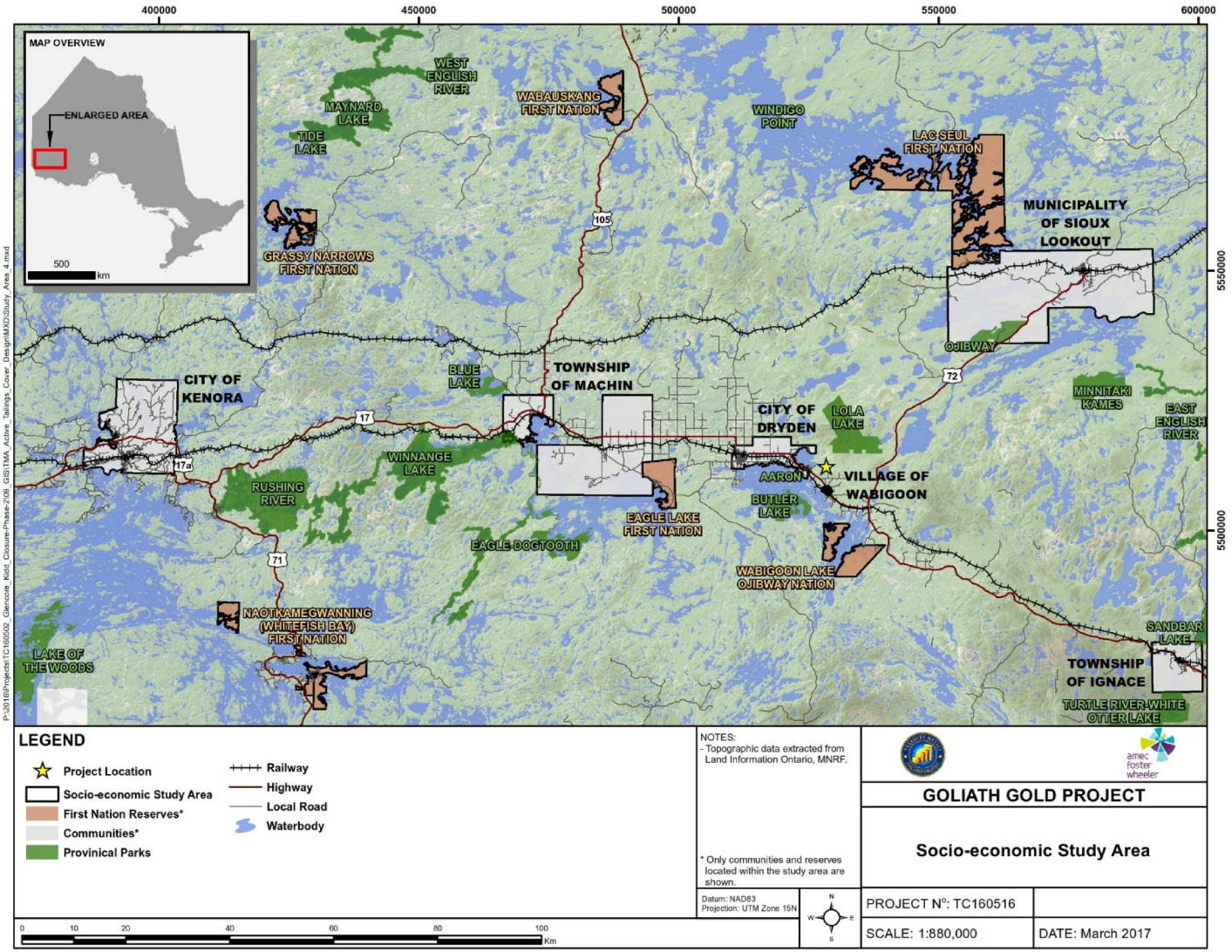


Figure 6.1.4.17-1: Socio-economic Study Area

The communities included in the socio-economic study area are:

- City of Dryden;
- City of Kenora;
- Municipality of Sioux Lookout;
- Municipality of Machin;
- Township of Ignace; and
- Village of Wabigoon.

The study area also includes the following Aboriginal communities which were identified by the Canadian Environmental Assessment Agency and Ministry of Northern Development and Mines:

- Wabigoon Lake Ojibway Nation;
- Eagle Lake First Nation;
- Lac Seul First Nation;
- Naotkamegwanning (Whitefish Bay) First Nation;
- Wabauskang First Nation;
- Grassy Narrows (Asubpeeschoseewagong) First Nation; and
- Métis Nation of Ontario – Region 1.

It is anticipated that Project-related social effects will be most noticeable within the socio-economic study area communities considered to be within commuting distance from the Project site (estimated 100 km). Effects occurring beyond the study area could occur anywhere within the province of Ontario or in other provinces.

6.1.4.18 Economic

The study area for economic effects is the same as used for the other socio-economic components as described in Section 6.1.4.17.

6.1.4.19 Human Health

The study areas for the evaluation of the effects of the Project on human health are dictated by the study areas for those disciplines that will contribute, directly or indirectly, to potential health effects. For this reason, the local study area (LSA) for air quality (Figure 6.1.4.6-1) has been selected as the LSA for health effects. The air quality and health LSA is sufficiently large to capture virtually all of the effects of the Project on air quality. As described in Section 6.1.4.6, the predicted effects of the Project on air quality are effectively at background levels at the limits of the LSA.

As part of the description of the air quality study areas (Section 6.1.4.6), a series of 44 sensitive receptors were introduced. These receptors correspond with the closest residential locations to the Project and represent the locations likely to experience the highest prolonged exposures to emissions and associated changes in air quality. Information is not readily available to determine which of these sensitive receptors represent Aboriginal receptors, and which represent non-Aboriginal receptors.

The health assessment also considers the potential effects of changes in water quality and changes in food quality on human health. Given the nature of the Project, these effects will all be higher the closer to the Project the individual exposed is located. Therefore, the majority of these effects will be captured within the air quality LSA.

6.1.4.20 Heritage Resources

As described in Section 6.1.3.19, the heritage resources component of the assessment focusses on those components of the environment regulated under the *Ontario Heritage Act*. As such, the heritage resources assessment focussed on the areas where there was a potential for the Project to result in physical disturbance of the ground, which could, in turn, affect any archaeological of historic heritage sites. The local study area (LSA) for the archaeological assessment was presented in Appendix U to the EIS, and has been reproduced as Figure 6.1.4.20-1. This archaeological LSA covers the areas where the open pit, waste rock storage area (WRSA), tailings storage facility (TSF) are proposed. The LSA also included one area to the south of proposed Project where one of the alternative locations that was originally being considered for the storage of tailings. The archaeological evaluation also considered the potential for areas adjacent to the subject property to confirm the accuracy of evaluations made, and to identify whether there were nearby areas that would have been the preferred locations for settlement, with an emphasis on factors such as available food resources (e.g., fish, rice), and access (travel routes).

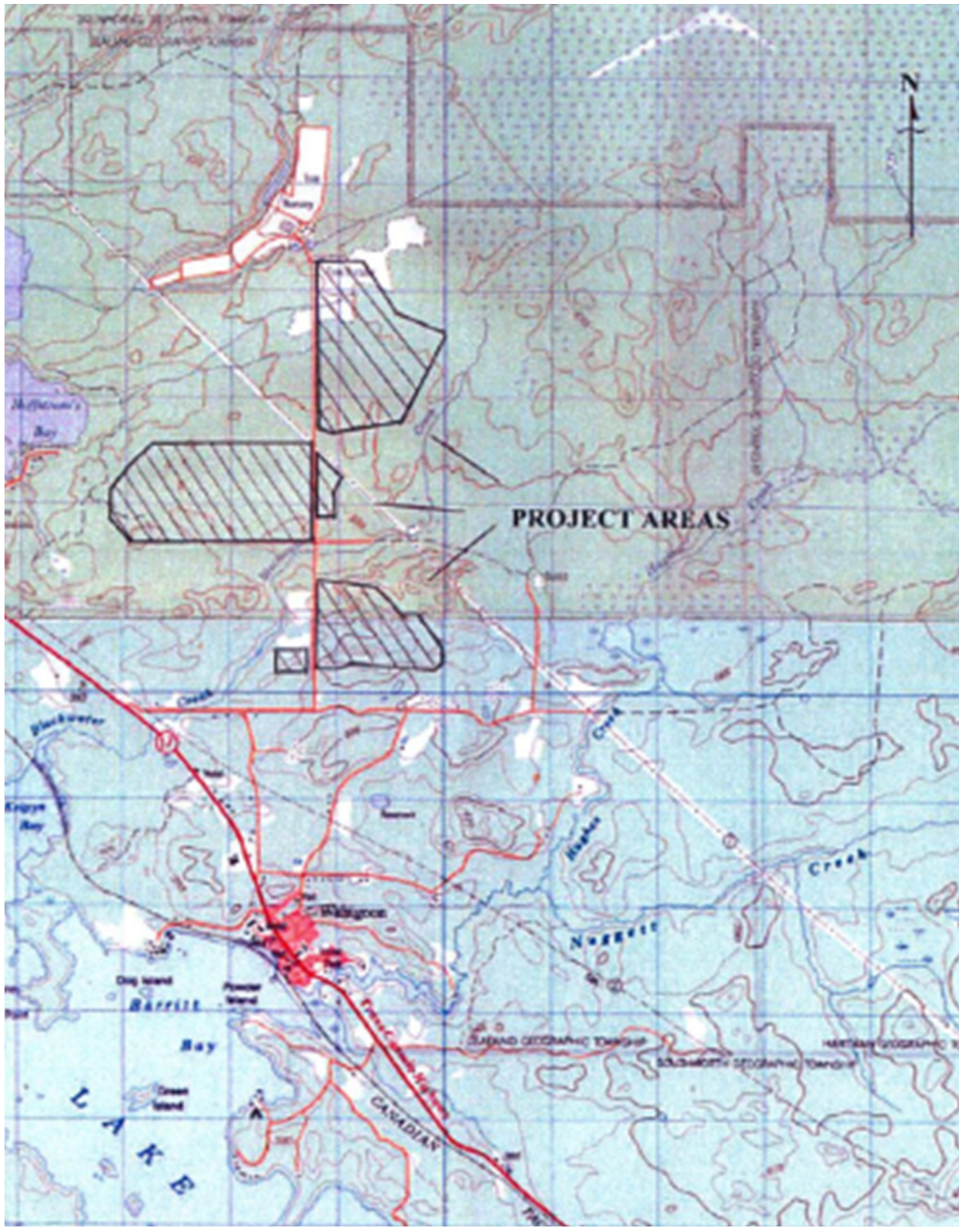


Figure 6.1.4.20-1: Heritage Resources Local Study Area (LSA)

The scope of the LSA used for the assessment of the effects of the Project on heritage and culture VCs is considered appropriate given the nature of the Project and the areas where physical disturbances will occur. Expanding the geographic scope of the archaeological and heritage assessment LSA beyond the development footprint area, as was suggested in one reviewer in the Round 1 information requests (TMI_664-AC(1)-337) would not substantively change the results of the assessment or evaluation of impacts. The archaeological assessment completed was done using a methodology developed by Ministry of Tourism, Culture and Sport (MTCS), and

is based on common archaeological practice. The reports prepared were submitted to MTCS for review, who expressed satisfaction at the recommendations made.

As part of the Round 1 information requests, the following questions was asked that specifically addressed the study areas used for the evaluation of effects of the Project on heritage resources:

- TMI_664-AC(1)-337: expand the study area

As part of the Round 1 information requests, questions were also raised with sites and activities considered to be culturally important by Aboriginal peoples. The importance of these effects is recognized by Treasury Metals, and the potential effects on these resources to Aboriginal peoples are assessed as part of the Aboriginal peoples VCs discussed in Section 6.1.3.20. The study areas for the Aboriginal peoples VCs is discussed in Section 1.4.21.

6.1.4.21 Aboriginal Peoples

The study area for Aboriginal peoples effects are the same as used for the other socio-economic components as described in Section 6.1.4.17.

6.1.5 Selection of Temporal Boundaries

The total lifespan of the Project is approximately 17 years, beginning with preparation of then site for construction activities and ending with the completion of the closure activities (EIS: Executive Summary). For the purposes of the EIS, the Project life has been divided into the following four phases, which are described below:

- Site preparation and construction phase;
- Operations phase;
- Closure phase; and
- Post-closure phase.

The above phases are deemed suitable to capture all of the environmental effects associated with the Project. Although the majority of activities associated with the Project will occur during the first three phases, some effects will occur during the post-closure phase.

6.1.5.1 Site Preparation and Construction Phase

Before mining operations can commence, Treasury will need to prepare the site and construct key elements of the Project infrastructure. The first activities to occur will be associated with the preparation of the site. These activities will include:

- Establish and implement environmental protection and monitoring plans;
- Initiate overburden stripping;
- Establish water management and flood protection infrastructure;
- Construction of dams and water realignment channels/ditches; and
- Construction of support buildings and infrastructure.
- Dewater ponds and wetlands within footprint of proposed infrastructure;
- Establish water management and flood protection infrastructure for mine components;
- Construct surface drainage diversion structures and water realignment channels/ditches;
- Construction of any access roads for planned infrastructure;
- Initiate overburden stripping over the ore body, the tailings storage facility (TSF) location, and mill site; and
- Construction of support buildings and infrastructure required for construction.

Treasury will initiate construction once site preparation activities are completed, with some activities overlapping in time (e.g., construction in one area of the site while site preparation in another area continues). Construction activities will be coordinated according to manpower and equipment availability, scheduling constraints and site conditions. Some activities, particularly those involving work in wet or poorly developed accessible terrains are best carried out under frozen ground conditions. Some of the key construction activities include:

- Procurement of materials and equipment;
- Movement of construction materials to identified laydown areas and site;
- Construction of additional site access roads and any possible required realignment of existing roads;
- Development of aggregate source(s) anticipated to be principally for possible concrete manufacturing, foundation work and TSF dam filter zones;
- Construction of the TSF;

- Establishment of site drainage works, including pipelines from freshwater/recycled water sources;
- Development and installation of construction facilities;
- Construction of associated building and facilities;
- Preparation of on-site mineral waste handling facilities; and
- Construction and energizing of a 115 kV transmission line including on-site electrical substation.

Overall, this phase of the project could last up to two years in length.

6.1.5.2 Operations Phase

Ore will begin to be produced immediately by processing incoming material from the open pit. The process plant will operate at approximately 2,700 tonnes per day (tpd) to process a total of approximately 5,500,000 tonnes of open pit ore and 3,500,000 tonnes of underground ore over the 10 to 12 year operational phase of the mine.

As the operations phase continues, the open pit will become progressively deeper. Approximately one half of the waste rock will be used to backfill the mined-out areas of the pit. The TSF capacity will be increased as required through dam raises.

Solid and liquid wastes/effluent will be managed to ensure regulatory compliance. Environment related activities that will be carried out during the operations phase are anticipated to include:

- Ongoing management of chemicals and wastes;
- Water management/treatment;
- Air quality and noise management;
- Biological monitoring;
- Environmental monitoring and reporting;
- Follow up environmental studies; and
- Progressive site reclamation, where practical.

6.1.5.3 Closure Phase

Closure of the Project will be governed by the *Ontario Mining Act* (the Act) and its associated regulations and codes. The Act requires that a closure plan be filed before the Project is initiated. Financial assurance is required before any substantive development takes place to ensure that funds are in place to carry out the closure plan.

The objective of the closure plan is to reclaim the Project site area to a naturalized and productive biological state when mining ceases. The terms naturalized and productive are interpreted to mean a reclaimed site without infrastructure, which while different from the existing environment, is capable of supporting plant, wildlife and fish communities, and other land uses. Treasury Metals expects the active closure period at the Project will take approximately two years after operations cease.

6.1.5.4 Post-closure Phase

Following the Closure Phase there will be a period of time (i.e., the Post-closure Phase) required until the final pit is fully flooded. During the Post-closure Phase, Treasury Metals will hold the site in care maintenance. Environmental monitoring and potentially effluent quality management will occur during this passive period of reclamation of post-closure. Once the pit is flooded, an additional period of active reclamation may occur to remove remaining Project infrastructure that was retained to facilitate the maintenance, monitoring, and final post-closure activities.

6.1.5.5 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, the following questions asked for information, clarification and/or justification for the temporal boundaries used in the EIS:

- TMI_235-HE(1)-42: Define temporal boundaries;
- TMI_388-AC(1)-63: Define temporal boundaries;
- TMI_524-AC(1)-198: Define temporal boundaries;
- TMI_539-AC(1)-213: Define temporal boundaries; and
- TMI_559-AC(1)-233: Define temporal boundaries.

6.1.6 Approaches for Prediction/Description of Project Effects

As part of the Round 1 information requests, Treasury Metals noted that there were a number of questions from the Agency and other reviewers related to the approach used in the EIS for organizing and presenting information regarding the potential effects of the Project. One notable

group of questions focused on the presentation of the description of the Project effects presented in Section 6.4 of the original EIS. Within the original EIS, the predicted effects and the determination of the significance of those effects was done collectively. In order to effectively address this, the revised EIS organizes the information in accordance with the EIS Guidelines using the following steps:

- **Likely Effects of the Project on the Environment**: The likely effects of the Project during each of the four Project phases (described in Section 6.1.5) are identified, along with the possible linkages between the various components. This is important as it should help the reviewers understand the connectivity between aspects of the environment that have been considered as part of the assessment.

- **Effects Prediction Methods**: Depending on the component and VC, effects can be predicted using quantitative methods (e.g., modelling), qualitative methods, or a combination of both. The methods used for predicting or describing the effects of the Project will be outlined, along with descriptions of models used, inputs to the models, assumptions used in the modelling and sources of data relied on.

- **Project Effects Avoidance Measures Used in Predictions**: As part of the Project design, there are aspects of the Project that will help avoid effects on the environment, and are incorporated into the effects predictions. Each of these avoidance measures will be set out and described, and if appropriate, the efficacy of the avoidance measured provided.

- **Predicted Effects**: The presentation of the predicted effects will make use of table to present the predicted effects in a way that can be related to the VCs being considered, and can be traced through the various stages of the assessment process.

- **Mitigation Measures**: In keeping with the objectives identified in the EIS Guidelines, Treasury Metals has adopted an approach to their Project that would avoid effects whenever practical. Where residual effects remain, Treasury will identify and clearly list enforceable measures that can be used to mitigate those effects. In keeping with the EIS Guidelines, such mitigation should be technically and economically feasible. The identified technically and economically feasible mitigation measure will be listed, along with those measures employed to help avoid effects so as to provide a clear outline of the actions to be used by Treasury Metals to avoid or mitigate the effects of the Project for each component of the assessment.

  To facilitate the review process, and to facilitate the management activities once the Project is operational, each of the avoidance measures and mitigation measures are provided with a unique identifier. In some cases, a single measure will be associated with multiple disciplines, and appears several locations throughout Section 6. A summary of all

of the mitigation measures relied on to avoid or lessen effects has been provided in Section 6.22.

- **Residual Effects**: Residual adverse effects are those that remain after technically and economically feasible mitigation measures are applied. The residual effects that remain after mitigation are those that are carried forward for consideration of possible cumulative effects (Section 7) and ultimately for the determination of significance (Section 8). Where the identified residual effects have a spatial component, these have been presented graphically in the context of where the predicted effects of the Project are identified as having the potential to impact traditional uses of the land.

The prediction/description of Project effects for each of the components evaluated in the EIS are presented in Sections 6.2 through 6.21. As described in Section 6.2.1, questions raised as part of the Round 1 information requests regarding the approach for predicting the effects, the effects themselves or the mitigation measures will be listed for easy cross reference. Responses to the information requests have been provided separately, and the relevant information incorporated into the text for the relevant components.

6.1.7 Approach for Evaluating Cumulative Effects

In keeping with the EIS Guidelines as well as the Round 1 information requests, the revised assessment of cumulative effects was done in a different manner that was used in the original EIS.

6.1.8 Approach for Determination of Significance

All residual and cumulative effects identified for the Project will be advanced for the determination of significance. This will be done giving consideration to the following, as required in Section 13.1 of the EIS Guidelines (CEAA, 2013):

- Magnitude;
- Geographic extent;
- Timing, duration and frequency;
- Reversibility;
- Ecological and social context; and
- Existence of environmental standards, guidelines or objectives for assessing the impact.

The determination of significance has been presented in Section 8 of this report and is organized in the following manner.

- **Methodology for Assigning Significance for Residual Adverse Effects**: This will include a detailed description as to how the above assessment measures were determined. In some cases, such as magnitude, the determination varies by component

and VC. In other cases, such as geographic extent, a common approach for all components and VCs. Where feasible, the approach for assigning measures will be quantitative, or clearly described if qualitative.

- **Determination of significance of residual adverse effects for each component**: The determination of significance will be completed for each of the components using the methods set out at the beginning of Section 8 of the revised EIS. In each case, the residual adverse effects and cumulative will be restated, the assessment measures outlined above will be assigned, and finally a determination of significance will be made. This determination will be made in two ways. Firstly, the decision tree introduced in Section 6.1.4 of the original EIS will be re-applied using the newly determined effects levels. Secondly, a "reasoned argument" approach will be applied where a hypothesis is provided of what would constitute a significant adverse effect for the component or VC, and the predicted residual adverse effects of the Project tested against that hypothesis.

6.2 Terrain and Soils

6.2.1 Potential Effects of the Project on the Environment

The potential effects of the Project on terrain and soils will commence during the site preparation and construction phase, with some effects continuing through into post-closure. The following lists the potential effects of the Project on terrain and soils by phase:

- **Site preparation and construction phase:**
  - Stripping of overburden in preparation for mining activities, and their storage in stockpiles will expose soils to the risk of erosion; and
  - The construction of the overburden stockpiles produce features that extend above the surrounding terrain.
- **Operations phase:**
  - Overburden stockpiles created during the site preparation and construction phase will remain features that extend above the surrounding terrain throughout the operations phase;
  - The continued storage of soils in the overburden stockpiles will expose them to the risk of erosion;
  - The construction of the waste rock storage area (WRSA) will produce a feature that will extend above the surrounding terrain;

- The construction and operation of the low-grade ore (LGO) stockpile will produce a feature that will extend above the surrounding terrain; and
- Mining activities will involve the use of chemicals and fuels that could affect the chemical compositions of soils in the event of spills;

- **Closure phase:**
  - Overburden stockpiles will be decommissioned and the soils used in the closure and reclamation of the site;
  - The LGO stockpile will be exhausted at the end of operations, or remaining material will be removed and placed within the open pit mine; and
  - The WRSA will remain after the closure of the Project, with the surface of the WRSA covered with a low permeability cover to reduce the potential for acid generation.

- **Post-closure phase:**
  - The closed WRSA will remain as a permanent feature on the landscape.

The potential effects of the Project on landscape and noise have been described using a simple linkage diagram on Figure 6.2.1-1. The figure illustrates the terrain and soil VCs (shown in blue on the figure) that are potentially affected during each phase of the Project. Additionally, the figure indicates those other components of the environment (shown in red in the figure) where the predicted effects of the Project on terrain and soils will act as an input for determining the effects on other VCs. For example, the physical features constructed during the various phases of the Project (i.e., overburden stockpiles, WRSA, LGO stockpile) will be used as an input for determining the potential effects of the Project on land and resource use. There are no other components or VCs that provide inputs to the assessment of noise effects.

6.2.2 Effects Prediction Methods

The effects of the Project on terrain and soils are described using qualitative and semi-qualitative methods consistent with the nature of the potential effects. The descriptions potential effects of the Project on the “natural landscapes” VC considered the heights of the constructed landscape features at the Project (i.e., overburden stockpiles, WRSA, LGO stockpile) to the existing terrain and vegetation. The potential effects of the Project on the “overburden” VC are described qualitatively, focussing on the activities to manage the overburden stripped during the site preparations and constructions phase, and stored in stockpiles until closure activities occur at the end of mining. Finally, the potential effects of the Project on the “soil chemistry” VC are also described qualitatively. These effects would only occur in the event there are spills of fuels or chemicals at the Project, and the potential effect on “soil chemistry” VC is dependent on the activities to manage any spill and remediate the effects.

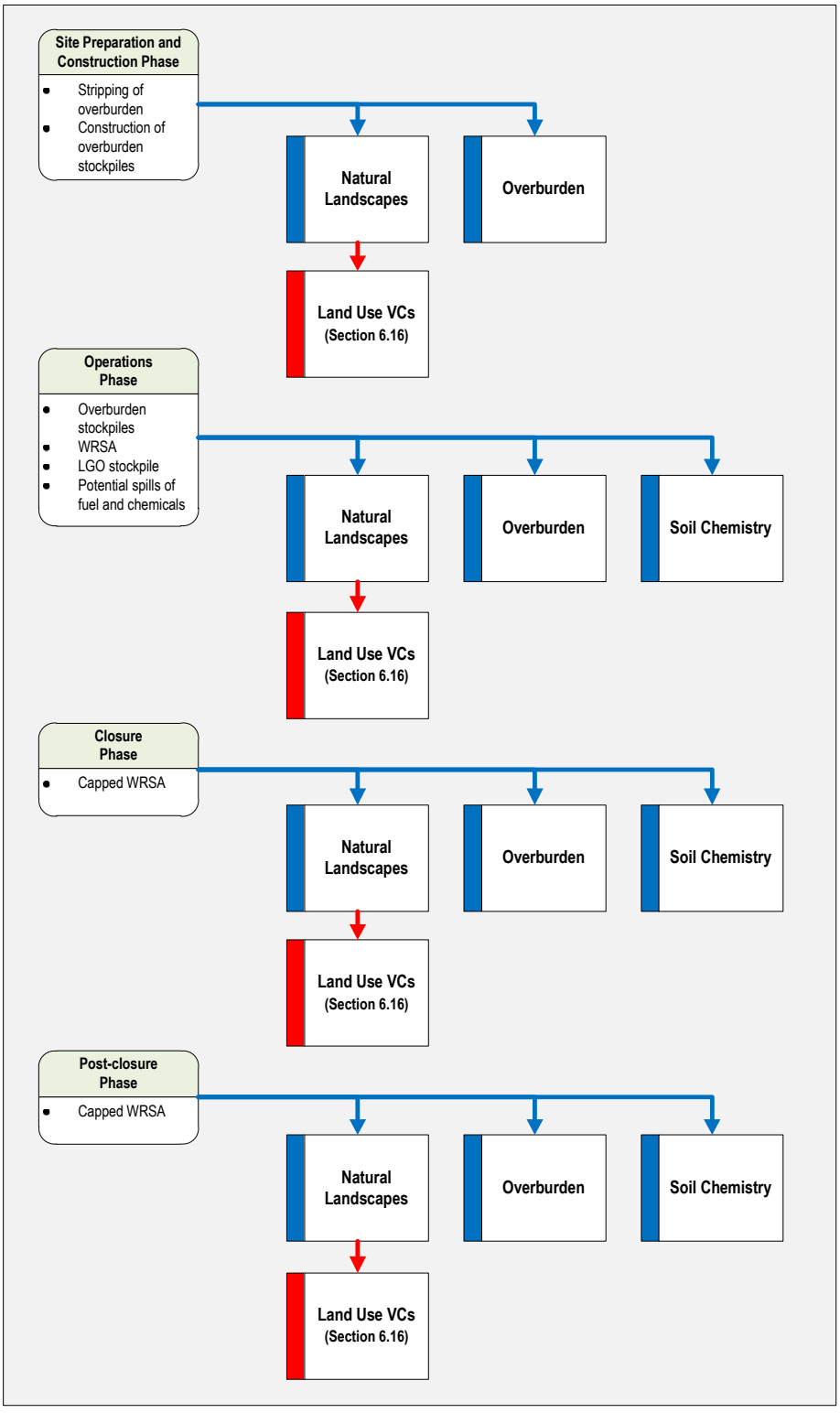


Figure 6.2.1-1: Terrain and Soils Linkage Diagram

6.2.3 Project Effects Avoidance Measures Used in Predictions

6.2.3.1 Natural Landscapes

As part of the design of the Project, Treasury Metals have incorporated the following to help mitigate the potential effects of the Project on the “natural landscapes” VC:

- Reduce the overall height of the constructed landscape features, to the extent possible [Mit_001].
- Use an overall slope of 3:1 (horizontal to vertical) for the WRSA to maintain a more natural looking slope [Mit_002].
- Use of a program in which the WRSA construction and revegetation is initiated on the western edge as soon as possible. This helps create a natural looking feature when viewed from Thunder Lake [Mit_003, Mit_004].
- Once the overburden stockpiles are constructed, during the site preparation and construction phase, they will be vegetated to avoid the potential for erosion and make the features appear as natural as possible [Mit_005].
- At the end of mining, the low-grade ore (LGO) stockpile will be exhausted of materials, or if materials remain they will be removed and disposed of in the open pit prior to flooding [Mit_006].

6.2.3.2 Overburden

As part of the design of the Project, Treasury Metals have incorporated the following to help mitigate the potential effects of the Project on the “overburden” VC:

- Overburden materials (clay, sand or organic material) stripped during the site preparation and construction phase will placed in the overburden stockpiles located directly to the south of the proposed open pits [Mit_007].
- The slopes of the stockpiles will generally have slopes at a grade of 3:1 (horizontal to vertical) [Mit_002].
- Slopes may be protected from erosion by vegetation until needed for reclamation [Mit_005].
- Ditching and seepage collection will be installed around the edges of the stockpile to direct and collect surface water runoff and seepage [Mit_008].

6.2.3.3 Soil Chemistry

The potential effects of the Project on soil chemistry are associated with the potential for spills or leaks of fuels and other chemicals. Such occurrences are not part of the planned operations of the Project, and represent upset conditions, the likelihood of which will be managed through the implementation of careful management procedures. In the unlikely event any spill does occur at the site, treasury Metals will ensure that procedures are followed to contain any spilled materials, and remediate any effects on the soils at the site to ensure that all soils remain suitable for use at the closure of the Project. The following specific measures will be incorporated by Treasury Metals in the design and operations to avoid effects on the "soils chemistry" VC:

- Equipment will be maintained in good working order and inspected regularly to ensure the equipment is not leaking [Mit_009].

- Re-fueling of equipment will be done in a manner to limit the potential for spills. Fuel will be stored in a lined, contained area. Fueling vehicles will be parked in a concrete lined area when not in use [Mit_010, Mit_011. Mit_012].

- Emulsion will be stored and dispensed in a lined, contained area. Trucks used for the delivery of emulsion will be parked in a concrete lined area when not in use [Mit_013, Mit_014].

- The processing plant area will be lined and equipped with seepage collection system and perimeter ditching to protect the soil beneath and adjacent from effects [Mit_015].

- The low-grade ore (LGO) stockpile area will be lined and equipped with a seepage collection system and perimeter ditching to protect the soil beneath and adjacent from effects [Mit_016].

- Activities on the overburden stockpiles will be minimized and the stockpiles left undisturbed until closure activities are underway [Mit_017].

6.2.4 Predicted Effects

6.2.4.1 Natural Landscapes

The most prominent constructed landscape feature at the Project will be the waste rock storage area (WRSA), which will be constructed adjacent to the north of the open pit. The overburden stockpiles will be constructed immediately to the south of the open pit and will be approximately 10 lower in height than the WRSA. As described in Section 3.1.3, Treasury Metals has endeavored to design the Project so as to reduce the overall height of the WRSA as much as possible. Additionally, Treasury Metals has proposed to use an overall slope of 3:1 (horizontal to

vertical) for the WRSA to maintain a more natural looking slope. The dimensions of the WRSA and overburden stockpile are listed in Table 6.2.4.1-1.

Table 6.2.4.1-1: Pit Lake Water Quality and Seepage Quality (dry TSF cover option)

Feature	Area (ha)	Length (m)	Average Width (m)	Maximum Height (m)
WRSA	37	1,264	315	25 – 30
Overburden stockpiles	25.6	855	285	15

The relative height of the WRSA to the surrounding landscape, as well as the exposure of the WRSA to view from individuals using Thunder Lake (the closest point of public access where the WRSA could be visible are illustrated in Figures 6.2.4.1-1 and 6.2.4.1-2. As shown in the figures, the WRSA will not be visible from the eastern portion of the lake but will be visible from the western side of the lake. The other features on the site (i.e., overburden stockpile and LGO stockpile) would not likely be visible because of their smaller height. In addition, these features would be decommissioned as part of the closure activities.

6.2.4.2 Overburden

As described in Section 6.1.3.2, Treasury Metals will implement practices that will protect and maintain the overburden materials removed during the site preparation. The overburden stockpiles will be constructed immediately to the south of the proposed open pit, and will generally be built using relatively shallow side slopes of 3 horizontal width to 1 vertical height. Slopes will also be allowed to develop a cover of vegetation until the overburden in used in the reclamation activities at the closure of the Project. Ditching and seepage collection will be installed around the edges of the stockpile to direct and collect surface water runoff and seepage.

Due to the conservative design factors placed on the overburden stock pile linked to the low seismicity potential in the Project area, there is an extremely low risk for failure of the slopes to the overburden stockpile due to either foundation conditions or a seismic event. Although the current design is considered to be well within a reasonable factor of safety, Treasury Metals continues to advance the engineering design of the Project such that it can be constructed in a safe and efficient manner. Part of this advancement is further geotechnical studies that will help to supplement a final Feasibility study. Subsequent to the Feasibility study, Treasury Metals will complete an engineered design for all landscape features to be constructed at the Project, including the overburden stockpile. This will take into account the most current engineering practices and will require the approval of a professionally designated engineer prior to construction.

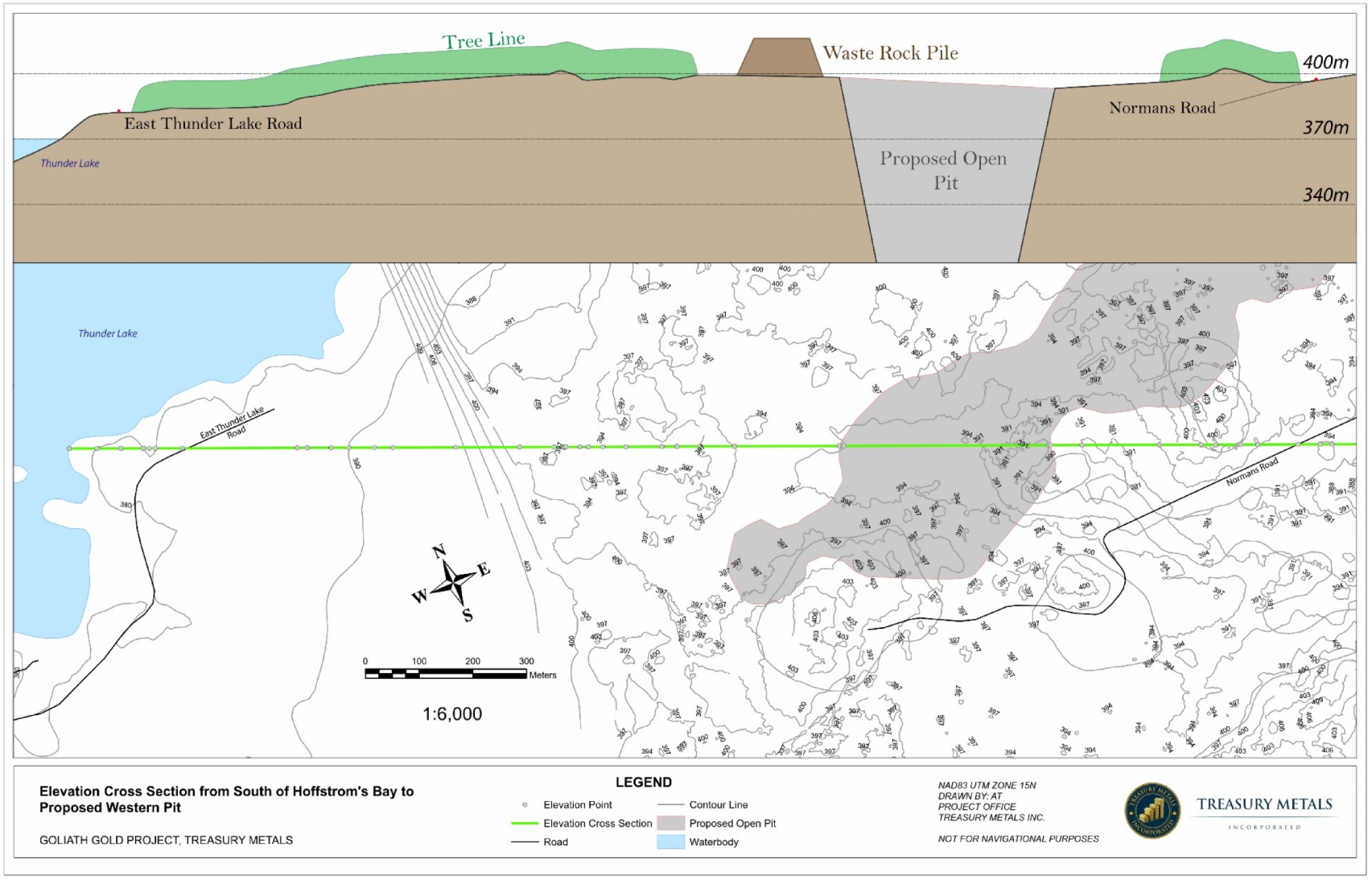


Figure 6.2.4.1-1: Cross Section from South Hoffstrom's Bay, Showing Relative Height of WRSA

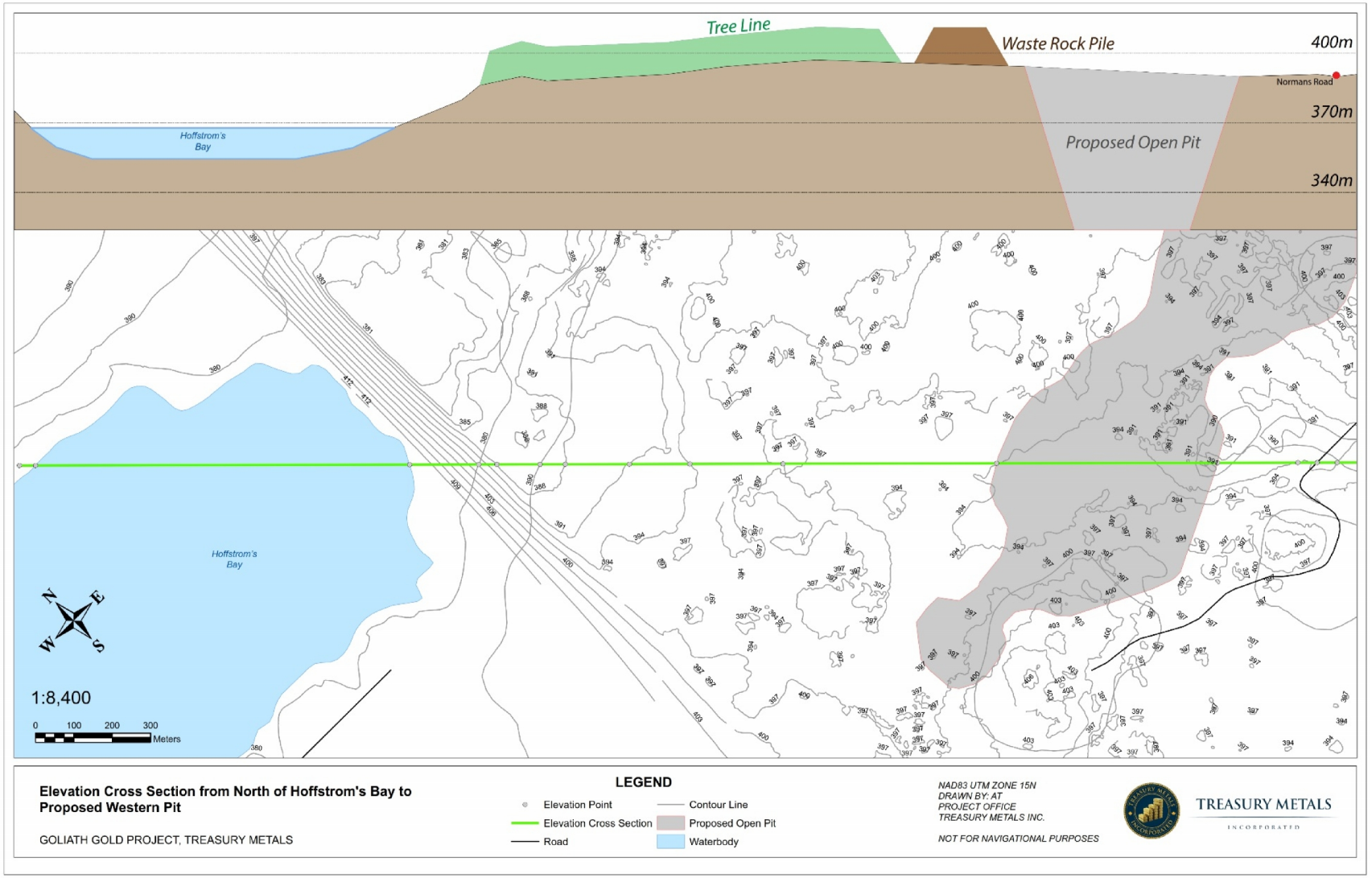


Figure 6.2.4.1-2: Cross Section from North of Hoffstrom's Bay, Showing Relative Height of WRSA

6.2.4.3 Soil Chemistry

As described in Section 6.2.3, Treasury Metals will implement procedures at the Project to limit the potential for spills and leaks that could affect soil chemistry. In the unlikely event that a spill or leak does occur (Section 6.2.4), procedures will be put in place to either remediate any soils that are affected.

6.2.5 Identified Mitigation

The following design features and procedures will be implemented as part of the Project to minimize or avoid the effects of the Project on the terrain and soil VCs:

- Natural landscapes
    - Limit the height of the constructed landscape features [Mit_001].
    - Use slopes of 3:1 (horizontal to vertical) to maintain a natural looking slope [Mit_002].
    - Vegetate the western edge of the WRSA to create a natural looking feature [Mit_004].
    - Vegetate overburden stockpiles once constructed to make them appear natural [Mit_005].
    - Remove material from the low-grade ore (LGO) stockpile during closure [Mit_006].
- Overburden
    - Place overburden materials stripped during the site preparation and construction phase the overburden stockpiles [Mit_007].
    - Use slopes of 3:1 (horizontal to vertical) and protect from erosion by vegetation [Mit_002].
- Soil Chemistry
    - Maintain equipment in good working [Mit_009].
    - Re-fueling done in a manner to limit the potential for spills [Mit_010].
    - Store fuel in a lined, contained area [Mit_011].
    - Fueling vehicles will be parked in a concrete lined area when not in use [Mit_012].

- Emulsion will be stored and dispensed in a lined, contained area [Mit_013].
- Emulsion delivery vehicles will be parked in a concrete lined area when not in use [Mit_014].
- The processing plant are will be lined and equipped with runoff collections system and perimeter ditching to protect the soil beneath and adjacent from effects [Mit_015].
- The low-grade ore (LGO) stockpile area will be lined and equipped with runoff collections system and perimeter ditching to protect the soil beneath and adjacent from effects [Mit_016].
- Activities on the overburden stockpiles will be minimized and the stockpiles left undisturbed until closure activities are underway [Mit_017].

In addition to these measures, Treasury Metals will regularly review their procedures and processes during the life of the Project to identify opportunities where practices can be modified, and new procedures put in place to further reduce and mitigate the potential effects of the Project.

6.2.6 Residual Adverse Effects

With consideration of the effects avoidance measures listed in Section 6.2.3 and the mitigation measures listed in Section 6.2.5, the following residual adverse effects remain for the terrain and soils VCs:

- **Natural Landscapes**: While smaller features on the site, including the overburden stockpiles and the LGO stockpile would effectively not extend above the treeline, and thus would not be visible beyond the operations low. Although the WRSA will be constructed with relatively shallow 3:1 (horizontal to vertical) side slopes, the WRSA may still be visible from certain areas of Thunder Lake.
- **Overburden**: There would be no residual effects on overburden as the material will be stockpiled during the site preparation and construction phase, and then covered to prevent erosion.
- **Soil Chemistry**: Finally, the soil chemistry will be protected through the implementation of procedures to minimize the potential for equipment leaks and spills at the Project. In the unlikely event leaks or spills occur, procedures to remediate any affected soils will be implemented. There would be no residual effects for soil chemistry.

The residual adverse effects for terrain and soils remain after the implementation of technically and economically feasible mitigation and avoidance measures are set out in Table 6.2.6-1.

Table 6.2.6-1: Residual Adverse Effects on Terrain and Soils

Valued Components (VCs)	Site Preparation and Construction	Operations	Closure	Post-closure
Natural landscapes	—	WRSA 25 to 30 m tall 3:1 slopes (h:v) West face re-vegetated	WRSA 25 to 30 m tall 3:1 slopes (h:v) Fully re-vegetated	WRSA 25 to 30 m tall 3:1 slopes (h:v) Fully re-vegetated
Overburden	—	—	—	—
Soil chemistry	—	—	—	—

Note: The "—" symbol indicates where there were no predicted residual adverse effects

Although there were no predicted residual effects of the Project on either the overburden and soil chemistry VCs, it is expected that the entire operations area would be affected to a point where traditional uses would not be possible during the site preparation and construction, operations and closure phases. The operation area would be available following the completion of the closure activities. The effect of the WRSA on the natural landscapes VC was the only residual adverse effects identified for the terrain and soils component. The WRSA will be the most prominent feature on site, and could be visible from areas on Thunder Lake. While the appearance of the WSRA would not alter the ability of Aboriginal peoples to practice traditional land uses, the WRSA would be noticeable and could be considered as altering the experience for those practicing traditional uses of the land. However, the WRSA will be covere3d and re-vegetated as part of the closure activities, making it unlikely that the WRSA will distinguishable from surrounding area.

Figure 6.2.6-2 illustrates provides an illustration of the extent of the predicted residual effects of the Project on the terrain and soil VCs. The operations area will disturbed throughout the operating life of the mine and is therefore considered to be unsuitable for use for traditional purposes. This portion of Figure 6.2.6-2 has been shaded in gold to indicate it as being impacted from the perspective of use for traditional purposes. The figure also illustrates the areas where the WRSA would be visible. These areas are shaded in green to indicate that traditional used of the land can still occur within the shaded areas, but that the Project effects from a terrain and soil perspective could be noticeable to those practicing traditional uses of the land.

6.2.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, the following questions were wholly, or partially, asking for information, clarification and/or justification for the approach used in predicting the effects of the Project on terrain and soils. Responses to the IRs were provided separately, and incorporated into the relevant sections of the Revised EIS. The following lists the Round 1 IRs related to the effects predictions for terrain and soils:

- TMI_39-MW(1)-01: dimensions of on-site features;
- TMI_229-HE(1)-36: Views of WRSA from Thunder Lake; and
- TMI_249-AM(1)-07: Stability of slopes.

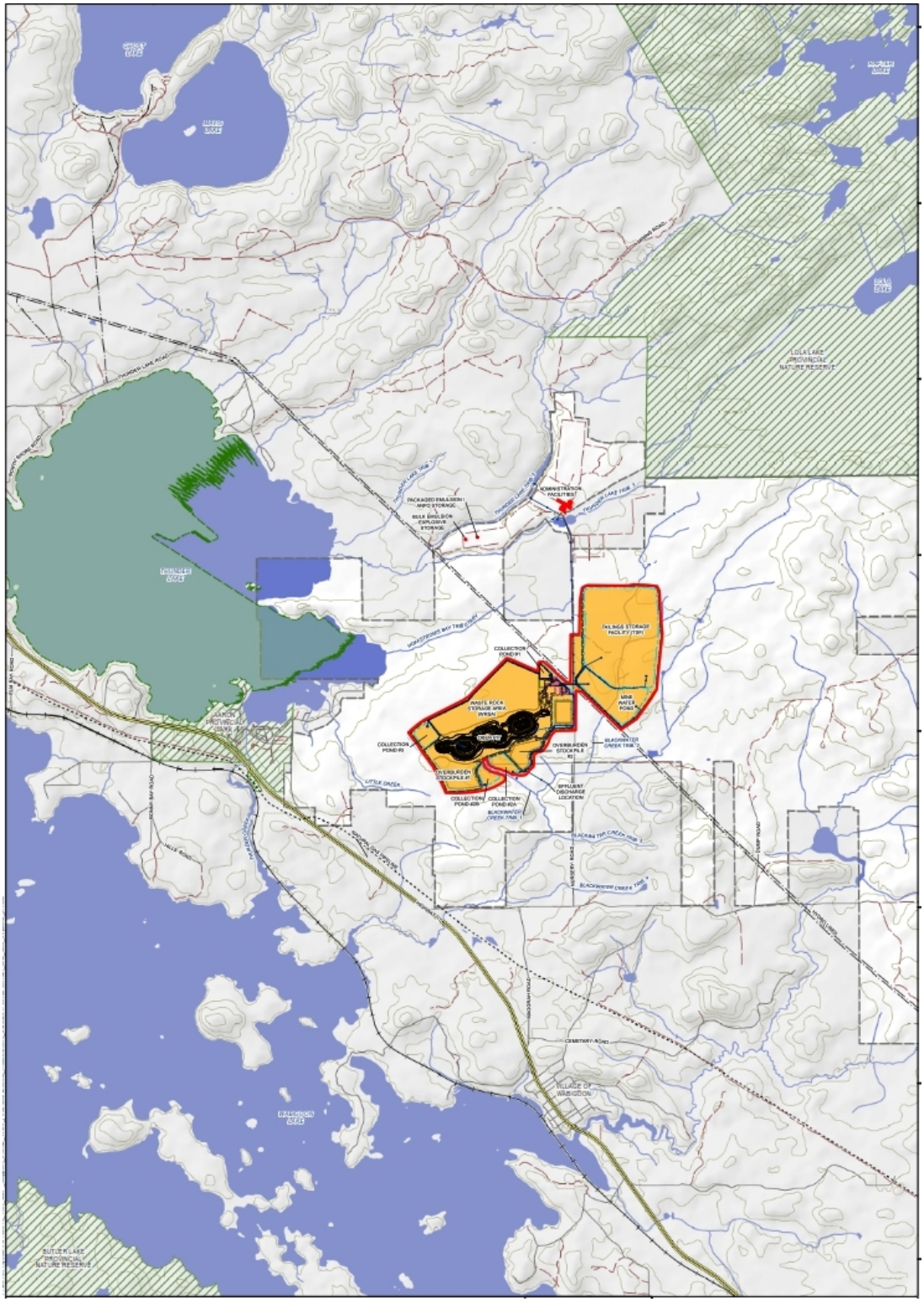


Figure 6.2.6-1: Spatial Extent of Effects for Terrain and Soils

6.3 Geology and Geochemistry

6.3.1 Potential Effects of the Project on the Environment

As described in Section 6.1.3.2, a single valued component “pit lake water quality” has been selected to help describe the potential effects of the Project related to geology and geochamistry. Geology and geochemistry were identified as being important as they determine the chemical transformations the mined material may experience when exposed over time. The following lists the potential geology and geochemistry effects by Project phase.

- **Site Preparation and Construction Phase**: There is expected to be no geochemical effects during the site preparation and construction phase as there will be no mining or processing activities underway during this relatively short phase of the Project.

- **Operations Phase**: During the initial stages of operations, waste rock will be mined and placed in the waste rock storage area (WRSA), immediately to the north of the proposed open pit. The material within the WRSA will be exposed to the elements until covered with a low permeability during closure activities.

  Once the open pit advances beyond pit 1, waste rock will be placed in the mined out sections of the open pit instead of in the WRSA. The waste rock in the open pit will be exposed to the elements until covered by water once the open pit is allowed to flood following closure.

  Tailings and water from the processing of the ore will be treated to remove cyanide and then discharged to the tailings storage facility (TSF) sub-aqueously. The tailings within the TSF will be maintained below a water cover to prevent acidification throughout operations.

  During operations, the open pit and underground mine will be dewatered to maintain a safe working environment. These dewatering activities will result in a drawdown zone of the water table, which will allow for groundwater and seepage within the drawdown zone to the open pit where it will managed as part of the minewater management system. This water will be used within the mining and processing operations, to the extent possible. Excess water will be treated to meet the Provincial Water Quality Objectives (PWQO) prior to discharge to Blackwater Creek.

  During operations, seepage from the WRSA and TSF will be collected in perimeter seepage collection systems and incorporated into the minewater management system. Any seepage that escapes the seepage collection systems will be captured within the drawdown zone caused by the dewatering of the open pit and underground mine, and will report to the open pit where it will be collected and managed. No seepage from the on-site facilities would leave the site during the operations phase.

- **Closure Phase**: Following the end of mining activities, the process water covering the TSF will be withdrawn, treated and used to help fill the open pit. The tailings will be physically isolated with a granular cover and then chemically isolated using either a dry, low-permeability cover or a wet cover using non-process water.

  The WRSA will be covered with a dry, low-permeability cover to reduce the potential for acidification. The waste rock placed within the open pit will remain exposed until covered with water as the open pit is allowed to flood. Following closure, equipment, chemicals and fuel present in the open pit will be removed and the open pit prepared for flooding. Dewatering activities will cease and the open pit and underground mine will be allowed to fill with water. The water to fill the pit will come from a combination of site runoff, water from the TSF and groundwater. It is expected to take between 5 and 8 years to fully flood the open pit, depending on weather conditions. At closure, all site drainage will be directed towards the open pit to aid in filling it with water. Although the dewatering activities will cease following the end of mining, the drawdown zone created during operations will remain during the post-closure phase. Groundwater and seepage within the drawdown zone will continue to be directed to the open pit and contribute to the filling.

- **Post-closure Phase**: In post-closure, all site drainage will continue to be directed towards the open pit. The open pit will be fully flooded between 5 and 8 years after the dewatering activities cease. This will create a pit lake that will eventually be allowed to release to Blackwater Creek Tributary 1 through an engineered spillway. Following the flooding of the open pit, groundwater will continue to flow into the open pit, contributing to the water that will be eventually released to Blackwater Creek Tributary 1. Once the open pit is filled, the groundwater table will return to the pre-development conditions and seepage from the WRSA and TSF will be able to escape the site and eventually affect adjacent surface water bodies.

The potential geology and geochemistry effects of the Project have been described using a simple linkage diagram on Figure 6.3.1-1. The figure illustrates that the geology and geochemistry VC “pit lake water quality” (shown in blue on the figure) is only going to be affected during the post-closure phase of the Project. Additionally, the figure indicates those other components of the environment (shown in red in the figure) where the predicted geology and geochemistry effects of the Project will act as an input for determining the effects on other VCs. For example, the seepage from the WRSA and TSF in the post-closure phase will be used as an input for determining the potential effects of the Project on surface water quality. In the case of geology and geochemistry, there are also effects that will directly affect both the surface water quality and groundwater quality VCs. Specifically, seepage from the WRSA and TSF are not considered assessment endpoints but are important inputs to understanding how the Project could affect the VCs for both of these components. The estimates of effects on the “pit lake water quality” VC rely on estimates associated with the surface water quantity and groundwater quantity VCs.

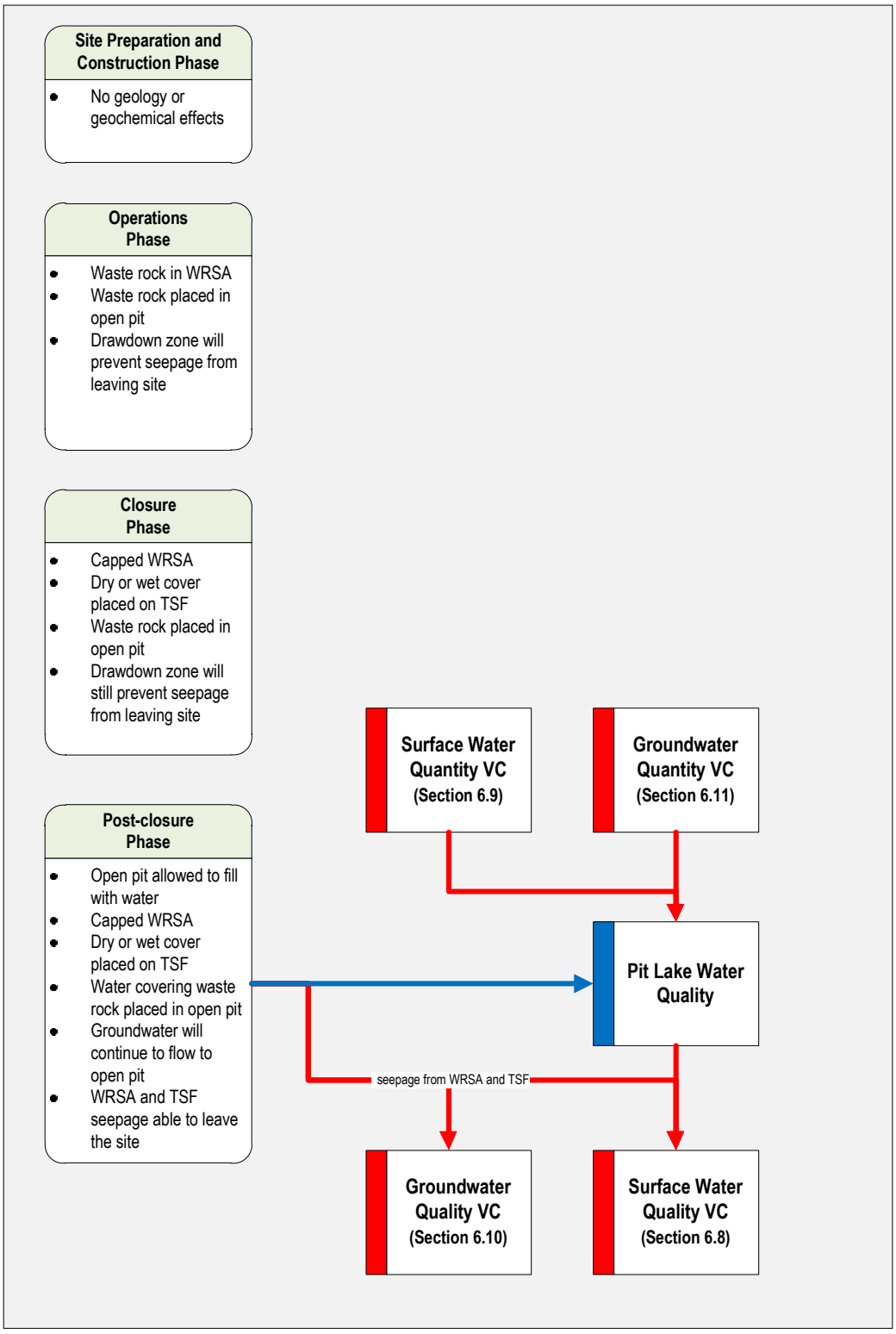


Figure 6.3.1-1: Geology and Geochemistry Linkage Diagram

6.3.2 Effects Prediction Methods

As part of preparing the responses to the Round 1 Information Requests, a re-evaluation of the available geochemical data was done to determine whether more conservative assumptions regarding the available information (provided in Appendix K to the EIS) would alter the assumptions and conclusions regarding either the potential for acid rock drainage (ARD) or metals leaching (ML). The following details the revised assessment of geochemistry prepared as part of the process to respond to the Round 1 information requests. Additional details regarding the re-evaluation of the geochemical assumptions has been provided in Section 5 of Appendix JJ (Water Report) to the revised EIS.

6.3.2.1 Pit Lake Water Quality Model

The estimated effects of the Project on the "pit lake water quality" VC made use of a mass balance water quality model that made use of the site water balance combined with estimated mass loading rates from the various loading sources at the site. The model is based on various defined mine plan constraints, site specific baseline monitoring results, laboratory data and assumptions/ estimates where site-specific data was not available.

Estimated loadings for each modelled constituent were determined on an annual basis. The post flooding pit water quality model applied the sum of the annual loads for each constituent while the pit floods to the final flooded volume of the open pit to determine each constituent concentration in an assumed completely mixed pit. The long-term pit water quality model applied the post flooding estimated annual load to the annual net pit in-flow to represent a steady-state average long-term water quality.

Open Pit Flooding Time

A flooded open pit is expected to limit sulphide oxidation on inundated pit walls and in-pit waste rock, therefore the time to flood the open pit was a key consideration in developing the water quality estimates. The water quality model therefore incorporated a simplified pit flooding scenario into the model design. The basis and assumptions for the pit flooding model included the following:

- A total pit volume to elevation 388 masl (spillway elevation) of 11.9 Mm^3;
- Final in-pit waste rock volume of 12.5 Mt with an assumed porosity of 19%;
- A constant groundwater inflow of 700 m^3/day;
- Surface catchment inflows assuming post-closure TSF dry cover hydrology that was adjusted in years 1 and 2 after end of mining for the uncovered WRSA and assumptions regarding run-off within the in-pit catchment;

- A one time transfer of 970,000 m^3 tailings supernatant in year one of the closure process; and

- Direction of all TSF run-off to the open pit in the closure and post-closure period.

The estimated pit flooding time for the above assumptions is 6.7 years after completion of mining. This value is based on the average meteorological conditions for the area. The actual filling is expected to be in the range of 6 to 8 years, depending on the actual meteorological conditions that are encountered.

Long-term Open Pit Water Quality Model

The long-term pit water quality model assumes the following post-closure conditions including:

- Flooded open pit with no legacy load inputs (no loads from in-pit waste rock or pit walls under water cover);

- Covered WRSA;

- Covered TSF; and

- All other steady-state surface and groundwater flows based on post-closure water balance.

6.3.2.2 Mass Loading Source Terms

Mass loading source terms were developed from site specific data or analogue site data as follows:

- Loadings from waste rock and open pit walls were derived based on surface area and scaled from laboratory humidity cell or field cell data.

- Due to a lack of site specific data, loadings from possible future acidic drainage from waste rock was estimated on an adjusted surface area basis from an unnamed analogue site with site specific adjustment of minor and trace metals based on acidic data from operating Project field cells.

- Loadings from tailings in the TSF were derived from estimated supernatant tailings water quality and laboratory tailings humidity cell data.

- Loadings from run-off on natural ground and the engineered WRSA and TSF covers were derived based on baseline surface water quality in natural drainage near the future mining development.

- Loadings from groundwater were derived from baseline groundwater quality data near the future open pit.

- NPAG and PAG rock source terms were based on the median (50th percentile) of the available concentration data.

The basis and description of the mass loading source terms for the pit lake water quality estimates are described in detail in Section 5 of the Water Report.

6.3.2.3 Assumptions and Uncertainties

In addition to the definitions and constraints specified above, other key assumptions and uncertainties in the water quality estimates specifically include the following:

Mine Schedule

- All open pits are complete and all surface waste rock is placed in WRSA and in-pit by the end of year 2 of operations.

- Pit flooding begins once mining ceases (year 12).

- Transfer of excess TSF supernatant water occurs in year 12.

- The model assumes the TSF cover is effectively placed immediately after the end of mining (year 12).

- Covering of WRSA occurs at year 14 (the end of year 2 in the closure period).

- The in-pit mine rock and pit walls are progressively covered by the flooding open pit in the closure and post-closure period.

Mine Rock

- The proportions by rock type assumed for all open pit walls and stored waste rock was 70% BMS (BMS and BS rock types combined), 15% MSS and 15% MSED (Table 5.4.3.3-2), since detailed production schedules by rock type are not yet available.

- The proportion of PAG rock at all open pit walls and stored waste rock was 7% (Appendix K).

- A surface area of 50 m^2/t was assumed for the in-pit and WRSA mine rock.

- For unflooded mine rock including in-pit rock and the WRSA, a flushing factor of 40% of surfaces was applied with no accumulation of load on unflushed surfaces.

- For flooded mine rock 100% of the rock surface was assumed to be flushed.

- During operations, all flushed load was assumed to be removed from the open pit by ongoing dewatering and treatment activities.

- No allowance for flushing of accumulated load during operations was included in the model on the basis that the largest fraction of this load would be released to in-pit porewater and the net transfer rate of this pore water to pit water was expected to be relatively slow.

- Below 360 masl, Pits 1 and 2 are separate from Pit 3. Pit 3, which has no waste rock, has a relatively large volume of 1.95 Mm^3 below 360 masl. Therefore, the model was adjusted to initially fill the volume below 360 masl (2.3 years) for all three pits and then fill the remainder of the pits.

- For each square metre of exposed pit wall, a fracture factor of 50 m^2/m^2 was assumed.

- The time to acid on-set for waste rock and pit walls in the model was conservatively assumed to be only two years.

- The load released from the covered WRSA was conservatively assumed to be reduced only in direct proportion to the reduction in seepage rate with no further reduction due to restricted oxygen and water ingress by the cover.

- No legacy load from in-pit waste rock and pit walls was included in the long-term water quality estimate.

- Upon pit flooding to 388 masl, it was assumed all waste rock and pit walls are water covered with no further load release to the flooded open pit.

Tailings

- Operations and closure activities were successful at preventing acidic drainage within the covered tailings during the period of pit filling.

- Consideration of possible brines placed in the TSF during operations or in post-closure were specifically excluded from the current estimate based on insufficient information.

- Limited acidic seepage was assumed to occur from the covered tailings in the long-term from a 10 cm active layer within covered, but unsaturated tailings.

- The engineered tailings cover was assumed to be 90% efficient at limiting load release from the active tailings volume.

- High estimated lead loads from acidic leaching within the TSF in the long-term post-closure scenario were assumed to be solubility limited by precipitation of anglesite ($PbSO_4$).

- Aside from lead, no further equilibration/reductions were included in current estimates as may occur due to changing geochemical conditions along the flow-path down-stream of TSF seepage.

Surface Water

- Direct precipitation onto the filling open pit water surface was assumed to be proportional to the flooded pit volume/total pit volume with the remainder of the in-pit catchment assumed to be uncovered waste rock.

- Complete mixing of water in the flooding open pit was assumed to occur.

Groundwater

- During the period of pit flooding, all seepage from the WRSA and TSF was assumed to be captured by the filling open pit.

- In the long-term post-closure model:

    - 67% of the WRSA seepage (20 m^3/day) was captured by the open pit (Appendix M);

    - 20% of the TSF seepage (10 m^3/day) was captured by the open pit (Appendix M); and

        - The remainder of seepage was released off-site, and would eventually intercept with surface receiving waters.

- Net groundwater inflow rates to the open pit were assumed to be:

    - 700 m^3/day during pit filling (Appendix M), and

    - 100 m^3/day for the fully flooded open pit.

6.3.3 Project Effects Avoidance Measures Used in Predictions

There are a range of measures incorporated into the design for the Project that will avoid potential effects associates with geology and geochemistry, including the following:

- The geochemical properties of the waste rock will be evaluated and non-acid generating (NAG) waste rock will be segregated from potentially acid generating (PAG) waste rock, if feasible [Mit_019].

- The PAG waste rock would be placed in the mined out areas of the open pit, to the extent practical, to minimize the volume of PAG material in the waste rock storage area (WRSA) [Mit_020].

- During operations, a water cover will be maintained over the tailings within the TSF to prevent the onset of acidification [Mit_021].

- As part of the closure activities, the WRSA will be covered with a low permeability cover to isolate the waste rock and reduce the potential for acidification [Mit_018].

- At closure, the open pit will be allowed to flood, isolating the exposed mine faces and the waste rock placed underneath a static cover of water to prevent acidification [Mit_022].

- At closure the process water will be withdrawn from the TSF, treated and used to help fill the open pit. The tailings within the TSF will be isolated using either a low permeability dry cover, or a wet cover of non-process water [Mit_023].

The predicted effects of the Project on the “pit lake water quality” VC, as well as the long-term quality of the seepage from the TSF and WRSA consider the following two options for closure of the TSF:

- The dry cover option where the tailings will be covered with a low-permeability dry cover to limit the potential for acidification [Mit_023].

- The wet cover option where the tailings will be isolated from oxygen using a cover of non-process water to prevent acidification [Mit_023].

During the filling of the open pit, Treasury Metals will monitor the quality of the water within the open pit to determine whether batch treatment [Mit_024] will be required to ensure the water quality in the fully flooded open pit meets the Provincial Water Quality Objectives (PWQO) prior to discharge.

6.3.4 Predicted Effects

6.3.4.1 Long-term Effects (dry TSF cover option)

Pit Lake Water Quality Estimates

All results were conservative estimates in that they assume complete mixing of load within the open pit volume with no allowance for reactions that may occur within the flooded open pit. As described above, the initial results for elevated lead seepage from the covered TSF were equilibrated for solubility control by anglesite precipitation, which would be expected to occur. All other results are presented without geochemical equilibration. For this estimate, the predominant source of load (83 to 89%) for sulphate, aluminum, cobalt, iron, and nickel is from possible acidic seepage from the covered WRSA. The dominant source of load for cadmium, copper, lead, and zinc (87 to 97%) is from the assumed acidic seepage from the TSF. The results are presented in Table 6.3.4.1-1. Treasury Metals realizes that they will need to monitor the quality of the water in the open pit as it is filling, and implement treatment to ensure the water quality will meet PWQO prior to it being discharged. Treatment options such as batch lime addition to adjust the pH has been shown in other similar applications to be effective at reducing the metals concentrations dramatically. To reflect this, Table 6.3.4.1-1 includes pit lake water quality predictions without mitigation, as well as the mitigated predictions.

Table 6.3.4.1-1: Pit Lake Water Quality and Seepage Quality (dry TSF cover option)

Parameter	Open Pit Water Quality (mg/L)		Seepage Quality (mg/L)	
	Untreated	Treated to meet PWQO	TSF	WRSA
Sulphate	54	54	812	6,121
Aluminum	0.81	0.075	21	85
Antimony	0.0012	0.0012	0.0097	0.0011
Arsenic	0.0016	0.0016	0.064	0.038
Beryllium	0.0010	0.0010	0.0047	0.0049
Boron	0.052	0.052	0.24	0.12
Cadmium	0.0019	0.00020	0.41	0.0074
Chromium	0.00097	0.00097	0.0024	0.0021
Cobalt	0.0072	0.00090	0.20	0.76
Copper	0.023	0.005	4.4	0.27
Iron	2.5	0.30	28	266
Lead	0.75	0.005	3.5*	0.21
Mercury	—	0.0002	—	—
Molybdenum	0.0010	0.0010	0.0012	0.00053
Nickel	0.049	0.025	0.64	5.8
Selenium	0.0010	0.0010	0.016	0.0027
Silver	0.00010	0.00010	0.00024	0.00011
Thallium	0.00031	0.00030	0.0033	0.00058

Table 6.3.4.1-1: Pit Lake Water Quality and Seepage Quality (dry TSF cover option) (continued)

Parameter	Open Pit Water Quality (mg/L)		Seepage Quality (mg/L)	
	Untreated	Treated to meet PWQO	TSF	WRSA
Uranium	0.0061	0.005	0.084	0.11
Vanadium	0.0011	0.0011	0.024	0.0055
Zinc	0.91	0.030	203	3.4

Notes:
Concentrations for mercury are not included due to incomplete source term data
* TSF seepage water quality estimate for lead is equilibrated (see text)
Un-equilibrated results except as indicated

It has been identified that the acidic tailings source term for TSF seepage used in this estimate may be very high, especially for cadmium, lead and zinc. The single humidity cell that was the origin of this data was terminated during the initial on-set of acidic conditions and the elements in question may have been measured as a short-term transient condition in the test. The test was stopped at this point in analysis and therefore confirmation of a transient response cannot be ascertained without additional testing. It is also noted that estimated antimony, arsenic, boron, chromium, molybdenum, silver and vanadium concentrations are primarily influenced by laboratory detection limit values in source terms.

Seepage Quality Estimates from the WRSA and TSF

Estimates of the long-term TSF and WRSA seepage quality under post-closure conditions were also determined since a portion of the seepage may not be captured by the open pit after flooding is complete.

Model results (Table 6.3.4.1-1) indicate that seepage from the WRSA is expected to be acidic with elevated sulphate and metals, although the net loads released due to the presence of the cover are relatively modest due to low seepage rates. It is noted that estimated boron, chromium, molybdenum, silver and vanadium concentrations are primarily influenced by laboratory detection limit values in source terms.

Acidic and metal-rich waters have also been projected for long-term seepage from the TSF. However, the elevated loads for cadmium, copper, lead and particularly zinc in the estimated seepage quality may be driven by a particularly aggressive laboratory humidity cell source term that is based on the limited available data. It is noted that estimated antimony, chromium, molybdenum, silver and vanadium concentrations are primarily influenced by laboratory detection limit values in source terms.

6.3.4.2 Long-term Effects (wet TSF cover option)

Pit Lake Water Quality Estimates

The long-term post-closure open pit water quality model results, assuming a TSF wet cover option, are presented in Table 6.3.4.2-1. The results indicated long-term pit lake water quality will have slightly elevated sulphate (50 mg/L), but generally low metal concentrations. Overall pit water quality is projected to be similar to that of the TSF dry cover option for some parameters (e.g., sulphate, aluminum, antimony, arsenic, beryllium, chromium, cobalt, iron, molybdenum, nickel, selenium, thallium, uranium, and vanadium), but much lower for other elements (cadmium, copper, lead and zinc) upon elimination of acidic drainage from the TSF. Mercury was also able to be estimated for this scenario, since source term data was available. Estimated mercury concentrations were relatively low since they are largely based on detection limit values in the available source term data.

Table 6.3.4.2-1: Pit Lake Water Quality and Seepage Quality (wet TSF cover option)

Parameter	Open Pit Water Quality (mg/L)		Seepage Quality (mg/L)	
	Untreated	Treated to meet PWQO	TSF	WRSA
Sulphate	58	58	31	6,121
Aluminum	0.79	0.075	0.015	85
Antimony	0.0011	0.0011	0.00074	0.0011
Arsenic	0.0015	0.0015	0.0025	0.038
Beryllium	0.0011	0.0011	0.0020	0.0049
Boron	0.055	0.055	0.12	0.12
Cadmium	0.00009	0.00009	4.4×10^{-5}	0.0074
Chromium	0.0010	0.0010	0.0020	0.0021
Cobalt	0.0071	0.00090	0.0016	0.76
Copper	0.0040	0.004	0.0056	0.27
Iron	2.6	0.30	0.27	266
Lead	0.0029	0.0029	0.0020	0.21
Mercury	0.00002	0.00002	4.0×10^{-5}	5.3×10^{-5}
Molybdenum	0.0011	0.0011	0.0023	0.00053
Nickel	0.052	0.025	0.0054	5.8
Selenium	0.0010	0.0010	0.0024	0.0027
Silver	0.00011	0.00010	0.00020	0.00011
Thallium	0.00032	0.00030	0.00060	0.00058
Uranium	0.0060	0.0050	0.0080	0.11
Vanadium	0.0011	0.0011	0.0020	0.0055
Zinc	0.033	0.030	0.0072	3.4

All pit water quality results are conservative estimates in that they assume complete mixing of load within only the annual estimated open pit discharge volume with no allowance for reactions and equilibration within the flooded open pit. For this estimate the predominant source of load (76 to 100%) for sulphate, aluminum, arsenic, cadmium, cobalt, copper, iron, lead, nickel and zinc is from possible acidic seepage from the covered WRSA. It is noted that in addition to mercury, estimated antimony, arsenic, boron, chromium, molybdenum, silver and vanadium concentrations are primarily influenced by laboratory detection limit values in source terms.

Treasury Metals realizes they will need to monitor the quality of the water in the open pit as it fills, and implement treatment to ensure the water quality will meet PWQO prior to it being discharged [Mit_024]. Treatment options such as batch lime addition to adjust the pH has been shown in other similar applications to be effective at reducing the metals concentrations dramatically. To reflect this, Table 6.3.4.2-1 includes pit lake water quality predictions without mitigation, as well as the mitigated predictions.

Seepage Quality Estimates from the WRSA and TSF

Estimates of the long-term TSF and WRSA seepage water quality under post-closure conditions were also determined since a portion of the seepage may not be captured by the open pit after flooding is complete (Table 6.3.4.2-1).

Estimates for the WRSA seepage quality are the same as for the dry cover options, since there is no relationship between TSF management and the future WRSA. The TSF seepage water quality is essentially estimated to be comparable to groundwater quality based on the simplifying assumptions made for this scenario.

It should be noted that careful management of tailings in the TSF during operations and at closure would be required to prevent possible localized ARD from features such as exposed tailings beaches and to achieve the management assumptions made for water quality estimates prepared for this scenario.

6.3.4.3 Summary of Predicted Adverse Effects

As described in Section 3.14, the Project will result in the formation of a pit lake pit lake. There will be adverse effects predicted to the pit lake quality VC used to describe the effects of the Project on geology and geochemistry. These adverse effects will only occur during the post-closure phase of the Project, and there are no predicted adverse effects during the other three phases (i.e., site preparation and construction, operations, or closure phases). Treasury Metals acknowledge that they will need to test the quality of the water in the open pit as it is filling, and batch treat the water if necessary, in order to meet Provincial Water Quality Objectives (PWQO) prior to water being released. The predicted adverse effects of the Project on the pit lake water quality VC are summarized in Table 6.3.4.3-1. The table shows the pit lake water quality predictions with and without required treatment to ensure that pit lake water quality discharge

meets PWQO prior to discharge. The residual adverse effects are also provided for the following two closure options for the TSF:

- The dry cover option where the tailings will be covered with a low-permeability dry cover to limit the potential for acidification.
- The wet option where the tailings will be isolated from oxygen using a cover of non-process water to prevent acidification.

Table 6.3.5-1: Predicted Adverse Effects for Pit Lake Water Quality

Parameter	Open Pit Water Quality Dry TSF cover option (mg/L)		Open Pit Water Quality Wet TSF cover option (mg/L)	
	Untreated	Treated to meet PWQO	Untreated	Treated to meet PWQO
Sulphate	54	54	58	58
Aluminum	0.81	0.075	0.79	0.075
Antimony	0.0012	0.0012	0.0011	0.0011
Arsenic	0.0016	0.0016	0.0015	0.0015
Beryllium	0.0010	0.0010	0.0011	0.0011
Boron	0.052	0.052	0.055	0.055
Cadmium	0.0019	0.00020	0.00009	0.00009
Chromium	0.00097	0.00097	0.0010	0.0010
Cobalt	0.0072	0.00090	0.0071	0.00090
Copper	0.023	0.005	0.0040	0.004
Iron	2.5	0.30	2.6	0.30
Lead	0.75	0.005	0.0029	0.0029
Mercury	—	0.0002	0.00002	0.00002
Molybdenum	0.0010	0.0010	0.0011	0.0011
Nickel	0.049	0.025	0.052	0.025
Selenium	0.0010	0.0010	0.0010	0.0010
Silver	0.00010	0.00010	0.00011	0.00010
Thallium	0.00031	0.00030	0.00032	0.00030
Uranium	0.0061	0.005	0.0060	0.0050
Vanadium	0.0011	0.0011	0.0011	0.0011
Zinc	0.91	0.030	0.033	0.030

6.3.5 Identified Mitigation

The following will be employed as part of the Project to limit or avoid the effects on geology and geochemistry:

- The geochemical properties of the waste rock will be evaluated and NAG waste rock will be segregated from PAG waste rock, if feasible [Mit_019].

- The PAG waste rock would be placed in the mined out areas of the open pit, to the extent practical, to minimize the volume of PAG material in the WRSA [Mit_020].

- During operations, a water cover will be maintained over the tailings within the TSF to prevent the onset of acidification [Mit_021].

- As part of the closure activities, the WRSA will be covered with a low permeability cover to isolate the waste rock and reduce the potential for acidification [Mit_018].

- At closure, the open pit will be allowed to flood, isolating the exposed mine faces and the waste rock placed underneath a static cover of water to prevent acidification [Mit_022].

- At closure the process water will be withdrawn from the TSF, treated and used to help fill the open pit. The tailings within the TSF will be isolated using either a low permeability dry cover, or a wet cover of non-process water [Mit_023].

- The pit lake will be monitored as it is filling to determine whether batch treatment will be required to ensure the water meets PWQO prior to the discharge from the pit lake to a tributary of Blackwater Creek [Mit_024].

A review of the predicted adverse effects shows that the effects on the pit lake quality VC, van be mitigated by the following:

- Use the wet cover closure option over the TSF as the preferred option. A wet cover prevents acidification of the tailings, which improves the quality of seepage in the long-term and results in improved pit lake water quality. The mitigation also benefits the quality of surface water in the receiving environment [Mit_023].

6.3.6 Residual Adverse Effects

Even with the application of avoidance measures (Section 6.3.3) and the mitigation measures summarized in Section 6.3.6, residual adverse effects on the pit lake water quality VC will remain. These residual adverse effects are summarized in Table 6.3.7-1.

Table 6.3.7-1: Residual Adverse Effects on Pit Lake Water Quality

Indicator	Pit Lake Water Quality (mg/L)			
	Site Preparation and Construction	Operations	Closure	Post-closure
Sulphate	—	—	—	58
Aluminum	—	—	—	0.075

Table 6.3.7-1: Residual Adverse Effects on Pit Lake Water Quality (continued)

Indicator	Pit Lake Water Quality (mg/L)			
	Site Preparation and Construction	Operations	Closure	Post-closure
Antimony	—	—	—	0.0011
Arsenic	—	—	—	0.0015
Beryllium	—	—	—	0.0011
Boron	—	—	—	0.055
Cadmium	—	—	—	0.00009
Chromium	—	—	—	0.0010
Cobalt	—	—	—	0.00090
Copper	—	—	—	0.004
Iron	—	—	—	0.30
Lead	—	—	—	0.0029
Mercury	—	—	—	0.00002
Molybdenum	—	—	—	0.0011
Nickel	—	—	—	0.025
Selenium	—	—	—	0.0010
Silver	—	—	—	0.00010
Thallium	—	—	—	0.00030
Uranium	—	—	—	0.0050
Vanadium	—	—	—	0.0011
Zinc	—	—	—	0.030

Note:
The "—" symbol indicates where there were no predicted residual adverse effects.

The predicted spatial extent of the effects on the single geochemistry VC, pit lake quality, identified in Section 6.1.2 will be the footprint of the pit lake. Any potential effects of geochemical reaction on surface water or groundwater quality are dealt with explicitly in the surface water quality and groundwater quality assessments provided in Sections 6.8 and 6.10, respectively.

6.3.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, the following questions were wholly, or partially, asking for information, and clarification regarding the predicted the effects of the Project on geology and geochemistry. Responses to the IRs were provided separately, and incorporated into the relevant sections of the Revised EIS. The following lists the Round 1 IRs related to the predicted geology and geochemistry effects of the Project.

- TMI_47-MW(1)-09: chemical stability of overburden;
- TMI_49-MW(1)-11: ARD/ML, including quality of seepage from TSF;
- TMI_50-MW(1)-12: pit water quality geochemical modeling;
- TMI_53-MW(1)-15: methods for estimating time to ARD onset;

- TMI_58-MW(1)-20: revise estimates and compare results to regulatory objectives;
- TMI_134-FH(1)-13: provide predicted water quality of the pit lake;
- TMI_294-RG(1)-29: details of the geochemical modelling and relation to water quality;
- TMI_345-AC(1)-19: detailed analysis of open pit water quality;
- TMI_622-AC(1)-295: acid rock drainage; and
- TMI_693-PC(1)-08: acid rock drainage.

6.4 Noise

6.4.1 Potential Effects of the Project on the Environment

The potential effects of the Project on noise will vary by Project phase, and with varying levels of activity. The following lists the potential noise effects by Project phase:

- **Site preparation and construction phase:**
  - Ambient noise associated with the equipment and activities to complete the site clearing and preparation;
  - Blasting noise; and
  - Traffic noise associated with construction vehicles moving to and from the Project.
- **Operations phase:**
  - Ambient noise associated with the equipment and activities involved with mining and processing;
  - Blasting noise; and
  - Traffic noise associated with operational vehicles moving to and from the Project.
- **Closure phase:**
  - Ambient noise associated with the equipment and activities to complete the closure and reclamation activities; and
  - Traffic noise associated with closure vehicles moving to and from the Project.

- **Post-closure phase:**
    - No sources of noise anticipated.

The potential effects of the Project on noise have been described using a simple linkage diagram on Figure 6.4.1-1. The figure illustrates the noise VCs (shown in blue on the figure) that are potentially affected during each phase of the Project. Additionally, the figure indicates those other components of the environment (shown in red in the figure) where the predicted effects of the Project on noise will be used as an input for determining the effects on other VCs. For example, noise effects will be used as an input for determining the effects of the Project on wildlife and wildlife habitat. There are no other components or VCs that provide inputs to the assessment of noise effects.

6.4.2 Effects Prediction Methods

The methods used to predict the noise effects of the Project are described in Section 3 of the Environmental Noise Assessment (included in Appendix H to the EIS). The general steps involved in predicting the noise effects are:

- Determine the sources of sound emissions;
- Use numerical models to predict the noise effects from continuous sources; and
- Use numerical calculations to determine blasting noise effects.

6.4.2.1 Sources of Sound Emissions

As described in Section 3.2 of the Environmental Nosie Assessment (included in Appendix H-4 of the revised EIS), the best-available data regarding future construction, operations, and decommissioning were collected from Treasury Metals, and used to predict sound level emissions for the Project. The basis for model inputs was primarily obtained from the Project description, with further information gathered through discussions with Treasury Metals. Equipment sizes for sources such as the excavators and bulldozers have not yet been defined. Therefore, sizes were estimated from production levels and sound levels were predicted using numerical modelling techniques, or taken from manufacturer data for typical equipment. Where limited data was available on equipment, typical levels were selected from the RWDI library. Additional details on the sound level emissions is also provided in the Acoustic Assessment Report (Appendix H-3 to the revised EIS).

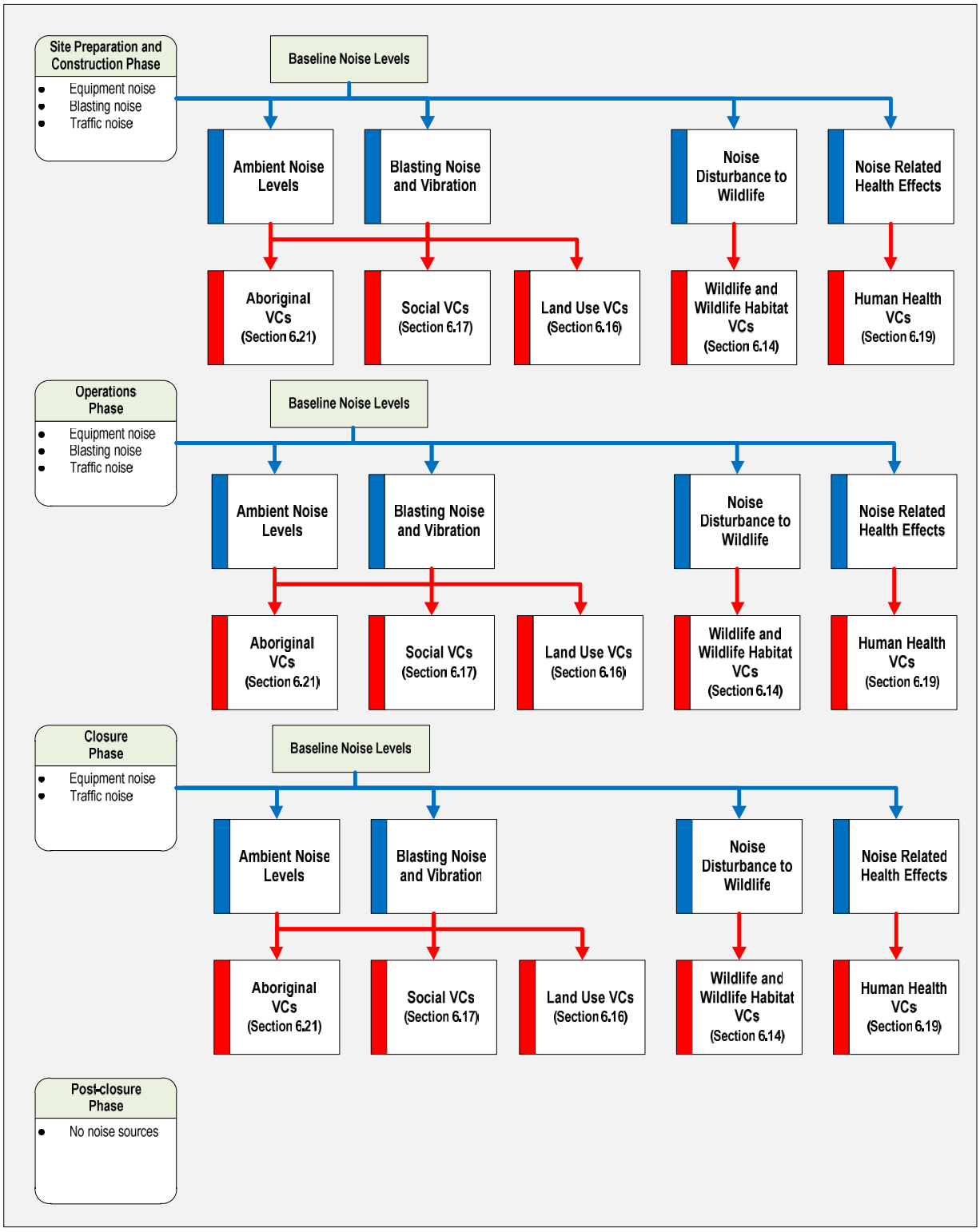


Figure 6.4.1-1: Noise Linkage Diagram

6.4.2.2 Noise Effects Predictions from Continuous Sources

As described in Section 3.3.1 of the Environmental Nosie Assessment (Appendix H-4 of the revised EIS), the modelling of noise from continuous sources was conducted using Cadna/A, a commercially available implementation of the ISO 9613 (ISO, 1994b and ISO, 1996) algorithms. Cadna/A is produced by Datakustik GmbH. The ISO-9613 algorithms are the current international standard for airborne sound propagation, and are widely used in noise impact assessments in Ontario and Canadian jurisdictions. Modelling parameters have been selected to conform to the preferred parameters of the Ministry of Environment and Climate Change (MOECC). These parameters introduce some additional conservatism to the modelling beyond that which would be achieved with strict conformance to the ISO standard, meaning that sound levels are predicted to be slightly higher than they otherwise would be. The modelling considered the following factors:

- Source sound power level and directivity;
- Distance attenuation;
- Source-receptor geometry including heights, elevations and topography;
- Barrier effects of the site and surrounding buildings;
- Duration of events;
- Ground and air (atmospheric) attenuation; and
- Meteorological effects on sound propagation.

The noise from vehicle traffic to and from the Project site (off-site traffic) was considered to be insignificant, and was not explicitly included in the modelling. This position is supported by the Goliath Gold Traffic Impact Study (Appendix E of the revised EIS), which indicates the vehicle traffic to and from the site will predominately be small vehicle traffic (94 to 96%), with larger vehicles larger vehicles accounting for less than 6% of the total annual traffic. When the number of vehicles associated with the Project are compared to the existing traffic on Highway 17, it is clear that the relatively small number of vehicles trips would not measurably change the background noise levels from existing traffic.

As described in the response to TMI_191-AE(1)-29, sound level adjustments per NPC-103 were not included in the calculations as the sources that would be present at the Project do not typically exhibit the sound characteristics to warrant adjustments (i.e., ventilation equipment, generators, building exhausts, on site vehicle traffic and rock crushing equipment). Note that backup alarms used on mobile equipment, depending on the variety, are tonal but are exempt from evaluation since they are a safety device.

The noise source summary tables for each of the Project phases are provided in the relevant sections of Appendix H-4 to the revised EIS (6.2: Site Preparation and Construction; 7.2: Operations; 8.2: Closure). Treasury Metals will ensure that equipment selected on site will either match or be quieter than the requirements outlined within the Environmental Noise Assessment (Appendix H-4).

6.4.2.3 Noise Effects from Blasting

As described in Section 3.3.2 of the Environmental Noise Assessment (Appendix H-4 of the revised EIS), the modelling of blasting sound levels was conducted using numerical modelling techniques presented in the International Society of Explosives Engineers Blaster's Handbook (ISEE, 2011). Airborne vibration due to blasting activities attenuates from a site at a slower rate than ground vibrations. The distribution of this air vibration energy from a blast is also strongly influenced by the prevailing weather conditions during the blast. Factors considered in the calculations include:

- Charge-weight per delay;
- Depth of burial;
- Volume of displaced rock;
- Delay time intervals;
- Type of explosive;
- Atmospheric conditions; and
- Topography.

6.4.3 Project Effects Avoidance Measures Used in Predictions

Those aspects of the Project that will that will help avoid or reduce the predicted noise effects (Sections 6.4, 7.4 and 8.4 of Appendix H-4 to the revised EIS) There were no predicted noise effects during the post-closure phase. In order to achieve compliance with MOECC criteria at all of the worst case receptors, the sound power levels of equipment were limited in some cases. The limited power levels used in the assessment are still within the accepted range of power levels from this type of equipment from different manufacturers and of different ages, but are quieter than average. Treasury Metals will ensure that sound levels from these pieces of equipment meet these requirements. The noise avoidance measures include the following:

- Conduct heavy equipment activity between the hours of 07:00 and 22:00, if possible, to reduce the noise effects to neighbouring residents [Mit_025].

- Advise nearby residents of significant noise-causing activities, such as blasting, and endeavour to schedule those events to reduce disruption to residents [Mit_026, Mit_027].

- Ensure that all internal combustion engines are fitted with appropriate muffler systems [Mit_028].

- Employ controlled blasting methods (site preparation and construction phase, and operations phase only) such as penetrating cone fracture [Mit_029].

- The location of the WRSA and overburden stockpiles will effectively act as noise berms reducing the levels of noise off-site [Mit_032].

6.4.4 Predicted Effects

The predicted noise effects associated with the Project were described in the Environmental Noise Assessment (included in Appendix H to the EIS). The predicted effects of the Project were presented separately for the site preparation and construction phase, operations phase, and closure phase to reflect the differing levels of activity, locations of activity in each phase. As no noise sources were identified in the post-closure phase, no post-closure predictions were made.

6.4.4.1 Site Preparation and Construction Phase

As described in Section 6.1.3.3, the assessment of the potential effects of the Project on noise considers following four VCs:

- Ambient noise levels;

- Noise disturbance to wildlife, including SAR;

- Blasting noise levels; and

- Noise related health effects.

In evaluating the effects of the Project on the ambient noise levels VC, a single indicator of equivalent noise levels (L_{EQ}) was used. Table 6.4.4.1-1 presents the predicted L_{EQ} values at the worst case receptors during the site preparation and construction phase.

Table 6.4.4.1-1: Ambient Noise Predictions, Site Preparations and Construction

Rec #	Description	Predicted L_{EQ} (dBA)	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	40	39
NR04	House – owned by Nystrom	33	32
NR30	House – East Thunder Lake Road	33	32

Table 6.4.4.1-1: Ambient Noise Predictions, Site Preparations and Construction (continued)

Rec #	Description	Predicted L_{EQ} (dBA)	
		Residence	Outdoor Receptor
NR44	House – near Trans-Canada Highway	29	28
NR47	House – East Thunder Lake Road	29	28

Although the evaluation of ambient noise levels focusses on the sensitive noise receptors, as described in Section 6.1.4.4, modelling of the noise levels was done across the LSA, shown on Figure 6.1.4.4-1. A spatial representation of the predicted ambient noise levels during the site preparation and construction phase is provided in the Appendix H-4 (Figure 5).

For evaluating the effects of the Project on the noise disturbance to wildlife VC, a single indicator of equivalent noise levels (LEQ) was also used. During the site preparation and construction phase the Project activities were predicted to result in areas with noise levels above the 50 dBA, threshold identified by Environment Canada. Figure 6.4.4.1-1 presents the predicted 50 dBA noise contour line during the site preparation and construction phase.

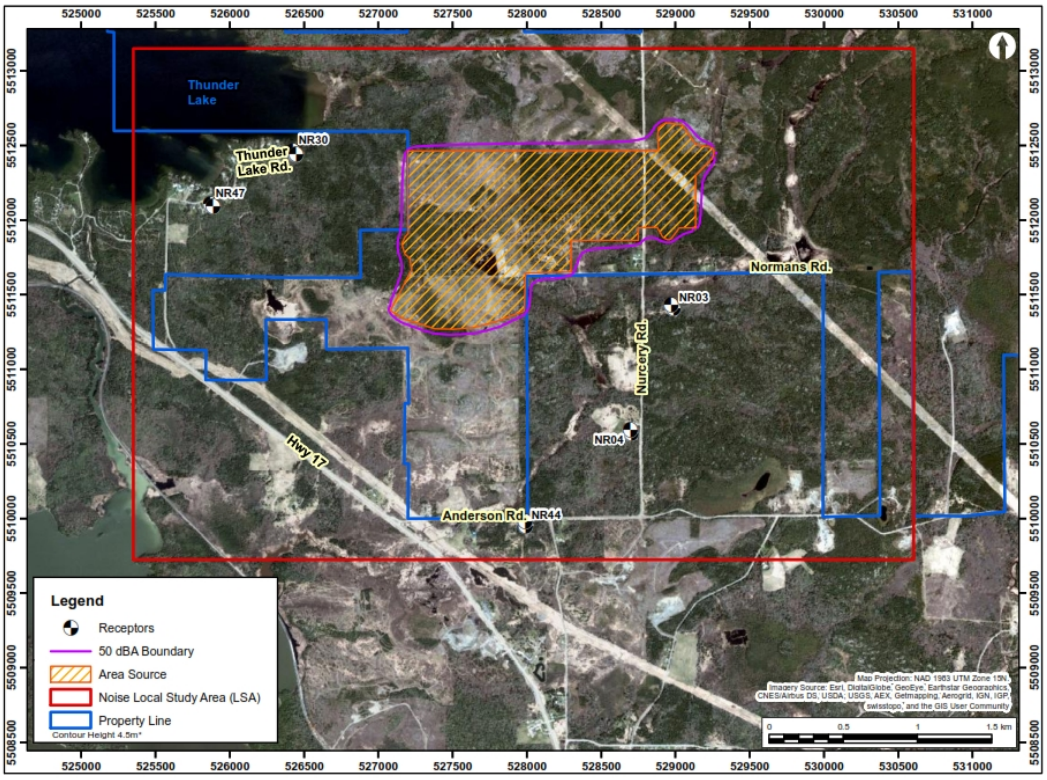


Figure 6.4.4.1-1: Predicted 50 dBA Contour, Site Preparation and Construction

The areal extents are out in Table 6.4.4.1-2. The table indicates the areas above 50 dBA within the Project site, the areas beyond the Project site but within the LSA predicted to exceed 50 dBA, and the areas beyond the LSA where noise is predicted to exceed t50 dBA.

Table 6.4.4.1-2: Areas with Noise Predicted above 50 dBA, Site Preparations and Construction

Measure	Project Site	LSA	RSA
Area > 50 dBA (ha)	430.1	0	0

During the site preparation and construction phase, blasting will be occurring at the open pit. Treasury Metals has committed that blasting will occur only once per day, and only on selected days during the week. As described in Section 6.1.3.3, two indicators were identified for evaluating the blasting noise and vibration VC, namely the peak sound pressure and the peak particle velocity. The predicted peak sound pressure during the site preparations and construction phase are provided in Table 6.4.4.1-3, while Table 6.4.4.1-4 provides the predicted peak particle velocities.

Table 6.4.4.1-3: Blasting Noise Predictions, Site Preparations and Construction

Rec #	Description	Distance (m)	Peak Sound Pressure (dB)
NR03	House - owned by McLeish	1,813	78
NR04	House - owned by Nystrom	3,000	71
NR30	House - East Thunder Lake Road	2,373	75
NR44	House - near Trans-Canada Highway	3,734	68
NR47	House - East Thunder Lake Road	3,187	70

Table 6.4.4.1-4: Blasting Vibration Predictions, Site Preparations and Construction

Rec #	Description	Distance (m)	Peak Particle Velocity (cm/s)
NR03	House - owned by McLeish	1,813	0.123
NR04	House - owned by Nystrom	3,000	0.057
NR30	House - East Thunder Lake Road	2,373	0.082
NR44	House - near Trans-Canada Highway	3,734	0.041
NR47	House - East Thunder Lake Road	3,187	0.052

To ensure the potential effects of noise on human health was captured, the EIS followed the guidance provided by Health Canada (2010; 2016). Three indicators were used when evaluating the noise related human health effects from the Project. The predictions for the site preparation and construction phase for these indicators are provided in Table 6.4.4.1-5 (absolute sound pressure) and Table 6.4.4.1-6 (change in percent highly annoyed).

Table 6.4.4.1-5: Absolute Sound Pressure Predictions, Site Preparations and Construction

Rec #	Description	Predicted L_{DN} (dBA)	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	56	56
NR04	House - owned by Nystrom	49	48
NR30	House - East Thunder Lake Road	49	48
NR44	House - near Trans-Canada Highway	45	44
NR47	House - East Thunder Lake Road	45	44

Table 6.4.4.1-6: Change in Percent Highly Annoyed, Site Preparations and Construction

Rec #	Description	Predicted Change in %HA	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	1.6	1.4
NR04	House – owned by Nystrom	0.4	0.3
NR30	House – East Thunder Lake Road	0.3	0.3
NR44	House – near Trans-Canada Highway	0.1	0.1
NR47	House – East Thunder Lake Road	0.1	0.1

6.4.4.2 Operations Phase

Table 6.4.4.2-1 presents the predicted L_{EQ} values, the indicator for the ambient noise VC, at the worst case receptors during the operations phase.

Table 6.4.4.2-1: Ambient Noise Predictions, Operations

Rec #	Description	Predicted L_{EQ} (dBA)	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	40	38
NR04	House - owned by Nystrom	34	33
NR30	House - East Thunder Lake Road	34	33
NR44	House - near Trans-Canada Highway	30	30
NR47	House - East Thunder Lake Road	31	30

Although the evaluation of ambient noise levels focusses on the sensitive noise receptors, as described in Section 6.1.4.4, modelling of the noise levels was done across the LSA, shown on Figure 6.1.4.4-1. A spatial representation of the predicted ambient noise levels during the operations phase is provided in the Appendix H-4 (Figure 7).

Figure 6.4.4.2-1 presents the predicted 50 dBA noise contour during the operations phase. During the operations phase the Project activities were predicted to result in areas with noise levels above 50 dBA, as set out in Table 6.4.4.2-2.

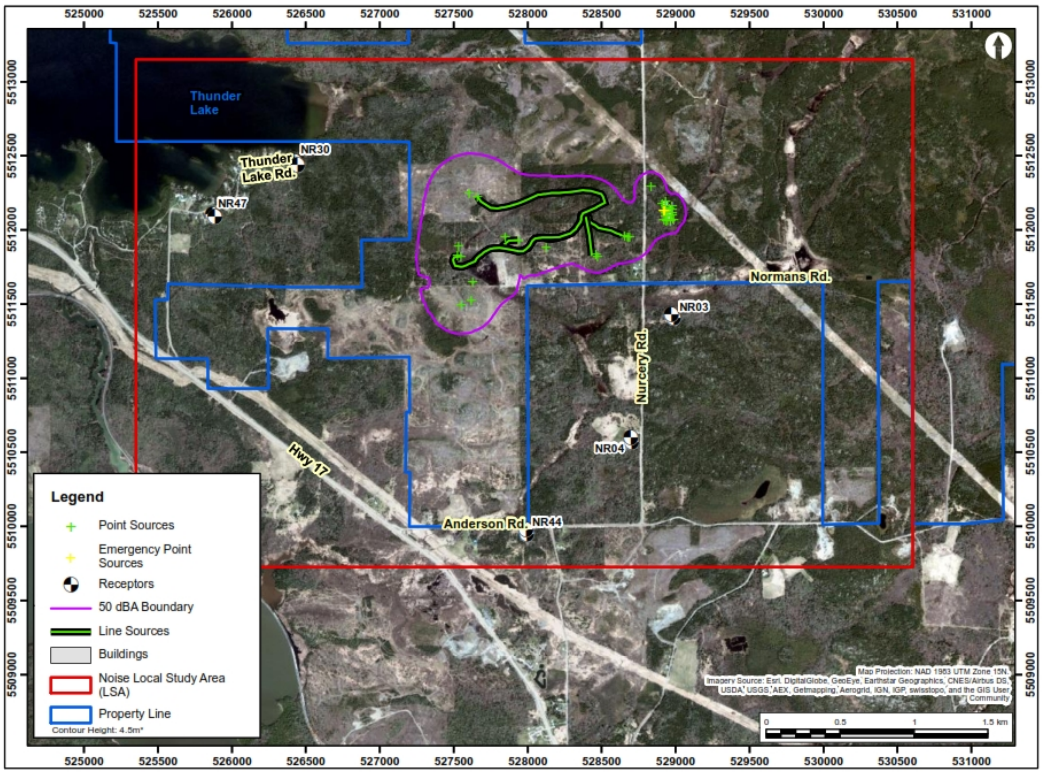


Figure 6.4.4.2-1: Predicted 50 dBA Contour, Operations

Table 6.4.4.2-2: Areas with Noise Predicted above 50 dBA, Operations

Measure	Project Site	LSA	RSA
Area > 50 dBA (ha)	198.9	0	0

During the operations, blasting will be occurring once per day, on selected days during the week. The two indicators were identified for evaluating the blasting noise and vibration VC are the peak sound pressure and the peak particle velocity. The predicted peak sound pressure during the operations phase are provided in Table 6.4.4.2-2, while Table 6.4.4.2-3 provides the predicted peak particle velocities.

Table 6.4.4.2-2: Blasting Noise Predictions, Operations

Rec #	Description	Distance (m)	Peak Sound Pressure (dB)
NR03	House - owned by McLeish	1,813	78
NR04	House - owned by Nystrom	3,000	71
NR30	House - East Thunder Lake Road	2,373	75
NR44	House - near Trans-Canada Highway	3,734	68
NR47	House - East Thunder Lake Road	3,187	70

Table 6.4.4.2-3: Blasting Vibration Predictions, Operations

Rec #	Description	Distance (m)	Peak Particle Velocity (cm/s)
NR03	House - owned by McLeish	1,813	0.123
NR04	House - owned by Nystrom	3,000	0.057
NR30	House - East Thunder Lake Road	2,373	0.082
NR44	House - near Trans-Canada Highway	3,734	0.041
NR47	House - East Thunder Lake Road	3,187	0.052

To ensure the potential effects of noise on human health was captured, the EIS followed the guidance provided by Health Canada (2010; 2016). Three indicators were used when evaluating the noise related human health effects from the Project. The predictions for the operations phase absolute sound pressure and change in percent highly annoyed in Tables 6.4.4.2-4 and 6.4.4.2-5, respectively.

Table 6.4.4.2-4: Absolute Sound Pressure Predictions, Operations

Rec #	Description	Predicted L_{DN} (dBA)	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	57	55
NR04	House - owned by Nystrom	51	50
NR30	House - East Thunder Lake Road	50	50
NR44	House - near Trans-Canada Highway	47	46
NR47	House - East Thunder Lake Road	47	46

Table 6.4.4.2-5: Change in Percent Highly Annoyed, Operations

Rec #	Description	Predicted Change in %HA	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	1.8	1.4
NR04	House - owned by Nystrom	0.5	0.4
NR30	House - East Thunder Lake Road	0.4	0.4
NR44	House - near Trans-Canada Highway	0.2	0.2
NR47	House - East Thunder Lake Road	0.2	0.2

6.4.4.3 Closure Phase

During the closure phase, Treasury Metals will be undertaking activities to decommission the Project and return the site to a condition that can function ecologically. Table 6.4.4.3-1 presents the predicted L_{EQ} values, the indicator for the ambient noise VC, at the worst case receptors during the closure phase. A spatial representation of the predicted ambient noise levels during the closure phase is provided in the Appendix H-4 (Figure 9).

Table 6.4.4.3-1: Ambient Noise Predictions, Closure

Rec #	Description	Predicted L_{EQ} (dBA)	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	39	39
NR04	House - owned by Nystrom	31	31
NR30	House - East Thunder Lake Road	31	30
NR44	House - near Trans-Canada Highway	27	25
NR47	House - East Thunder Lake Road	27	26

Figure 6.4.4.3-1 presents the predicted 50 dBA noise contour the closure phase. During the closure phase the Project activities were predicted to result in areas with noise levels above 50 dBA, as set out in Table 6.4.4.3-2.

Table 6.4.4.3-2: Areas with Noise Predicted above 50 dBA, Closure

Measure	Project Site	LSA	RSA
Area > 50 dBA (ha)	122.1	0	0

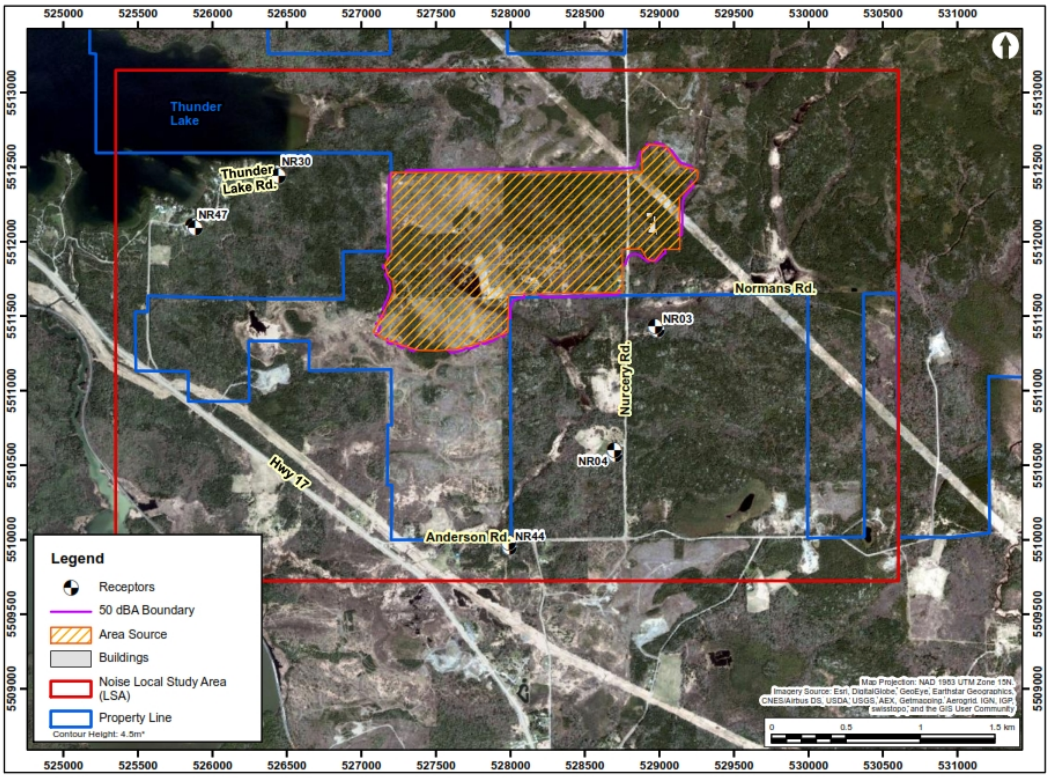


Figure 6.4.4.3-1: Predicted 50 dBA Contour, Closure

During the closure phase, no blasting will occur at the site. Therefore, there are no predicted effects for the blasting noise and vibration VC.

To ensure the potential effects of noise on human health was captured, three indicators were used to evaluate the noise related human health effects from the Project. The respective closure phase predictions of absolute sound pressure and change in percent highly annoyed are presented in Tables 6.4.4.3-3 and 6.4.4.3-4, respectively.

Table 6.4.4.3-3: Absolute Sound Pressure Predictions, Operations

Rec #	Description	Predicted L_{DN} (dBA)	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	55	55
NR04	House - owned by Nystrom	48	47
NR30	House - East Thunder Lake Road	47	46
NR44	House - near Trans-Canada Highway	43	42
NR47	House - East Thunder Lake Road	43	42

Table 6.4.4.3-4: Change in Percent Highly Annoyed, Operations

Rec #	Description	Predicted Change in %HA	
		Residence	Outdoor Receptor
NR03	House - owned by McLeish	1.3	1.2
NR04	House - owned by Nystrom	0.3	0.2
NR30	House - East Thunder Lake Road	0.2	0.2
NR44	House - near Trans-Canada Highway	0.1	0.1
NR47	House - East Thunder Lake Road	0.1	0.1

6.4.4.4 Post-closure Phase

As described in 6.4.4.1, there were no sources of noise that would measurable effect noise during the post-closure phase.

6.4.5 Identified Mitigation

The Project will employ best practices that will help reduce and mitigate noise effects, including the following:

- Blasting conducted in phased manner that optimizes the amount of explosives needed for a given area to be blasted, the amount of explosives detonated for a given time delay within the detonating procedure and that minimizes the area being blasted [Mit_029].
- Where potential effects of vibration to spawning shoals is identified, blasting practices will be adjusted to mitigate the effects [Mit_030].

- Advise nearby residents of significant noise-causing activities, such as blasting, and endeavour to schedule those events to reduce disruption to residents [Mit_026, Mit_027].

- Conduct heavy equipment activity between the hours of 07:00 and 22:00, if possible, to reduce the noise effects to neighbouring residents [Mit_025].

- Material will be loaded into haul trucks in a manner that minimizes the drop height from the loader or excavator to the bed of the truck [Mit_031].

- Ensure that all internal combustion engines are fitted with appropriate muffler systems [Mit_028].

In addition to these measures, Treasury Metals is exploring the feasibility of using other possible forms of noise mitigation such as the following:

- Possible rubber bedding material currently being investigated.

- Employing white noise backup alarms for surface equipment to reduce the tonal noise compared to traditional backup alarms. It should be noted that backup alarms are not included in the noise that is regulated in Ontario due to their importance for ensuring worker health and safety.

- In the event that complaints can lead to the identification of specific sources of concern, source-specific abatement such as noise walls, berms, or operational restrictions will be employed, as appropriate [Mit_033].

6.4.6 Residual Adverse Effects

Even with the identified mitigation measures summarized in Section 6.4.5, residual adverse effects are predicted to remain for each of the noise VCs and indicators. Residual adverse effects on the ambient noise levels, wildlife noise effects, and noise related health effects VCs are predicted during the site preparation and construction, operations, and closure phases. Residual adverse effects on blasting noise and vibration VC will only occur during the site preparation and construction, and operations phases. The predicted residual adverse effects are shown in Table 6.4.6-1

Table 6.4.6-1: Residual Adverse Effects for Noise

Valued Components (VCs)	Indicators	Measures	Predicted Noise Effects			
			Site Preparation Construction	Operations	Closure	Post-Closure
Ambient noise levels	L_{EQ}	dBA	40	40	39	N/A(2)
Noise disturbance to wildlife	Area > 50 dBA	ha	430 within Project Site	199 within Project Site	122 within Project Site	N/A(2)

Table 6.4.6-1: Residual Adverse Effects for Noise (continued)

Valued Components (VCs)	Indicators	Measures	Predicted Noise Effects			
			Site Preparation Construction	Operations	Closure	Post-Closure
			0 LSA	0 LSA	0 LSA	
			0 RSA	0 RSA	0 RSA	
Blasting noise and vibration	Peak sound pressure	dB	78	78	N/A(1)	N/A(2)
	Peak particle velocity	cm/s	0.123	0.123	N/A(1)	N/A(2)
Noise related health effects	L_{DN}	dBA	56	57	55	N/A(2)
	Δ %HA	%HA	1.6	1.8	1.3	N/A(2)

Notes:
(1) There will be no blasting during the closure phase
(2) There will be no sources of noise during the post-closure phase

It is important to keep in mind the following when considering these residual adverse effects:

- The noise predictions during operations are based on the maximum levels of activity, activities occurring in the open pit closest to the receptors, and activities with the least amount of natural shielding (i.e., mining near or at the surface). Therefore, the residual adverse effects for the Project on noise levels during operations are conservative. The residual adverse effects on noise will be less than shown as mining progresses deeper into the open pit, and once mining activities move underground.

- Even though there are residual adverse effects predicted for both of the indicators for the noise related health effects VC, this does not mean that there would be residual adverse health effects. In keeping with the process set out in the EIS Guidelines, the predicted adverse effects indicate that the predicted levels for these indicators will change relative to the baseline conditions as a result of the Project, even with the consideration of the identified mitigation measures. For there to be a health effect, the predicted levels would need to exceed the established thresholds for these indicators. The comparison of the residual noise effects to established thresholds has been completed as part of the determination of significance provided in Section 8.4.

For three of the noise VCs (i.e., ambient noise levels, blasting noise and vibration, health related noise effects) effects and the assessment of the effects are specifically tied to established sensitive receptor locations, such as residences. For these VCs, it is not appropriate to define effects and impacts where there are no sensitive receptors. However, ambient noise resulting from the Project could be disruptive for individuals practicing traditional uses of the land. In order to provide an indication of where noise may be noticeable, Figure 6.4.6-1 show those areas where the predicted noise levels could be above the MOECC guideline for nighttime noise levels in remote and rural areas (i.e., 40 dBA). Although the MOECC guidelines only apply for points of reception (e.g., residential dwellings), areas above 40 dBA (shown with green shading on Figure 6.4.6-1) indicates those areas where noise levels could be noticeable to people practicing traditional uses of the land.

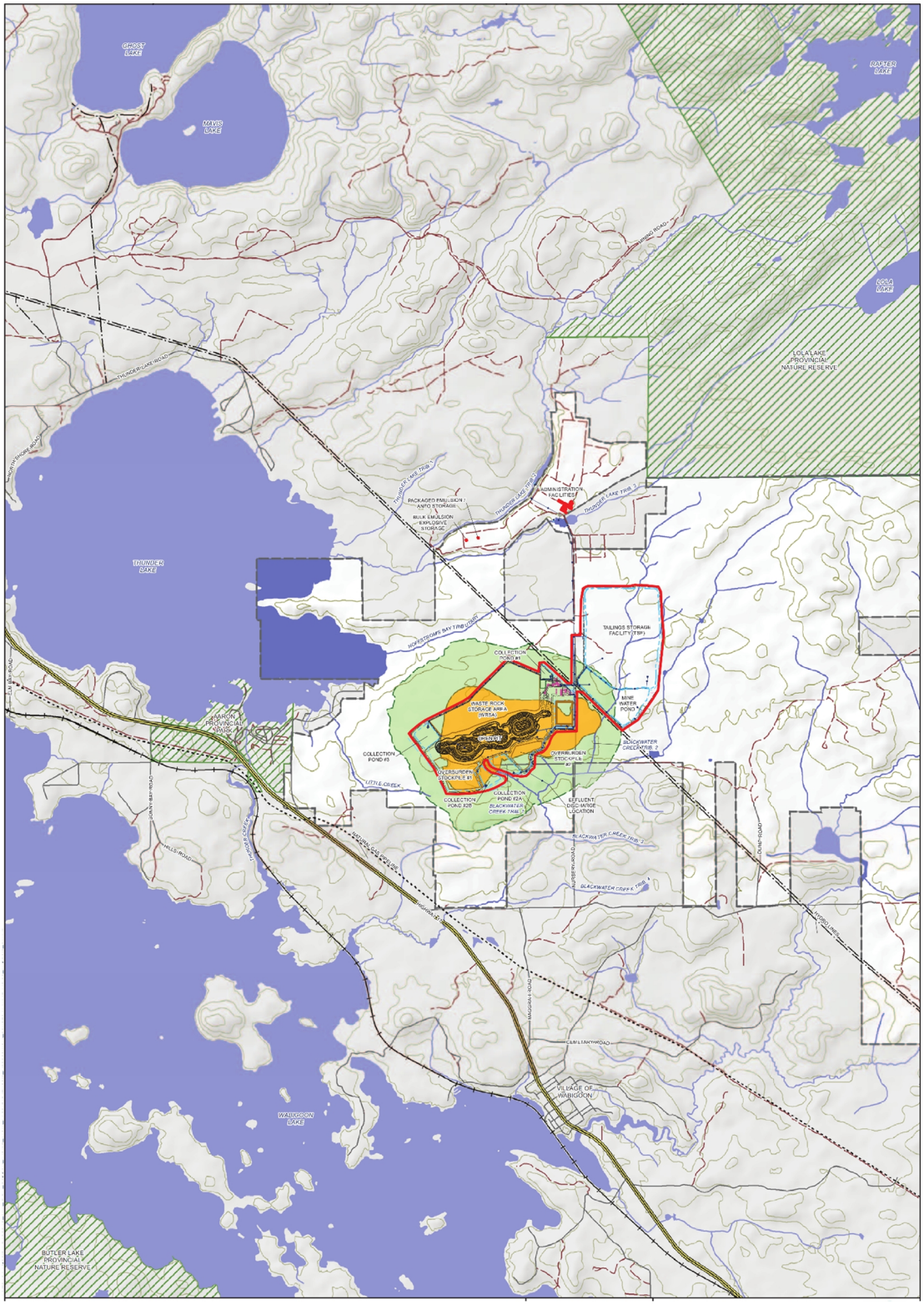


Figure 6.4.6-1: Spatial Extents of Predicted Noise Effects

Published literature (including data published by Environment Canada) suggest noise levels greater than 50 dBA would be disruptive to wildlife, especially migratory birds, causing changes in behaviour or avoidance of affected areas. As a result, areas with noise above 50 dBA (shown with gold shading on Figure 6.4.6-1) would likely not be suitable for traditional harvesting as species could be displaced or behave abnormally.

The data presented in Figure 6.4.6-1 represent the spatial extent of highest residual noise effects the operations phase, when mining activities are occurring relatively close to the surface in the open pit. Once mining advances lower in the pit of moves underground, the residual noise effects would be considerably less. Similarly, the residual effects on noise would be less during both the site preparation and construction, and the closure phases. As there would be no sources of noise during the post-closure phase, there would be no residual effects.

6.4.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, there were several questions that were wholly, or partially, asking for information, clarification and/or justification for the approach used in predicting the effects of the Project on noise. Responses to the IRs were provided separately, and incorporated into the relevant sections of the Revised EIS. The following lists the Round 1 IRs related to the noise predictions:

- TMI_184-AE(1)-22: Vibration from blasting;
- TMI_186-AE(1)-24: Traffic noise;
- TMI_190-AE(1)-28: Implications of new guidelines and standards;
- TMI_191-AE(1)-29: Adjust sound characteristics;
- TMI_192-AE(1)-30: Provide 50 dBA contour line;
- TMI_193-AE(1)-31: Revise noise modeling if equipment differs;
- TMI_302-RG(1)-37: Detailed listing of stationary noise sources;
- TMI_303-RG(1)-38: Adjust sound characteristics;
- TMI_304-RG(1)-39: Detailed listing of stationary noise sources;
- TMI_322-SD(1)-17: Implications of new guidelines and standards;
- TMI_323-SD(1)-18: Implications of new guidelines and standards;
- TMI_515-AC(1)-189: Blasting noise;

- TMI_526-AC(1)-200: Blasting noise;
- TMI_527-AC(1)-201: Linkages of noise with Aboriginal people VCs;
- TMI_539-AC(1)-213: Blasting noise;
- TMI_540-AC(1)-214: Linkages of noise with Aboriginal people VCs;
- TMI_565-AC(1)-239: Effects of nose on traditional uses of the land; and
- TMI_588-AC(1)-262: Effects of nose on traditional uses of the land.

6.5 Light

6.5.1 Potential Effects of the Project on the Environment

The potential effects of the Project on light relate to the exterior lighting will be installed to help ensure the safety of the workers and the security of the operations. Light is not identified as a contaminant such as noise or certain air compounds, but the light that is emitted from the Project (known as light trespass) can be regarded as a nuisance by adjacent property owners and residents. The potential for the Project to affect light, specifically the “light trespass” VC will vary by phase of the Project. The following lists the potential light effects by Project phase:

- **Site Preparation and Construction Phase**: There will be no permanent lighting structures during the site preparation and closure phase. Site preparation and construction activities are not expected to occur around the clock, but there may be some times of the year when portable lighting would be required to ensure the safety of the workers.

- **Operations Phase**: During operations, the processing plant and mining operations would occur 24-hours per day. However, deliveries and major significant work at the plant site would be restricted to daylight hours. Permanent lighting will be required at the processing plant and at key areas within the Project to ensure the safety of workers, and the security of the operations. Portable lighting may be required within the open pit for safety reasons, however, the light from the open pit would only affect the light trespass levels when mining is occurring at the surface. Lighting will be required for the underground mining operations, but this light would not affect light trespass levels at the surface.

- **Closure Phase:** There will be no permanent lighting structures during closure. Generally, closure activities will occur during the day. However, local portable lighting systems may be required to ensure the safety of workers.

- **Post-closure Phase**: Once the closure activities are completed, there will be no artificial lights at the project and therefore no light effects.

The potential effects of the Project on light have been described using a simple linkage diagram on Figure 6.5.1-1. The figure illustrates that the light VC (shown in blue on the figure) can be potentially affected during site preparation and construction, operations, and closure phases of the Project. For example, the predicted illuminance levels from the project will act as inputs to the wildlife and wildlife habitat VCs. No other VCs provide inputs to the light VC.

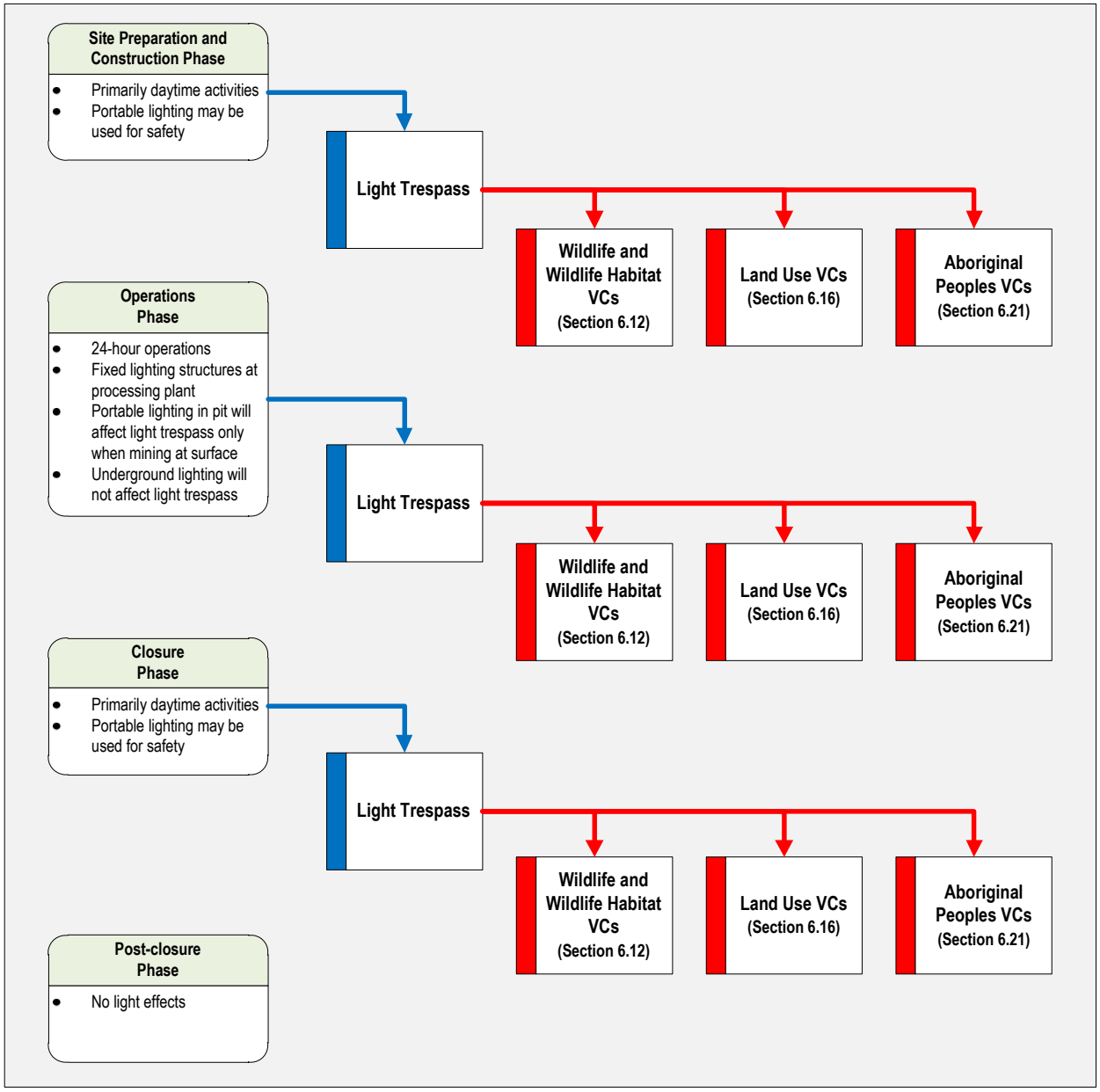


Figure 6.5.1-1: Light Linkage Diagram

6.5.2 Effects Prediction Methods

The predicted light effects of the Project will be determined quantitatively by calculating the levels of illuminance, in units of lux, resulting from the artificial lighting used at the Project site. The lighting plan and layout was modelled using software program AGi32. This is an industry standard lighting calculation software program and is widely accepted as a very accurate tool in determining the expected light levels for any specific plot plan.

The general steps involved in predicting the light effects of the Project are:

- Determine the number, configuration and intensity of artificial lights required to meet the lighting requirements for the Project; and
- Calculate the resulting illuminance levels at selected locations on-site and at sensitive receptors (Section 6.1.4.5).

Night-time lighting will be provided to sustain the safe operation of the Project 24-hours a day. On-site night-shift staff numbers will be significantly lower than during the day and the majority of operations and maintenance tasks will be within the process plant buildings. In addition, all site deliveries and process plant bulk chemical and warehouse deliveries will be scheduled for daylight hours. Night-time lighting will therefore be designed to provide the minimum illumination levels necessary to support the night-time operation, knowing that no significant work at the plant site will be performed outside during “normal operations”.

Table 6.5.2-1 provides a listing of the illumination design criteria used to develop the preliminary lighting plan.

Table 6.5.2-1: Plant and Mine Infrastructure Illumination Design Criteria

Area	Minimum Average Maintenance Illuminance (Lux)	Maximum Working Plane(m)
Switchrooms and control rooms	160	0.75
MCC control panels	160	0.75
Feeders	160	On Pan
Compressors and pumps	160	On Drive
Processing equipment, i.e., screens, etc.	160	On Deck/Drives
Milling area	160	On Drive
Hydraulic power packs	160	On Drive
Transfer chutes	80	0.75
Intermittent inspection area/tasks	80	0.75
Plant bunkers and pits	80	0.75
Internal stairs (within plant buildings)	80	0
Internal walkways (within plant buildings)	40	0
Platforms	40	0
Conveyors, gantries and tunnels	40	0

Table 6.5.2-1: Plant and Mine Infrastructure Illumination Design Criteria (continued)

Area	Minimum Average Maintenance Illuminance (Lux)	Maximum Working Plane(m)
External stairs and catwalks	20	0
Building access	10	0
Access roadways	5	0
Stockpile area lighting	5	0
Building surrounds	5	0

A preliminary night-time lighting layout has been designed to provide the minimum night-time illumination levels for the process plant and mine infrastructure. The lighting layout (Figure 6.5.2-1) outlines the external operations lighting. The key elements of the preliminary lighting plan includes the following:

- A single 6 m high mounted floodlight (132.2 Watts) will be installed on the Run Of Mine (ROM) pad above the ROM Bin to provide an area illumination level of 40 Lux over the ROM Bin to provide the Haul Truck drivers and Front End Loader (FEL) operators sufficient lighting for ore tipping. A 6 m high area light (56.9 Watts) also provides an illumination level of 5 Lux to the ground surface in front of the ROM Bin.

- There will be no external lighting for the enclosed raw ore conveyor galleries as these will be fully enclosed structures, with internal lighting provided.

- An area light (56.9 Watts) will be mounted at a height of 15m on each of the three external sides of the Primary Crusher Building to provide a surrounding ground illumination level of 5 Lux. A single floodlight (132.2 Watts) will be mounted at a height of 22 m off the Ore Feed Bin to provide a minimum stockpile illumination level of 5 Lux for the Bin overflow stockpile area. Two additional floodlights will be mounted at a height of 22 m off the Ore Feed Bin structure which will illuminate the stockpile reclaim hopper below to a level of 40 Lux.

- Fourteen area lights (56.9 Watts) will be mounted at a height of 15 m around the perimeter of the Process Plant Building, with an approximate distance of 18.5 m between each light. This lighting set-up will provide a ground perimeter illumination of 5 Lux.

- An area light (56.9 Watts) will be mounted at a height of 5 m on each side of the main HV switch room located beside the plant. A light will be installed above each main access door either side of the switch room. One light will then be located on each remaining side. This lighting arrangement will provide a ground perimeter illumination level of 5 Lux.

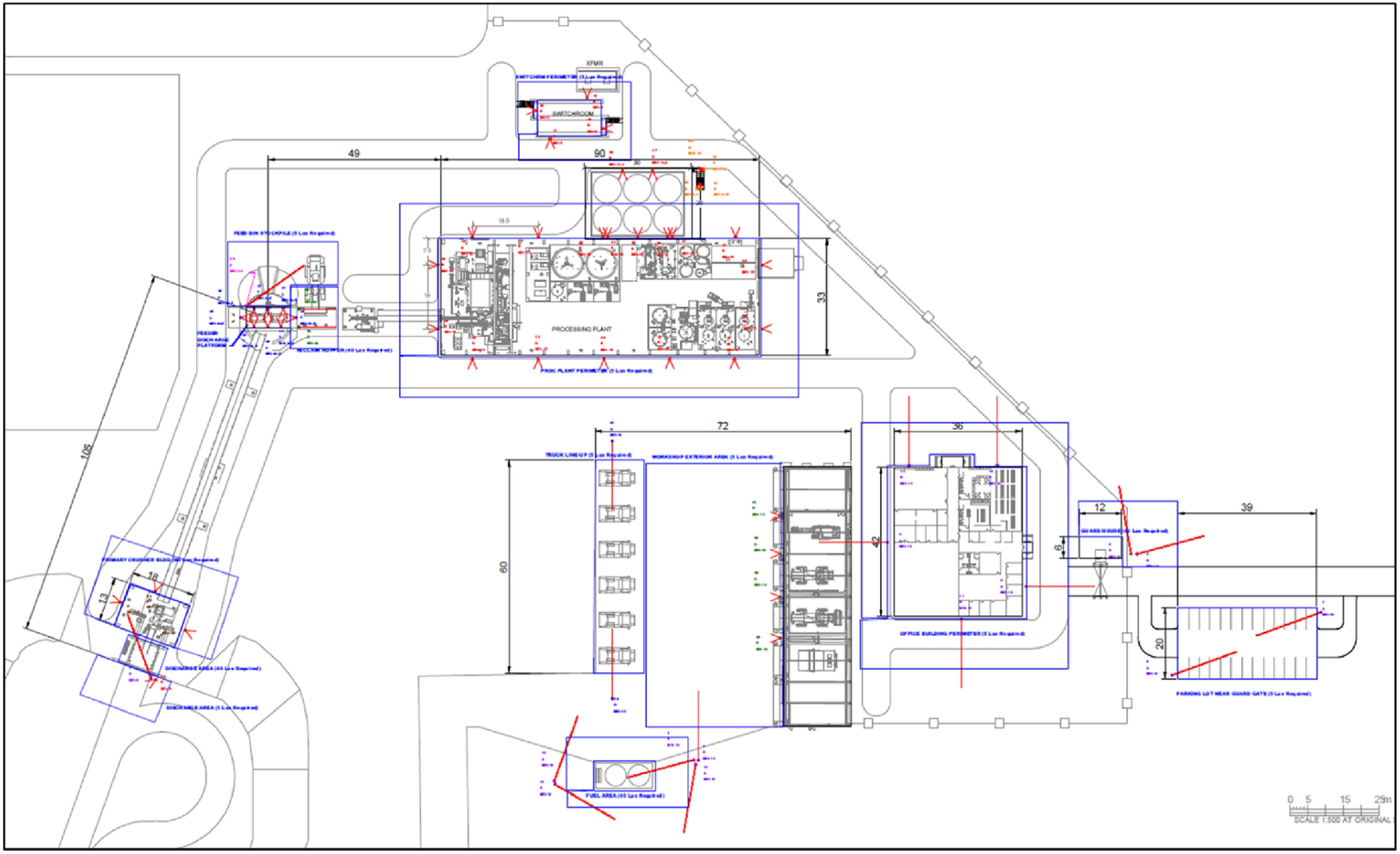


Figure 6.5.2-1: Process Plant and Mine Infrastructure, Lighting Plan

- Two 10 m high mounted floodlights (132.2 Watts) will be installed adjacent to the truck line-up area to provide a sufficient ground illumination of 5 Lux for the waiting mine haul trucks and operations equipment.

- Four area lights (56.9 Watts) will be mounted at a height of 10 m on the front of the truck workshop and maintenance building. There will be an approximate distance of 11 m between each light. These mounted workshop lights, together with one 10 m high floodlight (132.2 Watts) located beside the fuel tank area will provide a ground illumination of 5 Lux for the area in front of the workshop.

- Four 10 m high mounted floodlights (132.2 Watts) will be located at the fuel tank area to provide an fuel tank ground illumination level of 40 Lux

- Five 10 m high floodlights (132.2 Watts) will be mounted from the mine administration building to provide a perimeter ground illumination level of 5 Lux.

- Two 10 m high mounted floodlights (132.2 Watts) will be installed directly in front of the guard house to provide a sufficient illumination level of 40 Lux to the area adjacent the guardhouse and to the right of the site access road located off Nursery Tree Road. Two additional 10 m high mounted floodlights (132.2 Watts) will be located at either end of the plant parking lot outside of the perimeter fencing to provide a carpark ground illumination level of 5 Lux.

All plant area night-time lighting will be controlled by the process plant control system and will be automatically turned on/off from adjustable timers. The higher Lux illumination levels (>80) will be placed within the process plant and mine infrastructure buildings, which contains the process and electrical equipment. All externally mounted luminaires and their associated lamps will be designed to meet the requirements and recommendations of the Canadian Electrical Code (CEC), and the Building Code of Ontario. In particular, tilt and cut-off angles shall be such as to minimize the effect of the lighting system on the nearby residents and sensitive receivers. External light fixtures will be installed at a tilt angle of 45º. The technical specifications for the external plant and infrastructure light fixtures are detailed in Table 6.5.2-2.

In calculating the illuminance from the lighting fixtures, no credit was taken for shielding provided by the intervening topography, vegetation or the presence of the waste rock storage area (WRSA) and overburden stockpile that would effectively block any light from the process plant being visible to residents on Thunder Lake.

Table 6.5.2-2: Process Plant and Mine Infrastructure Light Fixture Technical Specifications

Cat.	Description	Plant Areas	#	Light Loss Factor	Lamp Lumen Depreciation	Luminaire Level (LUM)	Watts (W)	Tilt Angle (º)
A	Flood light, NEMA 6, very wide optic	Entry carpark and security gatehouse	4	0.903	0.950	6,427	56.9	45
		Mine administration building	5	0.903	0.950	6,427	56.9	45
		Fuel tanks	5	0.903	0.950	6,427	56.9	45
		ROM pad	1	0.903	0.950	6,427	56.9	45
B	Area light	Process plant building and CIL tanks	14	0.903	0.950	6,427	56.9	45
		HV switch room	4	0.903	0.950	6,427	56.9	45
		ROM pad	1	0.903	0.950	6,427	56.9	45
D	Area light	Truck workshop	4	0.903	0.950	6,427	56.9	45
E	Area light	Primary crusher building	3	0.903	0.950	6,427	56.9	45
F	Flood light, NEMA 6, very wide optic	Feed bin stockpile	1	0.903	0.950	6,427	56.9	45
G	Flood light, NEMA 6, very wide optic	Haul truck line-up area	2	0.903	0.950	6,427	56.9	45
H	Flood light, NEMA 6, very wide optic	Raw ore emergency reclaim hopper	2	0.903	0.950	6,427	56.9	22.5

6.5.3 Project Effects Avoidance Measures Used in Predictions

The following elements built into the design of the lighting layout and the configuration of the Project will help avoid potential effects of the Project on light:

- Activities during the site preparation and construction phase will generally occur during the daytime. If there are times when lighting is required to ensure the safety of the workers, portable lighting will be used in required areas only. Portable lighting will be directed downward to minimize any off-site effects [Mit_034, Mit_035].

- The higher Lux illumination levels (>80) will be placed within the process plant and mine infrastructure buildings, which contains the process and electrical equipment [Mit_036].

- All externally mounted luminaires and their associated lamps will be designed to meet the requirements and recommendations of the Canadian Electrical Code (CEC), and the Building Code of Ontario [Mit_037].

- External light fixtures will be installed at a tilt angle of 45º to minimize the off-site effect of the lighting system [Mit_038].

- Cut off angles for external lightings will be designed to minimize the off-site effect of the lighting system [Mit_039].

- Nighttime illumination will not be provided at the tailings storage facility (TSF) [Mit_040].

- Some activities in the open pit may require portable lighting to ensure the safety of the workers, portable lighting will be used in required areas only. Portable lighting will be directed downward to minimize off-site effects. Lighting within the open pit should not be visible to adjacent residents as it will be occurring below grade [Mit_035, Mit_041].

- Lighting required to support the underground mining operations will not be visible at the surface.

- Activities during the closure phase will generally occur during the daytime. If there are times when lighting is required to ensure the safety of the workers, portable lighting will be used in required areas only [Mit_035, Mit_042].

6.5.4 Predicted Effects

Using the preliminary lighting plan and the configuration of the proposed light fixtures described in Section 6.5.2, predicted illuminance levels over the areas near the processing plant were calculated and used to produce a Lux plot (Figure 6.5.4-1) and a rendered plan view showing the illuminance levels (Figure 6.5.4-2).

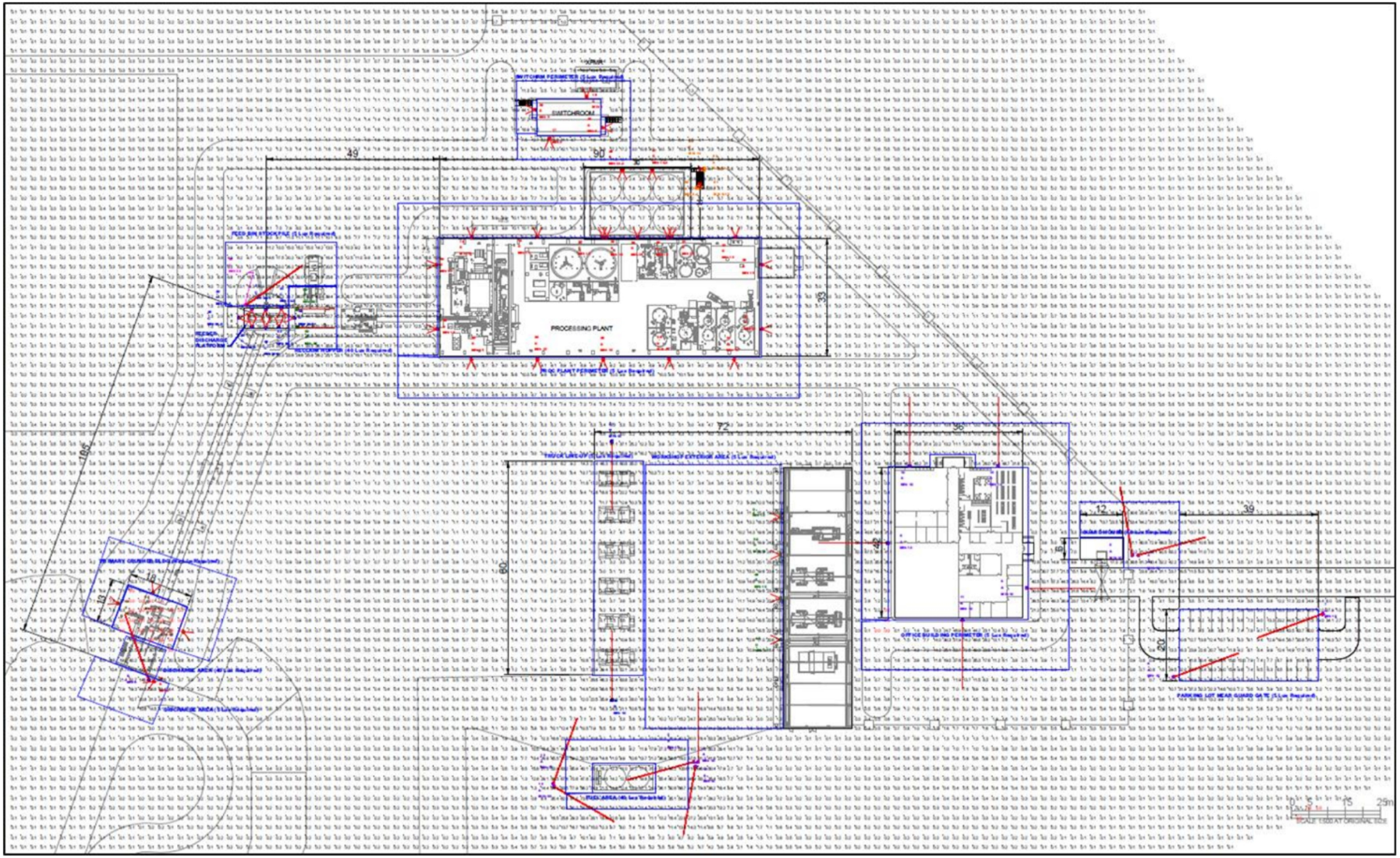


Figure 6.5.4-1: Process Plant and Infrastructure, Lux Plot

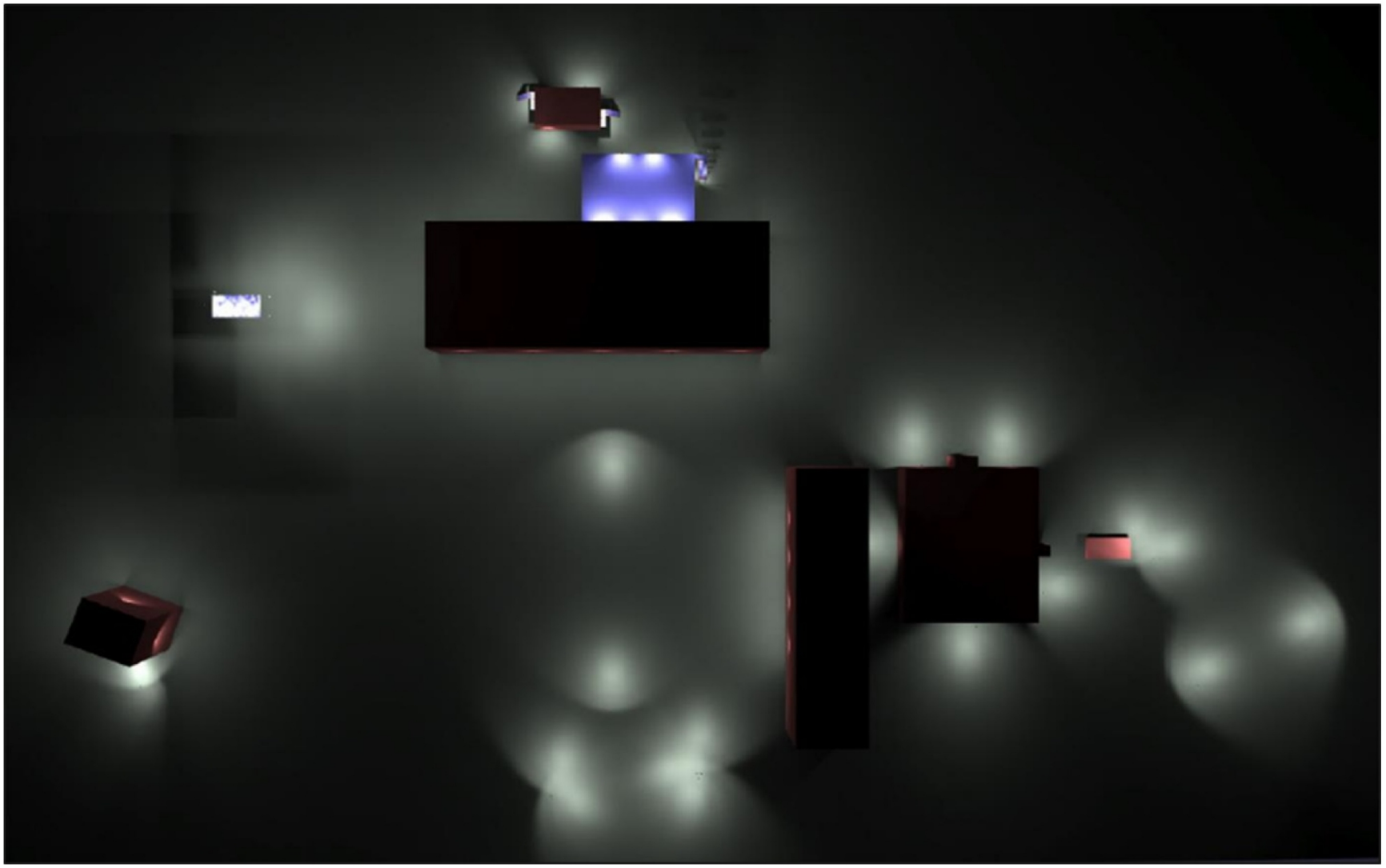


Figure 6.5.4-2: Process Plant and Infrastructure, Rendered Plan View

The methods were also used to calculate the light trespass as a result of the project at the 11 light receptors introduced in Section 6.1.4.5. These results are presented in Table 6.5.4-1. Only the results for the off-site receptor locations have been provided as the on-site receptors will not be there once mining activities commence. Both the plots and the tabular results confirm that illuminance from the Project lighting would not extend more than 100 to 200 m from the process plant infrastructure, and that there would be no light trespass at the neighbouring residences.

Table 6.5.4-1: Predicted Light Effects at Sensitive Receptor Locations

Sensitive Receptor	Baseline Illuminance (Lux)	Predicted Light Trespass (Lux)
R1 – Center of Proposed Pit	0 to 0	—
R2 – East of Proposed Pit	0 to 0	—
R3 – Nystrom House on Tree Nursery Road	0 to 0.01	0
R4 – Field to east of East Thunder Lake Road	0 to 0.01	0
R5 – 249 East Thunder Lake Road	2.4 to 4.3	0
R6 – East Thunder Lake Road near Little Creek	0.21 to 3.2	0
R7 – 352 East Thunder Lake Road	0 to 0.03	0
R8 – Thunder Lake Road near Highway 17	0 to 0.5	0
R9 – 65 Thunder Lake Road	0 to 15.2	0
R10 – North Shore and Thunder Lake Road	0 to 4.4	0
R11 – North side of Thunder Lake	0.02 to 0.22	0

It should be noted that the closest off-site receptor to the artificial lighting at the processing plant will R3 (Nystrom house on Tree Nursery Road), which is located approximately 1.6 km from the proposed process plant and mine infrastructure location. The calculated output from the lighting model showed the plant lux levels converging to 0 at distances between 100 to 200 m from the process plant boundary. As shown in Table 6.5.4-1, the modelled light trespass at receptor R3 is 0.0 lux. Based on the modelling, it is highly unlikely that light originating from the Project site would, or could, be measurable beyond the property boundaries.

6.5.5 Identified Mitigation

The following elements built into the design of the lighting layout and the configuration of the Project will help avoid potential effects of the Project on light:

- Activities during the site preparation and construction phase will generally occur during the daytime. If there are times when lighting is required to ensure the safety of the workers, portable lighting will be used in required areas only. Portable lighting will be directed downward to minimize any off-site effects [Mit_034, Mit_035].

- The higher Lux illumination levels (>80) will be placed within the process plant and mine infrastructure buildings, which contains the process and electrical equipment [Mit_036].

- All externally mounted luminaires and their associated lamps will be designed to meet the requirements and recommendations of the Canadian Electrical Code (CEC), and the Building Code of Ontario [Mit_037].

- External light fixtures will be installed at a tilt angle of 45º to minimize the off-site effect of the lighting system [Mit_038].

- Cut off angles for external lightings will be designed to minimize the off-site effect of the lighting system [Mit_039].

- Nighttime illumination will not be provided at the tailings storage facility (TSF) [Mit_040].

- Some activities in the open pit may require portable lighting to ensure the safety of the workers, portable lighting will be used in required areas only. Portable lighting will be directed downward to minimize off-site effects. Lighting within the open pit should not be visible to adjacent residents as it will be occurring below grade [Mit_035, Mit_041].

- Activities during the closure phase will generally occur during the daytime. If there are times when lighting is required to ensure the safety of the workers, portable lighting will be used in required areas only [Mit_035, Mit_042].

6.5.6 Residual Adverse Effects

As described in Section 6.1.3.4, a single VC, namely light trespass, was used for evaluating the effects of the Project on light. During operations, the mining and processing activities will occur 24-hours a day. Night-time lighting will be required to provide safe working conditions in and around the processing plant. The effects of the Project on light trespass at the nearby residences were modelled using the AGi32 software program and the preliminary night-time lighting layout designed to provide the minimum night-time illumination levels for the process plant and mine infrastructure (Section 6.5.2). Table 6.5.5-1, show that with consideration for the avoidance (Section 6.5.3) and mitigation (6.5.5) measures, there will be no predicted residual adverse effects on the light trespass for nearby for the residences as a result of the Project.

Table 6.5.5-1: Predicted Light Trespass Levels

Sensitive Receptor	Predicted Light Trespass (Lux)	Effects
R3 – Nystrom House on Tree Nursery Road	0	no adverse effect
R4 – Field to east of East Thunder Lake Road	0	no adverse effect
R5 – 249 East Thunder Lake Road	0	no adverse effect
R6 – East Thunder Lake Road near Little Creek	0	no adverse effect
R7 – 352 East Thunder Lake Road	0	no adverse effect
R8 – Thunder Lake Road near Highway 17	0	no adverse effect
R9 – 65 Thunder Lake Road	0	no adverse effect
R10 – North Shore and Thunder Lake Road	0	no adverse effect
R11 – North side of Thunder Lake	0	no adverse effect

Although light trespass requires there to be a receptor, such as a residence, it is possible to use the results of the light modelling to identify the spatial extents where predicted light trespass levels would be above 0 lux. As shown on Figure 6.5.6-1, residual adverse effects of light will be restricted to a small area in the immediate vicinity of the processing plant.

6.5.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, the following questions were asked regarding the predictions of effects on light:

- TMI_178-AE(1)-16: quantitative prediction of light effects;
- TMI_443-AC(1)-117: linkage between light and Aboriginal peoples;
- TMI_468-AC(1)-142: night-time illumination levels;
- TMI_527-AC(1)-201: linkage between light and Aboriginal peoples;
- TMI_540-AC(1)-214: linkage between light and Aboriginal peoples; and
- TMI_705-PC(1)-20: illumination of tailings pond.

6.6 Air Quality

6.6.1 Potential Effects of the Project on the Environment

The potential effects of the Project on air quality will vary during the Project life, depending on the Project phase, and with varying levels of activity. The following lists the potential air quality effects by Project phase:

- **Site Preparation and Construction Phase**: The activities that could result in air emission during the site preparation and construction phase were described in Section 6.1 of the Environmental Air Quality Assessment (RWDI, 2014e), included as part of Appendix J to the EIS. The early stages of site preparation would include tree clearing, grubbing, and the stripping of overburden. There would be limited blasting (at a reduced level compared to operations), the excavation and crushing of aggregate for road construction, as well as the construction of the Project facilities. The specific sources of air emissions considered during the site preparation and construction phase included:
    - Haul roads (including road dust and tailpipe emissions);
    - Operations of dozers (including tailpipe emissions);
    - Operation of loaders (including tailpipe emissions);

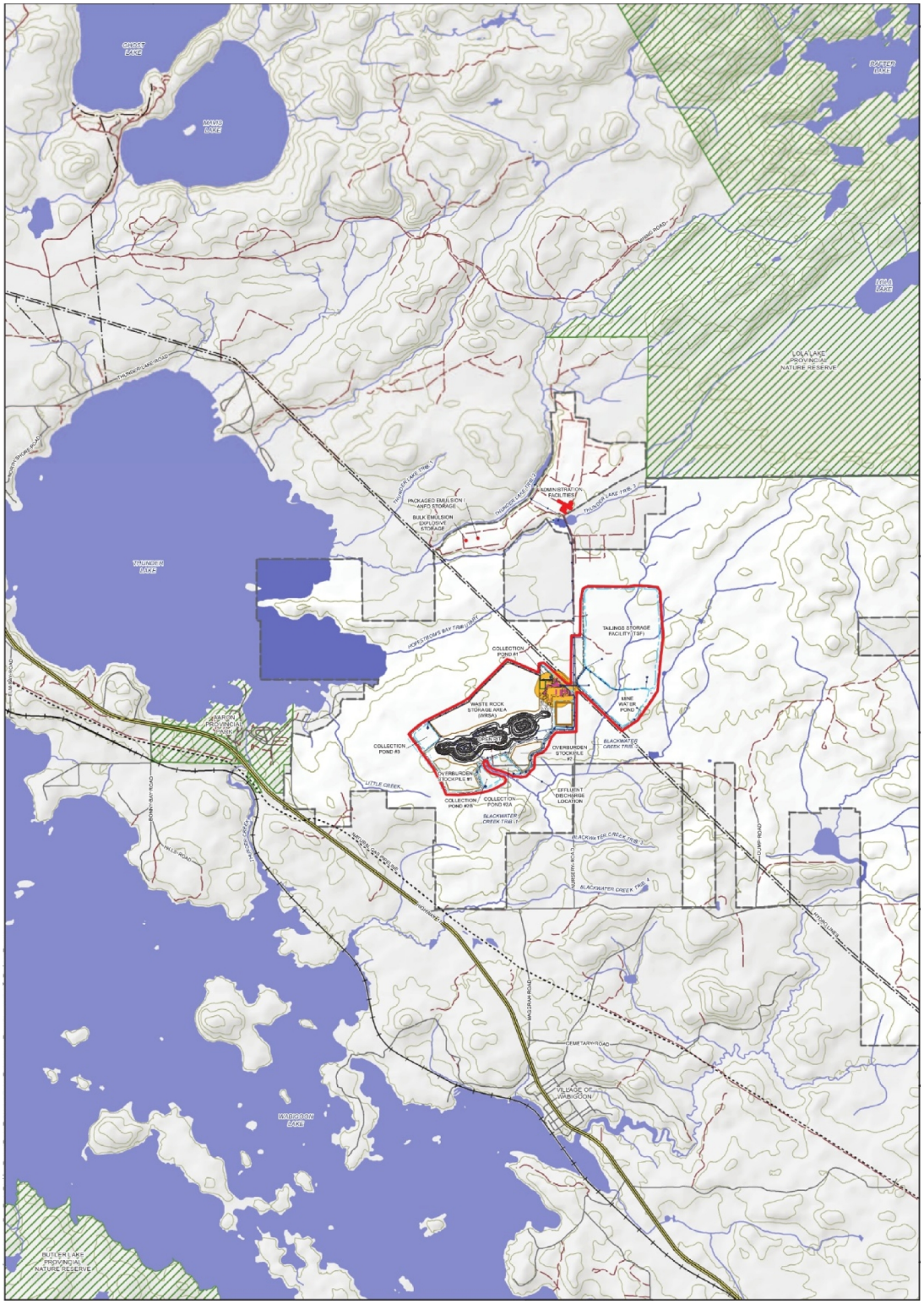


Figure 6.5.6-1: Spatial Extent of Residual Light Effects

- Material handling (loading and unloading of waste rock and overburden);
- Excavator (tailpipe emissions);
- Crusher; and
- Blasting, at 25% of the level during operations.

- **Operations Phase**: The activities that could result in air emission during the operation phase were described in Section 7.1 of the Environmental Air Quality Assessment (RWDI, 2014e). The operational phases will include both underground and open face mining activities. The activities in the open pit mine will include drilling, blasting, dozing, excavating and the transportation of rock material on-site. The underground activities will also include the operation of intake and exhaust vent raises and the transportation of rock material to the surface. A crusher is located adjacent to the processing plant to prepare the ore for processing. There is an existing 115 kV transmission line adjacent to the proposed processing plant that will avoid the need for on-site power generation. The site will be equipped with emergency power generation, which will be used when power supply from the 115 kV transmission line is not available. Testing of emergency generators will also occur periodically. The specific sources of air emissions considered during the operations phase included:
  - Haul roads (including road dust and tailpipe emissions);
  - Operations of dozers (including tailpipe emissions);
  - Operation of loaders (including tailpipe emissions);
  - Material handling (loading and unloading of waste rock and overburden);
  - Excavator (tailpipe emissions);
  - Crusher;
  - Wind erosion of tailings;
  - Blasting;
  - Vent raises;
  - Heaters; and
  - Emergency generators.

- **Closure Phase:** The activities that could result in air emission during closure were described in Section 8.1 of the Environmental Air Quality Assessment (RWDI, 2014e). The closure would include the activities to rehabilitate the site, as well as disassembling and removal of infrastructure and equipment. The specific sources of air emissions considered during the operations phase included:
    - Haul roads (including road dust and tailpipe emissions);
    - Operations of dozers (including tailpipe emissions);
    - Operation of loaders (including tailpipe emissions);
    - Material handling (loading and unloading of waste rock and overburden); and
    - Excavator (tailpipe emissions).
- **Post-closure Phase**: Once the closure activities are completed there are not expected to be any sources of air emissions at the Project.

As shown above, the assessment considered the emissions from on-site traffic including haul trucks and other heavy equipment. The emissions from personal vehicles, and other smaller vehicles travelling to and from the site were deemed insignificant with respect to air quality. Smaller vehicles are usually are limited to 1 or two trips a day, with the weight, number of wheels, and engine sizes combining to produce emissions that will have a minimal effect on air quality compared to the heavy mine trucks assumed to be operating constantly at the Project.

The potential effects of the Project on air quality have been described using a simple linkage diagram on Figure 6.6.1-1. The figure illustrates the air quality VC (shown in blue on the figure) potentially be affected during each phase of the Project life. Additionally, the figure indicates those other components of the environment (shown in red on the figure) where there will be a reliance on information about the effects of the Project on air quality as an input for determining the effects on other VCs. For example, air quality predictions will be used as an input to the human health component. There are no other components or VCs that provide inputs to the assessment of air quality effects.

6.6.2 Effects Prediction Methods

The methods used to predict the air quality effects of the Project are described in Section 3 of the Environmental Air Quality Assessment (RWDI, 2014e). The general steps involved in predicting the air quality effects of the Project are:

- Determine the air emissions from the Project; and
- Use a numerical model to predict the air concentrations and deposition rates.

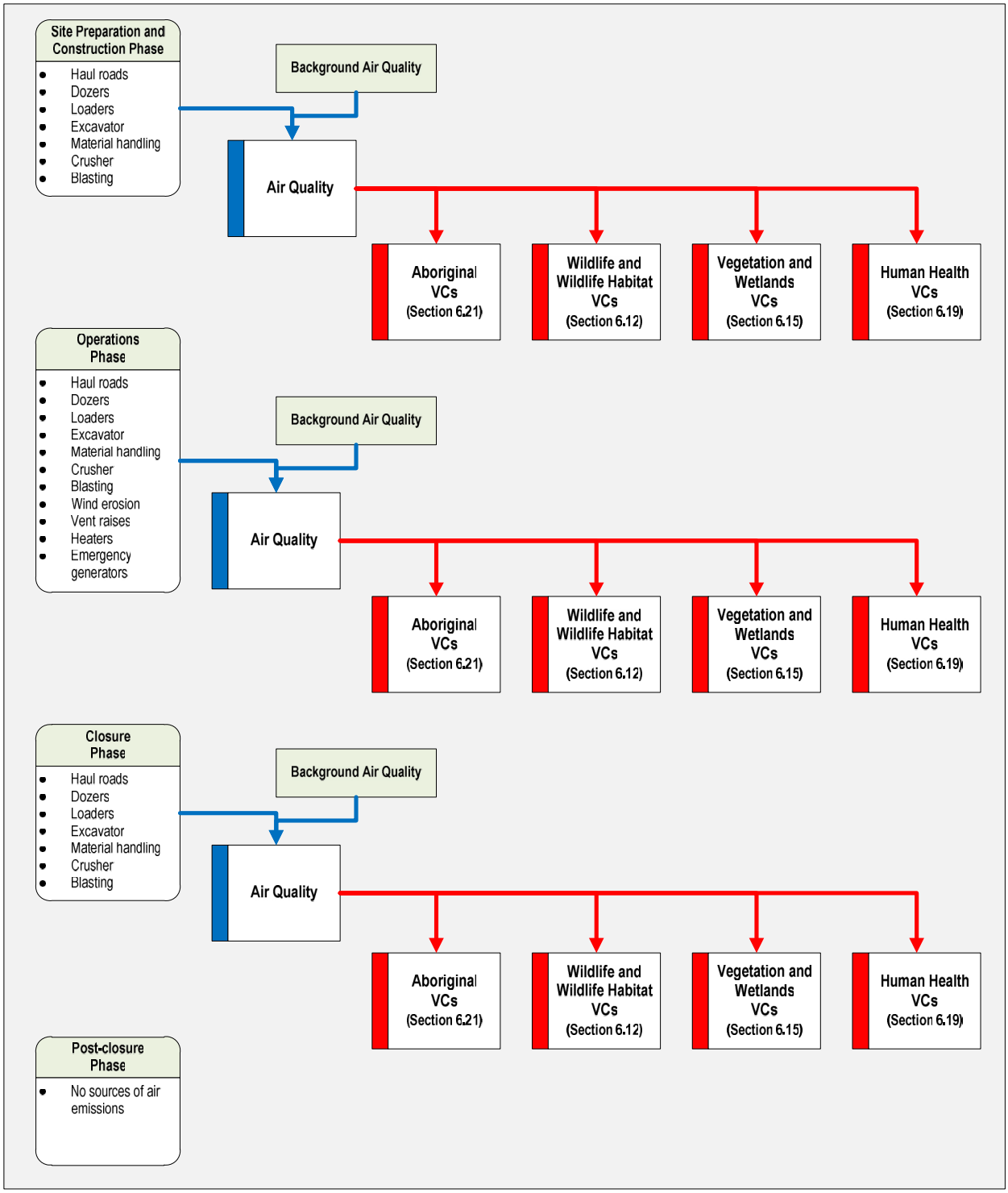


Figure 6.6.1-1: Air Quality Linkage Diagram

6.6.2.1 Determining Air Emissions

A description of the methods used for determining the air emissions from project was provided in Section 3.3 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS). These emissions were assumed to apply for all phases of the Project where those activities occur, with the total emissions varying on the basis of the mine processing and material handling rates. Detailed calculations for all of the emissions from the Project are provided in the various sections of Appendix B to the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS), as shown in Table 6.6.2.1-1.

Table 6.6.2.1-1: Appendices Listing Detailed Emission Calculations

Emission Category	Site Preparation and Construction	Operations	Closure
Dust from unpaved roads	Appendix B1	Appendix B6	Appendix B17
Tailpipe emissions	Appendix B2	Appendix B7	Appendix B18
Material handling	Appendix B3	Appendix B8	Appendix B19
Blasting	Appendix B4	Appendix B9	—
Dozers	Appendix B5	Appendix B10	Appendix B20
Wind erosion of tailings	—	Appendix B11	—
Back-up generators	—	Appendix B12/B13	—
Heaters	—	Appendix B14/B15	—
Vent raises	—	Appendix B16	—

Note: The above listing refers to the specific appendices of the Environmental Air Quality Assessment where the detailed calculations can be found. The Environmental Air Quality Assessment (RWDI, 2014e) was included as part of Appendix J to the EIS.

Dust from Unpaved Roads

Section 3.3.2 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) provides a description of the approach used for calculating the particulate emissions from the vehicles traveling on unpaved roads at the Project. The emissions were estimated using the method described in the Chapter 13.2.2 of AP-42 (U.S. EPA, 2014). The emission rates depend on the surface material silt content (%) of the roadway and mean vehicle weight. The surface silt content for the unpaved roads was assumed to be 5.8%. A. The values in the assessment used reflect taconite mining and processing, as shown on Table 13.2.2-1 of AP-42 (U.S. EPA, 2014). This was used a suitable surrogate for mining operations in the region, as the measurements reflects metal ore mining operations and were taken at the Erie Mining Company near Hoyt Lakes, MN, which is roughly 250 km south of the Project. The other value provided on Table 13.2.2-1 of AP-42 (U.S. EPA, 2014) are from facilities that are not comparable to the proposed Project. Facilities with higher silt contents are often indicative of that are expected to handle softer material than at the Project (e.g., limestone quarries) that would be more likely to abrade into silt.

The estimated emissions incorporate the effects if water and chemical suppressants will be used for dust control on the haul roads at the mine site, when temperatures are above freezing. The watering program requires dedicated watering equipment, and enough water must be available and applied to off-set evaporation and maintain a wetted road surface. This program would also

be supplemented with applications of an approved dust suppressant, as required, to minimize fugitive dust emissions. The control efficiency for each haul roads was conservatively assumed to be 75%.

Tailpipe Emissions

Section 3.3.4 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) provides a description of the approach used for calculating the particulate emissions from the tailpipe emissions at the Project. Emissions of products of combustion (particulate matter, NO_X and CO) were calculated for diesel fuelled non-road equipment such as bulldozers, haul trucks, loaders and excavators based on equipment horsepower, load factor, and emissions factors. Each piece of equipment was assumed to be manufactured in 2010 and was expected to comply with the phase in periods for emission standards. Load factors and the emissions factors for vehicles of different emission standard tiers were obtained from the U.S. EPA (2010).

Emissions of SO_2 were estimated using the brake specific fuel consumption for the different vehicles (U.S. EPA, 2010), and the sulphur content in diesel fuel. The sulphur content in diesel fuel was based on compliance with the sulphur content in diesel fuel limit in Canada for off-road engines (0.0015%). It was assumed that all the sulphur was converted to SO_2 during combustion.

Material Handling

Section 3.3.1 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) provides a description of the approach used for calculating the particulate emissions from material handling at the Project. Fugitive particulate emissions (TSP, PM_{10} and $PM_{2.5}$) were estimated using the emission factors obtained from Chapter 13.2.4 of the AP-42 (U.S. EPA, 2014). These factors depend primarily on the mean wind speed and moisture content of the material handled. A moisture content of 10% was used to estimate fugitive dust emissions from the material handling sources. As the emission estimates depend on wind speed, the hourly wind speeds from the meteorological data set used for the dispersion modelling were used to create an hourly-varying emission file to account for changing meteorological conditions

Blasting

As shown in Appendices B4 and B9 to Environmental Air Quality Assessment (Appendix J-2 to the revised EIS), the emissions from blasting were estimated using Sections 11.9 and 13.3 of AP-42 (U.S. EPA, 2014).

Bulldozing

Section 3.3.6 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) describes the approach for estimating the emissions from bulldozing operations that would occur at the ore dump, low grade ore stockpile and at waste rock stockpile. Fugitive emissions generated from the bulldozing at the mine site were estimated based on emission factors for

bulldozing overburden in Chapter 11.9 of AP-42 (U.S. EPA, 2014). The emissions depend on both silt content (%) and moisture content (%). The average silt content was assumed to be the same as that occurring on truck haul roads, described above. The moisture content of waste rocks and ore was estimated by Treasury Metals to be 10%.

Wind Erosion of Tailings

Section 3.3.3 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) describes the approach for estimating the emissions from wind erosions from the exposed areas of the tailings storage facility (TSF) at the Project. The total area of the TSF at the Project is expected to cover 750,000 m², of which 90% is expected to be water covered or vegetated. Therefore wind erosion of particulate matter from tailings at the mine site was estimated for 75,000 m² of dry, un-vegetated tailings (10% of the tailings area). The emissions of wind eroded particulate matter were calculated as per equation 15 of a paper by Nickling (1989), which is based on tests of tailings disposal areas in Arizona.

Wind erosion of the tailings takes place only when the friction velocity at the surface is above an identified threshold velocity. For this study, the friction velocity was assumed to be 0.2 m/s, which is the average of the threshold velocities for the two tailing sites in the paper (Nickling, 1989). The roughness length of the tailing surface was assumed to be 0.016 cm, which is the average roughness length of the two tailing sites in the paper (Nickling, 1989).

The emission estimates are also dependent on hourly wind speeds at the mine site. This results in a variable emission file that was used in the dispersion modelling to account for changing meteorological conditions and, hence, changing magnitudes in fugitive dust emissions. It was assumed that no wind erosion of the tailings took place when there was precipitation or snow cover on the ground. Snow cover for the region was obtained from the Climate Normals for Dryden (Environment Canada, 2012), where snow cover has been recorded from October to April. Hourly precipitation data was obtained from International Falls, which is approximately 145 km away from the mine site.

Emissions from Backup Generators

Section 3.3.6 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) describes the approach used for calculating the emissions from the emergency generators at the Project. These generators are present to provide back-up power in case of a power failure of the power supplied by the 115 kV transmission line that runs adjacent to the proposed plant site. Emissions were estimated using emission factors obtained from Chapter 11.9 of AP-42 (U.S. EPA, 2014).

Heaters

As shown in Appendices B14 and B15 to Environmental Air Quality Assessment (Appendix J-2 to the revised EIS), the emissions from the gas fired heaters during operations were estimated using detailed combustion spreadsheets developed by RWDI.

Mine Vent Emissions

Emissions from underground mining activities are released to the atmosphere through two vent raises. Emission factors from underground activities released to atmosphere are obtained from a report summarizing mine vent exhaust testing in Falconbridge, Ontario (Bovar, 1996) are used to estimate emissions from the underground vent raises.

6.6.2.2 Numerical Air Dispersion Modelling

AERMOD Dispersion Model

Dispersion modelling was conducted using the estimated emission rates discussed in the preceding section in conjunction with the U.S. EPA's AERMOD dispersion model to predict concentrations of all contaminants at all off-site receptor locations. The AERMOD model is the most advanced of the models currently approved for use in regulatory dispersion modelling assessments in Ontario, and has been used extensively to study potential impacts from mining operations in Ontario. The use of AERMOD is consistent with the air modelling guidance from the Ontario Ministry of Environment and Climate Change (MOECC), which requires the use of AERMOD for predicting concentrations of both gases and particulates. Both gases and particulates adhere to the same fundamental dispersion physics in the atmosphere.

All dispersion models have inherent inaccuracies, but due to the wide-scale use of the AERMOD model for many years, in a wide variety of applications, these inaccuracies are now well-understood. The U.S. EPA reviewed various studies of dispersion model accuracy with comparison between models and field measurements. Generally AERMOD and other dispersion models are more reliable at predicting longer time-averaged concentrations (e.g., annual averages) than short-term concentrations (e.g., 1-hour and 24-hour periods) at specific locations. With respect to the short-term concentrations, however, the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. Typical accuracy in highest estimated concentrations is in the range of ±10% to ±40% (U.S. EPA, 2003).

Modelling Particle Deposition

Particulate matter plumes differ from gaseous plumes in that the particles can settle out due to gravity. Heavier particles will tend to settle out quickly, reducing the particulate concentration in the plume as it moves farther from the source. The AERMOD model allows the user to account for this settling through the use of deposition plume depletion algorithms. The deposition results

that are produced by the model represent the deposition flux rate, in mass per area (g/m²/30 days). With the deposition algorithm, the model does not reduce the plume size by the deposition flux rate; it merely predicts the amount of deposition that could occurs from the plume at any receptor point. The AERMOD model also predicts the depletion of particulate concentrations as a result of particle deposition.

Since deposition rates depend on the mass of the particles contained within the plume, particle size ranges were included in the AERMOD model. These size ranges were based on the average mass of particles for each size category for each type of source. The particle size ranges were based on generic information from AP-42 (U.S. EPA, 2014). Particle size ranges were used for all on-site sources included in the AERMOD model.

Scenario Selection

A comparison of the air emissions during the site preparation and construction phase, the operations phase, and the closure phase, demonstrates that during the operations phase, the combustion source emissions (fine particulate [$PM_{2.5}$] and NO_X, and by extension CO and SO_2) are considerably higher than during the other phases of the Project. During the site preparation and construction phase, and the closure phase, the emissions of TSP and PM_{10} will be higher than operations due to the nature of the activities (earth moving and clearing). However, the emissions during those phases will be spread out across the entire site and will be constantly moving. In contrast, the emissions for the operations phase are modelled in a conservative manner, with mining in the open pit occurring at the surface and close to the edge of the property, concurrent with activity on the overburden storage pile, and the low grade ore stock pile (Figure 6.6.2.2-1). The modelling of air quality effects focussed on the operations phase only, for the following reasons:

- The conservative configuration used to evaluate the operations phase emissions will result in higher off-site effects, especially at receptors of interest, than the situation where the emissions are spread out over the entire site and constantly moving.

- The emissions of combustion compounds (fine particulate [$PM_{2.5}$] and NO_X, and by extension CO and SO_2) are considerably higher during the operations phase than the other phases of the Project.

- The air quality effects during the operations phase will be the longest lasting.

A comparison of the air emissions during the active life of the Project (i.e., site preparation, construction operations, and closure) are provided in Table 6.6.2.2-1.

Table 6.6.2.2-1: Comparison of Air Emissions by Phase

Emission Source	Annual Emission Rate (Mg/y)			
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Site Preparation and Construction	584.26	158.93	21.88	83.83
Operations	309.36	112.48	43.53	165.24
Closure	577.14	155.65	21.60	85.79

Source Configuration

Fugitive sources were modelled as a series of volume and line sources with parameters based on information obtained from Treasury Metals and typical dimensions of processing equipment and vehicles used at other facilities of this nature. The modelled source parameters are consistent with guidance from the National Stone, Sand & Gravel Association (NSSGA, 2004). Internal haul roads were modelled as adjacent volume sources, also in accordance with guidance from the NSSGA and the U.S. EPA (2012). Point sources were modelled with parameters based on information obtained from Treasury Metals. The relative locations of modelled sources and the property boundary were provided on Figure 4 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS). This is replicated as Figure 6.6.2.2-1.

Since the filing of the EIS, Treasury Metals has been advancing the engineering for the Project and have refined the Project configuration to help reduce the overall effects on the environment. One of these refinements, which are detailed in Section 3.16, is the re-location of the processing plant to a location to the west of Tree Nursery Road. This change avoids the need to re-along the lower reaches of Blackwater Creek Tributary 2, and provides a slightly more compact footprint overall. As a result of this change, the sources of air emissions at the processing plant will move about 300 m closer to the sensitive receptors located to the west of the Project, along the east shoreline of Thunder Lake. The sources at the processing plant will also move further away from the closest sensitive receptors, which are located to the south of the Project, along Tree Nursery Road. The effects of these changes on the air modelling predictions presented in the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS), included in Appendix J to the EIS, would be relatively minor, as the changes would only affect the emissions sources at the processing plant (about 7% of the total emissions during operations). The concentrations due to processing plant emissions at sensitive receptors to the west of the Project could increase by as much as 12%; however, since these sources represent less than 7% of the overall emissions, the overall change in concentrations at sensitive receptors to the west of the Projects would be less than 1% from the results in the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS), which are relied on in the subsequent sections. These very small changes would not alter the conclusions regarding the results in the subsequent sections.

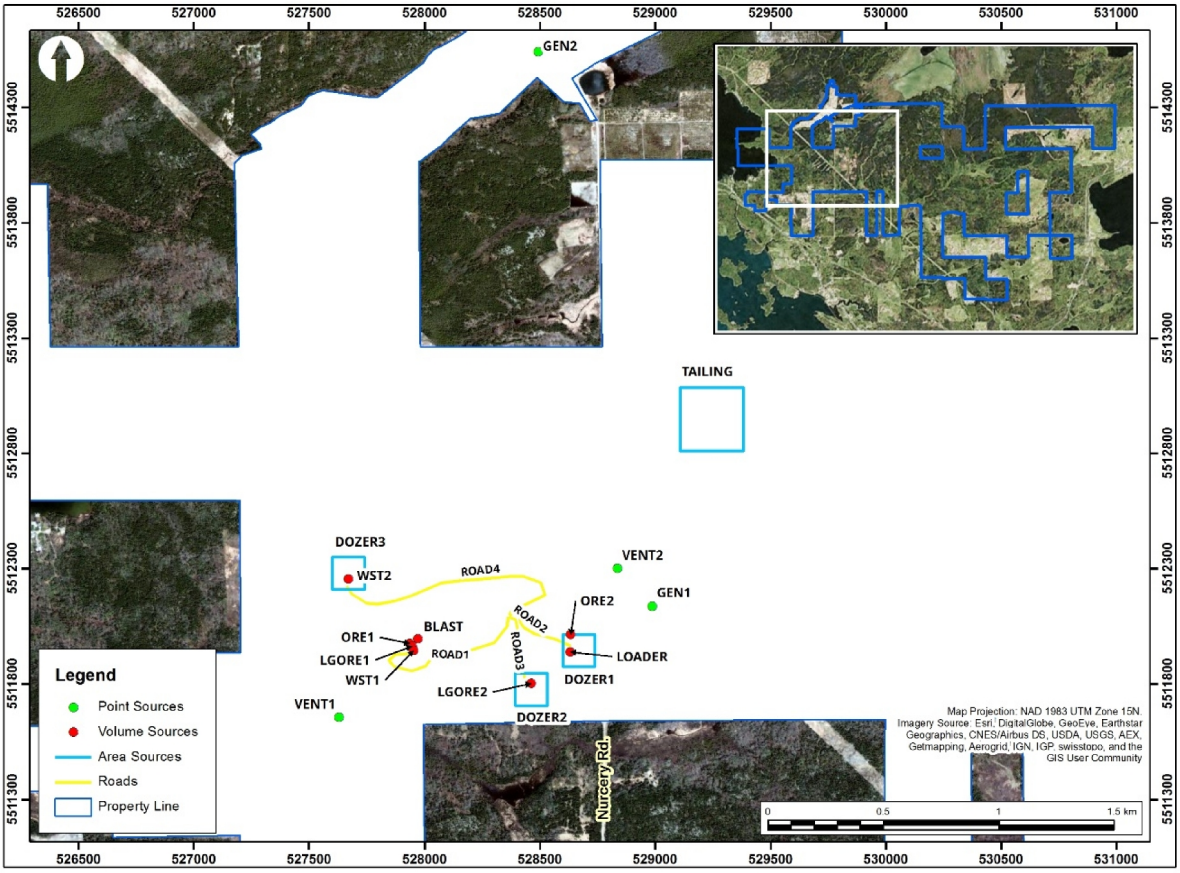


Figure 6.6.2.2-1: Modelled Source Configuration, Operations

Meteorological Data

Section 3.5.4 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) describes the meteorological data used in the dispersion modelling. Under the requirements of O.Reg. 419/05, the Ontario Ministry of Environment and Climate Change (MOECC) provides a series of pre-processed meteorological data sets for use in dispersion modelling assessments in Ontario. These data sets use surface observations and upper air data from airports that represent major geographical areas of Ontario.

The site is located near Dryden, therefore the Northern Region (Thunder Bay, Kenora) meteorological data set (MOECC, 2007) is recommended by the Ontario Ministry of Environment and Climate Change (MOECC) for use at this site. This includes both surface data and upper air data from International Falls, Minnesota. Within each region, the MOE provides alternative data sets with the choice of data set depending on the character of the terrain at the study site. The area surrounding the site is typically forested, with some areas of open water and clear-cuts. The default data set for “forest” was used based on the land use patterns surrounding the site. Figure 5 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) provides a wind rose for the pre-processed meteorological data used. Figure 6.6.2.2-2 replicates this wind rose.

Terrain Data

Section 3.5.6 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) describes the terrain information used in the dispersion modelling. Terrain information for the area surrounding the facility was obtained from the MOE Ontario Digital Elevation Model Data web site. The terrain data is based on the North American Datum 1983 (NAD83) horizontal reference datum. These data were run through the AERMAP terrain pre-processor to estimate base elevations for receptors and to help the model account for changes in elevation of the surrounding terrain.

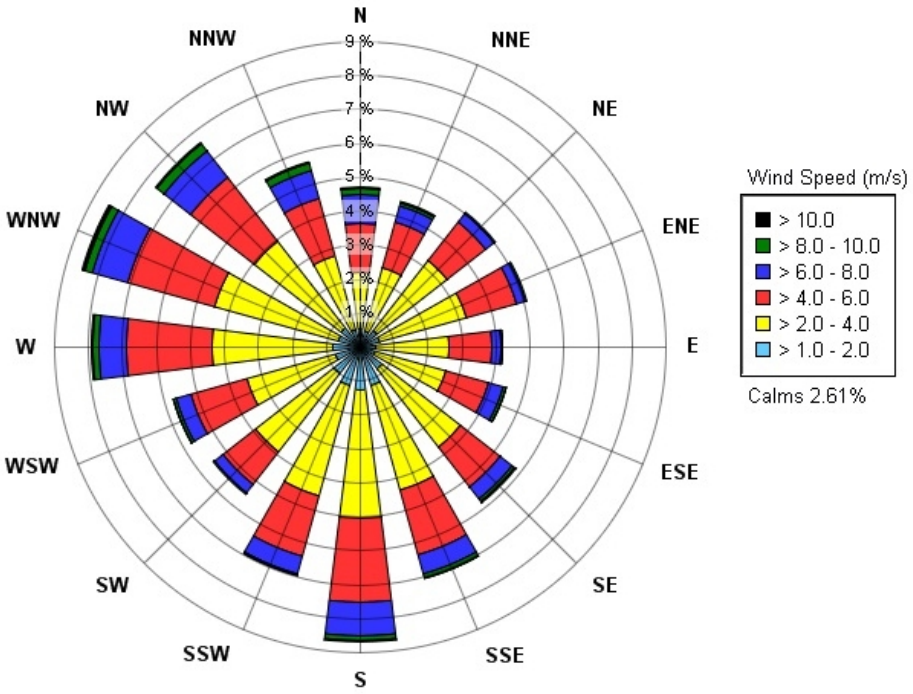


Figure 6.6.2.2-2: Wind Rose for Dispersion Meteorological Data

6.6.3 Project Effects Avoidance Measures Used in Predictions

Section 6.3 of the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) lists the following measures incorporated in the air modelling that reduce the air emissions from the Project and thus help avoid or reduce air quality effects:

- Blasting will be conducted in a phased manner that optimizes the amount of explosives needed for a given area to be blasted, and that minimizes the area being blasted. Modern

blasting methods used in mining are designed to direct the energy from the blasts into the rock. This reduces the amount of blasting agents required to achieve the desired blast objectives, and ultimately reduces the amount of dust generated. The dust generated from modern blasting result primarily from the physical impact of the displaced rock. The proposed blasting at the Project will likely be restricted to once per day, and only a few days during each week [Mit_029, Mit_043].

- Material will be loaded into haul trucks in a manner that minimizes the drop height from the loader or excavator bucket to the bed of the truck (or equivalent bed height as material is loaded into the truck) [Mit_031].

- Ensure that all internal combustion engines are properly maintained and all emission control systems (e.g., diesel particulate filters) are in good working order [Mit_044].

- A best management practices plan for dust will be implemented on the site to provide specific directions for operators. A draft Best Practices Plan for Dust was included as part of Appendix J to the EIS. Water and chemical suppressants will be used for dust control on the haul roads when temperatures are above freezing. This program would be supplemented with the application of other approved dust suppressant, as required, to minimize fugitive dust emissions [Mit_046].

6.6.4 Predicted Effects

6.6.4.1 Site Preparation and Construction Phase

Emissions

During the site preparation and construction phase there will be a variety of air emissions sources at the Project. These emission sources will be moving about the site and will be distributed over the operations area of the Project. As a result, the emission will be less concentrated, and maximum effects are expected to be further away from the sensitive receptor locations. The air emissions during the site preparation and construction phase are presented in Table 6.6.4.1-1. The emission are calculated using the methods described in Section 6.6.2.1, and detailed in the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS).

Table 6.6.4.1-1: Air Emissions: Site Preparation and Construction

Emission Source	Annual Emission Rate (Mg/y)			
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Haul Roads (Including tailpipe)	551.61	148.49	17.89	56.32
Dozers (including tailpipe)	19.42	3.9	2.6	10.42
Loader (including tailpipe)	0.93	0.69	0.52	15.08
Material Handling (load/unload)	4.94	2.33	0.35	—
Excavator (tailpipe)	0.12	0.12	0.12	1.99
Crusher	4.73	2.1	0.32	—

Table 6.6.4.1-1: Air Emissions: Site Preparation and Construction (continued)

Emission Source	Annual Emission Rate (Mg/y)			
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Blasting	2.51	1.3	0.08	0.02
Total:	**584.26**	**158.93**	**21.88**	**83.83**

The table presents air emissions for the indicator compounds of TSP, PM_{10}, $PM_{2.5}$ and NO_X. The NO_X is used as a surrogate for other combustion related emissions (CO and SO_2) as it is normally the most significant with respect to the relative evaluation criteria than any other combustion compounds. The metal emissions are directly proportional to the level of TSP, thus are implicitly included.

Predicted Effects

As described in Section 6.6.2.2, the effects during the operations phase of the Project are projected to be as high, or higher, than during the site preparation and construction phase. However, the effects during operations will be longer lasting, and the source activities can be more concentrated near the edge of the property and towards sensitive receptor locations. Therefore, the dispersion modelling was completed for the operations phase only and the predicted effects were conservatively assumed to be of the same magnitude during the site preparation and construction phase.

6.6.4.2 Operations Phase

Emissions

During the operations phase, there will be the greatest number of air emissions sources occurring at the Project. In addition, the emission sources will be more concentrated during this phase, and generally closer to the property line and sensitive receptors (Section 6.1.4.6) than during the other phases of the Project. The emissions primary associated with operations phase of the Project are presented in Table 6.6.4.2-1. These emission are calculated in accordance with the methods described in Section 6.6.2.1. Detailed emission calculations are appended to the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS). Please note that an error was found in the original table, which was addressed in the response to the IR TMI_169-AE(1)-07. The error did not affect any other results.

Table 6.6.4.2-1: Air Emissions: Operations

Emission Source	Annual Emission Rate (Mg/y)			
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Haul roads (Including tailpipe)	484	131	17.4	46.93
Dozers (including tailpipe)	29.85	6.55	4.58	26.94
Loader (including tailpipe)	0.07	0.08	0.07	2.28
Material handling (load/unload)	6.41	3.03	0.46	0

Table 6.6.4.2-1: Air Emissions: Operations (continued)

Emission Source	Annual Emission Rate (Mg/y)			
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Excavator (tailpipe)	0.02	0.02	0.02	0.3
Wind erosion of tailings	22.32	17.66	10.26	0
Crusher	0.18	0.18	0.18	0
Blasting	10.04	5.22	0.3	0.07
Vent raises	18.94	18.94	18.94	86.79
Heaters	0.1	0.1	0.1	1.35
Back-up generators	0.02	0.02	0.02	0.58
Total:	**309.36**	**112.48**	**43.53**	**165.24**

Predicted Effects

As described in Section 6.1.4.6, the air quality effects of the Project were predicted at a series of gridded receptor locations covering the LSA (Figure 6.1.4.6-1) and at 44 sensitive receptor locations (Figure 6.1.4.6-2). The maximum predicted effects at the gridded receptors are considered to be the maximum point of impingement (MPOI) concentrations, and correspond to the maximum predicted concentrations at the property boundary. The maximum predicted concentrations at the sensitive receptor locations represents the maximum predicted effects at the closest "community-oriented receptors" as defined by the CCME (2000). Table 6.6.4.2-2 presents the maximum predicted air quality effects of the Project at both the MPOI (based on the gridded receptor results) and at the nearby sensitive receptors (as defined by CCME [2000]).

Table 6.6.4.2-2: Predicted Air Quality Effects: Operations

Compound	Averaging Period	Maximum at Gridded Receptors (MPOI)			Maximum at Sensitive Receptors		
		Modelled Prediction	Background (1)	Cumulative Prediction	Modelled Prediction	Background (1)	Cumulative Prediction
TSP	24-hour	351.0	33.0	384.0	258.2	33.0	291.2
	Annual	57.4	14.0	71.4	42.4	14.0	56.4
PM_{10}	24-hour	96.5	15.0	111.0	70.8	15.0	85.8
$PM_{2.5}$	24-hour	10.9	10.0	20.9	15.6	10.0	25.6
	Annual	2.8	4.3	7.0	2.7	4.3	7.0
Dustfall (2)	30 day	5.5	— (3)	5.5	4.1	—	4.1
	Annual	4.5	—	4.5	3.2	—	3.2
CO	1-hour	199.0	1,248.0	1,450.0	167.4	1,248.0	1415.4
	8-hour (4)	111.0	1,248.0	1,360.0	93.5	1,248.0	1341.5
NO_2	1-hour	186.0	33.0	219.0	187.7	33.0	220.7
	24-hour	108.0	33.0	141.0	108.7	33.0	141.7
SO_2	1-hour	8.0	4.0	12.0	1.5117	4.0	5.5117
	24-hour	3.1	4.0	7.1	0.2400	4.0	4.2400
	Annual	0.7	1.0	1.7	0.0278	1.0	1.0278
Arsenic	24-hour	0.022	0.001	0.023	0.0146	0.001	0.0156
Barium	24-hour	0.250	—	0.250	0.1705	—	0.1705
Beryllium	24-hour	0.001	—	0.001	0.0009	—	0.0009
Cadmium	24-hour	0.002	—	0.002	0.0016	—	0.0016
Chromium	24-hour	0.077	0.005	0.082	0.0527	0.005	0.0577

Compound	Averaging Period	Maximum at Gridded Receptors (MPOI)			Maximum at Sensitive Receptors		
		Modelled Prediction	Background (1)	Cumulative Prediction	Modelled Prediction	Background (1)	Cumulative Prediction
Cobalt	24-hour	0.006	—	0.006	0.0041	—	0.0041
Lead	24-hour	0.166	0.005	0.171	0.1079	0.005	0.1129
Manganese	24-hour	0.286	0.019	0.305	0.1955	0.019	0.2145
Nickel	24-hour	0.020	—	0.020	0.0139	—	0.0139
	Annual	0.003	—	0.003	0.0019	—	0.0019
Phosphorous	24-hour	0.263	—	0.263	0.1796	—	0.1796
Platinum	24-hour	0.010	—	0.010	0.0069	—	0.0069
Rhodium	24-hour	0.003	—	0.003	0.0022	—	0.0022
Thallium	24-hour	0.009	—	0.009	0.0059	—	0.0059
Titanium	24-hour	0.918	—	0.918	0.6274	—	0.6274
Uranium	24-hour	0.005	—	0.005	0.0036	—	0.0036
	Annual	0.001	—	0.001	0.0005	—	0.0005
Vanadium	24-hour	0.024	—	0.024	0.0165	—	0.0165

Notes:
(1) The 1-hour and 24-hour background values were based on 90th percentile of the monitoring data. The annual background values were based on the highest of the annual mean value over the latest 5 years of available monitoring data (see Section 5.2.4)
(2) Predicted dustfall values are in units of g/m²/30 days.
(3) The "—" in the table indicates that background values were not available for the compound.
(4) The 8-hour predicted CO concentration is calculated from 1-hr predicted concentration using a published conversion factor [Ontario Regulation 419/05, 17(2)].

The "community-oriented receptors" defined by the CCME (2000), which correspond with the sensitive air receptors used in the air modelling (see Figure 6.1.4.6-2), were identified by CCME (200) as the appropriate locations for determining compliance with ambient air quality criteria. Therefore, the tabular results presented above are the most appropriate means for providing the air quality modelling results. In addition to the receptor based prediction, the dispersion modelling results provided in the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS) also provides graphical representations of the spatial distribution of predicted air quality (Figures 6 through 19 of Appendix J-2 to the revised EIS).

6.6.4.3 Closure Phase

Emissions

During the closure phase there will be a decreased level of activity at the Project relative to the operations phase. In fact, the emissions are comparable to those during the site preparation and construction phase with the exception of the crushing and blasting emissions, which are absent during closure. During the closure phase, the emission sources will be moving about the site and will be distributed over the operations area of the Project. As a result, the emission sources are less concentrated than during operations, and predicted effects are expected to be further away from the sensitive receptor locations. The air emissions during the closure phase are presented in Table 6.6.4.3-1. The emissions are calculated using the methods described in Section 6.6.2.1, and detailed in the Environmental Air Quality Assessment (Appendix J-2 to the revised EIS).

Table 6.6.4.3-1: Air Emissions: Closure

Emission Source	Annual Emission Rate (Mg/y)			
	TSP	PM_{10}	$PM_{2.5}$	NO_X
Haul Roads (Including tailpipe)	551.61	148.49	17.89	56.32
Dozers (including tailpipe)	19.42	3.90	2.60	10.42
Loader (including tailpipe)	0.93	0.69	0.52	15.08
Material Handling (load/unload)	4.94	2.33	0.35	0.00
Excavator (tailpipe)	0.24	0.24	0.24	3.97
Total:	**577.14**	**155.65**	**21.60**	**85.79**

Predicted Effects

As described in Section 6.6.2.2, the effects during the operations phase of the Project are projected to be as high as during the closure phase. However, the effects during operations will be longer lasting, and the source activities can be more concentrated near the edge of the property and towards sensitive receptor locations. Therefore, the dispersion modelling was completed for the operations phase only and the predicted effects were conservatively assumed to be of the same magnitude during closure.

6.6.4.4 Post-closure Phase

As described in Section 6.6.1, there are not expected to be any sources of air emissions at the Project during the post-closure phase.

6.6.5 Identified Mitigation

The Project will employ best practices that will help reduce and mitigate air quality effects, including the following:

- Blasting will be conducted in a phased manner that optimizes the amount of explosives needed for a given area to be blasted, and that minimizes the area being blasted. Modern blasting methods used in mining are designed to direct the energy from the blasts into the rock. This reduces the amount of blasting agents required to achieve the desired blast objectives, and ultimately reduces the amount of dust generated. The dust generated from modern blasting result primarily from the physical impact of the displaced rock. The proposed blasting at the Project will likely be restricted to once per day, and only a few days during each week [Mit_029, Mit_043].

- Material will be loaded into haul trucks in a manner that minimizes the drop height from the loader or excavator bucket to the bed of the truck (or equivalent bed height as material is loaded into the truck) [Mit_031].

- Ensure that all internal combustion engines are properly maintained and all emission control systems (e.g., diesel particulate filters) are in good working order [Mit_044].

- A best management practices plan for dust will be implemented on the site to provide specific directions for operators. A draft Best Practices Plan for Dust was included as part of Appendix J to the EIS. Water and chemical suppressants will be used for dust control on the haul roads is used at the mine site, when temperatures are above freezing [Mit_046].

6.6.6 Residual Adverse Effects

Although the identified mitigation measures summarized in Section 6.6.5 will help to reduce the Project effects on air quality, predicted residual adverse effects on air quality will remain. A summary of the residual adverse air quality effects associated with the Project is provided in Table 6.6.6-1. The results in the table represent the maximum predicted values of the indicator compounds at the sensitive receptor locations. The sensitive receptor locations (Section 6.1.4.6. and Figure 6.1.4.6-2) correspond with the description of "community-oriented locations" considered by the CCME (2000) as the appropriate locations for determination compliance with ambient air quality standards. The predicted effects of the Project on air quality were set out in Section 6.6.4 of this Revised EIS, and include the contribution of background concentrations that are described in Section 5.2.4. As described in Section 6.6.2.2, dispersion modelling was conducted for operations phase as it was determined to be the phase when air quality impacts (considering magnitude, extent and duration) would be highest. The values in the table for the site preparation and construction phase, as well as the closure phase, are based on the operations phase modelling. There are no sources of air emissions during the post-closure phase.

Table 6.6.6-1: Residual Adverse Air Quality Effects

Compound	Averaging Period	Maximum Cumulative Prediction at Sensitive Receptors (1)			
		Site Preparation (2) and Construction	Operations	Closure (3)	Post-closure (4)
TSP	24-hour	291.2	291.2	291.2	—
	Annual	56.4	56.4	56.4	—
PM_{10}	24-hour	85.8	85.8	85.8	—
$PM_{2.5}$	24-hour	25.6	25.6	25.6	—
	Annual	7.0	7.0	7.0	—
Dustfall (2)	30 day	4.1	4.1	4.1	—
	Annual	3.2	3.2	3.2	—
CO	1-hour	1415.4	1415.4	1415.4	—
	8-hour (4)	1341.5	1341.5	1341.5	—
NO_2	1-hour	220.7	220.7	220.7	—
	24-hour	141.7	141.7	141.7	—
SO_2	1-hour	5.5117	5.5117	5.5117	—
	24-hour	4.2400	4.2400	4.2400	—
	Annual	1.0278	1.0278	1.0278	—
Arsenic	24-hour	0.0156	0.0156	0.0156	—
Barium	24-hour	0.1705	0.1705	0.1705	—
Beryllium	24-hour	0.0009	0.0009	0.0009	—
Cadmium	24-hour	0.0016	0.0016	0.0016	—
Chromium	24-hour	0.0577	0.0577	0.0577	—

Table 6.6.6-1: Residual Adverse Air Quality Effects (continued)

Compound	Averaging Period	Maximum Cumulative Prediction at Sensitive Receptors [1]			
		Site Preparation [2] and Construction	Operations	Closure [3]	Post-closure [4]
Cobalt	24-hour	0.0041	0.0041	0.0041	—
Lead	24-hour	0.1129	0.1129	0.1129	—
Manganese	24-hour	0.2145	0.2145	0.2145	—
Nickel	24-hour	0.0139	0.0139	0.0139	—
	Annual	0.0019	0.0019	0.0019	—
Phosphorous	24-hour	0.1796	0.1796	0.1796	—
Platinum	24-hour	0.0069	0.0069	0.0069	—
Rhodium	24-hour	0.0022	0.0022	0.0022	—
Thallium	24-hour	0.0059	0.0059	0.0059	—
Titanium	24-hour	0.6274	0.6274	0.6274	—
Uranium	24-hour	0.0036	0.0036	0.0036	—
	Annual	0.0005	0.0005	0.0005	—
Vanadium	24-hour	0.0165	0.0165	0.0165	—

Notes:
(1) The air quality effects are presented at the sensitive receptor locations, which correspond to the definition of "community-oriented locations" used by CCME (2000). The cumulative predictions include background air concentrations.
(2) Predicted effects during the site preparation and construction phase are based on the operations phase modelling.
(3) Predicted effects during the closure phase are based on the operations phase modelling.
(4) There are no sources of air emissions during the post-closure phase.

As described by the by the CCME (2000), "community-oriented locations" are the appropriate locations for determination compliance with ambient air quality standards. The sensitive air receptor locations described in Section 6.1.4.6, and shown in Figure 6.1.4.6-2, correspond with "community-oriented locations" described by CCME (2000). These are the locations used for assessing the effects of the Project on air quality. In addition to the effects assessment of sensitive receptors, treasury Metals recognizes that changes in air quality could potentially affects Aboriginal peoples and member of Indigenous communities practicing traditional uses of the land.

Maximum concentrations that were predicted to exceed the relevant health-based ambient air quality criteria (AAQC) were considered separately from the maximum concentrations that were predicted to exceed AAQC that are established for aesthetic or nuisance reasons (e.g., 24-hour TSP AAQC is established to protect against visibility effects). Only annual total TSP, 24-hour PM_{10}, 24-hour $PM_{2.5}$, 1-hour NO_2 and 24-hour NO_2 were predicted to exceed relevant health-based criteria anywhere in the dispersion modelling domain. The spatial patterns for these compounds were overlain on top of each other and shaded in gold on Figure 6.6.6-1. The spatial patterns for the 24-hour TSP predictions were shaded in green on the figure. It should be noted that predicted concentrations in excess of these health-based criteria do not indicate that health impacts will occur as the criteria are established with margins of safety to protect the public.

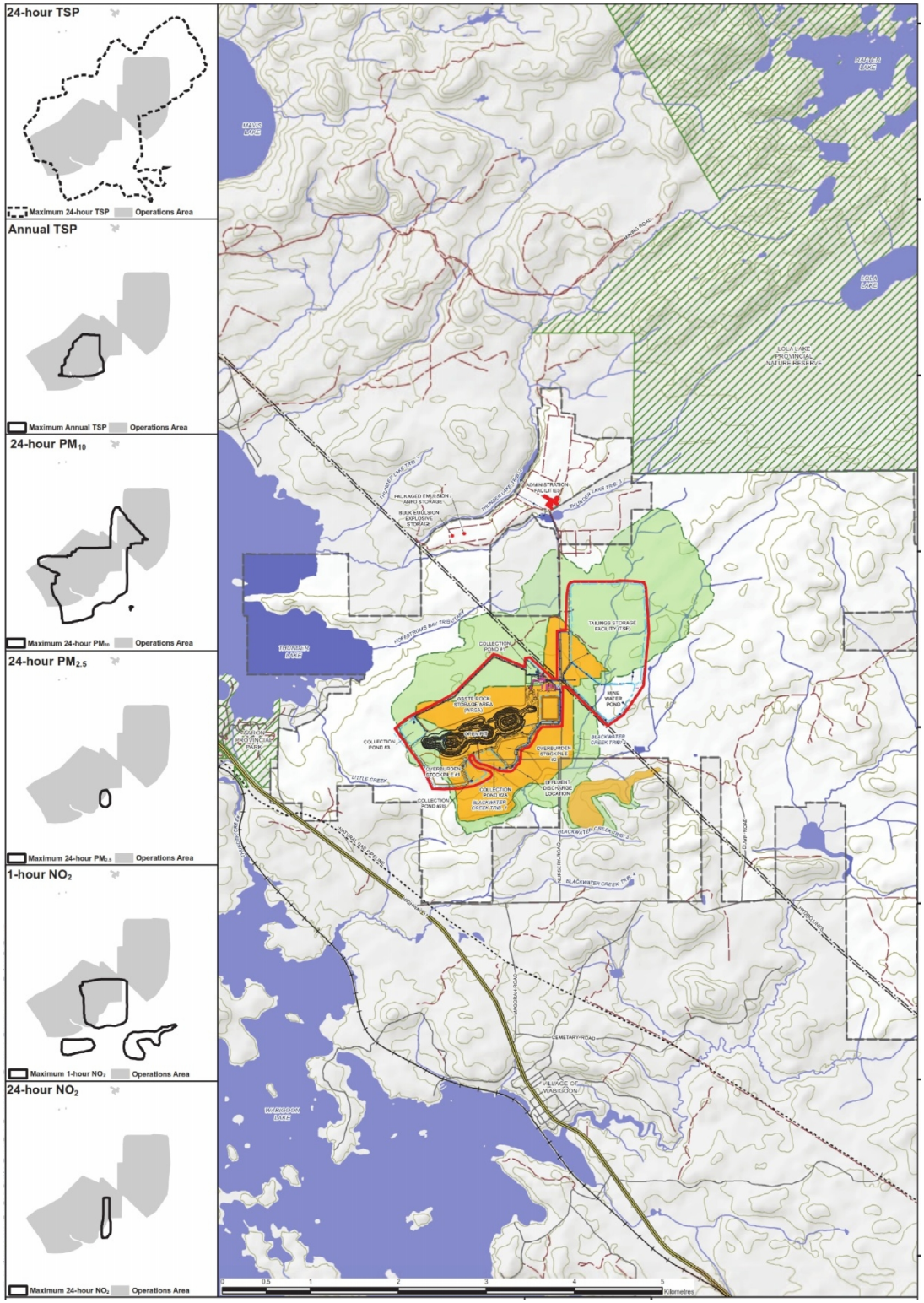


Figure 6.6.6-1: Spatial Distribution of Residual Air Quality Effects

6.6.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, there were a number of questions that were wholly, or partially, asking for information, clarification and/or justification for the approach used in predicting the effects of the Project on air quality, or the predicted effects themselves. Responses to the IRs were provided separately, and incorporated into the relevant sections of the Revised EIS. The following lists the Round 1 IRs related to the air quality predictions:

- TMI_165-AE(1)-03: potential for O_3 formation;
- TMI_166-AE(1)-04: background data used;
- TMI_167-AE(1)-05: use of Ontario AAQS;
- TMI_169-AE(1)-07: potential effects during site preparation and construction phase;
- TMI_170-AE(1)-08: air emissions from Project;
- TMI_171-AE(1)-09: sensitive receptors and CCME (2000) guidance;
- TMI_172-AE(1)-10: sensitive receptors and CCME (2000) guidance;
- TMI_174-AE(1)-12: model predictions at the limits of LSA;
- TMI_175-AE(1)-13: applicability of AERMOD for gaseous and particulate dispersion;
- TMI_176-AE(1)-14: air emissions from Project;
- TMI_194.1-HE(1)-01: sensitive receptors and CCME (2000) guidance;
- TMI_219-HE(1)-26: background data used;
- TMI_338-AC(1)-12: air emissions from Project;
- TMI_339-AC(1)-13: potential effects of dust;
- TMI_421-AC(1)-96: background data used;
- TMI_463-AC(1)-137: background data used;
- TMI_527-AC(1)-201: linkages to Aboriginal interests;
- TMI_540-AC(1)-214: linkages to Aboriginal interests;
- TMI_565-AC(1)-239: linkages to Aboriginal interests;

- TMI_598-AC(1)-263: linkages to Aboriginal interests;
- TMI_607-AC(1)-280: linkages to Aboriginal interests;
- TMI_611-AC(1)-284: potential air quality effects;
- TMI_616-AC(1)-289: potential air quality effects;
- TMI_655-AC(1)-328: linkages to Aboriginal interests;
- TMI_710-PC(1)-25: compliance with regulatory criteria;
- TMI_713-PC(1)-28: odours, dust from blasting, accidental releases;
- TMI_714-PC(1)-29: potential effects of dust; and
- TMI_751-PC(1)-66: consideration of sources in Dryden.

6.7 Climate

6.7.1 Potential Effects of the Project on the Environment

The effects of the Project on climate are related to its contribution towards greenhouse gas (GHG) emissions. These GHG emissions will result from the use of fossil fuels as part of the Project operations. Diesel fuel will be used in the mobile equipment used both in the open pit and underground mine. Additionally, natural gas will be used to heat the underground mine and ensure suitable working conditions. The Project will not have to generate its own electricity as there is an existing 115 kV transmission line that runs adjacent to the proposed processing plant. The Project will be equipped with backup diesel-fired generators that will be used in the event of a power outage to maintain key equipment and allow for the safe and orderly shutdown of operations. The backup generators are expected to be tested for about 1 hour every month. The potential effects of the Project on climate will vary during the Project life, depending on the phase, and the levels of activity. The following lists the potential climate effects by Project phase:

- **Site Preparation and Construction**: Mobile equipment used for tree clearing, grubbing, and the stripping of overburden, as well as the construction of roads and Project facilities will all require the use of diesel fuel, and will result in the generation of GHG emissions.

- **Operations**: During operations, the mine operations will rely on equipment that burns diesel fuel and generates GHG emissions. Additionally, natural gas will be used to heat the underground mine, generating additional GHG emissions. Finally, GHG emissions will result from the testing of the diesel fired backup generators, which will be operated an hour each month.

- **Closure:** Mobile equipment used to rehabilitate the site, and disassembling and removal of infrastructure and equipment will be diesel-fired and will generate GHG emissions.

- **Post-closure**: Once the closure activities are completed there are not expected to be any sources of combustion or GHG emissions at the Project.

The potential effects of the Project on air quality have been described using a simple linkage diagram on Figure 6.7.1-1. The figure illustrates the climate VCs (shown in blue on the figure) potentially be affected during each phase of the Project life. Climate VCs will not directly affect any of the other components or VCs, nor will other components or VCs affect the climate VCs.

6.7.2 Effects Prediction Methods

6.7.2.1 Methods for Calculating Project GHG Emissions

The approach used for calculating the Project GHG emissions relies on the methods and emission factors used by the Environment and Climate Change Canada for compiling the latest annual GHG emission report (ECCC, 2017a), which was submitted to the United Nations Framework Convention on Climate Change in 2017. The steps involved in the calculation included the following:

- Determine the annual usage of diesel fuel in mobile equipment;

- Determine the annual usage of diesel fuel in the backup generators; and

- Determine the annual usage of natural gas for heating the underground mine.

The fuel consumption rates were based on the air emissions data presented in Section 6.6.4, and detailed in Appendix J-2 to the revised EIS. Table 6.7.2.1-1 lists the fuel consumption used to calculate the Project GHG emissions.

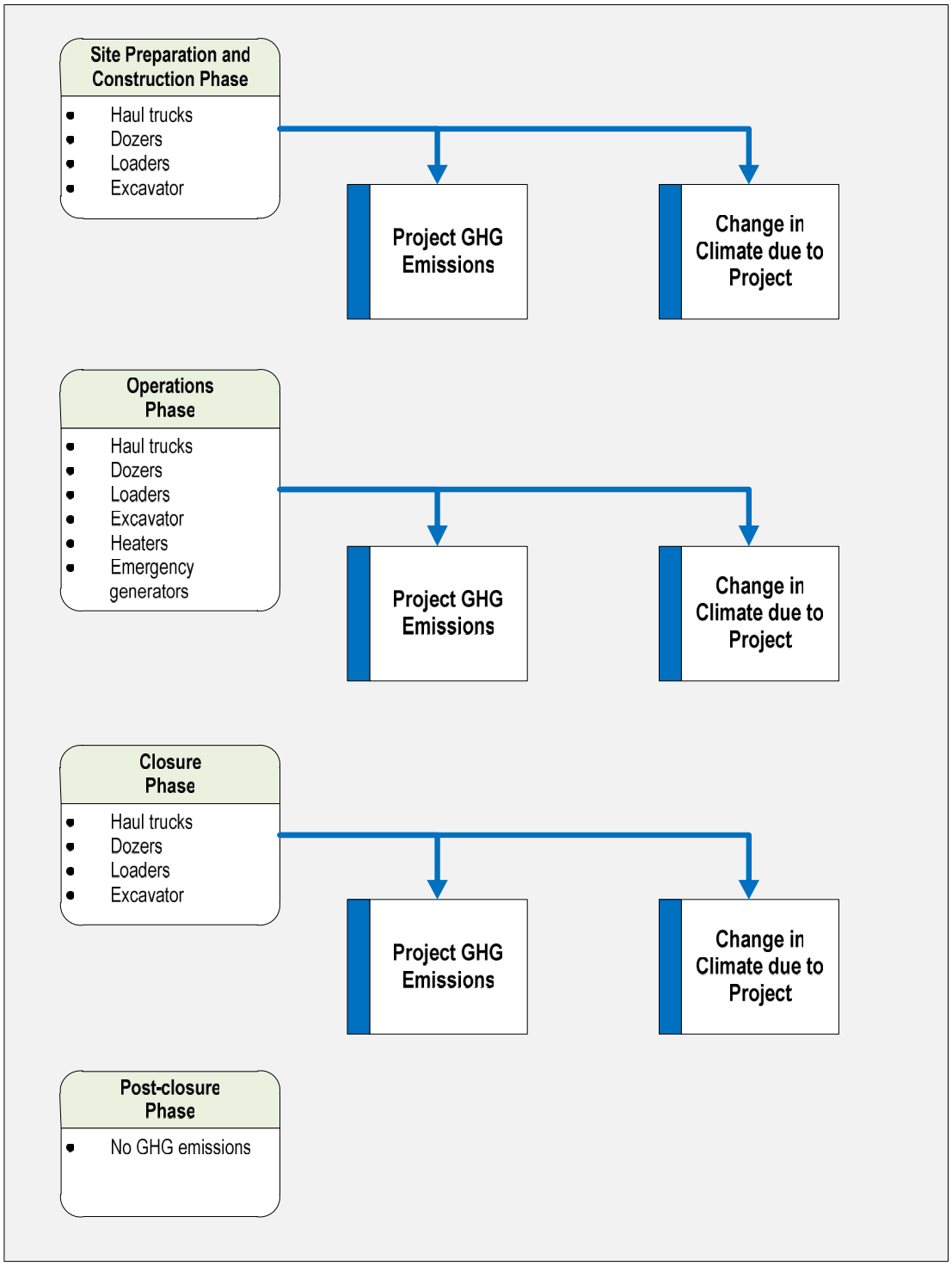


Figure 6.7.1-1: Climate Linkage Diagram

Table 6.7.2.1-1: Fossil Fuel Consumption

Source Category	Site Prep. and Construction	Operations	Closure
Diesel combustion in mobile equipment (L/y)(1)	3.63×10^6	3.86×10^6	4.04×10^6
Diesel combustion in backup generators (L/y)(2)	0	4.42×10^5	0
Natural gas combustion for heating (m^3/y)(1)	0	8.41×10^5	0

Notes:
(1) The fuel volumes for heating and mobile equipment are based on the maximum activity levels, and assumed continuous activity throughout the year.
(2) The fuel for the backup generators is based on running the units for 1 hour each month.

Once the base quantities are established, appropriate emission factors need to be identified in the Environment and Climate Change Canada reference report (ECCC, 2017b). The following emission factors were used to calculate Project GHG emissions:

Table 6.6.2.1-2 lists the emission factors for carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), the three primary compounds considered when calculating Project GHG emissions.

Table 6.7.2.1-2: GHG Emission Factors

Source Category	GHG Emission Factors		
	CO_2	CH_4	N_2O
Diesel combustion in mobile equipment (g/L)	2,690	0.15	1.0
Diesel combustion in backup generators (g/L)	2,753	0.18	0.031
Natural gas combustion for heating (g/m^3)	1,888	0.037	0.033

It is generally considered more convenient to discuss GHG emission using a single parameter referred to as the equivalent CO_2 emissions (eCO_2). The equivalent CO_2 is calculated by combining the CO_2, CH_4 and N_2O using the following greenhouse gas equivalency factors:

- Carbon dioxide (CO_2): 1;
- Methane (CH_4): 21; and
- Nitrous oxide (N_2O): 310.

6.7.2.2 Methods for Estimating Effects of the Project on Climate

Although the levels of GHG emissions Project are important to understand, the real concern with respect to climate is how those emissions could affect the climate in the future. To understand how the Project could contribute to changes in climate, it is necessary to understand both how the climate is projected to change (with an emphasis on the region in which the Project is located) and the GHG emissions provincially, nationally and globally that would be contributing to the predicted changes in climate.

Projections of Regional Changes in Climate

There is a wealth of scientific literature and research available regarding the projections for future climate change over the planet. For describing the potential changes in climate in northwestern Ontario, two documents compiled by, or for the Ontario government, have been relied on, namely climate change reports CCRR-05 (Columbo et al, 2007) and CCRR-44 (McDermid et al, 2015).

The summary report (Columbo et al, 2007) made use of data from the Canadian Coupled Global Climate Model (CGCM2) forecasts for emission scenarios presented in the Fourth Assessment Report (AR4) from the Intergovernmental Panel for Climate Change (IPCC, 2007). Specifically, Columbo et al (2007) presented the climate projections associated with the A2 emission scenarios, which is one of the four socio-economic scenarios relied on in AR4 (IPCC, 2007). Although the IPCC has not stated which of these scenarios are most likely to occur, the A2 scenario most closely reflects the current global socio-economic situation. In relation to the A2 scenario, scenarios A1, B1 and B2 result in lower long-term GHG emissions over the next century. Climate projections are presented as changes from the 1971–2000 baseline period, and are provided for the 2011–2040, 2041–2070, and 2071–2100 time horizons. These projections were used to compile the expected changes in summer and winter temperature and precipitation for the region near the Project. Changes in annual climate were not provided.

Generally, the picture presented for future climate in the area is one of increasing temperatures in both the winter and summer periods for all of the forecast horizons. For precipitation, the summer rates are projected to increase for the 2011 to 2040 horizon, changing to a decrease for the 2041 to 2070 and 2071 to 2100 horizons. During the winter, future precipitation is projected to decrease for the 2011 to 2040 and 2041 to 2070 time horizons, but increasing the 2071 to 2100 time horizon. The results (Columbo et al., 2007), presented in Table 6.7.2.2-1, suggest that the future climate for the region will continue to warm, with precipitation decreasing slightly except in the later stages of the century.

Table 6.7.2.2-1: Projections of Climate Change (AR4) in Northwestern Ontario

Forecast Horizon	Projected Changes in Climate (relative to 1971 to 2000)			
	Temperatures		Precipitation	
	Summer	Winter	Summer	Winter
2011 to 2040	+1 to +2°C	+1 to +2°C	0% to +10%	-10% to 0%
2041 to 2070	+2 to +3°C	+3 to +4°C	-10% to 0%	-10% to +10%
2071 to 2100	+4 to +5°C	+5 to +6°C	-10% to 0%	0% to +20%

Source: Columbo et al., 2007

In the updated summary for policymakers (McDermid et al, 2015), use was made of data from the Fifth Assessment Report (AR5) from the IPCC (2013), which replaces the socio-economic emission scenarios relied on in AR4 (IPCC, 2007) with new scenarios thought to better represent climate processes used in the modelling. The updated summary considered the RCP 2.6, RCP 4.5, and RCP 8.5 emission scenarios, and shows the 2011 to 2040, 2041 to 2070, and 2071 to 2100 time horizons. The updated summary also relies on statistically downscaled data from

Earth Systems Models rather than data from a single GCM. The data relied on by McDermid et al (2015) are described more fully by McKenney et al (2006; 2011; 2013). The Project is located within the Nelson River watershed.

The updated picture for future climate in the region (McDermid et al, 2015) is one of warming annual, summer and winter temperatures. The annual and winter precipitation projections show increasing precipitation. In contrast, the projections for summer precipitation show a decreasing trend. These predictions are summarized in Table 6.7.2.2-2.

Table 6.7.2.2-2: Projections of Climate Change (AR5) in Northwestern Ontario

Forecast Horizon	Scenario	Projected Changes in Climate (relative to 1971 to 2000)					
		Temperatures (°C)			Precipitation (mm)		
		Annual	Summer	Winter	Annual	Summer	Winter
2011 to 2040	RPC 2.6	+2.3	+2.2	+2.3	+18.1	-18.6	+21.7
	RPC 4.5	+2.2	+2.1	+2.1	+28.7	-19.1	+19.4
	RPC 8.5	+2.4	+2.3	+2.7	+32.8	-20.8	+18.8
2041 to 2070	RPC 2.6	+3.0	+2.7	+3.2	+51.8	-7.4	+24.0
	RPC 4.5	+4.0	+3.4	+4.7	+37.5	-19.8	+21.6
	RPC 8.5	+4.8	+4.6	+5.6	+54.3	-27.7	+30.6
2071 to 2100	RPC 2.6	+3.1	+2.9	+3.6	+57.5	-2.9	+21.9
	RPC 4.5	+5.0	+4.4	+5.6	+40.6	-24.1	+30.6
	RPC 8.5	+8.3	+7.8	+9.3	+64.0	-43.6	+39.7

Note: Data derived from McDermid et al, 2015

Canadian and Global GHG Emissions Associated with Changes in Climate

Each year, Canada submits a report summarizing its annual GHG emissions to the United Nations Framework Convention on Climate Change. The report, which is compiled by Environment and Climate Change Canada lists the total GHG emissions, GHG emissions by province/territory, GHG emissions by sector and by activity (ECCC, 2017a). Table 6.7.2.2-3 lists the total Canadian GHG emissions, as well as the provincial and territorial emissions for the latest reporting year (2015), as well as the emissions dating back to 2005.

Table 6.7.2.2-3: Canadian GHG Emissions by Province

Province or Territory	Annual GHG Emissions (kt/y)[1][2]						
	2005	2010	2011	2012	2013	2014	2015
Newfoundland and Labrador	10,100	10,300	10,300	9,900	9,600	10,600	10,300
Prince Edward Island	2,100	2,000	2,200	2,100	1,800	1,800	1,800
Nova Scotia	23,000	20,000	21,000	19,000	18,000	16,000	16,000
New Brunswick	20,000	19,000	19,000	17,000	15,000	14,000	14,000
Quebec	89,000	82,000	84,000	81,000	82,000	80,000	80,000
Ontario	204,000	175,000	175,000	171,000	171,000	168,000	166,000
Manitoba	21,000	20,000	19,000	21,000	21,000	21,000	21,000
Saskatchewan	70,000	70,000	69,000	72,000	74,000	75,000	75,000
Alberta	233,000	241,000	246,000	260,000	272,000	276,000	274,000
British Columbia	64,000	59,000	60,000	61,000	62,000	61,000	61,000

Table 6.7.2.2-3: Canadian GHG Emissions by Province (continued)

Province or Territory	Annual GHG Emissions (kt/y)[1][2]						
	2005	2010	2011	2012	2013	2014	2015
Yukon	400	400	400	400	400	300	300
Northwest Territories	1,600	1,300	1,400	1,500	1,400	1,300	1,400
Nunavut	500	500	500	600	600	700	600
Canada[3]	**738,000**	**701,000**	**707,000**	**716,000**	**729,000**	**727,000**	**722,000**

Notes:
(1) Data derived from ECCC, 2017a, Table S-4
(2) Emissions are provided in units of kilotonnes per year (10^9 g/y)
(3) Totals may not appear to add up due to rounding in the source information

The annual report also provides a breakdown of the GHG emissions by sector, as provided in Table 6.7.2.2-4. This table does not specifically break out the emissions for the mining sector, which are included as a component of the “heavy industry” category.

Table 6.7.2.2-4: Canadian GHG Emissions by Sector

Sector	Annual GHG Emissions (kt/y)[1][2]						
	2005	2010	2011	2012	2013	2014	2015
Oil and gas	158,000	158,000	160,000	161,000	174,000	185,000	190,000
Electricity	117,000	95,000	96,000	89,000	85,000	82,000	80,000
Transportation	163,000	163,000	171,000	171,000	173,000	176,000	173,000
Heavy industry[3]	86,000	71,000	73,000	80,000	79,000	77,000	77,000
Buildings	85,000	84,000	81,000	87,000	85,000	85,000	88,000
Agriculture	74,000	70,000	70,000	70,000	71,000	74,000	72,000
Waste and others	54,000	49,000	50,000	50,000	49,000	49,000	48,000
Canada[4]	**738,000**	**701,000**	**707,000**	**716,000**	**729,000**	**727,000**	**722,000**

Notes:
(1) Data derived from ECCC, 2017a, Table S-3
(2) Emissions are provided in units of kilotonnes per year (10^9 g/y)
(3) Heavy Industry represent emissions arising from non-coal, -oil and -gas mining activities, smelting and refining, and the production and processing of industrial goods such as paper or cement
(4) Totals may not appear to add up due to rounding in the source information

A breakdown of the “heavy industry” sector GHG emissions, highlighting the GHG emissions from the mining sector (exclusive of emissions associated with oil sands mining) have been provided in Table 6.7.2.2-5.

Table 6.7.2.2-5: Canadian GHG Emissions within the Heavy Industry Sector

Sub-sector	Annual GHG Emissions (kt/y)[1][2]						
	2005	2010	2011	2012	2013	2014	2015
Mining	7,000	7,000	8,000	8,000	8,000	8,000	8,000
Smelting and refining (non ferrous metals)	17,000	14,000	11,000	11,000	10,000	11,000	10,000
Pulp and paper	15,000	9,000	7,000	7,000	7,000	7,000	6,000
Iron and steel	16,000	16,000	14,000	17,000	17,000	15,000	16,000
Cement	10,000	13,000	10,000	10,000	11,000	10,000	10,000
Lime and gypsum	3,000	3,000	3,000	3,000	3,000	2,000	3,000

Table 6.7.2.2-5: Canadian GHG Emissions within the Heavy Industry Sector (continued)

Sub-sector	Annual GHG Emissions (kt/y)[1][2]						
	2005	2010	2011	2012	2013	2014	2015
Chemicals and fertilizers	29,000	23,000	21,000	23,000	24,000	24,000	24,000
Heavy industry[3]	**97,000**	**86,000**	**73,000**	**80,000**	**79,000**	**77,000**	**77,000**

Notes:
(1) Data derived from ECCC, 2017a, Table 2-12.
(2) Emissions are provided in units of kilotonnes per year (10^9 g/y)
(3) Totals may not appear to add up due to rounding in the source information

Unlike most environmental issues, climate change is affected on a global issue, rather than a local scale. That is to say that changes in climate are not most noticeable where the emissions are highest. While managing emissions on a provincial and national scale is important, this does not mean that the benefits of these reductions will occur locally. To understand the importance of the Project GHG emission to climate change, it is also important to understand the global emissions of GHGs. Table 6.7.2.2-6 provides a listing of the available historic GHG emission totals globally.

Table 6.7.2.2-6: Historic Global GHG Emissions

Region or Sub-region	Annual GHG Emissions (kt/y)[1][2]					
	1990	2005	2010	2011	2012	2013
Global Total[3]	23,541,006	32,027,075	36,843,140	41,288,274	42,790,113	43,634,306
UNFCCC Annex I	13,133,637	17,086,012	17,310,563	16,648,866	16,435,891	16,426,111
UNFCCC Non-Annex I	10,407,369	14,941,063	19,532,577	24,639,408	26,354,222	27,208,195
Asia	8,356,448	12,159,691	16,051,944	20,473,123	22,304,085	23,057,991
Africa	1,541,992	1,928,479	2,344,747	2,655,382	2,583,410	2,638,075
Europe	4,799,884	7,477,058	7,628,612	7,356,455	7,167,227	7,106,652
Northern America	6,426,680	7,408,118	7,472,876	7,170,425	6,911,848	7,018,219
Latin America and the Caribbean	1,857,959	2,374,784	2,686,793	2,974,156	3,075,389	3,132,597

Notes:
(1) Historic emissions data derived from WRI, 2017
(2) Emissions are provided in units of kilotonnes per year (10^9 g/y)
(3) Totals global emissions are based on the totals for the CAIT countries.

In order to estimate what the climate could be in the future, international organizations have developed forecasts of the future GHG emission based on varying estimates of economic behaviour globally and the success in mitigation emissions. The most comprehensive document was published by the IPCC (Nakicenovic, 2000), and was used as the basis for climate modelling up to the fourth assessment (AR4), and included the following four families of scenarios:

- The A1 scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies.

- The A2 scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Economic development is primarily regionally oriented and per capita economic growth.

- The B1 scenario family describes a convergent world with the same global population that peaks in mid-century and declines thereafter. There are rapid changes in economic structures toward a service and information economy. The emphasis is on global solutions to economic, social, and environmental sustainability.

- The B2 scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability.

The Projected increases in global GHG emissions for 2020, 2050, and 2100 associated with the above scenario families have been summarized in Table 6.7.2.2-7.

Table 6.7.2.2-7: Projected AR4 Increases in Global GHG Emissions

Forecast Horizon	Change in Annual GHG Global Emissions(1)					
	A1FI	A1B	A1T	A2	B1	B2
Increases relative to 1990 baseline						
2020	167%	164%	138%	163%	142%	167%
2050	301%	205%	164%	230%	148%	301%
2100	354%	165%	67%	373%	65%	354%
Increases relative to 2000 baseline						
2020	144%	141%	119%	141%	122%	106%
2050	260%	177%	141%	198%	128%	130%
2100	306%	142%	58%	322%	56%	156%

Notes:
(1) Data derived from IPCC 2000.

The latest analyses form the IPCC were presented as the Fifth Assessment Report (AR5) (IPCC, 2013). In the AR5 reports, the socio-economic emission scenarios relied on in AR4 (IPCC, 2007) have been replaced with four new scenarios referred to as Reference Concentrations Pathways (RCP), which are described as follows:

- RCP 2.6 is a low emissions scenario that is not comparable to any of the scenarios used in the AR4 analyses. The anthropogenic CO_2 emissions would remain relatively constant until 2020, then decline and become negative in 2100.

- RCP 4.5 is an intermediate emissions scenario that is comparable to the B1 scenario used in AR4. The anthropogenic CO_2 emissions would increase slightly relative to the current levels before starting to decline by 2040.

- RCP 6 is also an intermediate emissions scenario, which would be comparable to the B2 scenario from AR4. Anthropogenic CO_2 would continue to increase, reaching a peak above 75% above the current emissions by 2060. Emissions would then decrease to a level about 25% above the current emission levels

- RCP 8.5 is referred to as the high emissions, and would be comparable to scenario A1FI from AR4. Anthropogenic would reach three times the current levels by 2100. There would also be a rapid increase in methane emissions.

6.7.3 Project Effects Avoidance Measures Used in Predictions

The primary methods to avoid the effects of the Project on climate relate to the management of the GHG emissions from the Project. Some of the actions incorporated in the Project that will help avoid GHG emissions include the following:

- Using the 115 kV power line that runs adjacent to the Project for supplying electrical instead of generating electricity on-site [Mit_047].

- Placing the waste rock storage area immediately to the north of the open pit to reduce the haul distances. Shorter haul distances will reduce the fuel consumed and the associated GHG emissions [Mit_048].

- Once mining is complete in pit 1, waste rock will be placed in the mined out areas of the open pit. This reduces haul distances, fuel consumption and GHG emissions [Mit_020].

- Placing the overburden storage area immediately to the south of the open pit to reduce the haul distances. Reducing the haul distances reduces fuel consumption and GHG emissions [Mit_049].

- The compact footprint of the Project reduces the distances travelled, which will ultimately reduce the GHG emissions from the Project [Mit_050].

6.7.4 Predicted Effects

6.7.4.1 Project GHG Emissions

The GHG emissions from the Project will vary by phase and the amount of fossil fuel used. During the site preparation and construction phase there will be diesel-fired mobile equipment grubbing trees, stripping overburden, and preparing the site for mining activities, as constructing the Project facilities. Table 6.7.4.1-1 lists the Project GHG emissions during the site preparation and construction phase. The total equivalent CO_2 emissions (eCO_2) from the Project during this phase would be in excess of the 10,000 tonnes reporting limit under the Ontario Cap and Trade Program (O.Reg. 144/16). However, the Project would not be considered a “large emitted of GHGs” under the regulations as the annual emissions are below 25,000 tonnes annually.

Table 6.7.4.1-1: Project GHG Emissions, Site Preparation and Construction Phase

Source Category	Project GHG Emissions (t/y)(1)			
	CO_2	CH_4	N_2O	eCO_2
Mobile equipment(2)	9,771	0.54	3.63	10,909
Backup generators(3)	0	0.00	0.00	0
Natural gas heating(3)	0	0.00	0.00	0
Project Totals	**9,771**	**0.54**	**3.63**	**10,909**

Notes:

(1) Emissions are provided in units of tonnes per year (10^6 g/y)
(2) GHG emissions for mobile equipment are calculated on the basis of maximum activity levels, and continuous operations throughout the year
(3) There will be no backup generators or mine heating during the site preparation and construction phase

During the operations phase, mining activities would commence and the processing plant would begin operations. Mobile equipment would still be required to mine the ore and waste rock, as well as to deliver the mine materials to the processing plant. Most of the processing operations would rely on electrical power that would be supplied from the 115 kV electrical power line running through the site. Backup generators would be required to ensure that critical equipment can continue to operate and the process plant can be shut down safely in the event of a power outage. The GHG emissions during operations are provided in Table 6.7.4.1-2. The equivalent CO_2 (eCO_2) emissions exceed the Ontario Cap and Trade Program (O.Reg. 144/16) reporting threshold of 10,000 tonnes per year. The Project would not be considered a "large emitter of GHGs" as the annual emissions are less than 25,000 tonnes.

Table 6.7.4.1-2: Project GHG Emissions, Operation Phase

Source Category	Project GHG Emissions (t/y)(1)			
	CO_2	CH_4	N_2O	eCO_2
Mobile equipment(2)	10,377	0.58	3.86	11,585
Backup generators(3)	1,216	0.08	0.01	1,222
Natural gas heating(2)(4)	1,589	0.03	0.03	1,598
Project Totals	**13,182**	**0.69**	**3.90**	**14,405**

Notes:

(1) Emissions are provided in units of tonnes per year (10^6 g/y)
(2) GHG emissions for mobile equipment and mine heating are calculated on the basis of maximum activity levels, and continuous operations throughout the year
(3) GHG emissions for the backup generators are calculated assuming 1 hour of operations per month
(4) Mine heating emissions would not occur until the underground mine starts operations. Annual GHG emissions associated with mine heating would be lower than the values in the table as heating may not be required throughout the year

Once the mining activities cease, the Project will enter the closure phase where the site will be rehabilitated. Mobile equipment will be required to decommission and remove project facilities, as well as to help grade the site such that are runoff will report to the open pit. The GHG emissions from the Project during the closure phase are presented in Table 6.7.4.1-3. The total equivalent CO_2 emissions (eCO_2) from the Project exceed the 10,000 tonne reporting limit under the Ontario Cap and Trade Program (O.Reg. 144/16). However, the Project would not be considered a "large emitted of GHGs" under the regulations as the annual emissions are below 25,000 tonnes annually.

Table 6.7.4.1-3: Project GHG Emissions, Closure Phase

Source Category	Project GHG Emissions (t/y)(1)			
	CO_2	CH_4	N_2O	eCO_2
Mobile equipment(2)	10,857	0.61	4.04	12,121
Backup generators(3)	0	0.00	0.00	0
Natural gas heating(3)	0	0.00	0.00	0
Project Totals	**10,857**	**0.61**	**4.04**	**12,121**

Notes:
(1) Emissions are provided in units of tonnes per year (10^6 g/y)
(2) GHG emissions for mobile equipment are calculated on the basis of maximum activity levels, and continuous operations throughout the year
(3) There will be no backup generators or mine heating during the closure phase

6.7.4.2 Effects of the Project on Climate

The first step in understanding the potential for the Project to affect the climate is to put the Project emissions into context with the emissions contributing to changes in climate. Based on the peak level of activity and GHG emissions (i.e., during operations), the project would represent 0.002% increase in the Canadian GHG emission levels, a 0.18% increase in the GHG emissions levels for the mining sector in Canada, and a 0.009% increase in the GHG emissions for Ontario. A comparison of the GHG emissions from the Project to the national and provincial totals has been provided in Table 6.7.4.2-1.

Table 6.7.4.2-1: Comparison of Project to Canadian and Ontario GHG Emissions

Project Phase	Annual GHG Emissions (kt/y)(1)			
	Project	Canada(2)	Canadian Mining(2)	Ontario(2)
Site preparation and construction	10.9	722,000	8,000	166,000
Operations	14.4			
Closure	12.1			
Post-closure	0.0			

Notes:
(1) Emissions are provided in units of kilotonnes per year (10^9 g/y)
(2) Based on the reported GHG emissions for 2015 (ECCC, 2107a)

Although the emissions from the Project are extremely small compared to the total GHG emissions in Canada, changes in climate are expected to be related to global emissions rather than emissions in a single country or region. Although comparing emissions from the Project to the global GHG emissions is not a direct analogue for the expected climate effects, the comparison is useful in understanding how insignificant the emissions are on a global scale.

Table 6.7.4.2-2 compares the changes in climate estimated as part of AR4 (IPCC, 2013) along with the corresponding change in global emissions associated with those changes. Only the 2011 to 2040 forecast information has been provided as the proposed Project will only have a life of 15 years from site preparation and construction through closure. It should be clear that the effects of the relatively minor amount of Project GHG emissions on climate would not be measurable. This is consistent with the current federal guidance for incorporating climate impacts in

environmental assessments (FPTCCCEA 2003), which states that "…unlike most project-related environmental effects, the contribution of an individual project to climate change cannot be measured."

Table 6.7.4.2-2: Comparison of Project GHG Emissions to Changes in Global Emissions

Forecast Horizon	Parameter	Estimated Change in Climate(1)	Modelled Change in Global Emissions(2)	Change in Global Emissions due to the Project(3)
2011 to 2040	Temperature (summer)	+1 to +2°C	141%	0.00005%
	Temperature (winter)	+1 to +2°C		
	Precipitation (summer)	0% to +10%		
	Precipitation (winter)	-10% to 0%		

Notes:
(1) Based on the data presented in CCRR-05 (Columbo et al., 2007) (Table 6.6.2.2-1)
(2) Based on the changes calculated relative to 2000 AR4 data (Table 6.6.2.2-7)
(3) Calculated using the 2000 global emissions (WRI, 2017) (Table 6.6.2.2-6)

6.7.5 Identified Mitigation

The following measures will be incorporated into the Project to mitigate and avoid GHG emissions:

- Using the 115 kV power line that runs adjacent to the Project for supplying electrical instead of generating electricity on-site [Mit_047].
- Placing the waste rock storage area immediately to the north of the open pit to reduce the haul distances. Shorter haul distances will reduce the fuel consumed and the associated GHG emissions [Mit_048].
- Once mining is complete in pit 1, waste rock will be placed in the mined out areas of the open pit. This reduces haul distances, fuel consumption and GHG emissions [Mit_020].
- Placing the overburden storage area immediately to the south of the open pit to reduce the haul distances. Reducing the haul distances reduces fuel consumption and GHG emissions [Mit_049].
- The compact footprint of the Project reduces the distances travelled, which will ultimately reduce the GHG emissions from the Project [Mit_050].

6.7.6 Residual Adverse Effects

As described in Section 6.1.3.6, the effects of the Project on climate were evaluated using two VCs, namely; Project GHG emissions, and changes in climate due to the Project. The predicted effects of the Project on climate, described in Section 6.7.4.2, identified that there would be adverse effects for the Project GHG emissions VC during the site preparation and construction, operations, and closure phases of the Project. There would be no adverse effects for the Project

GHG emissions VC during the post-closure phase. No adverse effects were predicted for the "changes in climate due to the Project" VC. Even with the application of the mitigation measures summarized in Section 6.7.5, the Project will still emit GHG emissions. As a result, residual adverse effects were predicted for the Project GHG emissions VC during the site preparation and construction, operations, and closure phases of the Project. There would be no GHG emissions from the Project during the post-closure phase. There are no residual adverse effects for the "changes in climate due to the Project" VC. The residual adverse effects of the Project on climate are summarized in Table 6.7.7-1.

Table 6.7.6-1: Predicted Residual Adverse Effects for Climate

Valued Components (VCs)	Project GHG Emissions (t/y)(1)			
	Site Preparation and Construction	Operations	Closure	Post-Closure
Project GHG emissions	10,909	14,405	12,121	—
Changes in climate due to the Project	—	—	—	—

Notes:
The "—" symbol indicates where no adverse effects were predicted
(1) The GHG emissions are provided as equivalent carbon dioxide (eCO_2) in units of tonnes per year (10^6 g/y). The eCO2 combines the emissions of CO_2, methane (CH_4) and nitrous oxide (N_2O) using equivalency factors described in Section 6.7.2.1.

There are no spatial patterns associated with the residual effects on the "Project GHG emissions VC".

6.7.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, the following questions were asked regarding the predictions of effects on climate:

- TMI_263-EE(1)-06: quantitative assessment of changing climate;
- TMI_439-AC(1)-114: provide information on changing climate;
- TMI_539-AC(1)-213:potential effects for parameters, including climate.
- TMI_586-AC(1)-260: provide information on changing climate; and
- TMI_738-PC(1)-53: characterizing the effect on climate.

6.8 Surface Water Quality

6.8.1 Potential Effects of the Project on the Environment

The potential effects of the Project on surface water quality will vary during the Project life, depending on the Project phase, and with varying levels of activity. The following lists the potential surface water quality effects by Project phase:

- **Site Preparation and Construction Phase**: As described in the Section 3, one of the first activities during the site preparation and construction phase will be the construction of a perimeter ditch around the operations area that will effectively capture all site runoff and direct this runoff to the on-site ponds. This water will be used on-site to help initiate the tailings storage facility (TSF) and provide an inventory for when processing commences. There will be effectively no discharges during this phase. As the perimeter ditches are being constructed, soils will be disturbed and rainfall could cause eroded material to be transported of site. To mitigate against this, industry standard practices for erosion and sediment control will be implements as the perimeter ditches are being constructed.

- **Operations Phase**: During operations, there will be a single point of surface water discharge from the Project, through an engineered structure into Blackwater Creek. All runoff from the operations area will be captured during the operations phase and used in the minewater management system. To the extent possible, this water will be used in the mine and the processing plant. Excess water within the operations area will be treated to meet Provincial Water Quality Objectives (PWQO) prior to discharge to Blackwater Creek.

  The waste rock storage area (WRSA) and TSF will be equipped with a perimeter ditches and seepage collection systems to capture the majority of seepage, which will then be incorporated in the minewater management system. During operations, the open pit and underground mine will be dewatered to provide a safe working environment, which will create a drawdown zone in the water table where groundwater will be directed towards the open pit. Seepage from the WRSA and TSF that escapes the seepage collection systems will be captured within the drawdown zone, and will ultimately report to the open pit where it will be incorporated into the minewater management system.

  There will be no surface water discharges to Thunder Lake or any of the tributaries to Thunder Lake during operations. Although Hoffstrom's Bay Tributary and Little Creek will have a small reduction in catchment size as a result of the Project, it is anticipated this will affect surface water quality. In addition, it is expected that periodic water taking from Thunder Lake Tributary 2 and 3 will occur to support Project requirements. Although this will affect the flow in these tributaries, there will be no discharges and no expected changes in surface water quality.

- **Closure Phase:** There will be no discharges to surface water during the closure phase. The site will be graded as part of the closure activities so that all of the runoff from the site

will be directed towards the open pit. The process water in the TSF will be withdrawn, treated and used to help fill the open pit. Although dewatering activities will cease at the end of mining activities, the drawdown zone created during operations will continue to direct groundwater and seepage from the WRSA and TSF to the open pit until it is filled. The perimeter ditches will remain in place during this phase.

- **Post-closure Phase:** In the post-closure phase, all site runoff will continue to be directed to the open pit, and the open pit will continue to experience an influx of groundwater. Once the pit is fully flooded, excess water will be released through a spillway into a tributary of Blackwater Creek. Once the pit is flooded, groundwater levels will return to near pre-development conditions. At that point, a portion of the seepage from the TSF and WRSA will escape from the site, and will ultimately report to various nearby waterbodies during this phase.

The potential effects of the Project on surface water quality have been described using a simple linkage diagram on Figure 6.8.1-1. The figure illustrates the surface water quality VC (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. Additionally, the figure indicates those other components of the environment (shown in red on the figure) where there will be a reliance on information about the effects of the Project on surface water quality as an input for determining the effects on other VCs. For example, surface water quality predictions will be used as an input to the human health component. The prediction of effects on surface water quality will also rely on inputs from other component VCs. For example, surface water quantity predictions will be relied on in predicting potential effect on surface water quality.

6.8.2 Effects Prediction Methods

Surface water quality was predicted for the waterbodies surrounding the Project using a mass balance equation that considers background water quality as well as the discharges from the Project. A fulsome description of the model used is provided in Section 6 of the Water Report, included as Appendix JJ to the revised EIS.

6.8.2.1 Determining Background Surface Water Quality

One of the inputs required in the model is the background water quality. Background surface water quality was determined for each watercourse or waterbody potentially affected by the Project. Background water quality was based on background data collected in 2012 and 2013 (Appendix P of the EIS). For example, the determination of background water quality in Blackwater Creek was comprised of five water quality sampling stations within the Blackwater Creek catchment area.

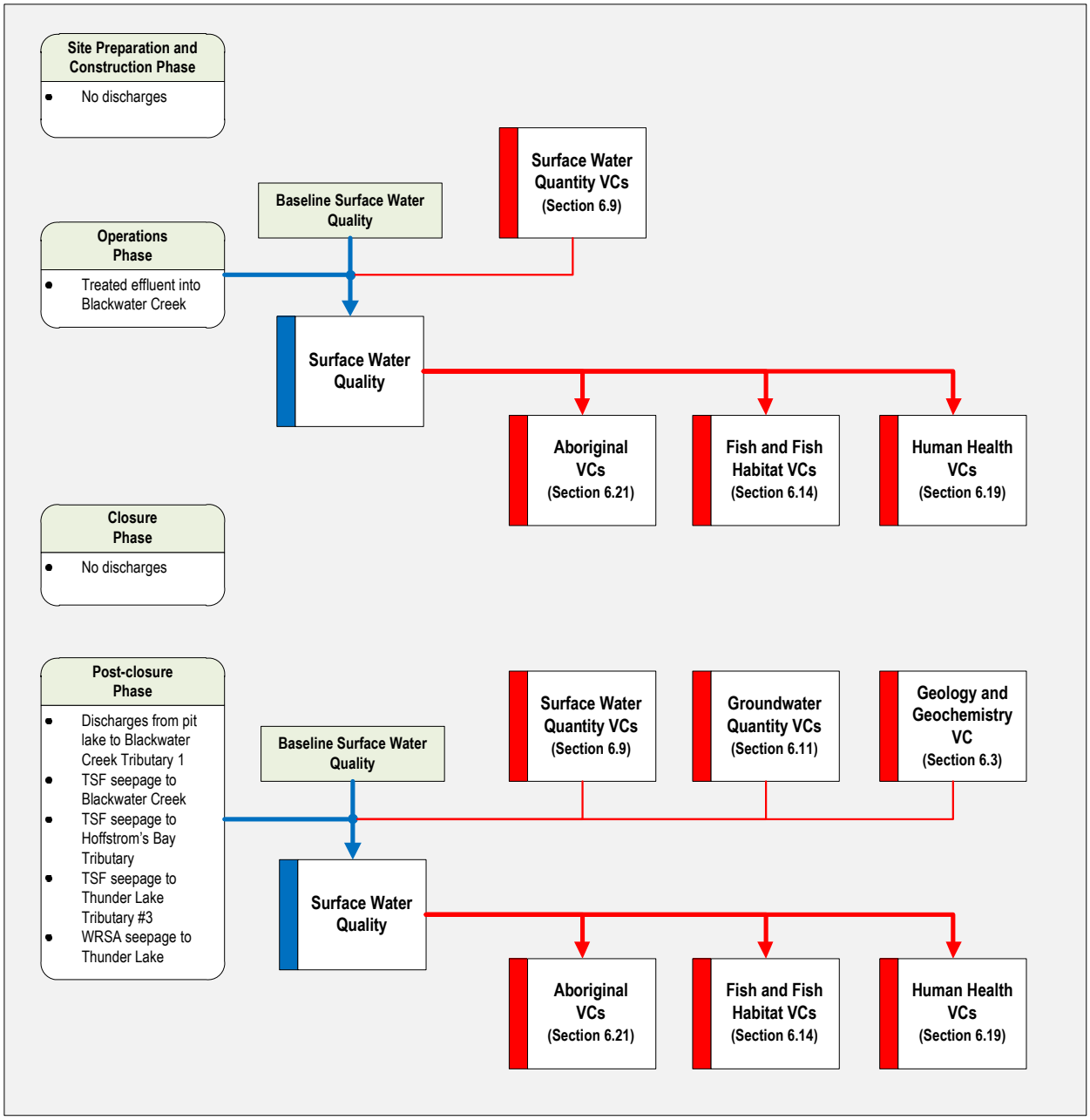


Figure 6.8.1-1: Surface Water Quality Linkage Diagram

Background water quality for each watercourse was determined by calculating the 50th percentile concentrations for each key parameter. For Blackwater Creek, this included taking the 50th percentile for all data of the following five stations: SW-TL1A, SW-TL2, SW-TL3, SW-JCTa, and SW-11. The location for these five stations is shown on Figure 6.8.2.1-1. This figure also includes a table listing each watercourse and corresponding sampling stations from Appendix P that were used for establishing background water quality. The background water quality at nodes BW1 and

BW2, both located in Blackwater Creek, would be equal to and would be based on all of the background water quality presented in Appendix P of the EIS for Blackwater Creek. The background water quality used in the model also corresponds to the information provided in Table 5.8.1.3-2. The background surface water quality by waterbody information is reproduced in Table 6.8.2.1-1.

6.8.2.2 Determining Existing Surface Water Quality

Existing water quality data was use to established representative water quality level for each node (node locations shown on Figure 6.8.2.2-1) against which predictions for the various phases of the Project could be compared. The surface water quality model is an annual mass balance model that combines volume-weighted quality inputs for each of the modelled nodes. A schematic diagram representing input parameters for each node (i.e., natural runoff, tributary flow and groundwater) is shown in Figure 6.8.2.2-2. For the existing conditions, the key input parameters to the model are the background surface water quality (described above in Section 6.8.2.1) and the surface water quantities, as flows. The surface water flows are described in Section 6.10. For reference, Table 6.8.2.2-1 provides the annual flows at each of the surface water quality nodes. The table lists a range of hydrologic predictions, including a dry year, wet year and average year. The predictions are described more fully in Section 6.10.

6.8.2.3 Determining Site Preparation and Construction Phase Surface Water Quality

As described in Section 6.8.1, there will be no water discharges from the Project site to the receiving environment during this phase. Therefore, surface water quality modelling was not completed during the site preparation and construction phase. A perimeter ditch will be constructed around the operations area of the Project site that will effectively capture all site runoff and direct it to onsite ponds where it will be held until it can be suitably released to the environment.

6.8.2.4 Determining Operations Phase Surface Water Quality

During operations, there will be a single point of discharge from the Project to Blackwater Creek (Figure 6.8.2.2-1). All site runoff from within the operations area will be collected and directed to the mine water management system. To the extent possible, the water will be used in the mine and processing plant. Excess water will be treated and discharged as effluent to Blackwater Creek. Treasury Metals has committed that treated effluent during operations will meet the provincial Water Quality Objectives (PWQO), the Canadian Water Quality Guidelines (CWQG) when there are no PWQO, or background concentrations for the case of mercury.

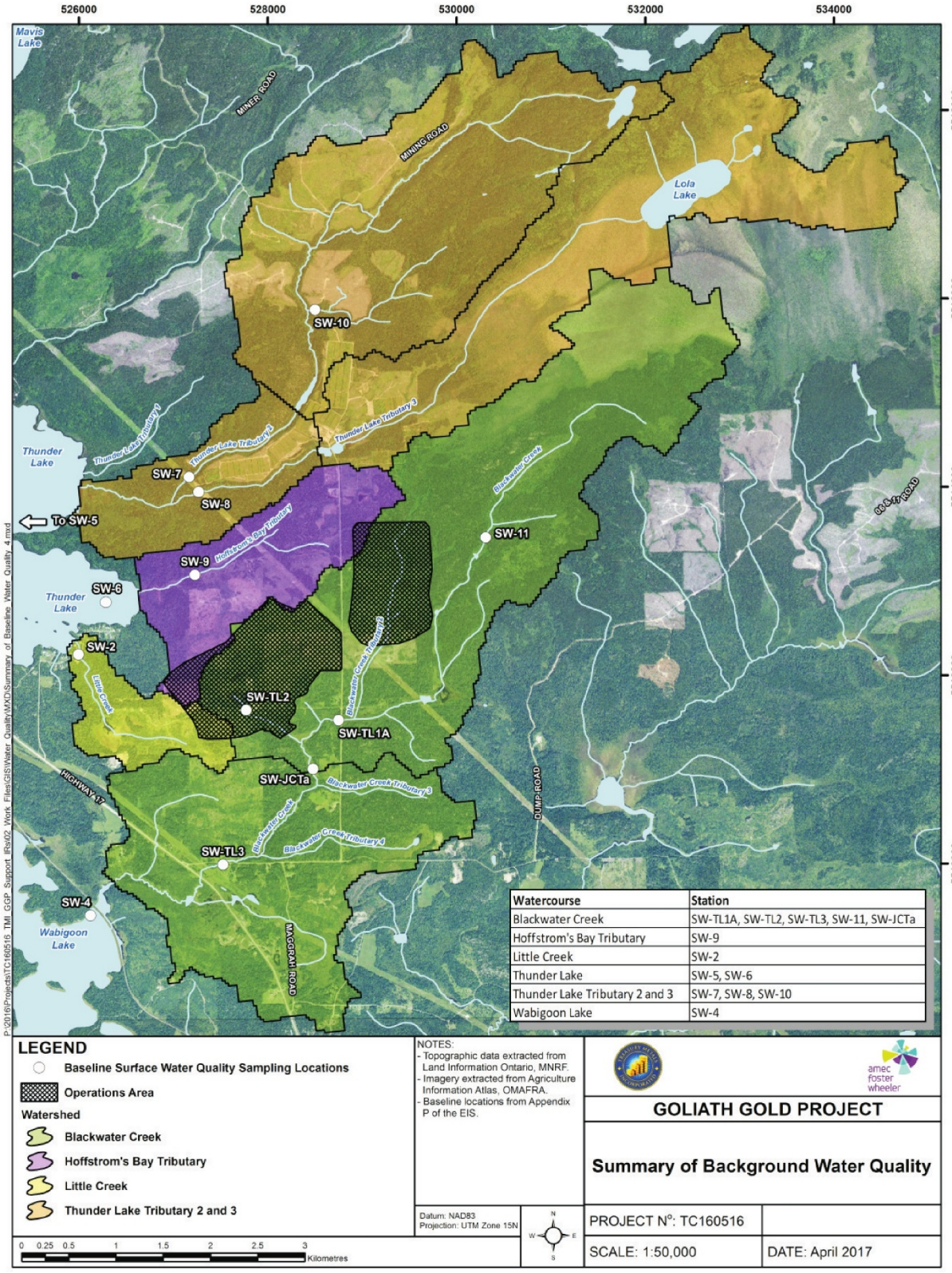


Figure 6.8.2.1-1: Locations of Background Water Quality Sampling Locations

Table 6.8.2.1-1: Background Surface Water Quality

Parameter	Thunder Lake Tributary 2/3 (mg/L)	Hoffstrom's Bay Tributary (mg/L)	Little Creek (mg/L)	Blackwater Creek (mg/L)	Thunder Lake (mg/L)	Wabigoon Lake (mg/L)
Aluminum	0.077	0.078	0.555	0.251	0.016	0.692
Antimony	0.001	0.001	0.001	0.001	0.001	0.001
Arsenic	0.001	0.001	0.001	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Chloride	0.3	0.4	1.2	0.9	4.2	3.2
Chromium	0.001	0.001	0.001	0.001	0.001	0.001
Cobalt	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.001	0.001	0.002	0.001	0.001	0.002
Cyanide	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.862	0.365	1.010	1.450	0.036	0.459
Lead	0.001	0.001	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	0.002	0.002	0.002	0.002	0.002	0.002
Nitrate	0.090	0.101	0.039	0.030	0.030	0.030
Phosphorus	0.011	0.011	0.047	0.027	0.008	0.024
Selenium	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.002	0.001	0.001	0.001
Zinc	0.003	0.003	0.005	0.004	0.003	0.003

Note:
Background surface water quality based on 50th percentile data

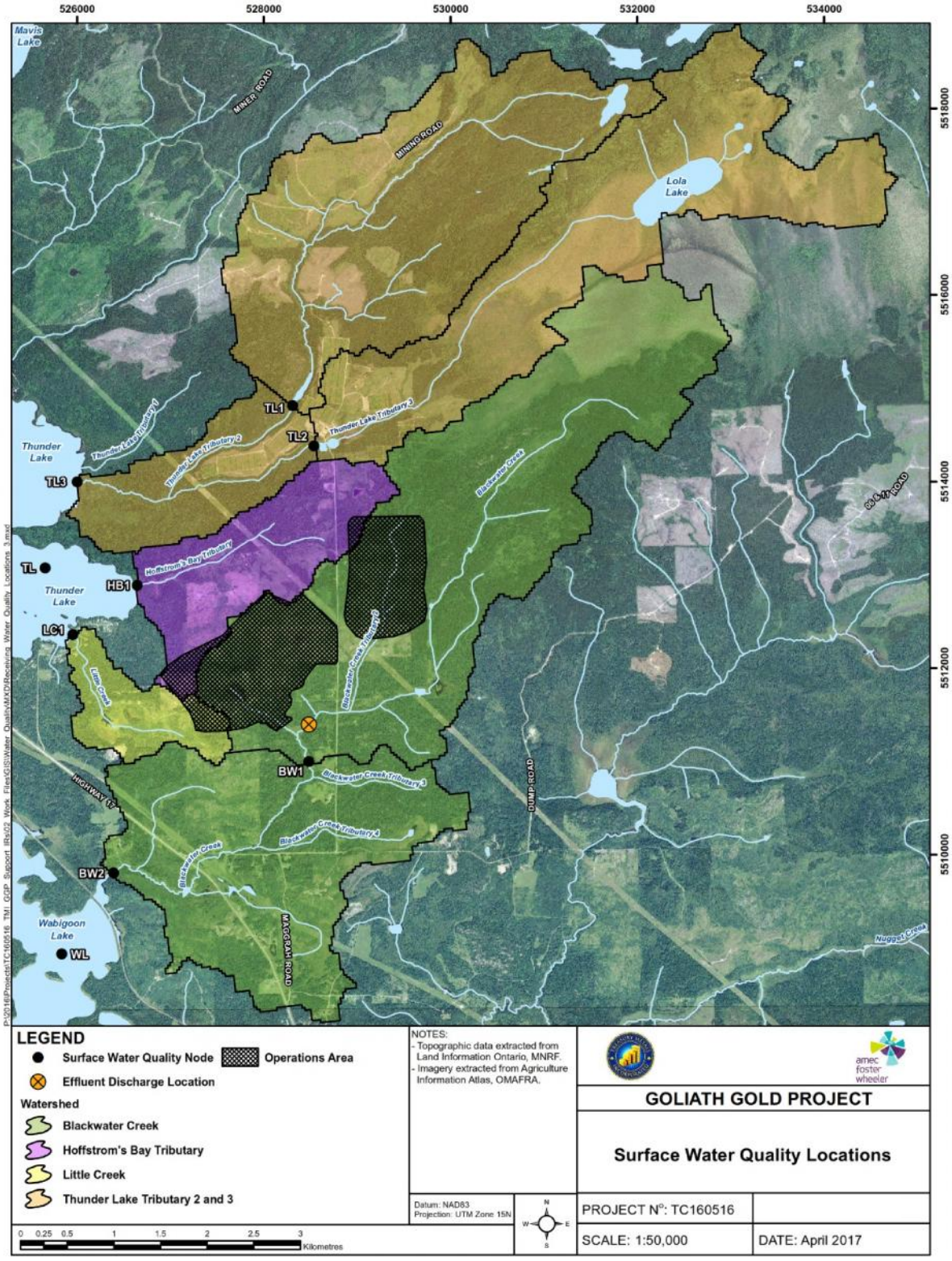


Figure 6.8.2.2-1: Locations of Water Quality Modelling Nodes

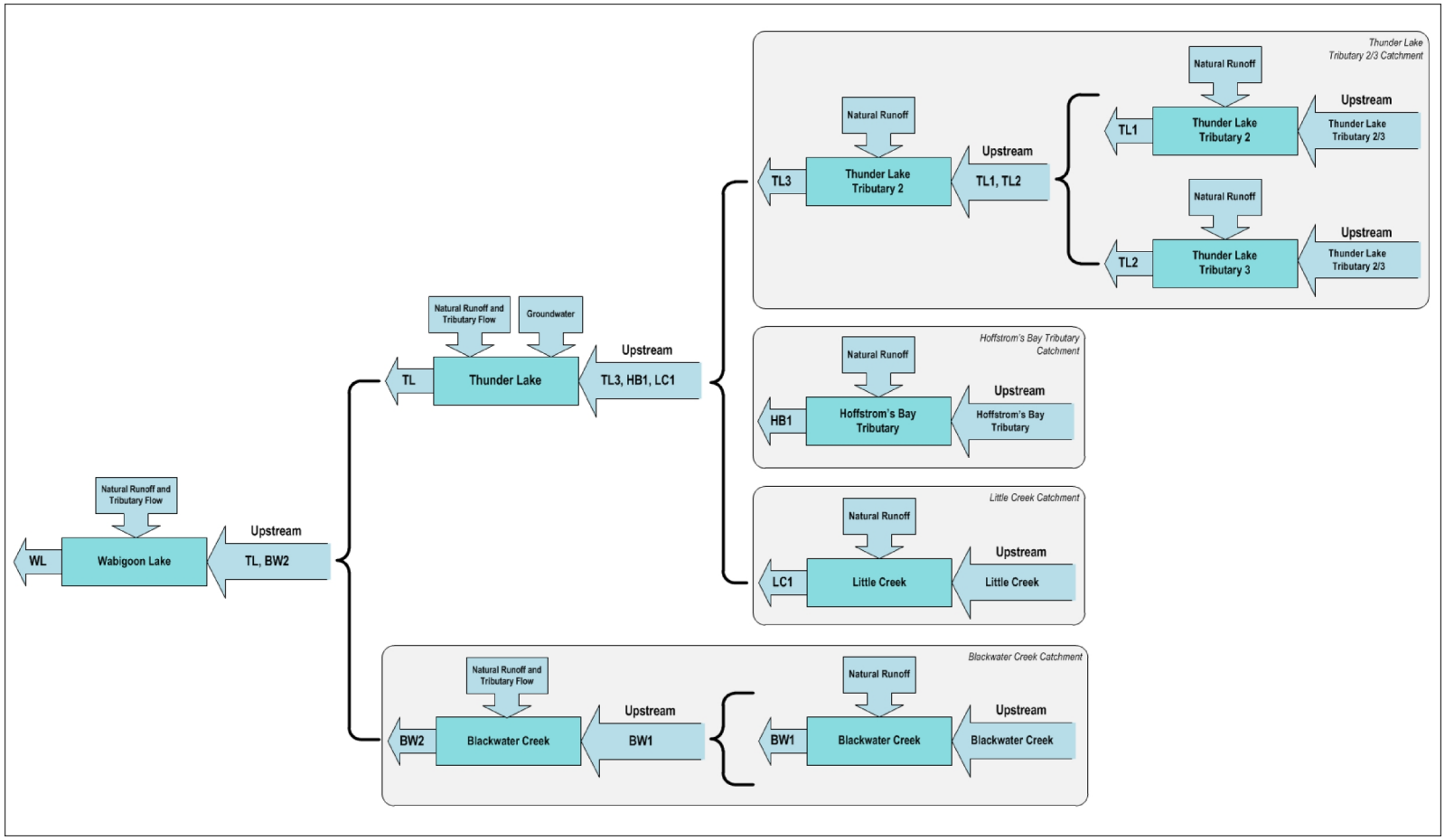


Figure 6.8.2.2-2: Surface Water Quality Model Schematic, Existing Conditions

Table 6.8.2.2-1: Flow Data used for Modelling Surface Water Quality

Modelling Node	Project Phase	Annual Flow Rate (m^3/s)		
		Dry Year	Average Year	Wet Year
BW1	Existing	0.0239	0.0851	0.1463
	Operations	0.0234	0.0857	0.1489
	Post-closure (TSF Dry Cover)	0.0301	0.0945	0.1652
	Post-closure (TSF Wet Cover)	0.0284	0.0919	0.1645
BW2	Existing	0.0379	0.1349	0.2320
	Operations	0.0374	0.1356	0.2346
	Post-closure (TSF Dry Cover)	0.0441	0.1444	0.2509
	Post-closure (TSF Wet Cover)	0.0424	0.1417	0.2502
HB1	Existing	0.0061	0.0216	0.0372
	Operations	0.0056	0.0200	0.0343
	Post-closure (TSF Dry Cover)	0.0057	0.0202	0.0346
	Post-closure (TSF Wet Cover)	0.0057	0.0202	0.0346
TL1	Existing	0.0178	0.0635	0.1091
	Operations	0.0169	0.0631	0.1091
	Post-closure (TSF Dry Cover)	0.0178	0.0635	0.1091
	Post-closure (TSF Wet Cover)	0.0178	0.0635	0.1091
TL2	Existing	0.0164	0.0585	0.1006
	Operations	0.0156	0.0582	0.1006
	Post-closure (TSF Dry Cover)	0.0164	0.0585	0.1006
	Post-closure (TSF Wet Cover)	0.0165	0.0586	0.1007
TL3	Existing	0.0393	0.1400	0.2406
	Operations	0.0376	0.1393	0.2406
	Post-closure (TSF Dry Cover)	0.0393	0.1400	0.2406
	Post-closure (TSF Wet Cover)	0.0394	0.1401	0.2408
LC1	Existing	0.0027	0.0096	0.0165
	Operations	0.0025	0.0088	0.0151
	Post-closure (TSF Dry Cover)	0.0025	0.0089	0.0153
	Post-closure (TSF Wet Cover)	0.0025	0.0089	0.0153

The same model used for estimating existing surface water quality was used for predicting surface water quality during operations. Modelling of the surface water quality during operations was done for each of the nine nodes shown on Figure 6.8.2.2-1. A schematic for the method used for modelling surface water quality during operations is provided as Figure 6.8.2.4-1. The following lists the key assumptions for modelling operations surface water quality:

- Seepage not captured by perimeter collection ditches will be captured within the drawdown zone caused by active mine dewatering, and will ultimately report to the open pit.
- Site runoff will be collected from within the Project site boundary area and treated prior to being discharged to Blackwater Creek. The effluent discharge point is located immediately upstream of node BW1 (Figure 6.8.2.2-1).
- The water quality of natural runoff from those areas outside of the operations area is assumed to be equivalent.

The key input information required by the model includes the following:

- Background water quality (Section 6.8.2.1 and Table 6.8.2.1-1);
- Annual flows at the model nodes (Section 6.7.2.2 and Table 6.8.2.2-1);
- Annual discharges of treated effluent to Blackwater Creek (Table 6.8.2.4-1); and
- Quality of the treated effluent (Table 6.8.2.4-2).

As previously described, surface water quality was modeled under three different hydrologic scenarios: an average year, a wet year, and a dry year. The annual volume of treated effluent discharged for each hydrologic scenario will vary as shown in Table 6.8.2.4-1.

Table 6.8.2.4-1: Surface Water Discharge Volumes during Operations

Node	Source	Climate Conditions	Waterbody Receiver	Volume of Discharge (m^3/d)
BW1	Effluent from Project	Dry year	Blackwater Creek	384
BW1		Average year	Blackwater Creek	1,573
BW1		Wet year	Blackwater Creek	2,829

Note: During operations, effluent will be treated and discharged to Blackwater Creek from a single point discharge location upstream of node BW1.

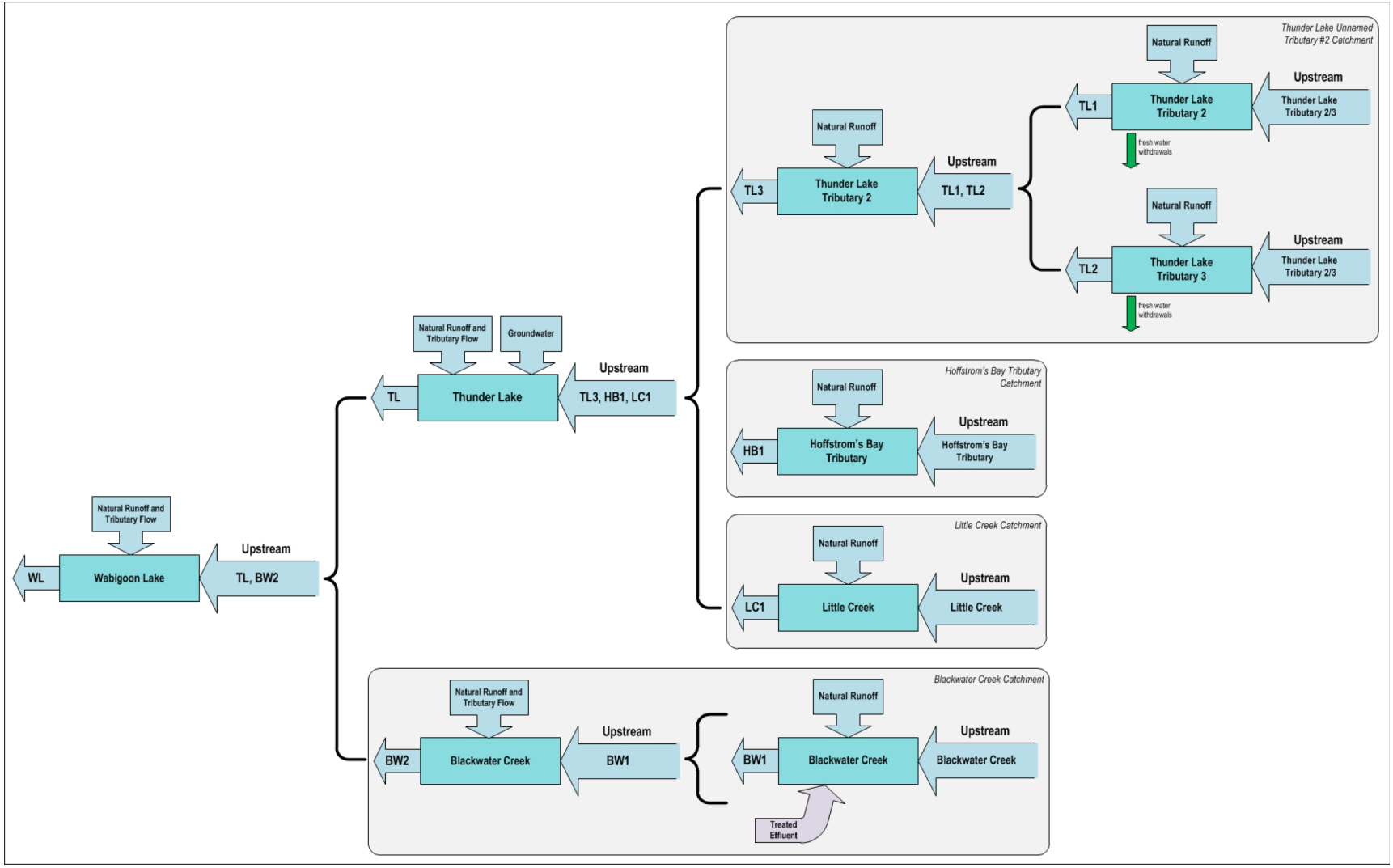


Figure 6.8.2.4-2: Surface Water Quality Model Operations Phase

Table 6.8.2.4-2: Treated Effluent Discharge Quality

Parameter	Effluent Concentration (mg/L)
Aluminum	0.075
Antimony	0.020
Arsenic	0.10
Beryllium	0.011
Boron	0.20
Cadmium	0.0002
Chloride	120
Chromium	0.0089 (1)
Cobalt	0.0009 (1)
Copper	0.005
Cyanide	0.005
Iron	0.30
Lead	0.005
Mercury	0.00002
Molybdenum	0.040 (1)
Nickel	0.025
Nitrate	13
Phosphorus	0.030
Selenium	0.10
Silver	0.0001
Thallium	0.0003
Uranium	0.005
Vanadium	0.006 (1)
Zinc	0.030

Source: Table 9.0.1 of the EIS
Note: (1) Chromium, cobalt, molybdenum and vanadium have been updated from Table 9.0.1 of the oiginal EIS to reflect current PWQO criteria (or interim PWQO when there is no firm PWQO criteria).

There will be no discharges to the surface water in any of the tributaries to Thunder Lake, however, fresh water will be withdrawn periodically from the irrigation ponds at the former MNRF tree nursery. These ponds are located on Thunder Lake Tributary 2 and Thunder Lake Tributary 3. Any seepage from the TSF and WRSA that escapes the seepage collection systems will be captured by the drawdown zone created by the dewatering of the open pit and underground mine, and will report to the open pit.

The following section provide detailed descriptions for the water quality schematic shown in Figure 6.8.2.4-2. The text is organized by the four watershed areas and two lakes covered by the nine modelling nodes (Figure 6.8.2.2-1).

Thunder Lake Tributary 2 and Tributary 3 Catchment

The surface water quality at node TL1, for Thunder Lake Tributary 2, was based on the following input parameters: upstream Thunder Lake Tributary 2 and Tributary 3 and natural runoff. The 'upstream' and 'natural runoff' input parameters for concentration were determined by taking the 50th percentile concentration of all background samples collected in Thunder Lake Tributaries 2

and 3 (SW-7, SW-8 and SW-10 from Figure 6.8.2.1-1). The input flow rates for TL1 were taken from Table 6.8.2.2-1. Using a mass-balance equation described above, the surface water quality concentration at node TL1 was determined. The water quality for node TL2 was determined in the same manner as described above for node TL1, however, input variables (i.e., flow rate and concentration) specific for node TL2 were used. The surface water quality and flow rates previously calculated for nodes TL1 and TL2 serve as inputs to determine the surface water quality at node TL3; representative of the 'upstream' input parameter. The second input parameter, natural runoff, was calculated by subtracting the sum of the flow rates associated at nodes TL1 and TL2 from the flow rate associated with node TL3 (Table 6.8.2.2-1). The water quality concentration associated with the natural runoff component was assumed to be the same as background water quality concentration determined for Thunder Lake Tributary 2 (based on data collected from SW-7 and SW-10 shown on Figure 6.8.2.1-1). Figure 6.8.2.4-1 shows the Thunder Lake Tributary 2 catchment area and summarizes the input and output variables and relationship between nodes TL1, TL2 and TL3. The determination of surface water quality at nodes TL1 and TL2 also took into account a fresh water withdrawal from Thunder Lake Tributaries 2 and 3 that occurs during the operations phase.

Hoffstrom's Bay Tributary Catchment

The water quality in Hoffstrom's Bay Tributary, at node HB1, was calculated using the same method as described above for nodes TL1 and TL2, but with flow and water quality data specific to HB1. Hoffstrom's Bay Tributary natural runoff and upstream input parameters (Figure 6.8.2.2-1) were the same in terms of water quality, and were based on station SW-9 background water quality data (Figure 6.8.2.1-1).

Little Creek Catchment

The water quality for node LC1 in Little Creek was determined in the same manner as described for the nodes above (i.e., for TL1, TL2 and HB1), however, input variables specific for node LC1 were used. Flow data from Table 6.8.2.2-1 and 50th percentile background water quality data for Little Creek (station SW-2 shown on Figure 6.8.2.1-1) were used as input parameters for calculating receiving water quality at node TL2. A schematic diagram depicting the input variables used to calculate the receiving water quality at node LC1 is shown on Figure 6.8.2.4-1.

Blackwater Creek Catchment

The determination of surface water quality at node BW1 was based on the following input parameters: upstream Blackwater Creek, natural runoff and treated effluent discharge. Surface water quality at node BW2 was based on the following inputs: natural runoff and tributary flow and water quality, and flow and water quality previously calculated for node BW1. Therefore, the outputs determined at node BW1 served as inputs for determining surface water quality at node BW2. Figure 6.6.13.4-2 illustrates this relationship between the two nodes BW1 and BW2 in the Blackwater Creek catchment. Water quality of the natural runoff and tributary flow was assumed

to be equivalent to background concentrations determined for Blackwater Creek that included the data collected for stations SW-TL1A, SW-TL2, SW-TL3, SW-JCTa and SW-11 (Figure 6.8.2.1-1).

Thunder Lake

Water quality in Thunder Lake for node TL, was determined based on the following input parameters and assumptions made for input water quality:

- Previously calculated flow rates and concentrations for nodes TL3, HB1 and LC1, which are upstream of TL, served as input parameters.
- It was assumed that groundwater quality directed to Thunder Lake was equal to background water quality in Thunder Lake (based on 50th percentile data collected at stations SW-5 and SW-6, as shown on Figure 6.8.2.1-1).
- Natural runoff and tributary flow water quality to Thunder Lake was assumed to be equal to Thunder Lake Tributary 2 and Tributary 3 background water quality (based on 50th percentile data collected at stations SW-7, SW-8 and SW-10, as shown on Figure 6.8.2.1-1).

Wabigoon Lake

Water quality for node WL, in Wabigoon Lake, was based on two input parameters, with the following assumptions:

- Previously calculated flow rates and concentrations for nodes TL and BW2 served as upstream input parameters.
- It was assumed that natural runoff and tributary flow water quality to Wabigoon Lake is the same as the background water quality and to the same as the 50th percentile data collected at stations SW-4 as per Figure 6.8.2.1-1).

6.8.2.5 Determining Closure Phase Surface Water Quality

As described in Section 6.8.1, there will be no discharges to surface water during the closure phase. The site will be graded as part of the closure activities so that all of the runoff from the site will be directed towards the open pit. The process water in the TSF will be withdrawn, treated and used to help fill the open pit. Although dewatering activities will cease at the end of mining activities, the drawdown zone created during operations will continue to direct groundwater and seepage from the WRSA and TSF to the open pit until it is filled. The perimeter ditches will remain in place during this phase. As there will be no discharges during this phase, no surface water quality modelling was completed for the closure phase.

6.8.2.6 Determining Post-closure Phase Surface Water Quality

During post-closure there will be no mining operations at the site and therefore no effluent. All site runoff will continue to be directed to the open pit, and the open pit will continue to experience an influx of groundwater. One the pit is fully flooded, excess water will be released through a spillway into a tributary of Blackwater Creek. The expected rate at which the pit lake will release water to the receiving environment is provided in Table 6.8.2.6-1.

Table 6.8.2.6-1: Surface Water Discharge Volumes during Post-closure

Node	Source	Climate Conditions	Waterbody Receiver	Volume of Discharge (m^3/d)
BW1	Passive discharge from pit lake	dry year	Blackwater Creek	967
BW1		average year	Blackwater Creek	2341
BW1		wet year	Blackwater Creek	4259

Note: During operations, effluent will be treated and discharged to Blackwater Creek from a single point discharge location upstream of node BW1

Once the pit is flooded, groundwater levels will return to near pre-development conditions. At that point, a portion of the seepage from the TSF and WRSA will escape from the site, and will ultimately report to various nearby waterbodies during this phase. The volumes of seepage to various waterbodies was provided in Appendix M to the revised EIS, and have been provided for reference in Table 6.8.2.6-2. The table lists the respective seepage rates from both the TSF and WRSA, as well as identifying the modelling node where the seepage is predicted to report, for both TSF closure options. As described in the effects predictions for geology and geochemistry (Section 6.3), the following two options are being considered for the closure of the TSF [Mit_023]:

- The dry cover option assumes that the process water in the TSF will be withdrawn at closure, treated and used to help fill the pit. The tailings will then be physically isolated using a granular cover. Finally, the tailings will be covered with a low-permeability dry cover to limit the potential for acidification.

- The wet cover option is similar in many ways to the dry cover option. The process water in the TSF will be withdrawn at closure, treated and used to help fill the pit. The tailings will then be physically isolated using a granular cover. Finally, the tailings will be isolated from oxygen using a cover of non-process water to prevent acidification.

Table 6.8.2.6-2: Seepage Discharge Volumes to Receiving Waters during Post-closure

Node	Source	Waterbody Receiver	Volume of Seepage (m^3/d)
TL	WRSA (capped)	Thunder Lake	10
TL2	TSF (dry cover)	Thunder Lake Tributary 3	10
HB1		Hoffstrom's Bay Tributary	10
BW1		Blackwater Creek	29
BW2		Blackwater Creek	1
TL	TSF (wet cover)	Thunder Lake	10

Table 6.8.2.6-2: Seepage Discharge Volumes to Receiving Waters during Post-closure (continued)

Node	Source	Waterbody Receiver	Volume of Seepage (m^3/d)
TL2		Thunder Lake Tributary 3	20
HB1		Hoffstrom's Bay Tributary	10
BW1		Blackwater Creek	50

Notes:
(1) During operations, seepage from the WRSA and TSF not captured by perimeter collection ditches will be captured within the drawdown zone caused by active dewatering, and will ultimately report to the open pit
(2) During operations, there will be no discharge from the pit lake to the surrounding environment

The quality of the water in the pit lake as well as the quality of the seepage from the WRSA and TSF was determined as part of the effects assessment for geology and geochemistry. Specifically, Tables 6.3.4.1-1 and 6.3.4.2-1 provide the predictions for the dry cover option for the TSF and the wet cover option for the TSF, respectively.

The following sections provide detailed descriptions for the water quality schematic shown in Figure 6.8.2.6-1. The text is organized by the four watershed areas and two lakes covered by the nine modelling nodes (Figure 6.8.2.2-1).

Thunder Lake Tributary 2 and 3 Catchment

Surface water quality for nodes TL1, TL2 and TL3 for the post-closure phase was determined using a similar method described above for the operations phase but with flow data specific to post-closure (Table 6.8.2.2-1), and with the following key changes listed below:

- There is no fresh water withdrawal from Thunder Lake Tributaries 2 and 3; and
- There is seepage from the covered TSF to Thunder Lake Tributary 3 at node TL2.

Figure 6.8.2.6-1 provides the input and output variables summarized above for nodes TL1, TL2 and TL3.

Hoffstrom's Bay Tributary Catchment

Surface water quality in Hoffstrom's Bay Tributary for node HB1 was determined using a similar method described above for HB1 for operations, however, a seepage component from the TSF was included for this phase and not relevant for operations. Figure 6.8.2.6-1 provides a schematic diagram, which depicts all of the input parameters used to determine surface water quality for HB1.

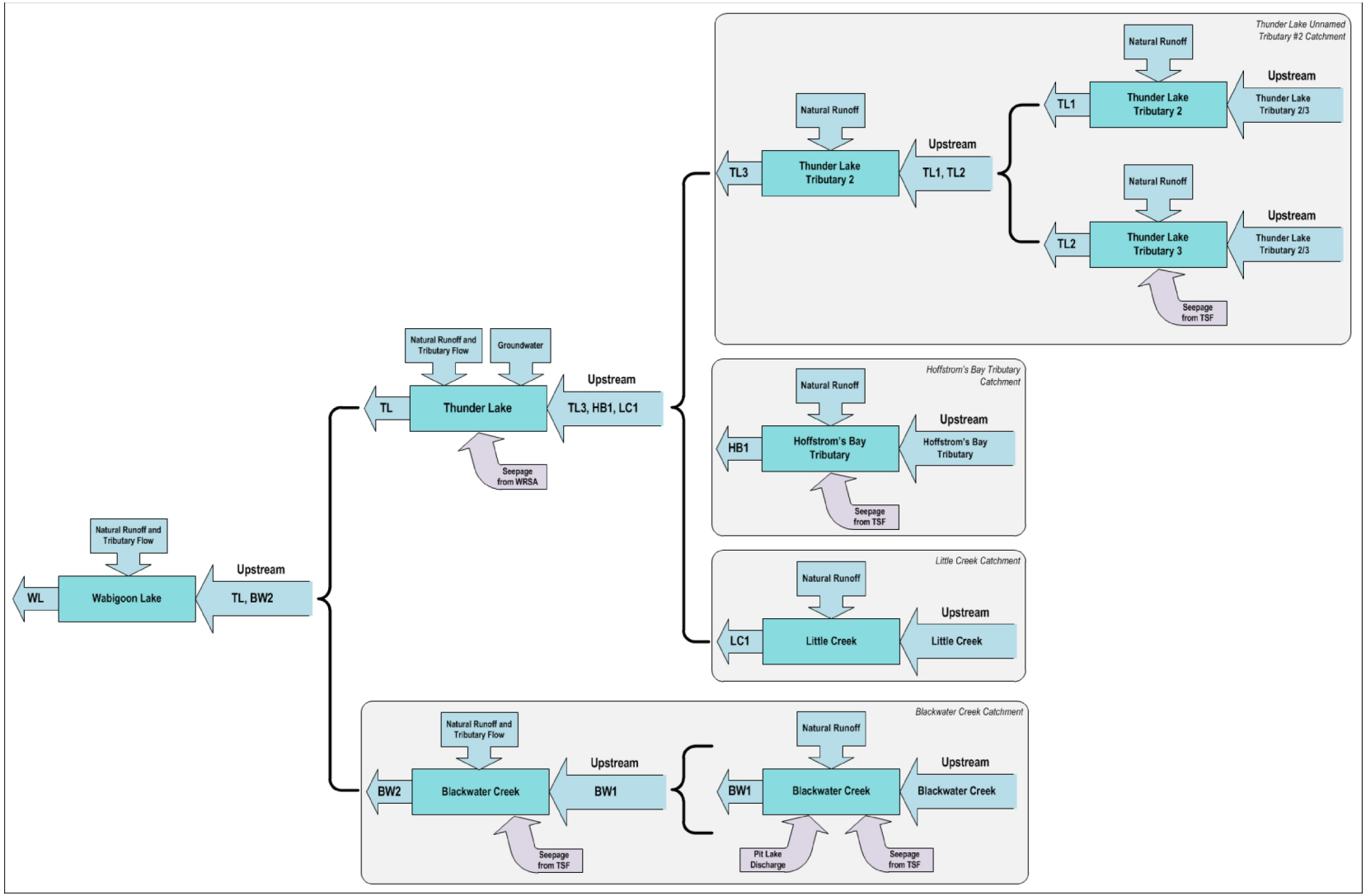


Figure 6.8.2.6-1: Surface Water Quality Model Post-Closure Phase

Little Creek Catchment

The water quality for node LC1 in Little Creek was determined in the same manner as TL1 and TL2 described above, however, input variables specific for node LC1 were used. Flow data from Table 6.8.2.2-1 of this report and 50th percentile background water quality data for Little Creek (station SW-2 shown on Figure 6.6.13.1-1) was assumed to represent natural runoff water quality, which is shown as an input parameter on Figure 6.8.2.6-1.

Blackwater Creek Catchment

Surface water quality was determined at nodes BW1 and BW2 for the post-closure phase. The method used to determine water quality during post-closure was based on a similar method described above for the same water catchment during operations, with the following key changes:

- Treated effluent (collection of site runoff from the Project site area) is no longer being discharged to Blackwater Creek (BW1) during the post-closure phase;
- Pit lake discharge occurs via a spillway and ditch into Blackwater Creek during post-closure (BW1);
- Seepage component from the TSF to Blackwater Creek (BW1); and
- Seepage component from the TSF to Blackwater Creek (BW2).

These key changes are summarized in Figure 6.8.2.6-1 for the Blackwater Creek Catchment. Pit lake discharge and TSF seepage volumes to the receiving environment are provided in Tables 6.8.2.6-1 and 6.8.2.6-2, respectively.

Thunder Lake

Surface water quality at TL in Thunder Lake was determined in a similar method described above for the same node during the operations phase. However, the following key change to the post-closure phase model was made: inclusion of a seepage component from the WRSA to Thunder Lake during the post-closure phase.

Wabigoon Lake

Surface water quality for node WL in Wabigoon Lake for post-closure was determined using the same method described above for the operations phase (as the input parameters are the same for both the operations and post-closure phases). However, flow data specific to post-closure (Table 6.8.2.2-1) instead of flow data corresponding to the operations phase was used. Figure 6.8.2.6-1 provides the input and output variables for the post-closure phase for the node WL.

6.8.3 Project Effects Avoidance Measures Used in Predictions

The following measures have been incorporated into the surface water quality modelling to help avoid or reduce surface water quality effects:

- A perimeter runoff and seepage collection ditch will be constructed around the operations area. This system will capture all of the runoff from the developed site area, which will be directed to the water management system for use at the site and in the process [Mit_008].

- All excess water not required in the process will be treated to concentrations that meet Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, prior to discharging to Blackwater Creek. In the case of mercury, effluent will be treated to meet the background concentrations in Blackwater Creek [Mit_053].

- Dewatering of the open pit and underground mine workings will provide dry working conditions and safe working environment. These dewatering activities will lower the groundwater table around the perimeter of the open pit and mine workings, creating what is referred to as a drawdown zone. Within this drawdown zone, groundwater will migrate towards the open pit. Therefore, seepage that escapes the seepage collection systems will be captured within the drawdown zone, and ultimately report to the open pit [Mit_052].

- During closure, the site will be graded such that runoff for the operations area will be directed to the open pit during closure and post-closure phases [Mit_056].

- The pit lake will be monitored as it is filling to determine whether batch treatment will be required to meet PWQO prior the release from the pit lake to a tributary of Blackwater Creek [Mit_024] The quality of the water discharged from the pit lake to Blackwater Creek during the post-closure phase will meet PWQO.

6.8.4 Predicted Effects

6.8.4.1 Site Preparation and Construction Phase

Discharges

As described in Section 6.8.1, there will be no discharges from the Project during the site preparation and construction phase.

Predicted Effects

There are no predicted effects during the site preparation and construction phase as there will be no discharges from the Project.

6.8.4.2 Operations Phase

Discharges

As described in Section 6.8.1, there will be a single point of discharge to surface water during the operations phase. All runoff from the site will be collected by perimeter ditches around the operations area and the collected water directed to the minewater management system. To the extent possible, the water collected will be used in the mine and processing plant. Any excess water collected during operations will be treated and discharged to Blackwater Creek at a single point location (Figure 6.8.2.4-1). Effluent will be treated to concentrations that meet Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, prior to discharge to Blackwater Creek. In the case of mercury, effluent will be treated to meet the background concentrations in Blackwater Creek prior to discharge to the environment. It is anticipated that there could be some level of treated effluent discharge throughout the year.

During operations, dewatering will occur in the open pit and underground mine workings in order to maintain a safe working environment. The dewatering activities will lower the groundwater table around the perimeter of the open pit and mine workings, creating what is referred to as a drawdown zone. Within this drawdown zone, groundwater will migrate towards the open pit. During operations, seepage from on-site structures, such as the TSF, WRSA will be captured largely by the perimeter seepage collection systems around each structure. The seepage that escapes the seepage collection systems will be captured within the drawdown zone caused by dewatering and will ultimately report to the open pit.

Predicted Effects

Estimated surface water quality during the operations phase was modelled, as described in Section 6.8.2.4. Modelled surface water quality for the nine modelling nodes shown on Figure 6.8.2.4-1 are provided in Tables 6.8.4.2-1 to 6.8.4.2-9. Although the model provides results for all modelling nodes and all parameters, the Project is only predicted to result in decreased surface water quality (i.e., higher concentrations) for certain parameters at the following modelling nodes:

- **Node BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location;
- **Node BW2**: Blackwater Creek, upstream of Wabigoon Lake; and
- **Node WL**: Wabigoon Lake.

The effects during the operations phase of the Project are predicted to result directly from the treated effluent that will be discharged into Blackwater Creek upstream of node BW1 (Figure 6.8.2.2-1).

Table 6.8.4.2-1: Receiving Water Quality Results for TL1

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
Arsenic	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Chloride	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Chromium	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cyanide	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.862	0.862	0.862	0.862	0.862	0.862	0.862	0.862	0.862	0.862	0.862	0.862
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.001	0.001	0.001
Nickel	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.002	0.002	0.002
Nitrate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Phosphorus	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.003	0.003	0.003

Table 6.8.4.2-2: Receiving Water Quality Results for TL2

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.077	0.077	0.077	0.077	0.077	0.077	0.092	0.081	0.080	0.076	0.077	0.077
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00061	0.00060	0.00060	0.00060	0.00060	0.00060
Arsenic	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.0010	0.0010	0.0010	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.051	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.0003	0.0001	0.0001	0.00002	0.00002	0.00002
Chloride	0.3	0.3	0.3	0.3	0.3	0.3	—	—	—	0.6	0.3	0.3
Chromium	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.0005	0.0005	0.0005
Copper	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.004	0.002	0.002	0.001	0.001	0.001
Cyanide	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.002	0.002	0.002
Iron	0.862	0.862	0.862	0.862	0.862	0.862	0.880	0.867	0.865	0.853	0.859	0.860
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.003	0.002	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00001	0.00001	0.00001
Molybdenum	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.001	0.001	0.001
Nickel	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0025	0.0021	0.0021	0.002	0.002	0.002
Nitrate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Phosphorus	0.011	0.011	0.011	0.011	0.011	0.011	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.15	0.04	0.03	0.003	0.003	0.003

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.4.2-3: Receiving Water Quality Results for TL3

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.077	0.077	0.077	0.077	0.077	0.077	0.083	0.079	0.078	0.077	0.077	0.077
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
Arsenic	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0010	0.0010	0.0010
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.0001	0.0001	0.0000	0.00002	0.00002	0.00002
Chloride	0.3	0.3	0.3	0.3	0.3	0.3	—	—	—	0.4	0.3	0.3
Chromium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0010	0.0010	0.0010
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.002	0.001	0.001	0.001	0.001	0.001
Cyanide	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.002	0.002	0.002
Iron	0.862	0.862	0.862	0.862	0.862	0.862	0.869	0.864	0.863	0.858	0.861	0.861
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00001	0.00001	0.00001
Molybdenum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.002	0.002	0.002	0.002	0.002	0.002
Nitrate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Phosphorus	0.011	0.011	0.011	0.011	0.011	0.011	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.063	0.020	0.013	0.003	0.003	0.003

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.4.2-4: Receiving Water Quality Results for HB1

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.078	0.078	0.078	0.078	0.078	0.078	0.491	0.196	0.147	0.077	0.078	0.078
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00078	0.00065	0.00063	0.00060	0.00060	0.00060
Arsenic	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.0023	0.0014	0.0012	0.0010	0.0010	0.0010
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.054	0.051	0.051	0.051	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.0083	0.0024	0.0014	0.00002	0.00002	0.00002
Chloride	0.4	0.4	0.4	0.4	0.4	0.4	—	—	—	0.8	0.5	0.5
Chromium	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.005	0.002	0.001	0.001	0.001	0.001
Copper	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.091	0.027	0.016	0.001	0.001	0.001
Cyanide	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.002	0.002	0.002
Iron	0.365	0.365	0.365	0.365	0.365	0.365	0.912	0.521	0.456	0.363	0.364	0.365
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.071	0.021	0.013	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00001	0.00001	0.00001
Molybdenum	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.001	0.001	0.001
Nickel	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.015	0.006	0.004	0.0021	0.0020	0.0020
Nitrate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Phosphorus	0.011	0.011	0.011	0.011	0.011	0.011	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.007	0.005	0.005	0.005	0.005	0.005
Vanadium	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0015	0.0011	0.0011	0.001	0.001	0.001
Zinc	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	4.09	1.17	0.68	0.003	0.003	0.003

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.4.2-5: Receiving Water Quality Results for LC1

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555	0.555
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
Arsenic	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002
Chloride	1	1	1	1	1	1	1	1	1	1	1	1
Chromium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0014	0.0014	0.0014
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.001	0.001	0.001
Copper	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Cyanide	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Iron	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010	1.010
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Nitrate	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.0	0.0	0.0
Phosphorus	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Zinc	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Table 6.8.4.2-6: Receiving Water Quality Results for BW1

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.251	0.251	0.251	0.221	0.214	0.212	0.413	0.273	0.240	0.178	0.198	0.198
Antimony	0.00060	0.00060	0.00060	0.0039	0.0047	0.0049	0.00091	0.00080	0.00079	0.00080	0.00075	0.00075
Arsenic	0.0010	0.0010	0.0010	0.018	0.022	0.023	0.0019	0.0014	0.0013	0.0012	0.0012	0.0011
Beryllium	0.001	0.001	0.001	0.003	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.076	0.081	0.083	0.053	0.051	0.051	0.054	0.052	0.052
Cadmium	0.00002	0.00002	0.00002	0.00005	0.0001	0.0001	0.0047	0.0015	0.0009	0.00005	0.00004	0.00004
Chloride	1	1	1	21	26	27	—	—	—	47	36	36
Chromium	0.0010	0.0010	0.0010	0.002	0.003	0.003	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.003	0.001	0.001	0.001	0.001	0.001
Copper	0.0012	0.0012	0.0012	0.0018	0.0020	0.0020	0.052	0.018	0.011	0.002	0.002	0.002
Cyanide	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Iron	1.450	1.450	1.450	1.253	1.209	1.195	1.321	1.214	1.162	0.981	1.105	1.103
Lead	0.001	0.001	0.001	0.002	0.002	0.002	0.041	0.014	0.009	0.002	0.002	0.002
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00002	0.00001	0.00001
Molybdenum	0.0010	0.0010	0.0010	0.0077	0.0092	0.0096	0.0010	0.0010	0.0010	0.001	0.001	0.001
Nickel	0.0020	0.0020	0.0020	0.0059	0.0068	0.0071	0.02	0.01	0.01	0.011	0.009	0.009
Nitrate	0.03	0.03	0.03	2	3	3	4.77	3.73	3.88	5.05	3.84	3.89
Phosphorus	0.027	0.027	0.027	0.027	0.027	0.027	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.018	0.022	0.023	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005
Vanadium	0.0012	0.0012	0.0012	0.0020	0.0022	0.0023	0.0014	0.0013	0.0012	0.001	0.001	0.001
Zinc	0.004	0.004	0.004	0.009	0.010	0.010	2.28	0.73	0.42	0.01	0.01	0.01

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.4.2-7: Receiving Water Quality Results for BW2

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.251	0.251	0.251	0.232	0.228	0.226	0.367	0.267	0.245	0.202	0.217	0.216
Antimony	0.00060	0.00060	0.00060	0.0027	0.0032	0.0033	0.00082	0.00073	0.00073	0.00073	0.00070	0.00070
Arsenic	0.0010	0.0010	0.0010	0.012	0.014	0.015	0.0017	0.0013	0.0012	0.0011	0.0011	0.0011
Beryllium	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.066	0.070	0.071	0.052	0.051	0.051	0.052	0.051	0.051
Cadmium	0.00002	0.00002	0.00002	0.00004	0.00004	0.00004	0.0033	0.0010	0.0006	0.00004	0.00003	0.00003
Chloride	1	1	1	14	17	18	—	—	—	32	24	24
Chromium	0.0010	0.0010	0.0010	0.002	0.002	0.002	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.002	0.001	0.001	0.001	0.001	0.001
Copper	0.0012	0.0012	0.0012	0.0016	0.0017	0.0017	0.037	0.013	0.008	0.002	0.002	0.002
Cyanide	0.0020	0.0020	0.0020	0.0023	0.0024	0.0024	0.0027	0.0026	0.0026	0.003	0.003	0.003
Iron	1.450	1.450	1.450	1.327	1.297	1.288	1.369	1.298	1.262	1.136	1.226	1.222
Lead	0.001	0.001	0.001	0.001	0.002	0.002	0.029	0.010	0.007	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00001	0.00001	0.00001
Molybdenum	0.0010	0.0010	0.0010	0.0052	0.0062	0.0065	0.0010	0.0010	0.0010	0.001	0.001	0.001
Nickel	0.0020	0.0020	0.0020	0.0045	0.0051	0.0052	0.013	0.008	0.007	0.008	0.006	0.007
Nitrate	0.03	0.03	0.03	1	2	2	3.27	2.46	2.56	3.39	2.50	2.57
Phosphorus	0.027	0.027	0.027	0.027	0.027	0.027	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.012	0.014	0.015	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.001	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.004	0.004	0.004	0.007	0.008	0.008	1.61	0.50	0.29	0.011	0.009	0.009

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.4.2-8: Receiving Water Quality Results for TL

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.025	0.026	0.027	0.025	0.026	0.027	0.028	0.029	0.030	0.028	0.029	0.029
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
Arsenic	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002
Chloride	4	4	4	4	4	4	—	—	—	—	—	—
Chromium	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.0005	0.0005	0.0005
Copper	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cyanide	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.152	0.150	0.148	0.151	0.149	0.147	0.161	0.159	0.157	0.160	0.158	0.156
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00001	0.00001	0.00001
Molybdenum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Nitrate	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Phosphorus	0.008	0.008	0.008	0.008	0.008	0.008	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.003	0.003	0.003	0.003	0.003	0.003	0.011	0.011	0.011	0.003	0.003	0.003

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.4.2-9: Receiving Water Quality Results for WL

Parameter (total metals)	Existing Concentrations (mg/L)			Operations Concentrations (mg/L)			Post-closure Concentrations TSF Dry Cover (mg/L)			Post-closure Concentrations TSF Wet Cover (mg/L)		
	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year	Dry Year	Avg. Year	Wet Year
Aluminum	0.671	0.669	0.666	0.671	0.668	0.666	0.671	0.669	0.666	0.671	0.668	0.665
Antimony	0.00060	0.00060	0.00060	0.00060	0.00062	0.00064	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060
Arsenic	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.0000	0.0000	0.0000	0.00002	0.00002	0.00002
Chloride	3.24	3.23	3.21	3.27	3.36	3.45	—	—	—	—	—	—
Chromium	0.0010	0.0010	0.0010	0.001	0.001	0.001	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cobalt	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Copper	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Cyanide	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Iron	0.452	0.457	0.463	0.452	0.456	0.461	0.452	0.457	0.462	0.452	0.456	0.461
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—	0.00001	0.00001	0.00001
Molybdenum	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nickel	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Nitrate	0.03	0.03	0.03	0.03	0.04	0.1	0.04	0.05	0.07	0.04	0.05	0.07
Phosphorus	0.023	0.023	0.023	0.023	0.023	0.023	—	—	—	—	—	—
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.003	0.003	0.003	0.003	0.003	0.003	0.007	0.007	0.007	0.003	0.003	0.003

Note: "—" indicates that surface water quality was not modelled due to insufficient source data

6.8.4.3 Closure Phase

Discharges

As described in Section 6.8.1, there will be no discharges from the Project during the closure phase.

Predicted Effects

There are no predicted effects during the active closure phase as there will be no discharges from the site to surface water.

6.8.4.4 Post-closure Phase

Discharges

As described in Section 6.8.1, there will be no mining activities during the post-closure phase. All site runoff will be directed to the open pit, and the open pit will continue to experience an influx of groundwater. Once the pit is fully flooded, excess water will be released through a spillway into a tributary of Blackwater Creek and groundwater levels will return to near pre-development conditions. At that point, a portion of the seepage from the TSF and WRSA will escape from the site, and will ultimately report to various nearby waterbodies during this phase. Estimates of surface water quality for the post-closure phase have been made for the following closure options for the TSF [Mit_023]:

- The dry cover option assumes that the process water in the TSF will be withdrawn at closure, treated and used to help fill the pit. The tailings will then be physically isolated using a granular cover. Finally, the tailings will be covered with a low-permeability dry cover to limit the potential for acidification.

- The wet cover option assumes that the process water in the TSF will be withdrawn at closure, treated and used to help fill the pit. The tailings will then be physically isolated using a granular cover. Finally, the tailings will be isolated from oxygen using a cover of non-process water to prevent acidification.

Predicted Effects

Estimated surface water quality during the post-closure phase was modelled, as described in Section 3.8.2.6. Modelled surface water quality for the nine modelling nodes shown on Figure 6.8.2.2-1 are provided in Tables 6.8.4.2-1 through 6.8.4.2-9, respectively. Although the model provides results for all modelling nodes and all parameters, the Project is only predicted to result in decreased surface water quality (i.e., higher concentrations) for certain parameters in at the following modelling nodes:

- **Node TL2**: Thunder Lake Tributary 3, downstream of the Tree Nursery Ponds;
- **Node TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **Node HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **Node BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location;
- **Node BW2**: Blackwater Creek, upstream of Wabigoon Lake;
- **Node TL**: Thunder Lake; and
- **Node WL**: Wabigoon Lake.

6.8.4.5 Predicted Adverse Effects

The predicted effects on surface water quality (Sections 6.8.4.1 through 6.8.4.4) varied by modelling node and indicator compound evaluated, as well as by varying the phase of the Project. Adverse effects on surface water quality were considered to occur in those cases where the predicted effects with the Project resulted in receiving water quality was degraded (i.e., had higher predicted concentrations) that the existing conditions. Depending on the phase of the Project, adverse effects were not predicted for all of the modelling nodes. The reasons for this vary include the following:

- The releases from the Project for a particular indicator could be lower than or equivalent to the existing conditions at a particular node. For example, Treasury Metals has committed that the effluent released during operations will meet the Provincial Water Quality Objectives (PWQO) prior to release into Blackwater Creek. Therefore, the effluent released from the Project will have lower concentrations for some indicators than the receiving waters.

- For a particular phase, there may be no releases from the Project to a particular watercourse. For example, the Project will not result in any releases to Hoffstrom's Bay Tributary during operations. There will be no surface runoff from the operations area as this will all be collected by the perimeter runoff and seepage collection system and used in the water management system. Additionally, there will be no seepage from the site during operations as any seepage from the TSF and WRSA that escapes the seepage collection system will be captured by the drawdown zone created by the dewatering of the open pit and underground mine. This seepage will report to the open pit and be used in the water management system.

Site Preparation and Construction Phase

There are no predicted adverse effects to surface water quality during the site preparation and construction phase as described in Section 6.8.4.1. All runoff from the site will be collected by a perimeter runoff and seepage collection system, and used to initiate the TSF and provide water for the start-up of processing.

Operations Phase

During operations, the Project will release treated effluent into Blackwater Creek. As a result, the modelling has identified adverse effects on surface water quality at three of the modelling nodes:

- **Node BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location;
- **Node BW2**: Blackwater Creek, upstream of Wabigoon Lake; and
- **Node WL**: Wabigoon Lake.

The predicted adverse effects on surface water quality are detailed in the following three locations (nodes) based on surface water quality modelling. The three locations are: BW1 and BW2 in Blackwater Creek and WL in Wabigoon Lake for some parameters as shown in Table 6.6.16.2-1. Results presented in Table 6.8.4.5-1 are based on an average year, dry year and wet year.

Table 6.8.4.5-1: Adverse Effect for Surface Water Quality during Operations

Parameter	BW1: Blackwater Creek (downstream of Project)			BW2: Blackwater Creek (discharge to Wabigoon Lake)			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Aluminum	—	—	—	—	—	—	—	—	—
Antimony	0.0047	0.0039	0.0049	0.0032	0.0027	0.0033	—	—	0.00064
Arsenic	0.022	0.018	0.023	0.014	0.012	0.015	0.0011	—	0.0012
Beryllium	0.0031	0.0027	0.0032	0.0023	0.0021	0.0024	—	—	—
Boron	0.081	0.076	0.083	0.070	0.066	0.071	—	—	—
Cadmium	0.00006	0.00005	0.00006	0.00004	0.00004	0.00004	—	—	—
Chloride	25.9	21.2	27.3	16.7	13.6	17.6	—	—	3.4
Chromium	0.0027	0.0024	0.0028	0.0020	0.0018	0.0021	—	—	—
Cobalt	0.0006	0.0006	0.0007	0.0006	0.0006	0.0006	—	—	—
Copper	0.0020	0.0018	0.0020	0.0017	0.0016	0.0017	—	—	—
Cyanide	0.0026	0.0025	0.0027	0.0024	0.0023	0.0024	—	—	—
Iron	—	—	—	—	—	—	—	—	—
Lead	0.0018	0.0017	0.0019	0.0015	0.0014	0.0016	—	—	—
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—
Molybdenum	0.0092	0.0077	0.0096	0.0062	0.0052	0.0065	—	—	0.0011
Nickel	0.0068	0.0059	0.0071	0.0051	0.0045	0.0052	—	—	—

Table 6.8.4.5-1: Adverse Effect for Surface Water Quality during Operations (continued)

Parameter	BW1: Blackwater Creek (downstream of Project)			BW2: Blackwater Creek (discharge to Wabigoon Lake)			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Nitrate(a)	2.8	2.2	2.9	1.8	1.4	1.9	0.044	0.033	0.056
Phosphorus	—	—	—	—	—	—	—	—	—
Selenium	0.022	0.018	0.023	0.014	0.012	0.015	0.0011	—	0.0012
Silver	—	—	—	—	—	—	—	—	—
Thallium	—	—	—	—	—	—	—	—	—
Uranium	—	—	—	—	—	—	—	—	—
Vanadium	0.0022	0.0020	0.0023	0.0018	0.0017	0.0019	—	—	—
Zinc	0.0097	0.0087	0.010	0.0078	0.0071	0.0080	—	—	—

Note: The "—" symbol indicates were no adverse effects predicted (i.e., predicted effects were less than or equal to existing conditions)

6.8.4.6 Closure Phase

There are no predicted adverse effects anticipated during the active closure phase as described in Section 6.8.1 as there will be no water discharges to the environment during this phase. Although dewatering activities will cease, the drawdown zone will continue to direct groundwater and seepage from the WRSA and TSF to the open pit until it is filled. The perimeter ditches will remain in place to collect surface runoff during this phase.

6.8.4.7 Post-closure Phase

Adverse effects on surface water quality during the post-closure phase will vary depending on the type of cover used for the TSF. For both a dry and wet cover on the TSF, adverse effects are predicted for the following modelling nodes:

- **Node TL2**: Thunder Lake Tributary 3, downstream of the Tree Nursery Ponds;
- **Node TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **Node HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **Node BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location;
- **Node BW2**: Blackwater Creek, upstream of Wabigoon Lake;
- **Node TL**: Thunder Lake; and
- **Node WL**: Wabigoon Lake.

The post-closure phase adverse effects for the dry cover on the TSF are presented in Table 6.8.4.5-1. The post-closure adverse effects for a wet cover over the TSF are presented in Table 6.8.4.5-2.

6.8.5 Identified Mitigation

The Project will employ best practices that will assist in a reduction and mitigate surface water quality effects, which are outlined below:

- Site Preparation and Construction Phase:
    - A perimeter runoff and seepage collection system will be constructed around the operations area. There will be no runoff from the operations area to the environment [Mit_008].
    - Industry standard erosion and sediment controls will be implemented during the site preparations and construction phase [Mit_054].
    - Once the perimeter ditch has been completed, there would be no discharges to surface water during this phase [Mit_045].
- Operations Phase:
    - All runoff from the operations area will be collected by the perimeter runoff and seepage collection system constructed at the start of the site preparation and construction phase [Mit_008].
    - Collected runoff will, to the extent possible, be used in the process [Mit_057].
    - Excess water will be treated to concentrations that meet Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, prior to discharge to Blackwater Creek. In the case of mercury, effluent will be treated to meet the background concentrations in Blackwater Creek [Mit_053].
    - A perimeter runoff and seepage collection systems will be constructed around the TSF [Mit_051].
    - Seepage that escapes the seepage collection systems will be captured by the drawdown zone created by the dewatering of the open pit and underground mine. This captured seepage will report to the open pit [Mit_052].
    - Effluent from the processing plant will be treated prior to being discharged to the TSF. Effluent directed to the TSF would meet MMER requirements [Mit_061].

Table 6.8.5.4-1: Adverse Effects for Surface Water Quality Effects during Post-closure (TSF dry cover)

Parameter	BW1: Blackwater Creek (Downstream of Project)			BW2: Blackwater Creek (Discharge to Wabigoon Lake)			HB1: Hoffstrom's Bay Tributary (at Thunder Lake)			TL2: Thunder Lake Tributary #3 (Downstream of Tree Nursery Ponds)			TL3: Thunder Lake Tributary #2 (at Thunder Lake)			Thunder Lake: Thunder Lake			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Aluminum	0.27	0.41	—	0.27	0.37	—	0.20	0.49	0.15	0.081	0.092	—	—	0.083	—	0.029	0.028	0.030	—	—	—
Antimony	0.00080	0.00091	0.00079	0.00073	0.00082	0.00073	0.00065	0.00078	0.00063	—	—	—	—	—	—	—	—	—	—	—	—
Arsenic	0.0014	0.0019	0.0013	0.0013	0.0017	0.0012	0.0014	0.0023	0.0012	—	—	—	—	—	—	—	—	—	—	—	—
Beryllium	—	0.0011	—	—	—	—	—	0.0011	—	—	—	—	—	—	—	—	—	—	—	—	—
Boron	—	0.053	—	—	—	—	—	0.054	—	—	—	—	—	—	—	—	—	—	—	—	—
Cadmium	0.0015	0.0047	0.0009	0.0010	0.0033	0.0006	0.0024	0.0083	0.0014	0.0001	0.0003	0.0001	0.0001	0.0001	0.00004	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
Chloride	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
Chromium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cobalt	0.0014	0.0029	0.0011	0.0011	0.0022	0.00092	0.0016	0.0045	0.0012	0.00054	0.00064	—	—	0.00056	—	0.00053	0.00053	0.00053	—	—	—
Copper	0.018	0.052	0.011	0.013	0.037	0.008	0.027	0.091	0.016	0.0019	0.0041	0.0015	0.0014	0.0023	0.0012	0.0013	0.0013	0.0013	—	—	0.0022
Cyanide	0.0028	0.0031	0.0029	0.0026	0.0027	0.0026	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Iron	—	—	—	—	—	—	0.52	0.91	0.46	—	—	—	—	—	—	0.16	0.16	0.16	—	—	—
Lead	0.014	0.041	0.009	0.010	0.029	0.007	0.021	0.071	0.013	0.0017	0.0034	0.0014	0.0013	0.0020	0.0012	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Mercury	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
Molybdenum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nickel	0.011	0.018	0.010	0.008	0.013	0.007	0.006	0.015	0.0041	0.0021	0.0025	—	—	0.0022	—	0.0022	0.0022	0.0022	—	—	—
Nitrate(a)	3.7	4.8	3.9	2.5	3.3	2.6	—	—	—	—	—	—	—	—	—	—	—	—	0.05	0.04	0.07
Phosphorus	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
Selenium	0.0011	0.0012	—	—	0.0011	—	0.0011	0.0013	0.0011	—	—	—	—	—	—	—	—	—	—	—	—
Silver	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thallium	—	0.00033	—	—	0.00032	—	0.00032	0.00036	—	—	—	—	—	—	—	—	—	—	—	—	—
Uranium	0.0053	0.0059	—	—	0.0056	—	0.0055	0.0066	0.0053	—	—	—	—	—	—	—	—	—	—	—	—
Vanadium	—	0.0014	—	—	0.0014	—	0.0011	0.0015	0.0011	—	—	—	—	—	—	—	—	—	—	—	—
Zinc	0.73	2.28	0.42	0.50	1.61	0.29	1.17	4.09	0.68	0.043	0.146	0.026	0.020	0.063	0.013	0.011	0.011	0.011	0.0075	0.0074	0.0075

Notes:
The "—" symbol indicates there were no adverse effects predicted (i.e., predicted effects were less than or equal to existing conditions)
The "†" indicates that surface water quality was not modelled due to insufficient source data

Table 6.8.5.4-2: Adverse Effects for Surface Water Quality Effects during Post-closure (TSF wet cover)

Parameter	BW1: Blackwater Creek (Downstream of Project)			BW2: Blackwater Creek (Discharge to Wabigoon Lake)			HB1: Hoffstrom's Bay Tributary (at Thunder Lake)			TL2: Thunder Lake Tributary #3 (Downstream of Tree Nursery Ponds)			TL3: Thunder Lake Tributary #2 (at Thunder Lake)			Thunder Lake: Thunder Lake			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Aluminum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.029	0.028	0.029	—	—	—
Antimony	0.00075	0.00080	0.00075	0.00070	0.00073	0.00070	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Arsenic	0.0012	0.0012	0.0011	0.0011	0.0011	0.0011	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Beryllium	—	0.0011	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Boron	—	0.054	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cadmium	0.00004	0.00005	0.00004	0.00003	0.00004	0.00003	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chloride(a)	36.01	47.43	36.43	23.65	32.07	24.24	0.51	0.84	0.46	0.35	0.58	0.31	0.30	0.39	0.28	—	—	—	—	—	—
Chromium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cobalt	0.0007	0.0007	0.0007	0.0006	0.0007	0.0006	—	—	—	—	—	—	—	—	—	0.00053	0.00053	0.00053	—	—	—
Copper	0.0020	0.0023	0.0020	0.0017	0.0019	0.0017	—	0.0011	—	—	0.0011	—	—	—	—	—	—	—	—	—	—
Cyanide	0.0029	0.0031	0.0029	0.0026	0.0028	0.0026	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Iron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.16	0.16	0.16	—	—	—
Lead	0.0016	0.0017	0.0016	0.0014	0.0015	0.0014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mercury	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	—	0.00001	—	—	—	—	—	—	—	—	—	—	—	—	—
Molybdenum	—	0.00106	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nickel	0.009	0.011	0.0089	0.006	0.008	0.007	—	—	—	—	—	—	—	—	—	0.0022	0.0022	0.0022	—	—	—
Nitrate(a)	3.8	5.1	3.9	2.5	3.4	2.6	—	—	—	—	—	—	—	—	—	—	—	—	0.051	0.039	0.068
Phosphorus	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
Selenium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Silver	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thallium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Uranium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vanadium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zinc	0.012	0.014	0.012	0.009	0.011	0.009	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Notes:
The "—" symbol indicates there were no adverse effects predicted (i.e., predicted effects were less than or equal to existing conditions)
The "†" indicates that surface water quality was not modelled due to insufficient source data

- Closure Phase:
  - The site will be graded to direct all runoff to the open pit [Mit_056].
  - The pit lake will be monitored as it is filling to determine whether batch treatment will be required to meet PWQO [Mit_024].
  - Although dewatering will stop at the end of operations, the drawdown zone will remain until the open pit fills with water and the groundwater returns to near pre-development levels. Seepage that escapes the seepage collection systems will be captured by the drawdown zone caused by the dewatering of the open pit and underground mine during operations. This captured seepage will report to the open pit [Mit_052].
  - There will be no discharges to surface water during this phase [Mit_055].
- Post-closure Phase:
  - A wet cover is the preferred closure option over the TSF. A wet cover prevents acidification of the tailings, which improves the quality of seepage in the long-term and results in improved surface water quality in the receiving environment [Mit_023].
  - The pit lake will be monitored as it is filling to determine whether treatment will be required to meet PWQO prior the discharge of water from the pit lake to a tributary of Blackwater Creek [Mit_024].

6.8.6 Residual Adverse Effects

Residual adverse effects during the operations and post-closure phases are predicted to remain after the application of the mitigation measures summarized in Section 6.8.5, which includes the use of a wet cover closures option for the TSF. The use of a wet cover for the closure of the TSF will help to reduce the Project effects on surface water quality during the post-closure phase but will not be eliminate the residual adverse effects entirely. The predicted residual adverse effects of the Project on surface water quality for the operations phase are presented in Table 6.8.6-1, while Table 6.8.6-2 presents the residual adverse effects on surface water quality during the post-closure phase..

Table 6.8.6-1: Residual Adverse Effects on Surface Water Quality during Operations

Indicator	BW1: Blackwater Creek (Downstream of Project)			BW2: Blackwater Creek (Discharge to Wabigoon Lake)			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Aluminum	—	—	—	—	—	—	—	—	—
Antimony	0.0047	0.0039	0.0049	0.0032	0.0027	0.0033	—	—	0.00064
Arsenic	0.022	0.018	0.023	0.014	0.012	0.015	0.0011	—	0.0012

Table 6.8.6-1: Residual Adverse Effects on Surface Water Quality during Operations (continued)

Indicator	BW1: Blackwater Creek (Downstream of Project)			BW2: Blackwater Creek (Discharge to Wabigoon Lake)			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Beryllium	0.0031	0.0027	0.0032	0.0023	0.0021	0.0024	—	—	—
Boron	0.081	0.076	0.083	0.070	0.066	0.071	—	—	—
Cadmium	0.00006	0.00005	0.00006	0.00004	0.00004	0.00004	—	—	—
Chloride	25.9	21.2	27.3	16.7	13.6	17.6	—	—	3.4
Chromium	0.0027	0.0024	0.0028	0.0020	0.0018	0.0021	—	—	—
Cobalt	0.0006	0.0006	0.0007	0.0006	0.0006	0.0006	—	—	—
Copper	0.0020	0.0018	0.0020	0.0017	0.0016	0.0017	—	—	—
Cyanide	0.0026	0.0025	0.0027	0.0024	0.0023	0.0024	—	—	—
Iron	—	—	—	—	—	—	—	—	—
Lead	0.0018	0.0017	0.0019	0.0015	0.0014	0.0016	—	—	—
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	—	—	—
Molybdenum	0.0092	0.0077	0.0096	0.0062	0.0052	0.0065	—	—	0.0011
Nickel	0.0068	0.0059	0.0071	0.0051	0.0045	0.0052	—	—	—
Nitrate	2.8	2.2	2.9	1.8	1.4	1.9	0.044	0.033	0.056
Phosphorus	—	—	—	—	—	—	—	—	—
Selenium	0.022	0.018	0.023	0.014	0.012	0.015	0.0011	—	0.0012
Silver	—	—	—	—	—	—	—	—	—
Thallium	—	—	—	—	—	—	—	—	—
Uranium	—	—	—	—	—	—	—	—	—
Vanadium	0.0022	0.0020	0.0023	0.0018	0.0017	0.0019	—	—	—
Zinc	0.0097	0.0087	0.010	0.0078	0.0071	0.0080	—	—	—

Note: The "—" symbol indicates there were no adverse effects predicted (i.e., predicted effects were less than or equal to existing conditions)

The predicted spatial extent of the residual adverse effects on the surface water quality VC will be limited to the watercourses that surface water quality modelling has determined may be altered as a result of the Project, AS identified in Tables 6.8.6-1 and 6.8.6-2. None of the predicted residual adverse effects in Tables 6.8.6-1 and 6.8.6-2 were predicted to exceed the PWQO, therefore there would be no watercourses beyond the operations areas where residual adverse effects could affect the ability to practice traditional used of the land.

6.8.7 Information to Address Round 1 Information Requests

As part of the Round 1 IRs, there were a number of questions that were wholly, or partially, asking for information, clarification and/or justification for the approach used in predicting the effects of the Project on surface water quality, or the predicted effects themselves. Responses to the IRs were provided separately, and incorporated into the relevant sections of the Revised EIS. The following lists the Round 1 IRs related to the surface water quality predictions:

- TMI_92-SW(1)-06: assess effects of seepage on surface water quality;

Table 6.8.6-2: Residual Adverse Effects on Surface Water Quality during Post-Closure

Indicator	BW1: Blackwater Creek (Downstream of Project)			BW2: Blackwater Creek (Discharge to Wabigoon Lake)			HB1: Hoffstrom's Bay Tributary (at Thunder Lake)			TL2: Thunder Lake Tributary #3 (Downstream of Tree Nursery Ponds)			TL3: Thunder Lake Tributary #2 (at Thunder Lake)			Thunder Lake: Thunder Lake			Wabigoon Lake: Wabigoon Lake		
	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year	Avg. Year	Dry Year	Wet Year
Aluminum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.029	0.028	0.029	—	—	—
Antimony	0.00075	0.00080	0.00075	0.00070	0.00073	0.00070	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Arsenic	0.0012	0.0012	0.0011	0.0011	0.0011	0.0011	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Beryllium	—	0.0011	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Boron	—	0.054	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cadmium	0.00004	0.00005	0.00004	0.00003	0.00004	0.00003	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chloride(a)	36.01	47.43	36.43	23.65	32.07	24.24	0.51	0.84	0.46	0.35	0.58	0.31	0.30	0.39	0.28	—	—	—	—	—	—
Chromium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cobalt	0.0007	0.0007	0.0007	0.0006	0.0007	0.0006	—	—	—	—	—	—	—	—	—	0.00053	0.00053	0.00053	—	—	—
Copper	0.0020	0.0023	0.0020	0.0017	0.0019	0.0017	—	0.0011	—	—	0.0011	—	—	—	—	—	—	—	—	—	—
Cyanide	0.0029	0.0031	0.0029	0.0026	0.0028	0.0026	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Iron	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.16	0.16	0.16	—	—	—
Lead	0.0016	0.0017	0.0016	0.0014	0.0015	0.0014	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mercury	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	—	0.00001	—	—	—	—	—	—	—	—	—	—	—	—	—
Molybdenum	—	0.00106	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nickel	0.009	0.011	0.0089	0.006	0.008	0.007	—	—	—	—	—	—	—	—	—	0.0022	0.0022	0.0022	—	—	—
Nitrate(a)	3.8	5.1	3.9	2.5	3.4	2.6	—	—	—	—	—	—	—	—	—	—	—	—	0.051	0.039	0.068
Phosphorus	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
Selenium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Silver	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thallium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Uranium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vanadium	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zinc	0.012	0.014	0.012	0.009	0.011	0.009	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Notes:
The numbers table incorporate the mitigation provided by using a wet cover for the closure of the TSF
The "—" symbol indicates that there was no adverse effect predicted (i.e., predicted effects were less than or equal to the existing conditions
The "†" symbol indicates that surface water quality was not modelled due to insufficient source data

- TMI_105-SW(1)-19: describe the effluent discharges through the Project life;
- TMI_349-AC(1)-23: identify potential impacts to water quality;
- TMI_514-AC(1)-188: measures to avoid or minimize effects;TMI_516-AC(1)-190: effects on surface water quality; and
- TMI_531-AC(1)-205: selection of water quality as a VC.

6.9 Surface Water Quantity

6.9.1 Potential Effects of the Project on the Environment

As described in Section 6.1.3.8 of this Revised EIS, the single valued component (VC) "surface water quantity" was used for evaluating the effects of the Project. The potential surface water quantity effects of the Project are described below by Project phase:

- **Site Preparation and Construction Phase**: There will be no discharges to surface water during this phase. The construction of a perimeter ditch around the operations area during this phase will effectively capture all site runoff and direct it to the on-site ponds. This water will help establish the TSF and provide a supply of water for use in the processing plant. There will be changes in catchment areas as a result of the Project to Blackwater Creek Tributaries 1 and 2 and watershed areas in Hoffstrom's Bay Tributary, Little Creek and Blackwater Creek during this phase and the effects on fish and fish habitat are provided in Section 6.14.

- **Operations Phase**: Prior to operations, a perimeter ditch and seepage collection system will be established to collect all of the runoff from the operations area. The footprint of the operations area will overlay small portions of the Hoffstrom's Bay and Little Creek sub-watersheds, diverting runoff towards the Blackwater Creek sub-watershed. The majority of the Project footprint will be located within the Blackwater Creek watershed. Blackwater Creek Tributaries 1 and 2 will be partially overprinted by the open pit and tailings storage facility (TSF), respectively.

  To the extent possible, water within the Project footprint will be managed to maximize the use of water available for use in the process and minimize the need to take fresh water from adjacent watercourses. The majority of the water used at the Project will be comprised of surface runoff within the operations area, and water from the dewatering of the open pit and underground mine. Effluent from the processing plant will be treated and discharged to the TSF where a portion of the water will be bound in within the tailings and will be unavailable for use. Excess water not required in the process will be treated and discharged into Blackwater Creek.

During operations, fresh water will be required periodically to support the processing plant requirements. This water will come from two dug ponds along Thunder Lake Tributary 3, referred to as the tree nursery ponds (bordering Tree Nursey Road), as well as a pond on Thunder Lake Tributary 2. Thunder Lake Tributary 3 flows into Thunder Lake Tributary 2 prior to feeding Thunder Lake.

During operations, dewatering of the open pit and underground mine will be required to provide a safe working environment. This will result in a decrease in the water table, referred to as a drawdown zone, where groundwater will flow towards the open pit. There is a potential for the drawdown of the water table to reduce any groundwater base flow currently entering the adjacent watercourses.

- **Closure Phase**: There will be no discharges to surface water during the closure phase. At closure, runoff from within the operations area will be directed to the open pit. There will be no water discharges from the Project site until the open pit fills with water. There will be changes in catchment areas as a result of the Project to Blackwater Creek Tributaries 1 and 2 and watershed areas in Hoffstrom's Bay Tributary, Little Creek and Blackwater Creek during this phase and the effects on fish and fish habitat are provided in Section 6.14.

- **Post-closure Phase**: All runoff from the operations area will continue to be directed to the open pit. Groundwater will continue to flow into the open pit, even after the open pit is filled with water. Once the open pit is fully flooded, during post-closure, the excess water flowing into the pit will be allowed to passively discharge to a tributary of Blackwater Creek.

The potential effects of the Project on surface water quantity have been described using a simple linkage diagram on Figure 6.9.1-1. The figure illustrates the surface water quantity VC (shown in blue on the figure) and how it can be potentially affected during each of the four phases of the Project life. The figure also indicates the other components of the environment (shown in red on the figure) where surface water quantity predictions are relied on as inputs for other VCs. For example, the surface water quantity predictions will be relied on in predicting potential effects on the surface water quality VC.

6.9.2 Effects Prediction Methods

A hydrologic modelling study was previously completed by Tetra-Tech WEI Inc., and included as Appendix O to the EIS. The previous hydrologic modelling study focused on the development and calibration of a hydrologic model that was based on limited surface water data collected to date. Based on the feedback and questions provided in the Round 1 Information Requests (IRs), reviewers had several concerns regarding the validity of the model based on limited surface water data and model calibration. Since the development of the previous hydrologic modelling study, several Project features have been refined as detailed in the Section 3.16.

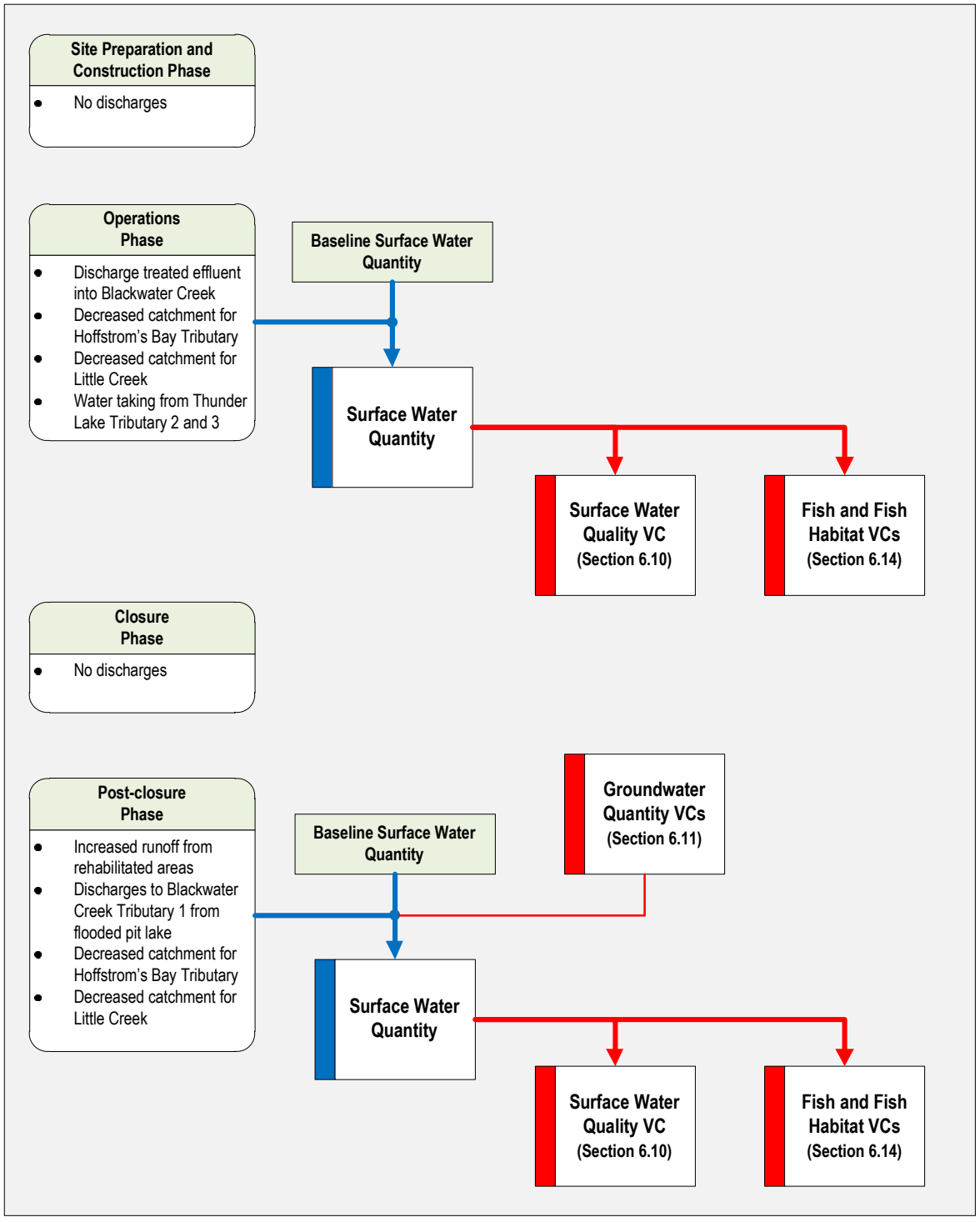


Figure 6.9.1-1: Surface Water Quantity Linkage Diagram

In light of the changes to the Project and water balance since the submission of the EIS, and considering the feedback as part of the Round 1 IRs, a surface water hydrologic model was developed and based on long-term flow statistics from a representative, regional Water Survey of Canada (WSC) station.

The updated surface water hydrologic model includes estimates of monthly flows in Thunder Lake Tributaries 2 and 3, Little Creek, Hoffstrom's Bay Tributary, and Blackwater Creek for establishing existing flow conditions. The hydrologic model also predicted flow rates for the operations and post-closure phases of the Project at the various waterbodies listed above; these flows were compared to existing conditions to quantify the changes in flows as a result of the Project during these two phases. The hydrologic model did not predict surface water flows for either the site preparation and construction phase nor the closure phase as there will be no discharges as described Section 6.9.1.

The hydrologic model also predicted annual average flow rates for existing conditions as well as for the operations and post-closure phases of the Project at Thunder Creek and Wabigoon River. The flow rate in Thunder Creek is assumed to be representative of water flowing into and out of Thunder Lake (assuming year over year change in lake level is negligible) and similarly, the flow rate in Wabigoon River is assumed to be representative of water flowing into and out of Wabigoon Lake (assuming year over year change in lake level is negligible). These flow rates were modelled on an annual basis as monthly data was not available.

6.9.2.1 Determining Flow Rates for Existing Conditions

The long term flow statistics for existing conditions have been developed based on regional runoff estimates. This approach estimates flow in the tributaries within the Project site area by directly prorating the data developed from a representative Water Survey of Canada (WSC) station.

Three WSC stations in relative close proximity to the site were considered. Wabigoon River at Dryden (05QD016) was considered since it is located on the same watershed as the Project Site, and would therefore have similar hydrologic characteristics (albeit at a much larger watershed size). North Current River (02AB015) was selected since it is a much smaller watershed compared the Wabigoon River at Dryden. Lake 240 Outlet near Kenora (05PD015) was the third station selected since it has a watershed area similar to those on the Project site (approximately 10 km^2), and is relatively close to the project site (only 83 km away).

The WSC Station Lake 240 Outlet near Kenora (05PD015) was considered to be the most applicable regional station to Project site sub-watershed conditions and was selected as the representative WSC Station for determining flow rates for existing conditions. Further details on the selection of this WSC Station are provided in Section 4 of the Water Report.

6.9.2.2 Determining Flow Rates for the Site Preparation and Construction Phase

As previously described in Section 6.9.1, no surface water quantity modelling was completed during the site preparation and construction phase as there will be no water discharges from the Project site to the receiving environment. A perimeter ditch will be constructed around the operations area of the Project site that will effectively capture all site runoff and direct it to onsite ponds where it will be held until it can be suitably released to the environment.

6.9.2.3 Determining Flow Rates for the Operations Phase Conditions

During the operations phase of the Project, the footprint of the mine site will overlap onto several of the existing sub-watersheds (Hoffstrom's Bay, Little Creek and Blackwater Creek) as shown in Figure 6.9.2.3-1. The mine site footprint shown in Figure 6.9.2.3-1 is based on the layout provided by WSP. Runoff from the un-affected portion of the sub-watersheds is calculated using the same methodology as that used for the existing conditions.

During operations, water takings from Thunder Lake Tributary 2 and 3 will be required for mine process water. Water taking rates have been estimated in the conceptual water balance provided in Table 6.9.2.3-1. The maximum flow taking at any given time has been limited to 5% of the available flow. No water taking is anticipated during a wet year, and only during some months in an average year.

During operations, all runoff from the operations area will be collected, managed, treated, and discharged to Blackwater Creek. Any seepage not captured by perimeter collection ditches will be captured within the drawdown zone generated by active mine dewatering, and will ultimately report to the open pit. Discharge to Blackwater Creek has been estimated in the conceptual water balance, which utilizes monthly runoff coefficients to generate average monthly flows. Anticipated discharge rates of treated effluent to Blackwater Creek are provided in Table 6.9.2.3-2. During average and wet years, effluent will be discharged to Blackwater Creek throughout the entire year, however during a dry year, no effluent is predicted to discharge between May and October. The effluent discharge to Blackwater Creek is combined with the runoff from the un-affected portion of the watershed to determine expected total monthly Blackwater Creek flows.

6.9.2.4 Determining Flow Rates for the Closure Phase

At closure, the tailings storage facility (TSF) and waste rock storage area (WRSA) will be capped with a low permeability cover to reduce infiltration. This will also have the effect of maximizing the runoff from these areas. All runoff and seepage from the TSF and WRSA, as well as from the rest of the operations area, will be directed towards the open pit. There will be no discharges from the Project during the closure phase and therefore hydrologic modelling was not undertaken for this phase.

Table 6.9.2.3-1: Fresh Water Takings from Thunder Lake Tributary 2 and 3 during Operations

Hydrologic Event	Monthly Water Takings (m³/day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Year	158	119	138	11	0	0	0	0	0	0	0	274
Dry Year	45	33	40	337	382	204	189	74	122	147	118	78
Wet Year	0	0	0	0	0	0	0	0	0	0	0	0

Table 6.9.2.3-2: Effluent Discharge Volumes during Operations

Hydrologic Event	Treated Effluent Discharge to Blackwater Creek (m³/day)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Year	715	799	1,276	3,556	924	1,558	1,335	1,277	2,637	2,124	1,963	749
Dry Year	206	258	662	2,548	0	0	0	0	0	0	918	71
Wet Year	740	850	1,474	4,549	2,945	4,925	3,915	3,213	4,451	3,362	2,720	785

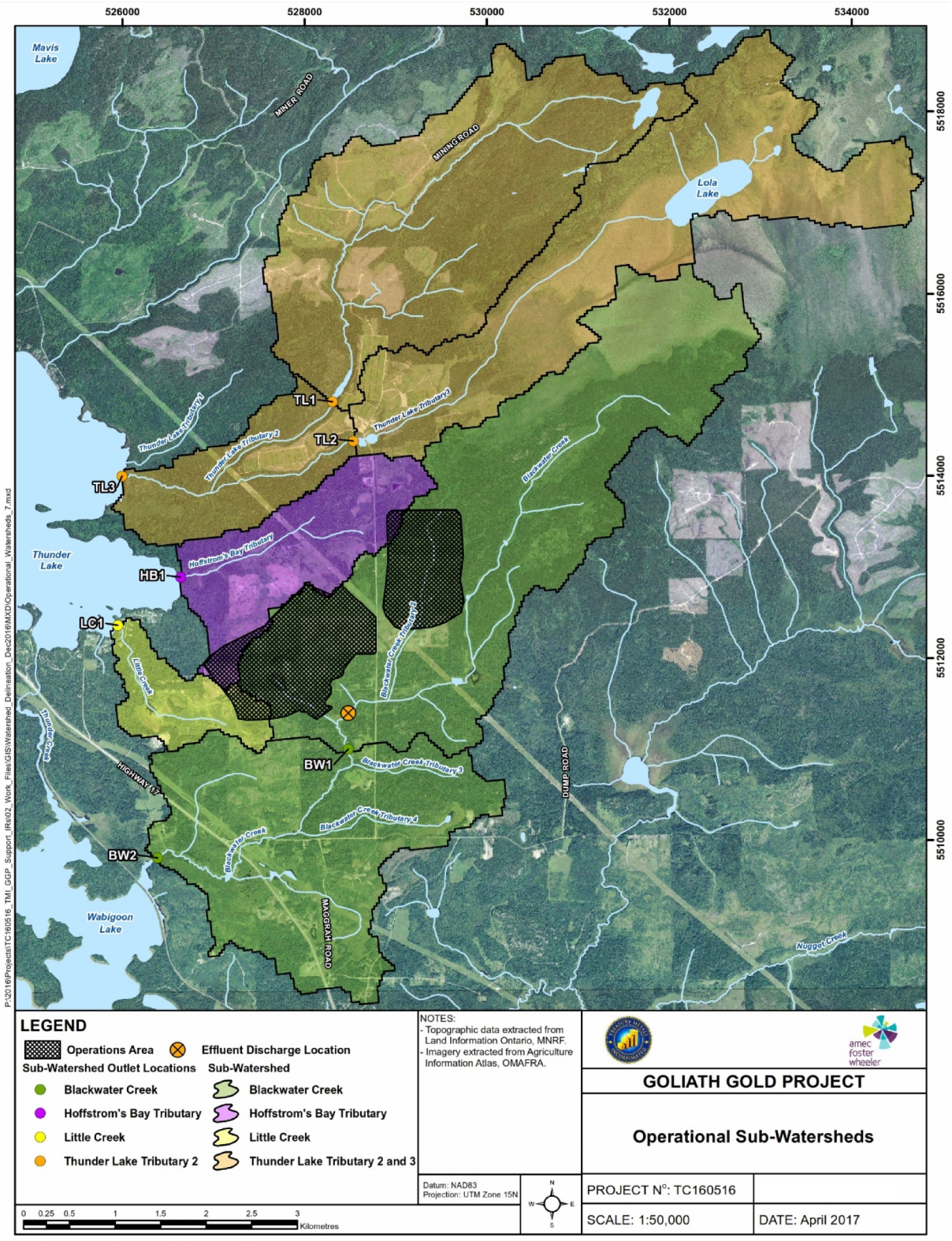


Figure 6.9.2.3-1: Overlay of Project on Local Watersheds

6.9.2.5 Determining Flow Rates for the Post-closure Phase

Once the open pit has been filled, about seven years after dewatering activities stop, excess water from the open pit will be passively released to a tributary of Blackwater Creek. Anticipated discharge rates of post-closure discharge to Blackwater Creek are provided in Table 6.9.2.5-1. All runoff from the former operations area will continue be directed towards the open pit, such that no runoff will be directed towards Little Creek and Hoffstrom's Bay. There will be no water taking from Thunder Lake Tributaries 2 or 3 during the post-closure phase. The post-closure watershed map and expected associated land uses are provided in Figure 6.9.2.5-1.

Table 6.9.2.5-1: Discharge Rates from Open Pit to Blackwater Creek during Post-closure

Month	Average Year	Dry Year	Wet Year
January	0.011	0.007	0.018
February	0.009	0.006	0.013
March	0.010	0.006	0.016
April	0.071	0.038	0.118
May	0.069	0.029	0.126
June	0.030	0.006	0.062
July	0.026	0.003	0.056
August	0.005	0.000	0.019
September	0.020	0.001	0.039
October	0.029	0.014	0.051
November	0.026	0.015	0.043
December	0.018	0.011	0.029
Annual	**0.027**	**0.011**	**0.049**

As a result of the change in land use within the mine site footprint, runoff from these areas will be calculated using an annual runoff coefficient, as opposed to the prorated runoff from WSC station (05PD015). The natural runoff coefficients have been calculated based on observed runoff data from the WSC station (05PD015). Other applicable post-closure runoff coefficients were estimated based on engineering judgement.

Monthly precipitation data and lake evaporation data were based on the existing data sources. Monthly precipitation data was redistributed to match the distribution of flows to the annual total at the WSC station (05PD015) flow gauge. This redistribution of precipitation produces potential runoff that accounts for the effects of the spring freshet.

Groundwater will inflow to the open pit as it is filling, and is estimated to continue once the pit has been fully flooded. This groundwater inflow has been conservatively estimated at 100 m^3/day and will combine with the runoff from the site being passively released to Blackwater Creek from the pit lake.

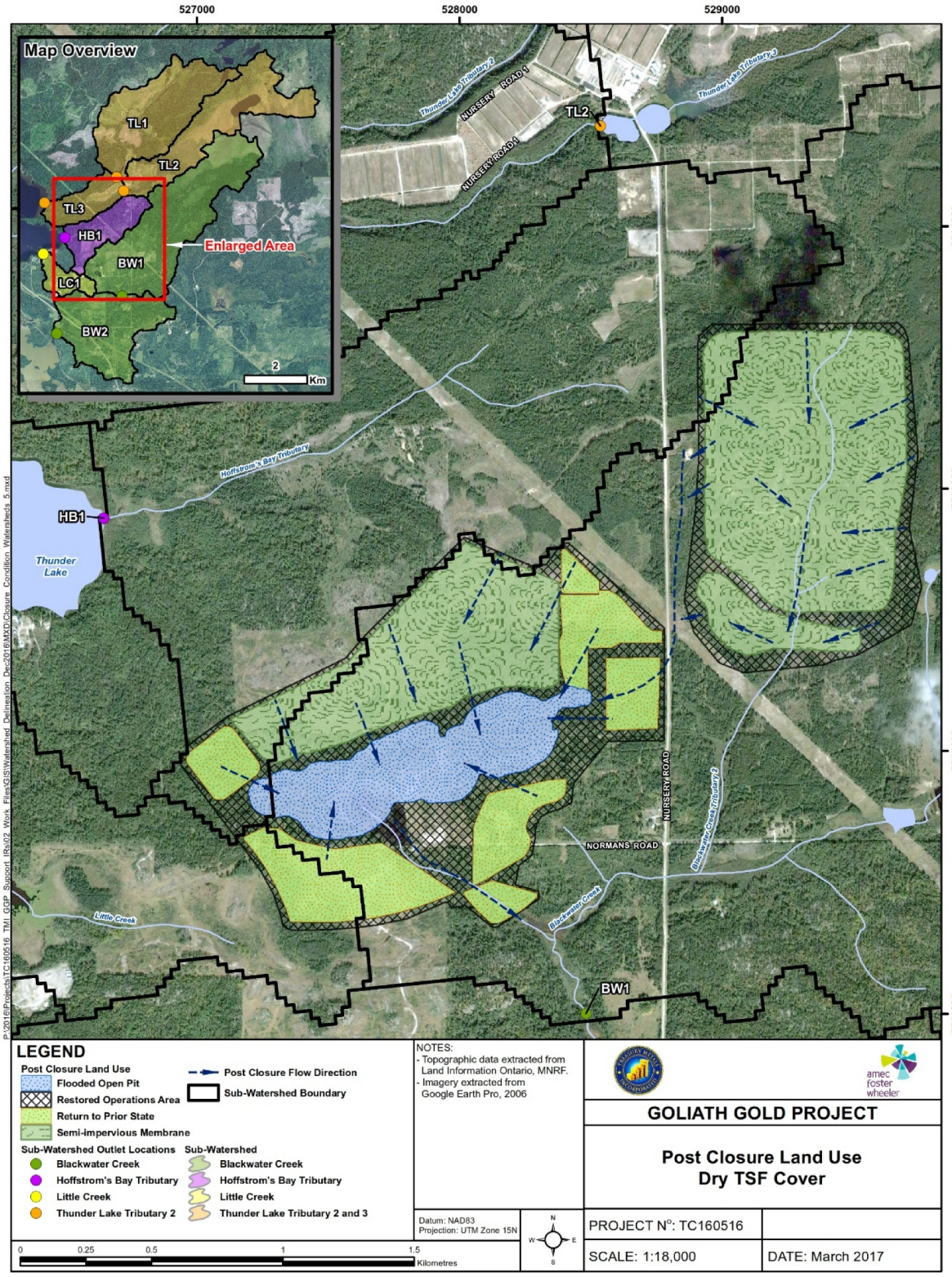


Figure 6.9.2.5-1: Post-closure Watersheds and Land Use

6.9.3 Project Effects Avoidance Measures Used in Predictions

The following measures have been incorporated into the surface water quantity model to help avoid or reduce surface water quantity effects during the various phases of the Project:

- **Site Preparation and Construction Phase**:
  - A perimeter ditch around the operations area will capture all runoff during the site preparation and construction phase [Mit_008].
  - Industry standard erosion and sediment controls will be implemented during the site preparations and construction phase [Mit_054].
  - Once the perimeter ditch has been completed, there would be no discharges to surface water during this phase [Mit_045].
- **Operations Phase**:
  - A perimeter ditch around the operations area will capture all runoff during the site preparation and construction phase [Mit_008].
  - The operations area will be minimized to the extent possible to reduce the amount of runoff directed from the Little Creek and Hoffstrom's Bay watersheds [Mit_050].
  - On-site storage facilities will allow for the effective management of water, reducing the need for discharges, especially during periods when conditions are not suitable. On-site storage facilities will allow for the effective management of water, reducing the amount for water taken from adjacent watercourses [Mit_057].
  - Excess water not required for processing will be treated and discharged to Blackwater Creek through an engineered structure designed to dissipate flows and avoid erosion [Mit_058].
  - Periodically, fresh water will be required to support Project operations. Fresh water withdrawals will be taken from two existing ponds on Thunder Lake Tributary 3 (referred to as the tree nursery ponds) and an existing pond on Thunder Lake Tributary 2. Fresh water takings from these ponds will not exceed 5% of the flow entering the ponds [Mit_059].
- **Closure Phase**:
  - A perimeter ditch around the operations area will capture all runoff during the closure phase [Mit_008].

- There will be no surface water discharges during this phase, thus, no mitigation measures are proposed [Mit_055].

- **Post-closure Phase**:

  - During closure, the site will be graded such that runoff for the operations area will be directed to the open pit during closure and post-closure phases [Mit_056].

  - Once the open pit has been filled, excess water from the open pit will be passively released through an engineered spillway into the existing channel of Blackwater Creek Tributary 1 [Mit_060].

6.9.4 Predicted Effects

6.9.4.1 Site Preparation and Construction Phase

As described in Section 6.8.1, there will be no discharges or withdrawals as a result of the Project during the site preparation and construction phase. Therefore, effects have not been predicted during this phase as they relate to surface water quantity but effects on fish and fish habitat have been predicted and are provided in Section 6.14.

6.9.4.2 Operations Phase

Changes in Flows

As described in Section 6.8.1, a perimeter ditch will be constructed around the operations area, which will collect all of the runoff from the enclosed area. The operations area will overprint small portions of the watersheds for Hoffstrom's Bay Tributary and Little Creek, reducing the size of those watersheds. These areas within the operations area will slightly increase the size of the watershed for Blackwater Creek, within which the majority of the Project resides (Figure 6.9.2.3-1). The runoff from within the operations area will be combined with the water from dewatering the open pit and underground mine and used in the processing of ore. Excess water will be treated and discharged, as effluent, to Blackwater Creek.

Table 6.9.2.3-2 provides a listing of the effluent volumes expected to be released from the site during operations. During operations, fresh water will be withdrawn from Thunder Lake Tributaries 2 and 3 on an as required basis to support Project processing requirements. The expected water taking volumes are provided in Table 6.9.2.3-1.

Estimated flows during the operations phase were modelled as described in Section 6.9.2.3. The results of the modelling and flows were predicted for the operations phase and compared to existing conditions. Results are provided in Tables 6.9.4.2-1 to 6.9.4.2-3 and indicate there is a change in surface flow between existing conditions and operations flows for all of the sub-watersheds that were modelled:

Table 6.9.4.2-1: Surface Water Hydrology Results for Operations, Average Year Conditions

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.019	0.014	0.017	0.145	0.164	0.087	0.081	0.032	0.052	0.063	0.050	0.034	0.063	—	—
	Operations	0.018	0.014	0.016	0.145	0.164	0.087	0.081	0.032	0.052	0.063	0.050	0.032	0.063	0.000	-0.6
TL2	Existing	0.018	0.013	0.016	0.133	0.151	0.081	0.075	0.029	0.048	0.058	0.047	0.031	0.058	—	—
	Operations	0.017	0.013	0.015	0.133	0.151	0.081	0.075	0.029	0.048	0.058	0.047	0.029	0.058	0.000	-0.6
TL3	Existing	0.043	0.032	0.037	0.319	0.362	0.193	0.179	0.070	0.116	0.139	0.111	0.074	0.140	—	—
	Operations	0.041	0.030	0.036	0.319	0.362	0.193	0.179	0.070	0.116	0.139	0.111	0.071	0.139	-0.001	-0.5
HB1	Existing	0.007	0.005	0.006	0.049	0.056	0.030	0.028	0.011	0.018	0.022	0.017	0.011	0.022	—	—
	Operations	0.006	0.005	0.005	0.046	0.052	0.027	0.025	0.010	0.016	0.020	0.016	0.011	0.020	-0.002	-7.8
LC1	Existing	0.003	0.002	0.003	0.022	0.025	0.013	0.012	0.005	0.008	0.010	0.008	0.005	0.010	—	—
	Operations	0.003	0.002	0.002	0.020	0.023	0.012	0.011	0.004	0.007	0.009	0.007	0.005	0.009	-0.001	-8.7
BW1	Existing	0.026	0.019	0.023	0.194	0.220	0.117	0.109	0.043	0.070	0.085	0.068	0.045	0.085	—	—
	Operations	0.029	0.025	0.033	0.195	0.185	0.111	0.102	0.049	0.086	0.092	0.076	0.044	0.086	0.001	0.8
BW2	Existing	0.041	0.031	0.036	0.308	0.349	0.186	0.172	0.068	0.111	0.134	0.107	0.071	0.135	—	—
	Operations	0.044	0.036	0.046	0.309	0.314	0.180	0.165	0.074	0.127	0.142	0.116	0.071	0.136	0.001	0.5

Table 6.9.4.2-2: Surface Water Hydrology Results for Operations, Dry Year Conditions

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.005	0.004	0.005	0.041	0.046	0.025	0.023	0.009	0.015	0.018	0.014	0.009	0.018	—	—
	Operations	0.005	0.004	0.005	0.039	0.044	0.023	0.022	0.008	0.014	0.017	0.013	0.009	0.017	-0.001	-5.0
TL2	Existing	0.005	0.004	0.004	0.037	0.042	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.016	—	—
	Operations	0.005	0.004	0.004	0.036	0.040	0.021	0.020	0.008	0.013	0.016	0.012	0.008	0.016	-0.001	-5.0
TL3	Existing	0.012	0.009	0.010	0.090	0.101	0.054	0.050	0.020	0.032	0.039	0.031	0.021	0.039	—	—
	Operations	0.011	0.009	0.010	0.086	0.097	0.052	0.048	0.019	0.031	0.037	0.030	0.020	0.038	-0.002	-4.4
HB1	Existing	0.002	0.001	0.002	0.014	0.016	0.008	0.008	0.003	0.005	0.006	0.005	0.003	0.006	—	—
	Operations	0.002	0.001	0.001	0.013	0.014	0.008	0.007	0.003	0.005	0.006	0.004	0.003	0.006	0.000	-7.8
LC1	Existing	0.001	0.001	0.001	0.006	0.007	0.004	0.003	0.001	0.002	0.003	0.002	0.001	0.003	—	—
	Operations	0.001	0.001	0.001	0.006	0.006	0.003	0.003	0.001	0.002	0.002	0.002	0.001	0.002	0.000	-8.7
BW1	Existing	0.007	0.005	0.006	0.054	0.062	0.033	0.030	0.012	0.020	0.024	0.019	0.013	0.024	—	—
	Operations	0.008	0.007	0.013	0.073	0.049	0.026	0.024	0.010	0.016	0.019	0.026	0.011	0.023	0.000	-2.0
BW2	Existing	0.012	0.009	0.010	0.086	0.098	0.052	0.048	0.019	0.031	0.038	0.030	0.020	0.038	—	—
	Operations	0.012	0.010	0.016	0.105	0.085	0.045	0.042	0.017	0.027	0.033	0.037	0.018	0.037	0.000	-1.3

Table 6.9.4.2-3: Surface Water Hydrology Results for Operations, Wet Year Conditions

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.033	0.025	0.029	0.249	0.282	0.150	0.139	0.055	0.090	0.109	0.087	0.058	0.109	—	—
	Operations	0.033	0.025	0.029	0.249	0.282	0.150	0.139	0.055	0.090	0.109	0.087	0.058	0.109	0.000	0.0
TL2	Existing	0.031	0.023	0.027	0.229	0.260	0.138	0.128	0.051	0.083	0.100	0.080	0.053	0.101	—	—
	Operations	0.031	0.023	0.027	0.229	0.260	0.138	0.128	0.051	0.083	0.100	0.080	0.053	0.101	0.000	0.0
TL3	Existing	0.073	0.054	0.064	0.549	0.622	0.331	0.307	0.121	0.199	0.240	0.191	0.127	0.241	—	—
	Operations	0.073	0.054	0.064	0.549	0.622	0.331	0.307	0.121	0.199	0.240	0.191	0.127	0.241	0.000	0.0
HB1	Existing	0.011	0.008	0.010	0.085	0.096	0.051	0.048	0.019	0.031	0.037	0.030	0.020	0.037	—	—
	Operations	0.010	0.008	0.009	0.078	0.089	0.047	0.044	0.017	0.028	0.034	0.027	0.018	0.034	-0.003	-7.8
LC1	Existing	0.005	0.004	0.004	0.038	0.043	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.017	—	—
	Operations	0.005	0.003	0.004	0.034	0.039	0.021	0.019	0.008	0.012	0.015	0.012	0.008	0.015	-0.001	-8.7
BW1	Existing	0.045	0.033	0.039	0.334	0.378	0.201	0.187	0.073	0.121	0.146	0.116	0.078	0.146	—	—
	Operations	0.044	0.036	0.048	0.317	0.334	0.217	0.194	0.096	0.147	0.155	0.124	0.071	0.149	0.003	+1.8
BW2	Existing	0.071	0.053	0.062	0.529	0.599	0.319	0.296	0.117	0.191	0.231	0.185	0.123	0.232	—	—
	Operations	0.070	0.056	0.071	0.513	0.556	0.335	0.303	0.139	0.218	0.240	0.192	0.116	0.235	0.003	+1.1

- **TL1**: Thunder Lake Tributary 2 downstream of reservoir;
- **TL2**: Thunder Lake Tributary 3 downstream of Three Nursery Ponds;
- **TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location; and
- **BW2**: Blackwater Creek, upstream of Wabigoon Lake.

Changes in Lake Levels

The same hydrologic model used for determining changes in stream flows was also used for determining the changes in inflow to both Thunder Lake and Wabigoon Lake. The resulting changes are provided in Table 6.9.4.2-4. The results indicated there would be a negligible change in inflows to both Thunder Lake and Wabigoon Lake as a result of the Project. Therefore, there would be a negligible change in water levels in both lakes. Furthermore, both Thunder Lake and Wabigoon Lake have control structures that are used to help control the water levels in the lakes.

Table 6.9.4.2-4: Changes in Surface Water Inflows to Lakes

Lake	Total Inflow (m^3/s)		
	Existing Conditions	Operations Phase	Change in Annual Inflow (%)
Thunder Lake	0.492	0.489	-0.6%
Wabigoon Lake	16.849	16.847	+0.01%

6.9.4.3 Closure Phase

As described in Section 6.8.1, there will be no discharges, withdrawals as a result of the Project during the closure phase. Therefore, effects have not been predicted during this phase as they relate to surface water quantity but effects on fish and fish habitat have been predicted for the closure phase and are provided in Section 6.14.

6.9.4.4 Post-closure Phase

Changes in Flows

Following the closure of the Project, all runoff from the former operations area will continue be directed towards the open pit. This will include those portions of the catchments of Little Creek and Hoffstrom's Bay that is captures within the perimeters ditches. There will be no water taking from Thunder Lake Tributaries 2 or 3 during the post-closure phase. Once the open pit is fully flooded, excess water will be released through a spillway into a tributary of Blackwater Creek.

The hydrologic modelling for the post-closure phase has been completed for two alternative closure scenarios for the TSF, namely the dry closure options and the wet closure option. Because of the differing land uses and runoff coefficients with each option, the predictions of surface water quantities will be different for each of the options.

Table 6.9.2.5-1 provides a listing of water expected to be released from the open once pit is fully flooded. Estimated flows during the post-closure phase were modelled according to the methods described in Section 6.9.2.5. The results of the modelling for the dry cover option are provided in Tables 6.9.4.4-1 to 6.9.4.4-3. The modelling indicates that there will be a change in surface flow between existing conditions and post-closure flows for the following sub-watersheds:

- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location; and
- **BW2**: Blackwater Creek, upstream of Wabigoon Lake.

The hydrologic model also predicted flow rates for the same sub-watersheds with a wet cover option over the TSF. Results for post-closure with a wet cover option are provided in Tables 6.9.4.4-4 to 6.9.4.4-6 and indicate a change in flow compared to existing conditions for the same sub-watersheds:

- **TL2**: Thunder Lake Tributary 3, downstream of the Tree Nursery Ponds;
- **TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;

Table 6.9.4.4-1: Surface Water Hydrology Results for Post-Closure, Average Year Conditions (dry cover TSF)

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.019	0.014	0.017	0.145	0.164	0.087	0.081	0.032	0.052	0.063	0.050	0.034	0.063	—	—
	Post-closure	0.019	0.014	0.017	0.145	0.164	0.087	0.081	0.032	0.052	0.063	0.050	0.034	0.063	0.000	0.0
TL2	Existing	0.018	0.013	0.016	0.133	0.151	0.081	0.075	0.029	0.048	0.058	0.047	0.031	0.058	—	—
	Post-closure	0.018	0.013	0.016	0.133	0.151	0.081	0.075	0.029	0.048	0.058	0.047	0.031	0.058	0.000	0.0
TL3	Existing	0.043	0.032	0.037	0.319	0.362	0.193	0.179	0.070	0.116	0.139	0.111	0.074	0.140	—	—
	Post-closure	0.043	0.032	0.037	0.319	0.362	0.193	0.179	0.070	0.116	0.139	0.111	0.074	0.140	0.000	0.0
HB1	Existing	0.007	0.005	0.006	0.049	0.056	0.030	0.028	0.011	0.018	0.022	0.017	0.011	0.022	—	—
	Post-closure	0.006	0.005	0.005	0.046	0.052	0.028	0.026	0.010	0.017	0.020	0.016	0.011	0.020	-0.001	-6.7
LC1	Existing	0.003	0.002	0.003	0.022	0.025	0.013	0.012	0.005	0.008	0.010	0.008	0.005	0.010	—	—
	Post-closure	0.003	0.002	0.002	0.020	0.023	0.012	0.011	0.004	0.007	0.009	0.007	0.005	0.009	-0.001	-7.5
BW1	Existing	0.026	0.019	0.023	0.194	0.220	0.117	0.109	0.043	0.070	0.085	0.068	0.045	0.085	—	—
	Post-closure	0.032	0.024	0.028	0.225	0.244	0.123	0.112	0.039	0.076	0.096	0.080	0.054	0.095	0.009	+11.1
BW2	Existing	0.041	0.031	0.036	0.308	0.349	0.186	0.172	0.068	0.111	0.134	0.107	0.071	0.135	—	—
	Post-closure	0.047	0.035	0.041	0.338	0.372	0.191	0.175	0.064	0.117	0.146	0.120	0.080	0.144	0.009	+7.0

Table 6.9.4.4-2: Surface Water Hydrology Results for Post-Closure, Dry Year Conditions (dry cover TSF)

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.005	0.004	0.005	0.041	0.046	0.025	0.023	0.009	0.015	0.018	0.014	0.009	0.018	—	—
	Post-closure	0.005	0.004	0.005	0.041	0.046	0.025	0.023	0.009	0.015	0.018	0.014	0.009	0.018	0.000	0.0
TL2	Existing	0.005	0.004	0.004	0.037	0.042	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.016	—	—
	Post-closure	0.005	0.004	0.004	0.037	0.042	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.016	0.000	0.0
TL3	Existing	0.012	0.009	0.010	0.090	0.101	0.054	0.050	0.020	0.032	0.039	0.031	0.021	0.039	—	—
	Post-closure	0.012	0.009	0.010	0.090	0.101	0.054	0.050	0.020	0.032	0.039	0.031	0.021	0.039	0.000	0.0
HB1	Existing	0.002	0.001	0.002	0.014	0.016	0.008	0.008	0.003	0.005	0.006	0.005	0.003	0.006	—	—
	Post-closure	0.002	0.001	0.002	0.013	0.015	0.008	0.007	0.003	0.005	0.006	0.005	0.003	0.006	0.000	-5.3
LC1	Existing	0.001	0.001	0.001	0.006	0.007	0.004	0.003	0.001	0.002	0.003	0.002	0.001	0.003	—	—
	Post-closure	0.001	0.001	0.001	0.006	0.006	0.003	0.003	0.001	0.002	0.002	0.002	0.001	0.002	0.000	-7.5
BW1	Existing	0.007	0.005	0.006	0.054	0.062	0.033	0.030	0.012	0.020	0.024	0.019	0.013	0.024	—	—
	Post-closure	0.013	0.010	0.011	0.081	0.078	0.032	0.027	0.010	0.016	0.032	0.030	0.021	0.030	0.006	+26.1
BW2	Existing	0.012	0.009	0.010	0.086	0.098	0.052	0.048	0.019	0.031	0.038	0.030	0.020	0.038	—	—
	Post-closure	0.017	0.013	0.015	0.113	0.114	0.051	0.045	0.017	0.028	0.046	0.041	0.028	0.044	0.006	+16.5

Table 6.9.4.4-3: Surface Water Hydrology Results for Post-Closure, Wet Year Conditions (dry cover TSF)

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.033	0.025	0.029	0.249	0.282	0.150	0.139	0.055	0.090	0.109	0.087	0.058	0.109	—	—
	Post-closure	0.033	0.025	0.029	0.249	0.282	0.150	0.139	0.055	0.090	0.109	0.087	0.058	0.109	0.000	0.0
TL2	Existing	0.031	0.023	0.027	0.229	0.260	0.138	0.128	0.051	0.083	0.100	0.080	0.053	0.101	—	—
	Post-closure	0.031	0.023	0.027	0.229	0.260	0.138	0.128	0.051	0.083	0.100	0.080	0.053	0.101	0.000	0.0
TL3	Existing	0.073	0.054	0.064	0.549	0.622	0.331	0.307	0.121	0.199	0.240	0.191	0.127	0.241	—	—
	Post-closure	0.073	0.054	0.064	0.549	0.622	0.331	0.307	0.121	0.199	0.240	0.191	0.127	0.241	0.000	0.0
HB1	Existing	0.011	0.008	0.010	0.085	0.096	0.051	0.048	0.019	0.031	0.037	0.030	0.020	0.037	—	—
	Post-closure	0.011	0.008	0.009	0.079	0.089	0.048	0.044	0.017	0.029	0.035	0.028	0.018	0.035	-0.003	-6.9
LC1	Existing	0.005	0.004	0.004	0.038	0.043	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.017	—	—
	Post-closure	0.005	0.003	0.004	0.035	0.040	0.021	0.020	0.008	0.013	0.015	0.012	0.008	0.015	-0.001	-7.5
BW1	Existing	0.045	0.033	0.039	0.334	0.378	0.201	0.187	0.073	0.121	0.146	0.116	0.078	0.146	—	—
	Post-closure	0.053	0.040	0.047	0.383	0.426	0.222	0.204	0.077	0.135	0.166	0.135	0.091	0.165	0.019	+12.9
BW2	Existing	0.071	0.053	0.062	0.529	0.599	0.319	0.296	0.117	0.191	0.231	0.185	0.123	0.232	—	—
	Post-closure	0.079	0.059	0.069	0.578	0.647	0.340	0.314	0.120	0.206	0.251	0.203	0.136	0.251	0.019	+8.2

Table 6.9.4.4-4: Surface Water Hydrology Results for Post-Closure, Average Year Conditions (wet cover TSF)

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)													ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ
TL1	Existing	0.019	0.014	0.017	0.145	0.164	0.087	0.081	0.032	0.052	0.063	0.050	0.034	0.063	—	—
	Post-closure	0.019	0.014	0.017	0.145	0.164	0.087	0.081	0.032	0.052	0.063	0.050	0.034	0.063	0.000	0.0
TL2	Existing	0.018	0.013	0.016	0.133	0.151	0.081	0.075	0.029	0.048	0.058	0.047	0.031	0.058	—	—
	Post-closure	0.018	0.013	0.016	0.133	0.151	0.081	0.075	0.029	0.048	0.058	0.047	0.031	0.059	0.000	+0.2
TL3	Existing	0.043	0.032	0.037	0.319	0.362	0.193	0.179	0.070	0.116	0.139	0.111	0.074	0.140	—	—
	Post-closure	0.043	0.032	0.038	0.319	0.362	0.193	0.179	0.070	0.116	0.140	0.111	0.074	0.140	0.000	+0.1
HB1	Existing	0.007	0.005	0.006	0.049	0.056	0.030	0.028	0.011	0.018	0.022	0.017	0.011	0.022	—	—
	Post-closure	0.006	0.005	0.005	0.046	0.052	0.028	0.026	0.010	0.017	0.020	0.016	0.011	0.020	-0.001	-6.7
LC1	Existing	0.003	0.002	0.003	0.022	0.025	0.013	0.012	0.005	0.008	0.010	0.008	0.005	0.010	—	—
	Post-closure	0.003	0.002	0.002	0.020	0.023	0.012	0.011	0.004	0.007	0.009	0.007	0.005	0.009	-0.001	-7.5
BW1	Existing	0.026	0.019	0.023	0.194	0.220	0.117	0.109	0.043	0.070	0.085	0.068	0.045	0.085	—	—
	Post-closure	0.031	0.024	0.028	0.230	0.239	0.115	0.105	0.037	0.072	0.091	0.076	0.052	0.092	0.007	+8.0
BW2	Existing	0.041	0.031	0.036	0.308	0.349	0.186	0.172	0.068	0.111	0.134	0.107	0.071	0.135	—	—
	Post-closure	0.046	0.035	0.041	0.343	0.368	0.184	0.169	0.062	0.113	0.141	0.116	0.078	0.142	0.007	+5.0

Table 6.9.4.4-5: Surface Water Hydrology Results for Post-Closure, Dry Year Conditions (wet cover TSF)

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)													ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ
TL1	Existing	0.005	0.004	0.005	0.041	0.046	0.025	0.023	0.009	0.015	0.018	0.014	0.009	0.018	—	—
	Post-closure	0.005	0.004	0.005	0.041	0.046	0.025	0.023	0.009	0.015	0.018	0.014	0.009	0.018	0.000	0.0
TL2	Existing	0.005	0.004	0.004	0.037	0.042	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.016	—	—
	Post-closure	0.005	0.004	0.005	0.038	0.043	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.017	0.000	+0.7
TL3	Existing	0.012	0.009	0.010	0.090	0.101	0.054	0.050	0.020	0.032	0.039	0.031	0.021	0.039	—	—
	Post-closure	0.012	0.009	0.011	0.090	0.102	0.054	0.050	0.020	0.033	0.039	0.031	0.021	0.039	0.000	+0.3
HB1	Existing	0.002	0.001	0.002	0.014	0.016	0.008	0.008	0.003	0.005	0.006	0.005	0.003	0.006	—	—
	Post-closure	0.002	0.001	0.002	0.013	0.015	0.008	0.007	0.003	0.005	0.006	0.005	0.003	0.006	0.000	-5.3
LC1	Existing	0.001	0.001	0.001	0.006	0.007	0.004	0.003	0.001	0.002	0.003	0.002	0.001	0.003	—	—
	Post-closure	0.001	0.001	0.001	0.006	0.006	0.003	0.003	0.001	0.002	0.002	0.002	0.001	0.002	0.000	-7.5
BW1	Existing	0.007	0.005	0.006	0.054	0.062	0.033	0.030	0.012	0.020	0.024	0.019	0.013	0.024	—	—
	Post-closure	0.013	0.011	0.012	0.075	0.071	0.029	0.025	0.010	0.016	0.030	0.029	0.020	0.028	0.005	+19.0
BW2	Existing	0.012	0.009	0.010	0.086	0.098	0.052	0.048	0.019	0.031	0.038	0.030	0.020	0.038	—	—
	Post-closure	0.017	0.014	0.016	0.107	0.107	0.049	0.042	0.017	0.027	0.044	0.040	0.028	0.042	0.005	+12.0

Table 6.9.4.4-6: Surface Water Hydrology Results for Post-Closure, Wet Year Conditions (wet cover TSF)

Sub-watershed ID	Scenario	Calculated Flows (m^3/s)														ΔQ (%)
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	ΔQ	
TL1	Existing	0.033	0.025	0.029	0.249	0.282	0.150	0.139	0.055	0.090	0.109	0.087	0.058	0.109	—	—
	Post-closure	0.033	0.025	0.029	0.249	0.282	0.150	0.139	0.055	0.090	0.109	0.087	0.058	0.109	0.000	0.0
TL2	Existing	0.031	0.023	0.027	0.229	0.260	0.138	0.128	0.051	0.083	0.100	0.080	0.053	0.101	—	—
	Post-closure	0.031	0.023	0.027	0.229	0.260	0.139	0.129	0.051	0.083	0.100	0.080	0.053	0.101	0.000	+0.1
TL3	Existing	0.073	0.054	0.064	0.549	0.622	0.331	0.307	0.121	0.199	0.240	0.191	0.127	0.241	—	—
	Post-closure	0.074	0.055	0.064	0.549	0.622	0.332	0.307	0.121	0.199	0.240	0.192	0.128	0.241	0.000	0.0
HB1	Existing	0.011	0.008	0.010	0.085	0.096	0.051	0.048	0.019	0.031	0.037	0.030	0.020	0.037	—	—
	Post-closure	0.011	0.008	0.009	0.079	0.089	0.048	0.044	0.017	0.029	0.035	0.028	0.018	0.035	-0.003	-6.9
LC1	Existing	0.005	0.004	0.004	0.038	0.043	0.023	0.021	0.008	0.014	0.016	0.013	0.009	0.017	—	—
	Post-closure	0.005	0.003	0.004	0.035	0.040	0.021	0.020	0.008	0.013	0.015	0.012	0.008	0.015	-0.001	-7.5
BW1	Existing	0.045	0.033	0.039	0.334	0.378	0.201	0.187	0.073	0.121	0.146	0.116	0.078	0.146	—	—
	Post-closure	0.056	0.042	0.050	0.395	0.425	0.211	0.191	0.072	0.127	0.164	0.141	0.095	0.164	0.018	+12.4
BW2	Existing	0.071	0.053	0.062	0.529	0.599	0.319	0.296	0.117	0.191	0.231	0.185	0.123	0.232	—	—
	Post-closure	0.082	0.062	0.072	0.591	0.646	0.329	0.301	0.116	0.198	0.249	0.209	0.140	0.250	0.018	+7.8

- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project effluent discharge location; and
- **BW2**: Blackwater Creek, upstream of Wabigoon Lake.

Changes in Lake Levels

The same hydrologic model used for determining changes in stream flows was also used for determining the changes in inflow to both Thunder Lake and Wabigoon Lake. The resulting changes are provided in Table 6.9.4.4-7. The results indicated there would be a negligible change in inflows to both Thunder Lake and Wabigoon Lake as a result of the Project. Therefore, there would be a negligible change in water levels in both lakes. Furthermore, both Thunder Lake and Wabigoon Lake have control structures that are used to help control the water levels in the lakes.

Table 6.9.4.4-7: Changes in Surface Water Inflows to Lakes

Lake	Total Inflow (m^3/s)		
	Existing Conditions	Operations Phase	Change in Annual Inflow (%)
Thunder Lake	0.492	0.490	-0.4
Wabigoon Lake	16.849	16.857	+0.005

6.9.4.5 Description of Predicted Adverse Effects

Hydrologic modelling was used to predict surface water flows for all seven sub-watershed areas, and for three hydrologic scenarios (i.e., average year, dry year, wet year). Surface water flows were calculated for the operations phase, as well as the post-closure phase. For the modelling of post-closure flows, predictions were made for each of the two dry closure options considered for the TSF, namely a dry cover and a wet cover. No predictions were made for either the site preparation and construction phase or the closure phase as there would be no surface water discharges or withdrawals during these phases. However, during the site preparation and construction and closure phases, there will be changes in catchment areas as a result of the Project to Blackwater Creek Tributaries 1 and 2 and watershed areas in Hoffstrom's Bay Tributary, Little Creek and Blackwater Creek. A description of predicted adverse effects on fish and fish habitat for these two phases are provided in Section 6.14. The results of the modelling, which were provided in Sections 6.8.4.1 through 6.8.4.4, were used to calculate the changes in flows from existing conditions as a result of the Project. Adverse effects on surface water quantity were considered to occur in those cases where a non-negligible change was predicted in the surface flows.

The predicted changes in surface water quantity during the operations phase are provided in Table 6.9.4.5-1. During operations, hydrologic modelling predicted adverse effects on surface water quantity for all seven sub-watersheds modelled for the dry and average year, specifically in the following sub-watersheds:

Table 6.9.5-1: Adverse Effects for Surface Water Quantity during Operations

Scenario	Calculated Change in Flows, ΔQ (m^3/s)													Annual ΔQ (%)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
Average Year														
TL1	-0.0010	-0.0007	-0.0008	-0.0001	—	—	—	—	—	—	—	-0.0017	-0.0004	-0.55
TL2	-0.0009	-0.0007	-0.0008	-0.0001	—	—	—	—	—	—	—	-0.0015	-0.0003	-0.55
TL3	-0.0018	-0.0014	-0.0016	-0.0001	—	—	—	—	—	—	—	-0.0032	-0.0007	-0.48
HB1	-0.0005	-0.0004	-0.0004	-0.0038	-0.0043	-0.0023	-0.0021	-0.0008	-0.0014	-0.0017	-0.0013	-0.0009	-0.0017	-7.77
LC1	-0.0003	-0.0002	-0.0002	-0.0019	-0.0022	-0.0012	-0.0011	-0.0004	-0.0007	-0.0008	-0.0007	-0.0004	-0.0008	-8.74
BW1	+0.0029	+0.0053	+0.0101	+0.0012	-0.0346	-0.0061	-0.0070	+0.0060	+0.0160	+0.0071	+0.0088	-0.0006	+0.0007	+0.78
BW2	+0.0029	+0.0053	+0.0101	+0.0012	-0.0346	-0.0061	-0.0070	+0.0060	+0.0160	+0.0071	+0.0088	-0.0006	+0.0007	+0.49
Dry year														
TL1	-0.0003	-0.0002	-0.0002	-0.0020	-0.0023	-0.0012	-0.0011	-0.0004	-0.0007	-0.0009	-0.0007	-0.0005	-0.0009	-5.00
TL2	-0.0002	-0.0002	-0.0002	-0.0019	-0.0021	-0.0011	-0.0010	-0.0004	-0.0007	-0.0008	-0.0007	-0.0004	-0.0008	-5.00
TL3	-0.0005	-0.0004	-0.0005	-0.0039	-0.0044	-0.0024	-0.0022	-0.0009	-0.0014	-0.0017	-0.0014	-0.0009	-0.0017	-4.36
HB1	-0.0001	-0.0001	-0.0001	-0.0011	-0.0012	-0.0006	-0.0006	-0.0002	-0.0004	-0.0005	-0.0004	-0.0002	-0.0005	-7.77
LC1	-0.0001	-0.0001	-0.0001	-0.0005	-0.0006	-0.0003	-0.0003	-0.0001	-0.0002	-0.0002	-0.0002	-0.0001	-0.0002	-8.74
BW1	+0.0009	+0.0019	+0.0063	+0.0183	-0.0127	-0.0068	-0.0063	-0.0025	-0.0041	-0.0049	+0.0067	-0.0018	-0.0005	-1.98
BW2	+0.0009	+0.0019	+0.0063	+0.0183	-0.0127	-0.0068	-0.0063	-0.0025	-0.0041	-0.0049	+0.0067	-0.0018	-0.0005	-1.25
Wet Year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
HB1	-0.0009	-0.0007	-0.0008	-0.0066	-0.0075	-0.0040	-0.0037	-0.0015	-0.0024	-0.0029	-0.0023	-0.0015	-0.0029	-7.77
LC1	-0.0004	-0.0003	-0.0004	-0.0033	-0.0037	-0.0020	-0.0018	-0.0007	-0.0012	-0.0014	-0.0012	-0.0008	-0.0014	-8.74
BW1	-0.0006	+0.0030	+0.0090	-0.0161	-0.0439	+0.0155	+0.0068	+0.0220	+0.0266	+0.0088	+0.0075	-0.0069	+0.0026	+1.76
BW2	-0.0006	+0.0030	+0.0090	-0.0161	-0.0439	+0.0155	+0.0068	+0.0220	+0.0266	+0.0088	+0.0075	-0.0069	+0.0026	+1.11

Note: The "—" symbol indicates where no adverse effects were predicted.

- **TL1**: Thunder Lake Tributary 2 downstream of reservoir;
- **TL2**: Thunder Lake Tributary 3 downstream of Three Nursery Ponds;
- **TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location; and

BW2: Blackwater Creek, upstream of Wabigoon Lake.For the wet year scenario, only the following watersheds experienced adverse effects:

- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location; and
- **BW2**: Blackwater Creek, upstream of Wabigoon Lake.

The modelling indicated there would be no adverse effect on lake levels in either Thunder Lake or Wabigoon Lake during operations.

The predicted changes in surface water flows for the post-closure phase with the dry cover option for TSF closure are provided in Table 6.9.5-2. The modelling predicted adverse effects for the following four sub-watershed areas:

- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location; and
- **BW2**: Blackwater Creek, upstream of Wabigoon Lake.
-

Table 6.8.5-2: Adverse Effects for Surface Water Quantity during Post-closure (dry TSF cover)

Scenario	Calculated Change in Flows, ΔQ (m^3/s)													Annual ΔQ (%)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
Average Year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
HB1	-0.0004	-0.0002	-0.0003	-0.0034	-0.0039	-0.0020	-0.0019	-0.0007	-0.0012	-0.0014	-0.0011	-0.0007	-0.0014	-6.69
LC1	-0.0002	-0.0002	-0.0002	-0.0016	-0.0019	-0.0010	-0.0009	-0.0004	-0.0006	-0.0007	-0.0006	-0.0004	-0.0007	-7.49
BW1	+0.0058	+0.0048	+0.0054	+0.0306	+0.0238	+0.0056	+0.0031	-0.0041	+0.0059	+0.0113	+0.0123	+0.0088	+0.0094	+11.09
BW2	+0.0058	+0.0048	+0.0054	+0.0306	+0.0238	+0.0056	+0.0031	-0.0041	+0.0059	+0.0113	+0.0123	+0.0088	+0.0094	+6.99
Dry year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
HB1	-0.0000	+0.0000	-0.0000	-0.0009	-0.0010	-0.0005	-0.0004	-0.0001	-0.0002	-0.0003	-0.0002	-0.0001	-0.0003	-5.31
LC1	-0.0001	-0.0000	-0.0001	-0.0005	-0.0005	-0.0003	-0.0003	-0.0001	-0.0002	-0.0002	-0.0002	-0.0001	-0.0002	-7.49
BW1	+0.0053	+0.0044	+0.0049	+0.0265	+0.0161	-0.0007	-0.0033	-0.0025	-0.0033	+0.0086	+0.0109	+0.0079	+0.0062	+26.10
BW2	+0.0053	+0.0044	+0.0049	+0.0265	+0.0161	-0.0007	-0.0033	-0.0025	-0.0033	+0.0086	+0.0109	+0.0079	+0.0062	+16.46
Wet Year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
HB1	-0.0007	-0.0005	-0.0006	-0.0060	-0.0068	-0.0036	-0.0033	-0.0012	-0.0021	-0.0026	-0.0020	-0.0013	-0.0026	-6.91
LC1	-0.0004	-0.0003	-0.0003	-0.0028	-0.0032	-0.0017	-0.0016	-0.0006	-0.0010	-0.0012	-0.0010	-0.0007	-0.0012	-7.49
BW1	+0.0083	+0.0066	+0.0075	+0.0491	+0.0477	+0.0205	+0.0176	+0.0034	+0.0143	+0.0202	+0.0186	+0.0130	+0.0189	+12.94
BW2	+0.0083	+0.0066	+0.0075	+0.0491	+0.0477	+0.0205	+0.0176	+0.0034	+0.0143	+0.0202	+0.0186	+0.0130	+0.0189	+8.16

Note: The "—" symbol indicates where no adverse effects were predicted.

The predicted changes in surface water quantities for the post-closure phase and a wet cover closure option for the TSF are provided in Table 6.9.5-3. Adverse effects were predicted for the following six sub-watershed areas:

- **TL2**: Thunder Lake Tributary 3 downstream of Three Nursery Ponds;
- **TL3**: Thunder Lake Tributary 2 at Thunder Lake;
- **HB1**: Hoffstrom's Bay Tributary at Thunder Lake;
- **LC1**: Little Creek at Thunder Lake;
- **BW1**: Blackwater Creek; downstream of the Project site and effluent discharge location; and

BW2: Blackwater Creek, upstream of Wabigoon Lake.The modelling indicated there would be no adverse effect on lake levels in either Thunder Lake or Wabigoon Lake during post-closure.

6.9.5 Identified Mitigation

The Project will employ best practices that will assist in a reduction and mitigate surface water quantity effects, which are outlined below for each of the four Project phases.

- **Site Preparation and Construction Phase**:
  - A perimeter ditch around the operations area will capture all runoff during the site preparation and construction phase [Mit_008].
  - Industry standard erosion and sediment controls will be implemented during the site preparations and construction phase [Mit_054].
  - Once the perimeter ditch has been completed, there would be no discharges to surface water during this phase [Mit_045].
- **Operations Phase**:
  - A perimeter ditch around the operations area will capture all runoff during the site preparation and construction phase [Mit_008].
  - The operations area will be minimized to the extent possible to reduce the amount of runoff directed from the Little Creek and Hoffstrom's Bay watersheds [Mit_050].

Table 6.9.5-3: Adverse Effects for Surface Water Quantity during Post-closure (wet TSF cover)

Scenario	Calculated Change in Flows, ΔQ (m^3/s)													Annual ΔQ (%)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
Average Year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.20
TL3	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.08
HB1	-0.0004	-0.0002	-0.0003	-0.0034	-0.0039	-0.0020	-0.0019	-0.0007	-0.0012	-0.0014	-0.0011	-0.0007	-0.0014	-6.69
LC1	-0.0002	-0.0002	-0.0002	-0.0016	-0.0019	-0.0010	-0.0009	-0.0004	-0.0006	-0.0007	-0.0006	-0.0004	-0.0007	-7.49
BW1	+0.0053	+0.0048	+0.0051	+0.0356	+0.0191	-0.0020	-0.0038	-0.0059	+0.0019	+0.0062	+0.0085	+0.0068	+0.0068	+7.98
BW2	+0.0053	+0.0048	+0.0051	+0.0356	+0.0191	-0.0020	-0.0038	-0.0059	+0.0020	+0.0062	+0.0085	+0.0068	+0.0068	+5.04
Dry year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.71
TL3	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.29
HB1	-0.0000	+0.0000	-0.0000	-0.0009	-0.0010	-0.0005	-0.0004	-0.0001	-0.0002	-0.0003	-0.0002	-0.0001	-0.0003	-5.31
LC1	-0.0001	-0.0000	-0.0001	-0.0005	-0.0005	-0.0003	-0.0003	-0.0001	-0.0002	-0.0002	-0.0002	-0.0001	-0.0002	-7.49
BW1	+0.0059	+0.0052	+0.0056	+0.0207	+0.0094	-0.0036	-0.0059	-0.0025	-0.0041	+0.0065	+0.0099	+0.0077	+0.0045	+19.03
BW2	+0.0059	+0.0052	+0.0056	+0.0207	+0.0094	-0.0036	-0.0059	-0.0025	-0.0041	+0.0065	+0.0099	+0.0077	+0.0045	+12.00
Wet Year														
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.12
TL3	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.0001	+0.05
HB1	-0.0007	-0.0005	-0.0006	-0.0060	-0.0068	-0.0036	-0.0033	-0.0012	-0.0021	-0.0026	-0.0020	-0.0013	-0.0026	-6.91
LC1	-0.0004	-0.0003	-0.0003	-0.0028	-0.0032	-0.0017	-0.0016	-0.0006	-0.0010	-0.0012	-0.0010	-0.0007	-0.0012	-7.49
BW1	+0.0115	+0.0094	+0.0105	+0.0616	+0.0467	+0.0094	+0.0043	-0.0010	+0.0062	+0.0178	+0.0245	+0.0174	+0.0182	+12.43
BW2	+0.0115	+0.0094	+0.0105	+0.0617	+0.0467	+0.0094	+0.0043	-0.0010	+0.0062	+0.0178	+0.0245	+0.0174	+0.0182	+7.84

Note: The "—" symbol indicates where no adverse effects were predicted.

- On-site storage facilities will allow for the effective management of water, reducing the need for discharges, especially during periods when conditions are not suitable. On-site storage facilities will allow for the effective management of water, reducing the amount for water taken from adjacent watercourses [Mit_057].

- Excess water not required for processing will be treated and discharged to Blackwater Creek through an engineered structure designed to dissipate flows and avoid erosion [Mit_058].

- Periodically, fresh water will be required to support Project operations. Fresh water withdrawals will be taken from two existing ponds on Thunder Lake Tributary 3 (referred to as the tree nursery ponds) and an existing pond on Thunder Lake Tributary 2. Fresh water takings from these ponds will not exceed 5% of the flow entering the ponds [Mit_059].

- **Closure Phase**:

  - A perimeter ditch around the operations area will capture all runoff during the closure phase [Mit_008].

  - There will be no surface water discharges during this phase, thus, no mitigation measures are proposed [Mit_055].

- **Post-closure Phase**:

  - During closure, the site will be graded such that runoff for the operations area will be directed to the open pit during closure and post-closure phases [Mit_056].

  - Once the open pit has been filled, excess water from the open pit will be passively released through an engineered spillway into the existing channel of Blackwater Creek Tributary 1 [Mit_060].

6.9.6 Residual Adverse Effects

Even with the mitigation measures summarized in Section 6.9.5, residual adverse effects are predicted for surface water quantity during the operations and post-closure phases. The predicted adverse effects to surface water during the operations phase and post-closure phase are presented in Tables 6.9.6-1 and 6.9.6-2, respectively.

Table 6.9.6-1: Residual Adverse Effects for Surface Water Quantity during Operations

Scenario	Calculated Change in Flows, ΔQ (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Year													
TL1	-4.92%	-4.99%	-4.90%	-0.05%	—	—	—	—	—	—	—	-4.91%	-0.55%
TL2	-4.92%	-4.99%	-4.90%	-0.05%	—	—	—	—	—	—	—	-4.91%	-0.55%
TL3	-4.28%	-4.35%	-4.27%	-0.04%	—	—	—	—	—	—	—	-4.28%	-0.48%
HB1	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%
LC1	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%
BW1	+11.27%	+27.39%	+44.33%	+0.59%	-15.76%	-5.23%	-6.40%	+13.96%	+22.84%	+8.37%	+12.95%	-1.39%	+0.78%
BW2	+7.11%	+17.27%	+27.95%	+0.37%	-9.94%	-3.30%	-4.04%	+8.81%	+14.40%	+5.28%	+8.17%	-0.88%	+0.49%
Dry year													
TL1	-4.99%	-4.93%	-5.06%	-5.00%	-5.00%	-5.01%	-5.01%	-4.98%	-5.00%	-4.99%	-5.02%	-4.98%	-5.00%
TL2	-4.99%	-4.93%	-5.06%	-5.00%	-5.00%	-5.01%	-5.01%	-4.98%	-5.00%	-4.99%	-5.02%	-4.98%	-5.00%
TL3	-4.35%	-4.30%	-4.41%	-4.36%	-4.36%	-4.37%	-4.36%	-4.34%	-4.36%	-4.35%	-4.37%	-4.34%	-4.36%
HB1	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%
LC1	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%
BW1	+12.13%	+34.63%	+99.47%	+33.55%	-20.62%	-20.62%	-20.62%	-20.62%	-20.62%	-20.62%	+35.33%	-14.12%	-1.98%
BW2	+7.65%	+21.84%	+62.73%	+21.16%	-13.00%	-13.00%	-13.00%	-13.00%	-13.00%	-13.00%	+22.28%	-8.91%	-1.25%
Wet Year													
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	—	—	—	—	—	—	—	—	—	—	—	—	—
TL3	—	—	—	—	—	—	—	—	—	—	—	—	—
HB1	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%	-7.77%
LC1	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%	-8.74%
BW1	-1.42%	+9.09%	+23.01%	-4.84%	-11.60%	+7.67%	+3.63%	+29.99%	+22.05%	+6.07%	+6.43%	-8.90%	+1.76%
BW2	-0.90%	+5.73%	+14.51%	-3.05%	-7.32%	+4.84%	+2.29%	+18.91%	+13.90%	+3.83%	+4.06%	-5.61%	+1.11%

Note: The "—" symbol indicates where no residual adverse effects were predicted.

Table 6.9.6-2: Residual Adverse Effects for Surface Water Quantity during Post-closure

Scenario	Calculated Change in Flows, ΔQ (%)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Year													
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	+0.65%	+0.87%	+0.74%	+0.09%	+0.08%	+0.14%	+0.15%	+0.39%	+0.24%	+0.20%	+0.25%	+0.37%	+0.20%
TL3	+0.27%	+0.37%	+0.31%	+0.04%	+0.03%	+0.06%	+0.06%	+0.16%	+0.10%	+0.08%	+0.10%	+0.16%	+0.08%
HB1	-5.47%	-4.86%	-5.22%	-6.99%	-7.01%	-6.83%	-6.80%	-6.16%	-6.57%	-6.68%	-6.55%	-6.21%	-6.69%
LC1	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%
BW1	+20.58%	+25.08%	+22.41%	+18.34%	+8.71%	-1.70%	-3.48%	-13.77%	+2.78%	+7.36%	+12.61%	+15.10%	+7.98%
BW2	+12.98%	+15.81%	+14.13%	+11.57%	+5.49%	-1.07%	-2.19%	-8.68%	+1.75%	+4.64%	+7.95%	+9.52%	+5.04%
Dry year													
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	+2.31%	+3.12%	+2.64%	+0.31%	+0.27%	+0.51%	+0.55%	+1.40%	+0.85%	+0.71%	+0.89%	+1.33%	+0.71%
TL3	+0.97%	+1.30%	+1.10%	+0.13%	+0.11%	+0.21%	+0.23%	+0.59%	+0.36%	+0.30%	+0.37%	+0.56%	+0.29%
HB1	-0.97%	+1.20%	-0.09%	-6.38%	-6.48%	-5.84%	-5.73%	-3.42%	-4.91%	-5.31%	-4.82%	-3.62%	-5.31%
LC1	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%
BW1	+80.50%	+96.51%	+87.01%	+38.06%	+15.24%	-11.02%	-19.35%	-20.76%	-20.76%	+27.27%	+52.08%	+60.94%	+19.03%
BW2	+50.77%	+60.86%	+54.87%	+24.00%	+9.61%	-6.95%	-12.20%	-13.09%	-13.09%	+17.20%	+32.84%	+38.43%	+12.00%
Wet Year													
TL1	—	—	—	—	—	—	—	—	—	—	—	—	—
TL2	+0.38%	+0.51%	+0.43%	+0.05%	+0.04%	+0.08%	+0.09%	+0.23%	+0.14%	+0.12%	+0.14%	+0.22%	+0.12%
TL3	+0.16%	+0.21%	+0.18%	+0.02%	+0.02%	+0.03%	+0.04%	+0.10%	+0.06%	+0.05%	+0.06%	+0.09%	+0.05%
HB1	-6.20%	-5.85%	-6.06%	-7.08%	-7.10%	-6.99%	-6.98%	-6.60%	-6.84%	-6.91%	-6.83%	-6.63%	-6.91%
LC1	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%	-7.49%
BW1	+25.68%	+28.29%	+26.74%	+18.48%	+12.35%	+4.67%	+2.32%	-1.34%	+5.11%	+12.21%	+21.04%	+22.49%	+12.43%
BW2	+16.20%	+17.84%	+16.87%	+11.66%	+7.79%	+2.95%	+1.46%	-0.84%	+3.23%	+7.70%	+13.27%	+14.18%	+7.84%

Note: The "—" symbol indicates where no residual adverse effects were predicted.

The predictions of surface water quatlity focussed on predicting changes in the watercourses surrounding the Project. A spatial representation of the watercourses affected has been provided in Figure 6.9.6-1. The figure highlights those watercourses where changes in surface water flows were predict to result from the Project. The watercourses where changes in flow may be measurable have been shaded in green in the figure. The green shading indicated that the flows will change, but that those changes would be small enough that fish populations would not be impacted, and the streams would continue to provide Aboriginal peoples opportunities to practice traditional uses of the land. The operations area for the Project is shaded gold, as surface water quantities within this area will be managed by Treasury Metals through the site preparation and construction, operations, and closure phases. Once the pit lake fills during the post-closure phase (approximately 6 to 8 years following the cessation of dewatering) natural surface water flows within the operations area will be established. This area would be shaded green once the natural surface water flows are re-established.

6.9.7 Information to Address Round 1 Information Requests

The following questions regarding the predicted effects on surface water quantity were received as part of the Round information requests:

- TMI_27-AA(1)-08: water requirements and sources;
- TMI_72-GW(1)-09: drainage and catchment areas;
- TMI_85-GW(1)-22: analyze effects to the surface water regime;
- TMI_102-SW(1)-16: flows in Blackwater Creek;
- TMI_113-SW(1)-27: runoff coefficients;
- TMI_114-SW(1)-28: infiltration loss calculation;
- TMI_115-SW(1)-29: sensitivity of prediction to different condition;
- TMI_117-SW(1)-31: predicted flow rates through Project life;
- TMI_118-SW(1)-32: water balance and effects;
- TMI_119-SW(1)-33: evaporation inputs to model;
- TMI_138-FH(1)-17: water taking rates and locations;
- TMI_344-AC(1)-18: water use at Project;
- TMI_383-AC(1)-57: water use over Project life;
- TMI_559-AC(1)-233: lake levels; and
- TMI_704-PC(1)-19: effects to Thunder Lake.

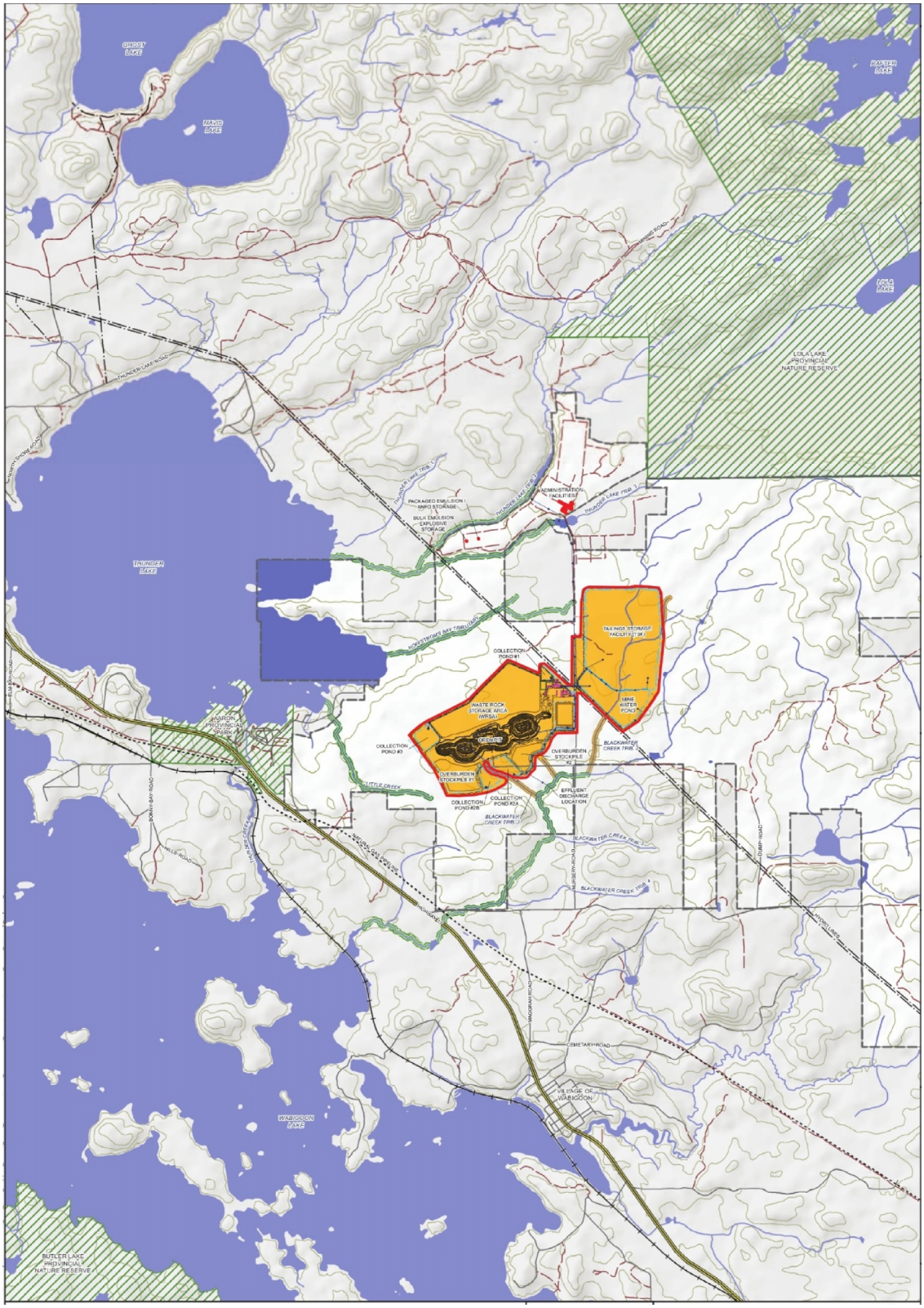


Figure 6.9.6-1: Spatial Extent Surface Water Quantity Effects

6.10 Groundwater Quality

6.10.1 Potential Effects of the Project on the Environment

Section 6.1.3.9 introduces the “groundwater quality” VC that will be used for evaluating the effects of the Project. Rock excavated as part of the mining and processing at the Project has the potential to undergo chemical reactions when exposed to the environment. As described in Section 6.3, much of the rock targeted for mining has exhibited potential acid generating (PAG) characteristics that could result in acid rock drainage (ARD) and associated metals leaching (ML). As a result, there is a potential that seepage from onsite facilities such as the waste rock storage area (WRSA) and tailings storage facility (TSF) to have seepage that could affect groundwater quality should it leave the site. The potential effects of the Project on the “groundwater quantity” for the various Project phase are as follows:

- **Site Preparation and Construction Phase**: As described in the Section 3, a perimeter ditch and seepage collection system will be constructed around the operations area during the early stages of the site preparation and construction activities. There will be no mining activities occurring during this phase of the Project so no potential effects on groundwater quality are identified.

- **Operations Phase**: Prior to the start of mining the open pit, active dewatering of the open pit and underground workings will provide a safe and dry working environment. These dewatering activities will result in a lowering of the water table around the mine, creating a drawdown zone. Within the drawdown zone, groundwater will flow inwards towards the open pit. The dewatering activities will continue throughout the operations phase, as mining advances from the open pit to the underground mine. The open pit will remain free of water, and act as a sink for groundwater flow until mining activities cease and the dewatering is stopped.

  During operations, waste rock excavated from the open pit will be excavated and stored in the WRSA. As mining advances, waste rock will be stored in the mined out areas of the open pit to minimize the footprint of the WRSA. Waste from the ore processing will be treated to remove cyanide and will be discharged to the TSF sub-aqueously. The TSF will have a permanent water cover throughout the operations period. The materials in both the WRSA and TSF will likely contain PAG materials, and can produce seepage that would be affected by ARD/ML. The TSF will be equipped with a perimeter ditch and seepage collection system [Mit_051] to capture the majority of the seepage. A perimeter ditch and seepage collection system will also be constructed around the operations area [Mit_008]. The runoff and seepage collected will be incorporated into the water management system. Seepage from the WRSA and TSF that escapes the seepage collection systems will be captured within the drawdown zone, and will ultimately report to the open pit [Mit_052] where it will be incorporated into the water management system.

- **Closure Phase**: Following the end of mining activities, the process water covering the TSF will be withdrawn, treated and used to help fill the open pit. The tailings will be physically isolated with a granular cover and then chemically isolated using either a dry, low-permeability cover or a wet cover using non-process water. The WRSA will be covered with a dry, low-permeability cover to reduce the potential for acidification. The waste rock placed within the open pit will remain exposed until covered with water as the open pit is allowed to flood. The PAG materials present will continue to contribute to seepage, although the rate of ARD/ML will be reduced as a result of the closure activities.

  At the end of mining operations, the dewatering activities will cease and the open pit and underground mine will be allowed to fill with water. Although the dewatering activities will cease following the end of mining, the drawdown zone created during operations will remain until the post-closure phase. Groundwater and seepage within the drawdown zone will continue to be directed to the open pit.

- **Post-closure Phase:** Once the pit is flooded, groundwater levels will return to near pre-development conditions. At that point, a portion of the seepage from the TSF and WRSA will escape from the site, and potentially affect the quality of groundwater in wells at adjacent properties.

The potential effects of the Project on groundwater quality have been described using a simple linkage diagram on Figure 6.10.1-1. The figure illustrates the groundwater quality VC (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. The figure also indicates the other components of the environment (shown in red on the figure) that can be affected by the groundwater quality VC. For example, the surface water quality predictions will rely on information regarding the groundwater quality during the post-closure phase. The groundwater quality VC relies on the predicted effects for geochemistry.

6.10.2 Effects Prediction Methods

Groundwater quality effects were based on information generated as part of the geochemical and groundwater quantity assessments described in Sections 6.3 and 6.11, respectively.

6.10.3 Project Effects Avoidance Measures Used in Predictions

The following measures incorporated into the Project to avoid of minimize the effects of the Project on groundwater quality have been considered in the modelling:

- A perimeter runoff and seepage collection ditch will be constructed around what is referred to as the operations area [Mit_008].

- The geochemical properties of the waste rock will be evaluated and non-acid generating (NAG) waste rock will be segregated from potentially acid generating (PAG) waste rock, if feasible [Mit_019].

- As part of the closure activities, the WRSA will be covered with a low permeability cover to isolate the waste rock and reduce the potential for acidification [Mit_018].
- The PAG waste rock would be placed in the mined out areas of the open pit, to the extent practical, to minimize the volume of PAG material in the WRSA [Mit_020].
- At closure, the open pit will be allowed to flood, isolating the exposed mine faces and the waste rock placed underneath a static cover of water to prevent acidification [Mit_022].

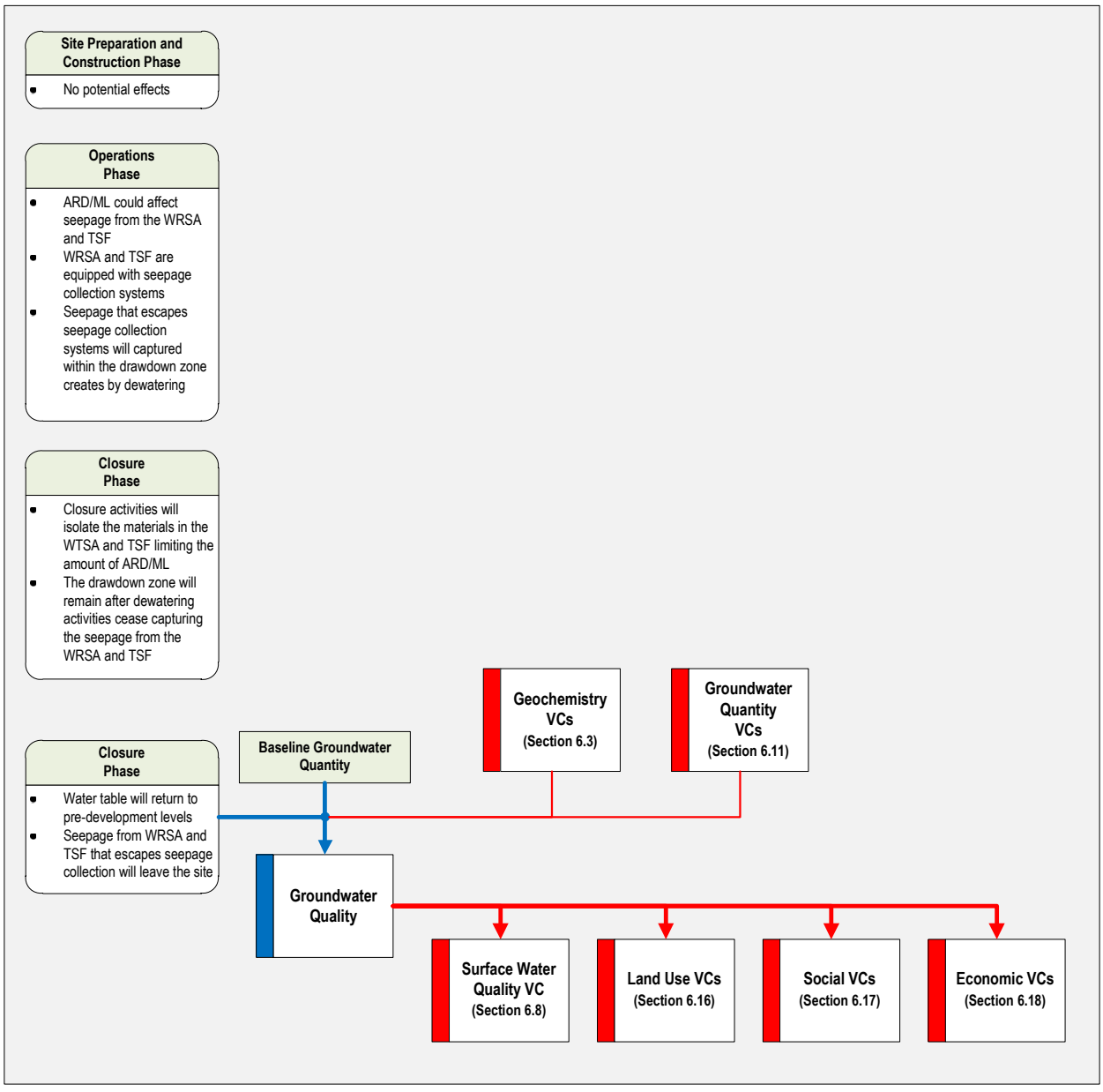


Figure 6.10.1-1: Groundwater Quality Linkage Diagram

- The floor of the tailings storage facility (TSF) will be low-permeability. Where native soils do not provide a sufficiently thick low-permeability horizon beneath the TSF, it will be augmented with suitable clay from open pit stripping. If the volume of clay is insufficient, a synthetic liner will be used to ensure a low-permeability floor for the TSF [Mit_062].

- The TSF will be equipped with a perimeter seepage collection system [Mit_051].

- During operations, a water cover will be maintained over the tailings within the TSF to prevent the onset of acidification [Mit_021].

- At closure the process water will be withdrawn from the TSF, treated and used to help fill the open pit. The tailings within the TSF will be isolated using either a low permeability dry cover, or a wet cover of non-process water [Mit_023].

- Dewatering of the open pit and underground mine workings will provide dry working conditions and safe working environment. These dewatering activities will lower the groundwater table around the perimeter of the open pit and mine workings, creating what is referred to as a drawdown zone. Within this drawdown zone, groundwater will migrate towards the open pit. Therefore, seepage that escapes the seepage collection systems will be captured within the drawdown zone caused by dewatering and ultimately report to the open pit (operations phase) [Mit_052].

6.10.4 Predicted Effects

6.10.4.1 Site Preparation and Construction Phase

During the site preparation and construction phase, the emphasis of the Project is on clearing and preparing the site for the mining activities during operations. One of these activities will be the removal of the overburden from the open pit and subsequent placement in the overburden storage piles for use in the reclamation of the site during closure. The clearing of the overburden would require limited dewatering of the surficial layer that would only have a localized effect on the shallow groundwater. These effects are not expected to extend beyond the mine footprint. There will be no material during the site preparation and construction phase that could result in seepage. Therefore, there will be no effects on groundwater quality during the site preparation and construction phase.

6.10.4.2 Operations Phase

Some of the waste rock and the tailings associated with the Project have been identified as being potentially acid generating (PAG). As a result, the materials within the waste rock storage area (WRSA) and tailings storage facility (TSF) have the potential to experience acid rock drainage and metals leaching (ARD/ML) over time that could produce seepage with elevated levels of metals. This seepage, if transported off-site could affect the quality of groundwater reaching

nearby private wells. Additionally, if the seepage reaches surface watercourses, the seepage could affect the quality of surface water in the receiving environment.

Seepage from the on-site structures (e.g., WRSA and TSF) will be managed by a series of perimeter seepage collection systems. These seepage collection systems will capture the majority of the seepage, which will be collected and incorporated into the water management system. However, no system can be relied on to capture 100% of the seepage. The seepage that escapes the seepage collections systems during the operations phase will be captured by the drawdown zone created by the dewatering of the open pit and underground mine. This seepage will be directed towards the open pit where it will be collected and incorporated into the water management system. There will be no seepage from the on-site structures during the operations phase that will leave the site. Therefore there will be no effects on groundwater quality.

6.10.4.3 Closure Phase

At the end of mining operations, the dewatering activities will cease and the open pit and underground mine will be allowed to start filling with water. Although the dewatering will no longer be occurring during the closure phase, the drawdown of the groundwater during operations will take more decades to fully recover to near pre-development conditions. As a result, the seepage from the on-site structures (e.g., WRSA and TSF) that escape the seepage collection systems will be captured by the drawdown zone created by the dewatering during operations, and will be directed towards the open pit. There will be no seepage from the on-site structures during the closure phase that will leave the site. Therefore there will be no effects on groundwater quality.

6.10.4.4 Post-closure Phase

Over time, the drawdown of the groundwater levels during operations will recover to near pre-development levels. It is expected to take decades following the end of dewatering for the levels to fully recover. The groundwater modelling completed to support the Project (Appendix M to the EIS) indicates that groundwater inflow to the open pit will continue to occur, even after the open pit is completely flooded. Therefore, the open pit will not be a source of seepage during closure.

Once the open pit is flooded and the groundwater levels return to near pre-development conditions, seepage from the on-site structures (e.g., WRSA and TSF) that escapes the seepage collection systems will leave the site. The groundwater modelling (Section 6.11.4) indicated that the seepage from the WRSA and TSF that escapes the seepage collection would likely report to the nearby watercourses over time. The groundwater modelling did not predict measurable volumes of seepage from the WRSA or TSF getting transported towards the private water wells in the areas. Therefore, seepage from the Project is not predicted to have an adverse effect on the quality of water in the private water wells located near the Project. However the effects of seepage from the WSRA and TSF in the post-closure phase have been incorporated into the surface water quality modeling described in Section 6.8.4. The estimated volumes of seepage and the surface waterbodies where the seepage is predicted to report are summarized below in Table 6.10.4.4-1.

Table 6.10.4.4-1: Estimated Seepage Quantities during Post-Closure

Waterbody Receiver	Volume of Discharge (m^3/day)		
	Capped WRSA (1)	Capped TSF (2) (dry cover)	Uncapped TSF (3) (wet cover)
Thunder Lake	10	much less than 10	10
Thunder Lake Tributary 3	—	much less than 10	20
Hoffstrom's Bay Tributary	—	10	10
Blackwater Creek	—	30	50
Open Pit	20	10	—
Total Seepage	**30**	**50**	**90**

Notes:
(1) Seepage quantity for capped WRSA from Figure 25 of Appendix M of the EIS
(2) Seepage quantities for dry cover TSF from Figure 24 of Appendix M of the EIS
(3) Seepage quantities for wet cover TSF from Figure 22 of Appendix M of the EIS

6.10.4.5 Predicted Adverse Effects

As described in Section 6.1.3.9, the effects of the Project on groundwater quality were evaluated using a single VC, namely groundwater quality. There were no adverse effects of the Project on groundwater quality predicted during the site preparation and construction phase.

Some of the waste rock and the tailings have been identified as potentially acid generating (PAG), and are likely to experience acid rock drainage and metals leaching (ARD/ML) over time if exposed to oxygen and moisture. As a result, the materials within the waste rock storage area (WRSA) and tailings storage facility (TSF) have the potential to produce seepage with elevated levels of metals. During the operations and closure phases, this seepage will be captured by either the perimeter seepage collection systems around each structure, or by the drawdown zone created by the dewatering of the open pit and underground mine. As no seepage from the on-site structures will leave the site, there will be no adverse effects on groundwater quality during the operations and closure phases.

Once the open pit is flooded and the groundwater levels return to near pre-development conditions during the post-closure phase, seepage from the on-site structures (i.e., WRSA and TSF) that escapes the seepage collection systems will leave the site. The groundwater quantity modelling (Section 6.11.4) indicated that the seepage leaving the site will report to nearby watercourses and would not be transported towards private wells surrounding the Project. The effects of seepage on surface water is described as part of the assessment for surface water quality in Section 6.8.4. There were no adverse effects predicted for groundwater quality.

6.10.5 Identified Mitigation

The following measures have been incorporated into the Project to avoid or minimize the effects of the Project on groundwater quality have been considered in the modelling:

- A perimeter runoff and seepage collection ditch will be constructed around what is referred to as the operations area [Mit_008].

- The geochemical properties of the waste rock will be evaluated and non-acid generating (NAG) waste rock will be segregated from potentially acid generating (PAG) waste rock, if feasible [Mit_019].

- As part of the closure activities, the WRSA will be covered with a low permeability cover to isolate the waste rock and reduce the potential for acidification [Mit_018].

- The PAG waste rock would be placed in the mined out areas of the open pit, to the extent practical, to minimize the volume of PAG material in the waste rock storage area (WRSA) [Mit_020].

- At closure, the open pit will be allowed to flood, isolating the exposed mine faces and the waste rock placed underneath a static cover of water to prevent acidification [Mit_022].

- The floor of the tailings storage facility (TSF) will be low-permeability. Where native soils do not provide a sufficiently thick low-permeability horizon beneath the TSF, it will be augmented with suitable clay from open pit stripping. If the volume of clay is insufficient, a synthetic liner will be used to ensure a low-permeability floor for the TSF [Mit_062].

- The TSF will be equipped with a perimeter seepage collection system [Mit_051].

- During operations, a water cover will be maintained over the tailings within the TSF to prevent the onset of acidification [Mit_021].

- At closure, the process water will be withdrawn from the TSF, treated and used to help fill the open pit. The tailings within the TSF will be isolated using either a low permeability dry cover, or a wet cover of non-process water [Mit_023].

- Dewatering of the open pit and underground mine workings will provide dry working conditions and a safe working environment. These dewatering activities will lower the groundwater table around the perimeter of the open pit and mine workings, creating what is referred to as a drawdown zone. Within this drawdown zone, groundwater will migrate towards the open pit. Therefore, seepage that escapes the seepage collection systems will be captured within the drawdown zone caused by dewatering and ultimately report to the open pit (operations and closure phases) [Mit_052].

- The use of a wet cover as a closure option over the TSF is the preferred option. A wet cover prevents acidification of the tailings, which improves the quality of seepage in the long-term. The mitigation also benefits the quality of surface water in the receiving environment [Mit_023].

6.10.6 Residual Adverse Effects

As set out in Section 6.10.4.5, there were no predicted adverse effects of the Project on groundwater quality. During the site preparation and construction phase, there will be no seepage generated from the Project. During operations and closure, the seepage generated from the waste rock storage area (WRSA) and tailings storage facility (TSF) will be captured by the perimeter seepage collections systems or will be captured within the drawdown zone created by the dewatering of the open pit and underground mine during operations. Once the open pit is flooded and the groundwater levels return to near pre-development conditions, seepage from the WRSA and TSF that escape the seepage collection systems will leave the site. The results of the groundwater quantity modelling (Section 6.11.4) indicated that the seepage leaving the site will not affect private wells in the vicinity of the Project, but will report to nearby watercourses instead. There would be no adverse effects on groundwater quality during the post-closure phase, but the effects of seepage on surface water during post-closure is evaluated as part of the assessment for effects on surface water quality (Section 6.9). Additionally, as there are no residual adverse effects to groundwater quality assessed in this groundwater quality section, no spatial extent has been provided.

6.10.7 Information to Address Round 1 Information Requests

The following questions were asked as part of the Round 1 Information Requests regarding the predicted effects of the Project on groundwater quality:

- TMI_70-GW(1)-07: effects of seepage on groundwater
- TMI_345-AC(1)-19: effects on groundwater
- TMI_512-AC(1)-186: groundwater quality
- TMI_617-AC(1)-290: protection of groundwater
- TMI_629-AC(1)-302: risks for underground water contamination
- TMI_632-AC(1)-305: effects of seepage on wells
- TMI_703-PC(1)-18: effects of seepage on wells
- TMI_718-PC(1)-33: effects on quality of water in private wells
- TMI_767-PC(1)-82: effects on private wells on East Thunder Lake Road

6.11 Groundwater Quantity

6.11.1 Potential Effects of the Project on the Environment

Section 6.1.3.10 introduces the “groundwater quantity” VC that will be used for evaluating the effects of the Project. As part of the operations of the Project, both the open pit mine and underground workings will need to be dewatered in order to provide a safe and dry working environment. As a result of these activities, the water table will be lowered, resulting in potential effects on groundwater quantities. The potential effects of the Project on the “groundwater quantity” for the various Project phase are as follows:

- **Site Preparation and Construction Phase**: As part of the site preparation and construction activities, overburden will be stripped from the area of the open pit mine to prepare for the start of mining operations. As part of this process, water present in the overburden will be collected and stored on site for use in initiating the tailings storage facility and for use in the processing plant once operations begin. The dewatering of the overburden will have a localized effect within the footprint of the open pit.

- **Operations Phase**: As the mining of the open pit starts, the water table will need to be lowered in order to provide a safe working environment. These dewatering activities will result in a lowering of the water table around the mine, creating a drawdown zone. Within the drawdown zone, groundwater will flow inwards towards the open pit. The dewatering activities will continue throughout the operations phase, as mining shifts from the open pit to the underground mine. The open pit will remain free of water, and act as a sink for groundwater flow until mining activities cease and the dewatering is stopped.

- **Closure Phase**: At closure, the dewatering activities will cease and the open pit and underground mine will be allowed to start refilling with water. The drawdown zone created by the dewatering will remain after dewatering activities stop, and throughout the closure phase as the open pit is filling with water.

- **Post-closure Phase**: Once the open pit is fully flooded, the groundwater will gradually return to near the pre-development conditions. However, groundwater will continue to flow into the open pit, even after it has filled with water. It will take tens of years following the flooding of the open pit for the groundwater quantities to return to the levels prior to the development of the Project.

The potential effects of the Project on groundwater quantity have been described using a simple linkage diagram on Figure 6.11.1-1. The figure illustrates the groundwater quantity VC (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. The figure also indicates the other components of the environment (shown in red on the figure) that can be affected by the groundwater quantity VC. For example, the surface water quality predictions will rely on information regarding the groundwater quantities. The groundwater quantity VC does not rely on information from other VCs.

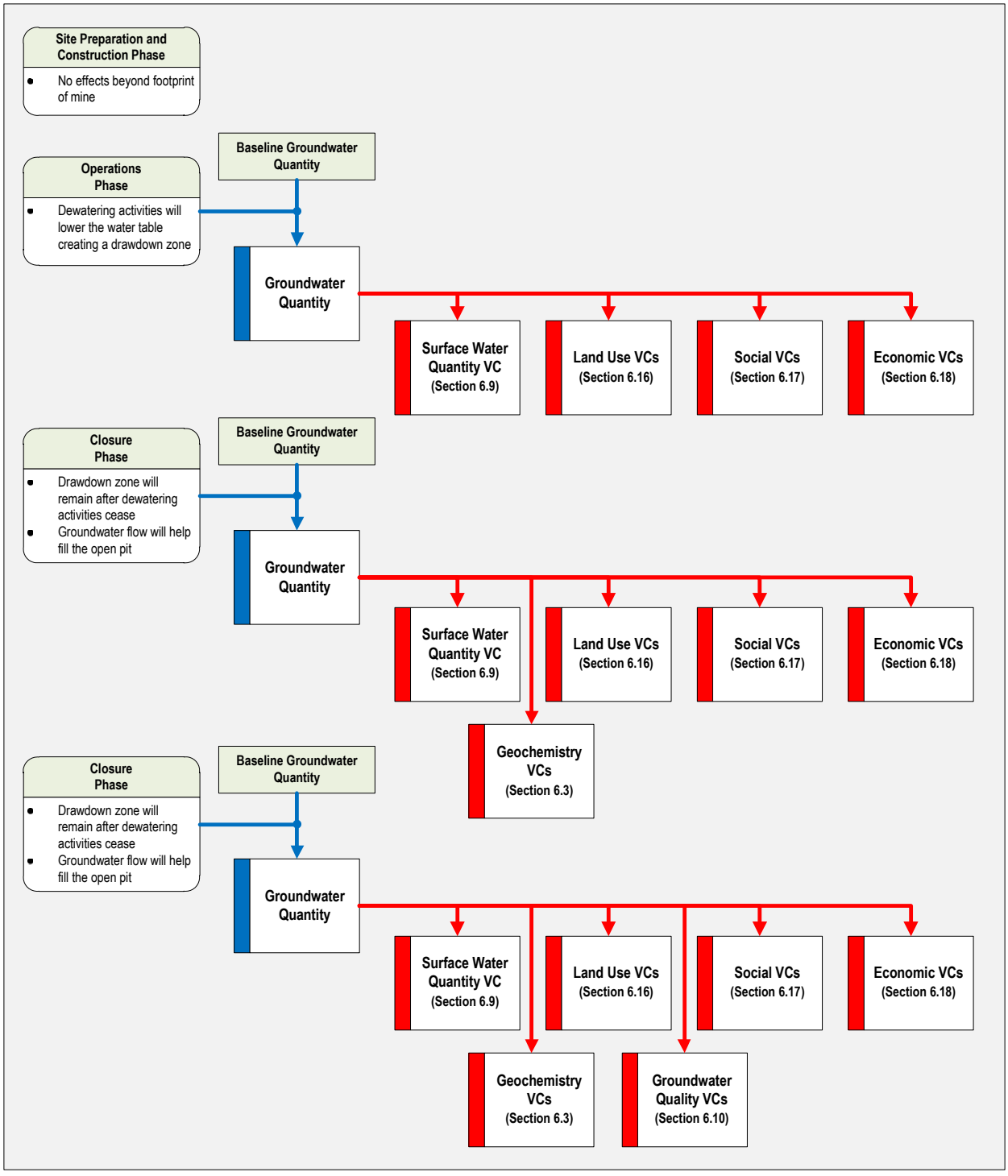


Figure 6.11.1-1: Groundwater Quantity Linkage Diagram

6.11.2 Effects Prediction Methods

6.11.2.1 Conceptual Understanding of Hydrogeological Conditions

The hydrogeology of the proposed Project site has been based on the overburden and rock characteristics and the data obtained from a hydrogeological investigation undertaken primarily during the period from 2012 to 2013. Details of the groundwater modelling is provided in the hydrogeological appendix (Appendix M) to the revised EIS.

Physiographic Setting

As described in Appendix M to the revised EIS, the Project is located within the Wabigoon Basin. The Upper English Basin Watershed lies immediately to the northeast of the project area. The area is characterised by gently undulating topography with elevations generally between 370 and 430 metres above sea level (masl). Topography has been strongly influenced by glaciation, which on higher ground has left bedrock exposed, and in lower lying areas has thicker sedimentary deposits primarily of glacial origin. The overburden thickness is generally thin (<10 m) and mostly of glaciolacustine. In the north-eastern part of the study area, a regionally mapped end-moraine, known at the Hartman Moraine, occurs. There are no large creeks in the vicinity of the Project.

The area of the Project site is drained primarily by Blackwater Creek and its tributaries, which drains into Wabigoon Lake. Wabigoon Lake is the most prominent waterbody in the area and has elevations regulated between elevations of 368.5 and 369.2 masl (MNRF, 2013). The Project area is also drained by the following four watercourses that drain into Thunder Lake:

- Thunder Lake Tributary 2;
- Thunder Lake Tributary 3;
- Hoffstrom's Bay Tributary; and
- Little Creek.

Overburden and Shallow Bedrock Geology

The surficial deposits of the study area are predominantly glacial in origin, with the area have undergone a number of glaciations. The deposits are considered to be mainly associated with the last period of glaciation (Minning et al., 1994). The surficial deposits are broadly subdivided into two the following main deposit types:

- In the north east, surficial deposits are predominantly sandy and coarser grained deposits including boulders of the Hartman Moraine; a major regionally mapped end moraine trending north-west to south-east and marked by a ridge at an elevation of 430 to

450 masl. The north-eastern extent of the watersheds of Blackwater Creek is formed by the Hartman Moraine;

- In the south-west, surficial deposits are predominantly clay and silt deposited in pro-glacial Lake Agassiz (Minning et al., 1994). Progressively finer sediments would be expected in the deeper parts of the Wabigoon Basin towards the south-west.

The characterization of the overburden geology in the study area is the mapping by the Ontario Geologic Service, or OGS (Roed, 1980), and by the geologic Service of Canada, or GSC (Cowan and Sharpe, 1991). Since the publication of both the Cowan and Sharpe (1991) and the Roed (1980) surficial geology maps the following additional data has become available, or been collected by Treasury Metals:

- The water well records from wells drilled after publication of these maps (note these have occurred around Thunder Lake and Wabigoon are not a significant addition to areas immediately around the proposed Goliath open pit).

- The Beakhouse and Pigeon (2003) map, which has delineated locations of bedrock outcrops (shown on Figure 4 of Appendix M to the EIS), and has provided some localized comments on sediments at surface.

- Bedrock outcrop mapping under taken by Treasury Metals in the immediate vicinity of the proposed Goliath open pit (shown on Figure 4 of Appendix A to the EIS). This information is taken to be more accurate than the outcrop location data from Beakhouse and Pigeon (2003) and is used in preference where mapped as indicated on Figure 4 of Appendix M to the EIS.

- The overburden thickness from the exploration boreholes, whose locations are clustered around the east – west trending zone of mineralization that runs through the proposed Goliath open pit.

- Nine groundwater quality wells drilled by Treasury Metals in May 2013 (Appendix A of Appendix M to the EIS for borehole logs).

- Twenty geotechnical boreholes drilled by Treasury Metals in March 2014 (Appendix B of Appendix M to the EIS for borehole logs).

A combination of the above information was used to create the 3D delineation of superficial deposits used in the groundwater model (Figure 4 in Appendix M to the EIS). As both the Cowan and Sharpe (1991) and Roed (1980) maps are 1:100,000 scale maps, neither provide detailed information on the surficial geology in the area of interest around the proposed open pit. It is noteworthy that around the proposed Goliath open pit and immediately to the west and north, the Cowan and Sharpe (1991) map is discordant with the detailed site-specific data as discussed in Section 3.1.1 of Appendix M to the revised EIS. Overall, the Roed (1980) map is more consistent

with the site specific geologic data. The Roed (1980) map was used in preference to the Cowan and Sharpe (1991) to provide supplemental information as it is known to be more accurate in the vicinity of the proposed Goliath open pit. Ultimately, this led to the identification of a larger extent of clay cover around the proposed open pit that was considered to present a conservative assessment of effects for the following reasons:

- It leads to a greater predicted drawdown zone (inflows are controlled by the transmissivity at the open pit); and
- Overall groundwater flow rates are predicted to be lower, which limits the dilution potential of any contaminants entering the groundwater.

From a hydrogeological perspective, the surficial deposits can be subdivided into the following five units:

- Clay: Fine-grained glaciolacustrine deposits of dominantly clay composition (clay, silty clay, layered clay and silt) are located around the Project site and dominate the southern part of the Project area. This unit is an aquitard providing little or no flow to creeks rising on it. The effectiveness of this aquitard is expected increase towards the south-west where the Wabigoon basin deepens.
- Basal Sand: This is a relatively thin discontinuous sand layer at the base of the clay that is on average 3 to 4 m thick, when present. This is a minor aquifer that has limited groundwater flow with a hydraulic conductivity around 1×10-6 m/s.
- Bedrock knolls: These represent areas where the bedrock is exposed or covered with a very thin sand layer.
- Sand-Clay/Silt-Sand: These are units with generally silty sand, overlying a largely continuous clay/silt, overlying the basal sand. These units occur in the north-western part of the Blackwater Creek Watershed (top of Blackwater Creek Tributary 2). The upper sand provides some baseflow to Blackwater Creek and is expected to have a similar hydraulic conductivity as the basal sand.
- Sand and Gravel: These coarser glacial deposits are located mainly on the northern to north-eastern edge of the Project. These are the only reasonable aquifer present within the vicinity of the Project, and are providing baseflow to Thunder Lake Tributary 2 and Thunder Lake Tributary 3.

Overall, it appears that groundwater levels are relatively close to surface and approximately follow topography. Groundwater flow from the Project site follows the surface drainage with flow both to the west towards Thunder Lake and to the south towards Wabigoon Lake. The information further suggests that the groundwater regime has limited groundwater flow that groundwater provides minimal baseflow to creeks in the immediate vicinity of the Project site, and for much of the Project

area. The creeks in the area of the proposed Project are runoff dominated. Groundwater baseflow represents a small proportion of the total flow in the surface watercourses near the Project.

6.11.2.2 Prediction Method for Groundwater Flow

A numerical three-dimensional steady-state groundwater flow model was developed, based on surficial and bedrock geology and used to predict the potential effects of the Project on groundwater quantity. The modelling is based on the Modular Finite-Difference Groundwater Flow Model (MODFLOW) platform originally developed by McDonald and Harbaugh (1988) for the United States Geological Survey (USGS). The MODFLOW modelling platform is a groundwater flow simulator that has been accepted by regulatory agencies and used extensively for a variety of applications. Specifically, the fully integrated Visual MODFLOW (Version 4.6) platform developed by Schlumberger Water Services (SWS, 2011), was used to assemble the input data for the groundwater flow model and to present the MODFLOW output results. Simulations were conducted by using the MODFLOW-NWT version of MODFLOW (Niswonger et. al., 2011).

Steady-state groundwater flow models were developed for the pre-mining (i.e., existing conditions), fully mined and post-closure conditions. The model corresponding to the existing conditions was calibrated to observed groundwater water levels and baseflow contribution to some of the creeks. The developed model was used to simulate groundwater flow in both the overburden and bedrock aquifer zones. Although MODFLOW was primarily developed to simulate flow in porous media it is often used for groundwater flow modelling in fractured rocks if they behave as equivalent porous media at the scale of study.

The conceptual understanding of the hydrogeological conditions was compiled, and used to construct the numerical groundwater flow model. The model considered the following hydrostratigraphic units:

- Clay;
- Basal sand;
- Sand-clay/silt-sand;
- Sand and gravel;
- Shallow bedrock;
- Intermediate bedrock; and
- Deep bedrock

The application of these hydrostratigraphic units the model was constructed in the following way:

- Where surficial clay is absent, it was replaced by sand and gravel (i.e., kame and glaciofluvial outwash) or bedrock outcrop (bedrock knolls);

- The sand-clay/silt-sand unit was simulated as two layers. The upper layer represents sand above clay/silt and has a horizontal hydraulic conductivity the same as the Basal Sand unit and a vertical hydraulic conductivity the same as the Clay unit. The lower layer is treated the same as the Basal Sand unit.

The overburden unit contact elevations for the groundwater model have been derived from the geological data available. The bedrock unit surface elevations are based on data available from the hydrogeological and geomechanical investigations, as well as information from the Treasury Metals' resource model.

The deformation zone of the Central Unit, coinciding in the Project area with the Main Zone and C subzone (Figure 11 in Appendix M to the EIS) was simulated as a bedrock zone with increased hydraulic conductivity, compared with the surrounding country rock. The deformation zone was assumed to extend north-east and further west, towards Thunder Lake, from the project site, based on the aeromagnetic anomalies mapped by Caracle Creek (2008a) and Beakhouse and Pigeon (2003).

The regional-scale Wabigoon fault (Figure 6 in Appendix M to the EIS) was assumed to act as discrete vertical feature with lower hydraulic conductivity reducing groundwater flow in bedrock across the fault. The Wabigoon Fault is an inferred structure in the Thunder Lake – Wabigoon Lake area and its geological characteristics are not well known. It may be considered a ductile shear zone based on the brief overview of the surrounding geology given by Beakhouse (2000, 2001). Ductile shear zones are characterized by crystal plastic deformation with generally no development of brittle fractures. Such a shear zone may have lower hydraulic conductivity than the surrounding bedrock, particularly in the direction perpendicular to the shear zone foliation (in this case east – west).

6.11.3 Project Effects Avoidance Measures Used in Predictions

Dewater of the open pit and underground is needed in order to provide a safe working environment, and is thus essential to the success of the Project. There are no credible ways to avoid the need or requirement for dewatering. However, the following natural features of the local geology help avoid the effects of the dewatering and associated drawdown zone:

- Groundwater baseflow is not an important component of the baseflows in Little Creek or Hoffstrom's Bay Tributary. These tributaries are runoff dominated, sit atop clay, and have little or no baseflow from groundwater.

- Although Blackwater Creek appears to have a higher contribution of groundwater baseflow than either Little Creek or Hoffstrom's Bay Tributary, the baseflow is not a significant

contributor as flows in Blackwater Creek have been shown to cease during dry years (e.g., 2011).

6.11.4 Predicted Effects

6.11.4.1 Site Preparation and Construction Phase

During the site preparation and construction phase, the emphasis of the Project is on clearing and preparing the site for the mining activities during operations. One of these activities will be the removal of the overburden from the open pit and subsequent placement in the overburden storage piles for use in the reclamation of the site during closure. The clearing of the overburden would require limited dewatering of the surficial layer that would only have a localized effect on the shallow groundwater. These effects are not expected to extend beyond the mine footprint.

6.11.4.2 Operations Phase

Once operations start, dewatering activities of the open pit will commence. The amount of water that will flow into the open pit and underground mine workings will increase to a maximum level once the mine is fully developed.

The dewatering activities will continue throughout the operations phase will create a drawdown of the groundwater tables that will extend beyond the limits of the mine footprint. The predicted drawdown within the basal sand/shallow bedrock aquifer as a result of dewatering was modelled as described in Section 6.11.3 and detailed Appendix M to the revised EIS. The results, which are presented in Figure 6.11.4.2-1, show two drawdown lines. The first line is the zone of influence that defines the limits of where the effects of the Project on groundwater quantities would be experienced. The second contour represents the limit of the predicted 5 m drawdown.

Effects on Water Levels in Private Wells

Of the private water wells identified in the LSA (Figure 6.1.4.11-1), 77 wells are located within the zone of influence (ZOI) of the drawdown caused by the dewatering of the open pit and the underground mine. All these wells have some potential to be affected by groundwater drawdown, however, the degree to which they could be affected depends on the following factors:

- The hydrogeological unit from which the groundwater is sourced;
- The depth of the well compared to static water level, specific capacity of well and pump intake depth;
- The amount of drawdown at the well location; and
- The local hydrogeological setting of the well, specifically the proximity and connection to recharge boundaries and/or sources.

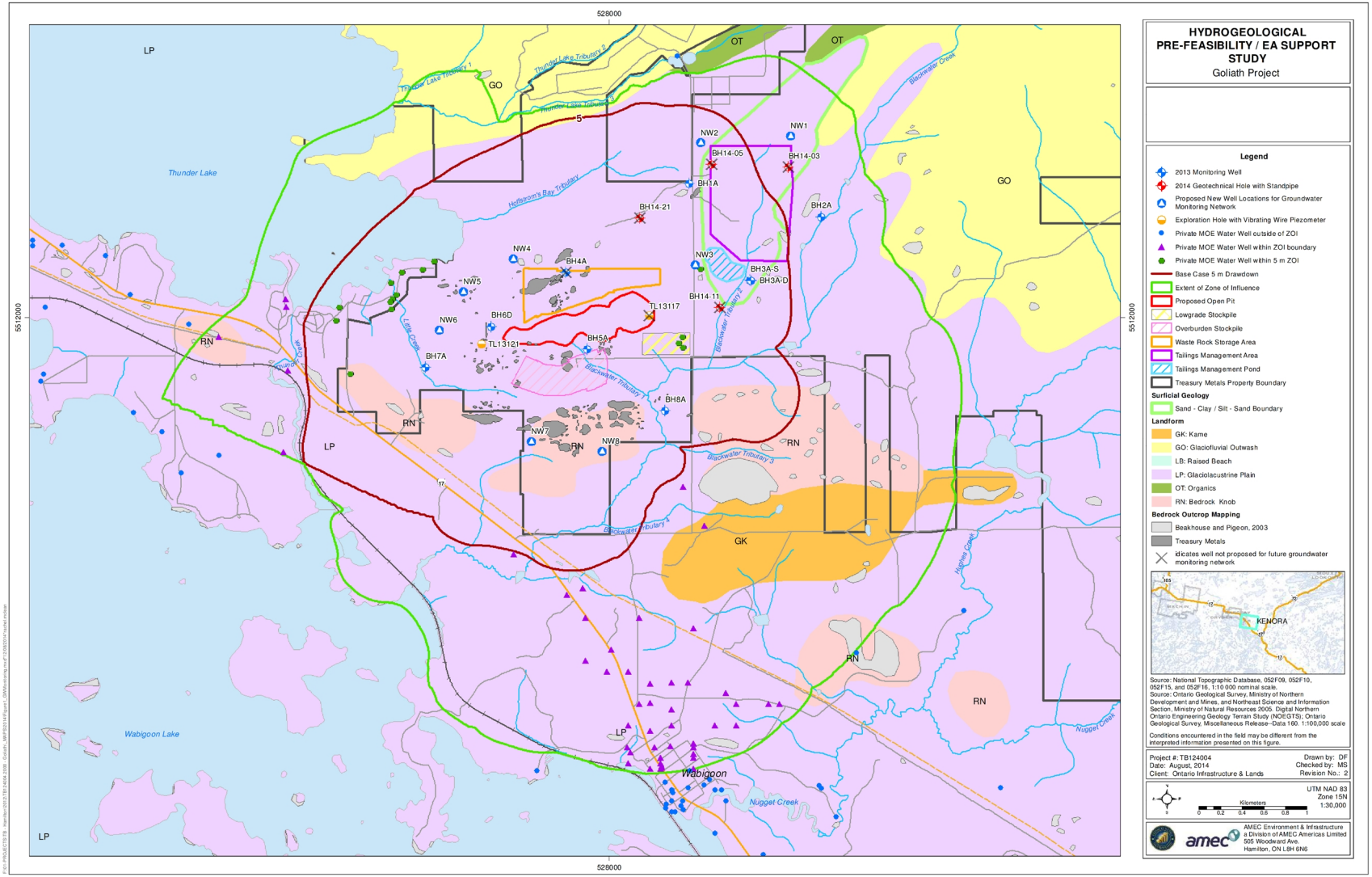


Figure 6.11.4.2-1: Predicted Groundwater Drawdown during Operations

- The risk of the dewatering activities affecting the wells within the ZOI were characterized primarily based on the level of drawdown and the potential recharge, as described in Table 6.11.4.2-1.

Table 6.11.4.2-1: Potential Risk to Private Wells

Group of Wells	Description	Mitigating Factor	Risk of Effects to Private Wells
55 wells within ZOI but outside 5 m drawdown	5 wells near Thunder Creek	Thunder Creek hydraulically connected to bedrock and basal sand	Low to very low
	35 wells around Wabigoon	Located close to Kame sand and gravel deposit	Low to very low
	15 wells to southwest of Project	—	Low to moderate
22 wells within the 5 m drawdown	5 wells within the Project	NA	NA
	17 wells outside the Project	5 wells > 30 m deep	low
		12 wells < 25 m deep	Moderate to high

Effects on Surface Water Flow Patterns

Most of the watercourses in the vicinity of the Project are runoff dominated creeks that have watersheds that sit predominantly on clay. The likely effects of dewatering on the surface water flows in the surrounding watercourses are as follows:

- Groundwater baseflow is not an important component of the baseflows in Little Creek or Hoffstrom's Bay Tributary, which are both tributaries of Thunder Lake. These tributaries are runoff dominated, sit atop clay, and have little or no baseflow from groundwater. Any changes in flows in these watercourses would be so small that they would not be measurable.

- Blackwater Creek would appear to have a higher contribution of groundwater baseflow; however, this baseflow is not a significant contributor as flows in Blackwater Creek have been shown to cease during dry years (e.g., 2011), particularly in the upper reaches. It is highly unlikely that the changes in flows in this watercourse due to dewatering would be measurable. Additionally, any small decreases in the flows in Blackwater Creek would not be distinguishable from the additional flows from treated effluent during operations,

- Thunder Lake Tributary 2 and Thunder Lake Tributary 3 are the exception in the area, with coarser material associated with the Hartman Moraine beneath portions of the streams. The groundwater modelling indicates that the dewatering of the open pit and underground mine could reduce the total groundwater baseflows within these watersheds by as much as 150 m^3/d.

Groundwater Inflows and Seepage Amounts

During the operations phase, when active dewatering is occurring, groundwater will inflow to the open pit and underground workings where it will be collected and used in the minewater management system. The estimated inflow rates for the base modelling case (Appendix M to the EIS) were 1,320 m³/d. Sensitivity analyses completed on the groundwater modelling presented in Appendix M to the EIS indicated that these inflow rates could range between 1,000 and 1,900 m³/d.

Seepage from the on-site structures (e.g., waste rock storage area (WRSA) and tailings storage facility (TSF)) will be managed by a series of perimeter seepage collection systems around each structure. These seepage collection systems will capture the majority of the seepage, which will be collected and incorporated into the minewater management system. However, no system can be relied on to capture 100% of the seepage. The seepage that escapes the seepage collections systems during the operations phase will be captured by the drawdown zone created by the dewatering of the open pit and underground mine. The seepage will be directed towards the open pit where it will be collected and incorporated into the minewater management system. There will be no seepage from the on-site structures during the operations phase that will leave the site.

6.11.4.3 Closure Phase

At the end of mining operations, the dewatering activities will cease and the open pit and underground mine will be allowed to start filling with water. Although the dewatering will no longer be occurring during the closure phase, the drawdown of the groundwater during operations will take more decades to fully recover to near pre-development conditions. Therefore the effects described for operations will remain throughout the closure phase.

Effects on Water Levels in Private Wells

The ZOI and drawdown zone created by the dewatering of the open pit and underground mine will not have had sufficient time to recover during the closure phase; therefore, the effects on private wells are expected to be the same as during operations. The number of wells at risk, and the level of risk to effects related to the groundwater drawdown were provided in Table 6.11.4.2-1.

Effects on Surface Water Flow Patterns

The ZOI and drawdown zone created by the dewatering of the open pit and underground mine will not have had sufficient time to recover during the closure phase, therefore the potential effects of groundwater drawdown on surface water flows are expected to be the same as during operations.

Groundwater Inflows and Seepage Amounts

Once mining operations end and dewatering activities cease, the open pit will be allowed to start refilling with water. The groundwater modelling indicates a groundwater inflow rate to the open pit will reduce once dewatering stops to an average volume of approximately 700 m^3/day while the open pit is filling with water.

The drawdown of groundwater during the operations phase will continue through to the closure phase. Seepage from the on-site structures (e.g., WRSA and TSF) that escapes the seepage collection systems will be captured by the drawdown zone created by the dewatering during operations, and will be directed towards the open pit. There will be no seepage from the on-site structures during the closure phase that will leave the site.

6.11.4.4 Post-closure Phase

Over time, the groundwater will recover to near pre-development levels. It is expected to take decades following the end of dewatering for groundwater levels to fully recover. Therefore the effects caused by dewatering will remain until the groundwater levels recover.

Effects on Water Levels in Private Wells

As the groundwater levels recover with time, the number of private wells potentially affected by the groundwater drawdown will diminish. The effects predicted for private wells are expected to be similar to those effects during the operations phase and at the start of the post-closure phase which is decreasing to no effects.

Effects on Surface Water Flow Patterns

As the groundwater levels recover with time, any effects of drawdown on surface water will decrease to return to pre-development conditions.

Groundwater Inflows and Seepage Amounts

As the open pit is filling with water, the modelling estimates that groundwater will inflow at an average about 700 m^3/day. Once the open pit is completely flooded, the modelling indicates that there will continue to be an inflow of groundwater to the open pit, at an estimated rate of 100 m^3/day.

Once the open pit is flooded and the groundwater levels return to near pre-development conditions, seepage from the on-site structures (e.g., WRSA and TSF) that escape the seepage collection systems will leave the site. Groundwater modelling estimated the volumes of seepage leaving the site, as well as the surface watercourses where the seepage will report. The effects of this seepage have been incorporated into the surface water quality modeling described in

Section 6.8.4. The estimated volumes of seepage and the surface waterbodies where the seepage is predicted to report are summarized in Table 6.11.4.4-1.

Table 6.11.4.4-1: Estimated Seepage Quantities during Post-Closure

Waterbody Receiver	Volume of Discharge (m^3/day)		
	Capped WRSA (1)	Capped TSF (2) (dry cover)	Uncapped TSF (3) (wet cover)
Thunder Lake	10	much less than 10	10
Thunder Lake Tributary 3	—	much less than 10	20
Hoffstrom's Bay Tributary	—	10	10
Blackwater Creek	—	30	50
Open Pit	20	10	—
Total Seepage	**30**	**50**	**90**

Notes:
(1) Seepage quantity for capped WRSA from Figure 25 of Appendix M of the EIS
(2) Seepage quantities for dry cover TSF from Figure 24 of Appendix M of the EIS
(3) Seepage quantities for wet cover TSF from Figure 22 of Appendix M of the EIS

6.11.5 Identified Mitigation

The following mitigation measures are available for managing the effects of the Project on groundwater quantity:

- Deepen those wells where the drawdown affects the wells ability to provide the required water supply [Mit_063].

- Financial assurance will be provided to MNDM to deepen neighbouring residential wells, if required, as part of Project start-up approvals [Mit_064].

6.11.6 Residual Adverse Effects

The application of the identified mitigation measures would eliminate the adverse effects of the Project caused by the decrease in elevations in private wells. As a requirement of the permitting process for the Project, Treasury Metals will be required to provide financial bonds sufficient to deepen wells affected by the drawdown of the water caused by the dewatering during operations. However, the decrease contribution of groundwater to the flows in the Thunder Lake Tributary 2 and Thunder Lake Tributary 3 catchment will remain as a residual adverse effect. The residual adverse effects of the Project on groundwater quantities as summarized in Table 6.11.6-1.

The spatial extent of the effects to groundwater quantity as a result of the Project are limited to flow reductions in Thunder Lake Tributaries 2 and 3. The remaining watercourse located within the drawdown zone of the Project have been identified as being underlain by clay and silt substrates, which large isolates these watercourses from the drawdown effects of the Project. Additionally, there are no adverse effects to groundwater levels in private drinking wells as Treasury Metals is required to deepen those wells that become dry as a result of the Project.

Table 6.11.6-1: Residual Adverse Effects on Groundwater Quantity

Indicator	Site Preparation and Construction	Operations	Closure	Post-closure
Decreasing elevations in private wells	—	—	—	—
Decreasing contribution to surface flow patterns	—	Decrease in average flows for Thunder Lake Tributary 2 and 3 watershed for due to reduction in groundwater baseflow 1.2%: average year 4.4%: dry year 0.7%: wet year	Decrease in average flows for Thunder Lake Tributary 2 and 3 watershed for due to reduction in groundwater baseflow 1.2%: average year 4.4%: dry year 0.7%: wet year	Decrease in average flows for Thunder Lake Tributary 2 and 3 watershed for due to reduction in groundwater baseflow 1.2%: average year 4.4%: dry year 0.7%: wet year

Note:
The "—" symbol indicates where no residual adverse effects were predicted

6.11.7 Information to Address Round 1 Information Requests

The following questions regarding the predicted effects on groundwater quantity were received as part of the Round information requests:

- TMI_49-MW(1)-11: seepage from TSF;
- TMI_62-MW(1)-24: effects of the Wabigoon Fault;
- TMI_70-GW(1)-07: amounts and effects of seepage;
- TMI_71-GW(1)-08: effects of surficial geology on modelling;
- TMI_72-GW(1)-09: recharge rates in modelling;
- TMI_73-GW(1)-10: characteristics of the Wabigoon Fault;
- TMI_74-GW(1)-11: sensitivity analysis of modelling;
- TMI_77-GW(1)-14: control of infiltrations from the WSRA;
- TMI_82-GW(1)-19: effects of Wabigoon fault and surficial geology on modelling;
- TMI_83-GW(1)-20: travel times for seepage to surface water;
- TMI_84-GW(1)-21: effects of drawdown zone on surface water;
- TMI_85-GW(1)-22: effects of drawdown zone on surface water;

- TMI_86-GW(1)-23: groundwater contribution to flooding of pit;
- TMI_91-SW(1)-05: seepage from overburden and low-grade ore (LGO) stockpiles;
- TMI_103-SW(1)-17: groundwater contribution to flooding of pit;
- TMI_340-AC(1)-14: groundwater quantity effects on surface water and private wells;
- TMI_341-AC(1)-15 groundwater quantity effects and mitigation for private wells;
- TMI_625-AC(1)-298: groundwater effects on TSF;
- TMI_629-AC(1)-302: groundwater flow and quality;
- TMI_632-AC(1)-305: groundwater flow and quality;
- TMI_641-AC(1)-314: interactions between groundwater and surface water;
- TMI_700-PC(1)-15: effects of drawdown on water levels in Thunder Lake;
- TMI_716-PC(1)-31: effects of blasting on wells;
- TMI_717-PC(1)-32: effects and mitigation of water quantity in private wells; and
- TMI_767-PC(1)-82: effects of groundwater on private wells.

6.12 Wildlife and Wildlife Habitat

6.12.1 Potential Effects of the Project on the Environment

The wildlife and wildlife habitat VCs used for assessing the effects of the Project were introduced in Section 6.1.3.11. The Project, as proposed, will involve the clearing of lands and vegetation to accommodate the Project structures and facilities (e.g., processing plant, tailings storage facility [TSF]), as well as for the open pit mine. In addition, the mine will include equipment and activities that can have a direct or indirect effect on wildlife. The potential effects of the Project on the wildlife and wildlife habits VCs for the various Project phase are as follows:

- **Site Preparation and Construction Phase**: Most of the removal of vegetation, displacement of wildlife and disturbance and of soils and overburden will occur during the site preparation and construction phase. The potential effects of these activities on wildlife and wildlife habitat includes the following:
    - Direct loss of habitat as a result of vegetation clearing and overburden stripping;

- Functional loss of habitat as a result of fragmentation and noise levels;
- Wildlife exposure to compounds released through from Project activities;
- Direct mortality of species due site clearing and construction activities; and
- Direct mortality of species as a result of vehicle collisions.

- **Operations Phase**: Once mining starts, most of the activities at the site will be occurring within the limits of the areas disturbed during the site preparation and construction phase. As operations progress, waste rock will continue to be added to the waste rock storage area (WRSA) until the mined out portions of the open pit can be used. As operations continue, the footprint of the TSF will continue to grow as additional tailings are added to it. The potential effects of these activities on wildlife and wildlife habitat includes the following:
  - The effects of direct habitat loss during the site preparation and construction phase will continue through operations;
  - The functional loss of habitat as a result of fragmentation during the site preparation and construction phase will continue through operations;
  - Direct habitat loss due to the expansion of the WRSA and TSF footprints;
  - Functional loss of habitat as a result of light and noise;
  - Wildlife exposure to compounds released through from Project activities; and
  - Direct mortality of species as a result of vehicle collisions.

- **Closure Phase**: Following the end of mining activities, the Project facilities will be decommissioned and removed and the site will be re-graded to ensure all runoff drains towards the open pit. The process water covering the TSF will be withdrawn, treated and used to help fill the open pit. The TSF will be covered with a granular layer to isolate the tailings, and then covered with either a dry low permeability cover, or a wet cover with non-process water to prevent acidification. Suitable plant species will be used to help re-vegetate the site and return it to a condition suitable to support a functioning ecosystem. The potential effects of these activities on wildlife and wildlife habitat includes the following:
  - The effects of direct habitat loss during the site preparation and construction and operations phase will continue until the reclaimed landscape is able to provide replacement habitat;

- The functional loss of habitat as a result of fragmentation during the site preparation and construction phase will continue until the reclaimed landscape can return some of the habitat functionality;
- Functional loss of habitat as a result of noise;
- Wildlife exposure to compounds released through from Project activities;
- Direct mortality of species due reclamation and closure activities; and
- Direct mortality of species as a result of vehicle collisions.

- **Post-closure Phase**: Once the closure activities are complete there will be no further disturbance of habitat or habitat function at the site. With time, the reclaimed closure landscape will begin to replace the loss of habitat and habitat function. The potential effects of the Project on wildlife and wildlife habitat during this phase includes the following:
  - The effects of direct habitat loss will continue until the reclaimed landscape is able to provide replacement habitat;
  - The effects of the of habitat function as a result of fragmentation will continue until the reclaimed landscape can return habitat functionality; and
  - Wildlife exposure to compounds present in the reclaimed landscape (e.g., reclaimed TSF and WRSA).

The potential effects of the Project on wildlife and wildlife habitat have been described using a simple linkage diagram in Figures 6.12.1-1 and 6.12.1-2. The figures illustrate the wildlife and wildlife habitat VCs (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. The figure also indicates the other components or VCs (shown in red on the figure) that can be affected by effects to wildlife and wildlife habits. For example, effects on wildlife and wildlife habitat will be relied on for evaluating the effects of the Project on Aboriginal peoples. Similarly, other components that provide inputs to the evaluation of the effects of the Project on wildlife and wildlife habitat are shown in red on the figure. For example, the effects of the Project on noise are used in determining the effects on the wildlife and wildlife habitat VCs.

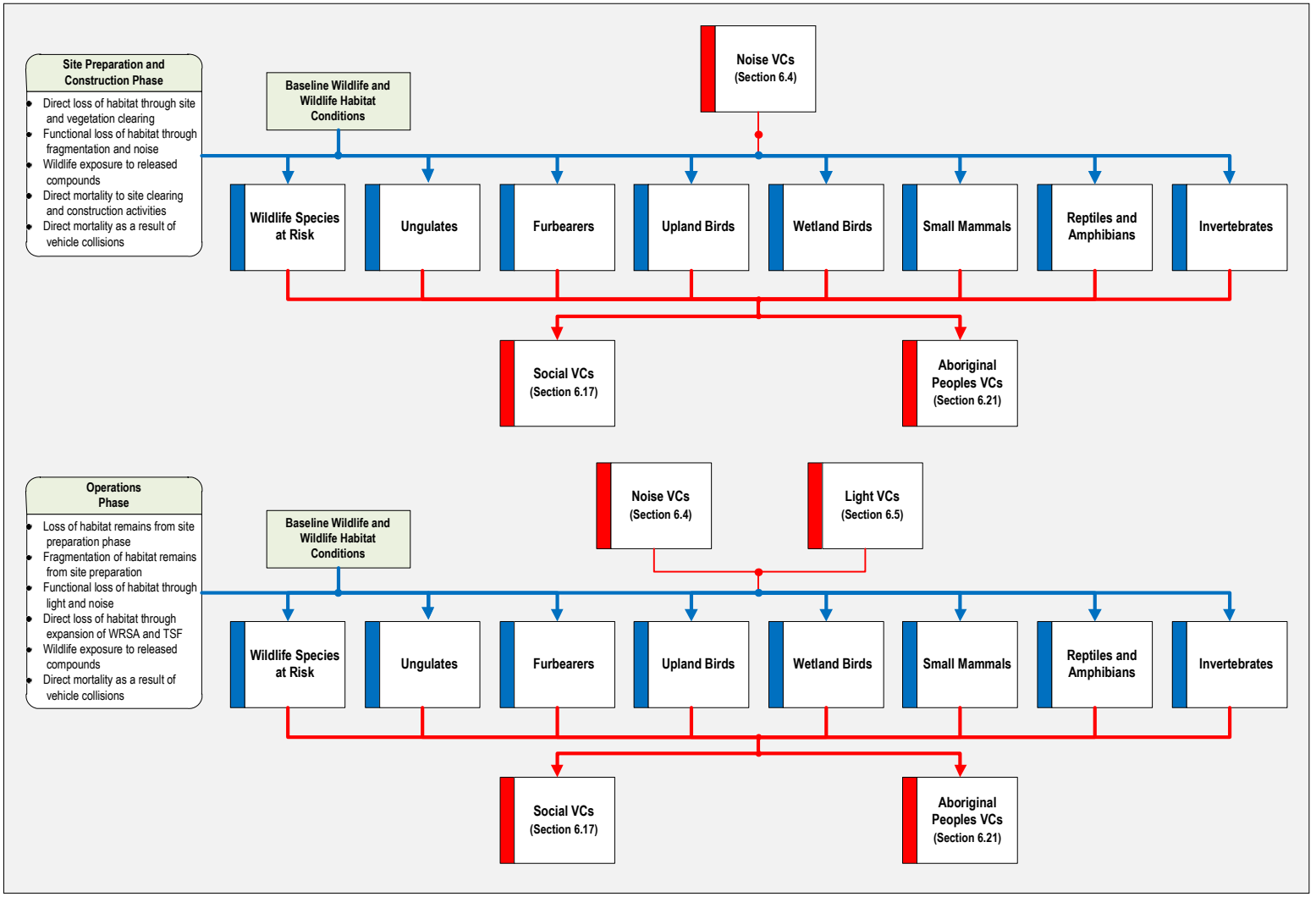


Figure 6.12.1-1: Wildlife and Wildlife Habitat Linkage Diagram

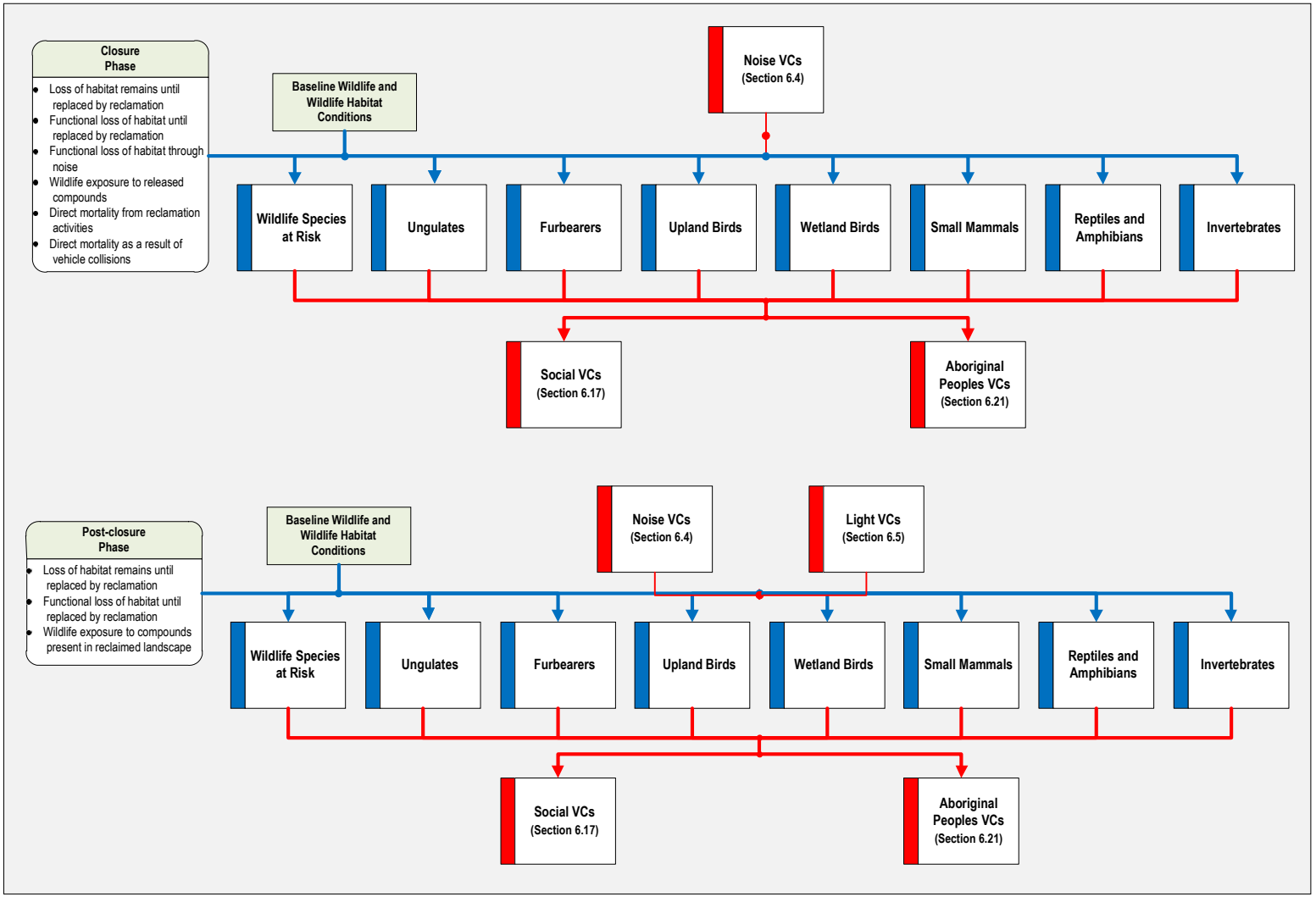


Figure 6.12.1-2: Wildlife and Wildlife Habitat Linkage Diagram (continued)

6.12.2 Effects Prediction Methods

A numerical geographic information system (GIS) approach was used for predicting the effects of the Project on wildlife and wildlife habitat. Modelled wildlife habitat suitability for most VCs using the Ontario Landscape Tool (OLT) (2016, build 3.5.6117), a modeling program developed by the Ontario Ministry of Natural Resources and Forests (MNRF). A variety of habitat suitability models are incorporated into the software (e.g., Holloway, 2004). These models are applied to digital Forest Resources Inventory (FRI) data. Specifically, the OLT overlays a grid of hexagons on the FRI data (as well as built-in datasets with climate information and the location of roads, urban areas, and waterbodies) and determines the suitability of each hexagon as a function of ecosite (forest type) and development stage (forest age class) and — for some species — patch size and climate. Depending on the species, the hexagons are either 0.1 or 0.8 ha in size. These results are then summarized over larger hexagons (normally 1 ha in size) and then averaged and reported for each inventory polygon (Elkie et al., 2013). For moose, two different models are available in the OLT; as the wildlife LSA and RSA is best described as Boreal forest, the modelling used the “bioclimatic” moose models developed by the Centre for Northern Forest Ecosystem Research rather than the OWHAM (Ontario Wildlife Habitat Assessment Model), which was originally built for the Great Lakes-St. Lawrence forest region.

Some VCs, modelled results are not available within the OLT. For these VCs, a habitat suitability models was constructed in ArcGIS (v10.4) using the FRI and other spatial layers available through Land Information Ontario (LIO). Habitat for terrestrial invertebrate species was considered to be suitable throughout the study areas, excepting water bodies and bedrock. All areas except water were considered suitable for small mammals. For reptiles and amphibians, potential habitat was considered to include wetlands and 120 m around all wetlands surrounded by forests.

For bats, we selected the following ecosites, which the MNRF indicates provide suitable roosting and maternity roost habitats (see also MNRF 2011):

- B015-019 Very Shallow: Dry to Fresh: Mixedwood/hardwood;
- B023-028 Very Shallow: Humid: Conifer/Mixedwood;
- B039-043 Dry, Sandy: Hardwood/Mixedwood;
- B054-059 Dry to Fresh: Coarse: Mixedwood/Hardwood;
- B069-076 Moist, coarse: Mixedwood/Hardwood;
- B087-092 Fresh, Clayey: Mixedwood/hardwood;
- B103-108 Fresh, Silty to Fine Loamy: Mixedwood/Hardwood;
- B118-125 Moist. Fine: Mixedwood/Hardwood; and

- B130-133: Swamps.

As roosting habitat is primarily in tree snags and cavities, potential bat habitat was further refined by selecting those polygons with forests greater than 40 years in age, at least 10 m in height, and not simply single-storied (i.e., are two-tiered, complex, and/or contain veteran trees).

6.12.3 Project Effects Avoidance Measures Used in Predictions

The following are effects avoidance measures that will be utilized to reduce potential adverse effects to wildlife and wildlife habitat.

- Minimized the amount of habitat clearing required for the Project by optimizing the pit design and siting Project infrastructure in previously disturbed areas [Mit_050, Mit_065].
- Optimized utilization of existing road network [Mit_065].
- Provide vegetated buffers of 120 m along rivers creeks and wetlands wherever feasible [Mit_066].
- Conducting timber clearing outside of the breeding bird window (May 1 to August 15) to avoid potential mortality to birds. This will also protect roosting bats [Mit_067].
- Proper management of WRSA, including covering with a low-permeability dry cover at closure to help manage ARD [Mit_018].
- Restoration of disturbed habitats at closure or encouraging development of habitats capable of supporting a diversity of wildlife species [Mit_068].
- Enforcement of speed limits within the Project area to reduce the potential for wildlife/vehicle collisions [Mit_069].
- Protection of suitable bird breeding habitat, where possible [Mit_070].
- Wildlife awareness training for all staff including SAR identification/legislation and education regarding seasonal changes in animal behaviour and their presence [Mit_071].
- Disposing of food waste generated on site in an appropriate manner to limit wildlife attraction to the area [Mit_072].
- Restricting the clearing of potential terrestrial reptile and amphibian breeding habitats to periods outside the breeding season as directed by MNRF [Mit_073].

- Implementation of noise abatement strategies to limit the negative effects of sound on wildlife [Mit_025, Mit_028, Mit_029, Mit_031].

- Develop a wetland clearing strategy with the local MNRF reduce the effects to overwintering frogs (e.g., draining wetlands to discourage hibernation) [Mit_074].

- Where feasible, direct anthropogenic lighting to reduce excess production of light into the surrounding environment [Mit_034, Mit_035, Mit_036, Mit_037, Mit_038, Mit_039, Mit_040, Mit_041, Mit_042].

6.12.4 Predicted Effects

The predicted effects of the Project on wildlife and wildlife habitat will vary throughout the Project life, depending on the Project phase, and will vary according to specific levels of activity. Project effects will also vary by VC.

6.12.4.1 Site Preparation and Construction Phase

Wildlife Species at Risk

Common Nighthawks are currently listed as Threatened federally, and Special Concern provincially, therefore they are afforded general habitat protection under the *Ontario Species at Risk Act*, and under the Migratory Birds Convention Act. Two Common Nighthawk were recorded calling in the tree nursery in 2011 and a single Common Nighthawk was heard during WPW surveys in 2012 on Tree Nursery Road. Suitable nesting habitat occurs in the sandy openings in the tree nursery grounds as well as the cutover immediately to the north. The species likely nests in the LSA. Common Nighthawks nest in a wide range of habitats including open and vegetated sites such as sand dunes, beaches, recently harvested sites, burned areas, rocky outcrops, grasslands, peat bogs, marshes and mixed and coniferous stands (Environment Canada 2012). Common Nighthawks have also been known to nest on manmade structures and in aggregate pits and quarries.

Vegetation clearing and construction will remove a total of 300 ha of forested habitat, which may provide suitable nesting and feeding habitat for Common Nighthawk. However, based on the survey results, none of the vegetation clearing for the construction of Project components will occur in the areas where Common Nighthawks have been heard (i.e., the tree nursery). Sound disturbance during site preparation and construction can have a negative effect on this species as it may interfere with the ability of calling breeding males to attract mates. Sound levels above ambient levels may have an influence on Common Nighthawk behaviour within affected areas, through a reduction in habitat suitability. The total area that may be affected by increased noise levels during this phase of the project is 198 ha of potential habitat. None of the affected habitat lies in the areas where Common Nighthawks have been heard.

Northern Myotis, big Brown Myotis and Little Brown Myotis have all been recorded within the project area. These species are known to be cavity-roosting species. Northern Myotis and Little Brown Myotis were added to the Species at Risk in Ontario List as Endangered in October of 2012, and as such, are currently protected by the ESA. These species require a high density of mature cavity trees (>25 cm at dbh), which they utilize for summer roosting sites and maternity roosting sites. The identification of potential roost habitat involved the Ecological Land Classification (ELC) of key areas potentially impacted by development. A map of the proposed Project footprint for the mine infrastructure was overlaid with Forest Resource Inventory (FRI) data to search for the following ELC communities and ELC codes:

- Deciduous Forests (FOD);
- Mixedwood Forests (FOM);
- Coniferous Forests (FOC);
- Deciduous Swamp (SWD);
- Mixedwood Swamps(SWM); and
- Coniferous Swamps (SWC).
- ELC Codes:
- G/B015-019 Very Shallow: Dry to Fresh: Mixedwood/hardwood;
- G/B023-028 Very Shallow: Humid: Conifer/Mixedwood;
- G/B039-043 Dry, Sandy: Hardwood/Mixedwood;
- G/B054-059 Dry to Fresh: Coarse: Mixedwood/Hardwood;
- G/B069-076 Moist, coarse: Mixedwood/Hardwood;
- G/B087-092 Fresh, Clayey: Mixedwood/hardwood;
- B103-108 Fresh, Silty to Fine Loamy: Mixedwood/Hardwood;
- B118-125 Moist. Fine: Mixedwood/Hardwood; and
- B130-133: Swamps.

Forest stands possessing this ELC information were highlighted by the MNRF as having potential for bat roost habitat. The FRI data (Wabigoon (2010) and Dryden (2015) Forest Resource Inventory) were searched using ArcMap (v.10.3.1) to determine the locations of the fore mentioned ELC communities and codes, which led to the identification of three stands as having the potential for maternity roost habitat. These stands were then ground surveyed to determine the potential for roost sites. Once potential roost sites were located, an exit survey was conducted to determine its use. Two exit surveys were completed, which investigated all potential roost sites. A total of 2 bats were observed, but failed to be recorded on the ultrasonic recorder. The site preparation and construction phase of this Project will remove approximately 15.85 ha of potential roosting habitat.

It is not anticipated that the sound levels generated by site clearing and construction will interfere with the echolocation, and therefore the hunting success, of these bat species. Sound pulses generated by bat species are generally above 18 kHz, which is well above the frequency of any traffic or construction activities that will be associated with the Project.

Although vehicle/bat collisions are uncommon, collisions with vehicles will be a risk to bats found in the project area, and this risk will increase as traffic during this phase of the project increases.

Bats are insectivores, and as such, they tend to feed in areas of high insect density. Natural sources of these areas include forest edges and wetlands, lakes and ponds. Any reduction to wetlands as a result of the project may reduce potential feeding areas for bats. A total of 33 ha of wetlands are planned for removal during the site preparation and construction phase. Lights can be considered an anthropogenic source of high insect densities. The use of lights during site preparation and construction activities are expected to be limited as the majority of these activities will occur during the day. There will, however, be period when localized sources of light will be required for safety reasons. T use of artificial light sources during construction may produce areas of high insect densities, as nocturnal insects are commonly attracted to artificial light sources.

Barn Swallows are listed as Threatened provincially and federally. As such, they are provided protection under the ESA and the SARA. Barn Swallows have been observed in the buildings at the tree nursery as well as in some out buildings at a residence within the Project area. A concerted effort was made to close all doors and windows of the buildings at the tree nursery, which eliminated nesting opportunities for Barn Swallows. Barn Swallows are known to nest in human-built structures such as barns, sheds and the overhangs of houses. They will also nest in culverts and under bridges, as well as natural rock faces. The residence and associated outbuildings will be removed as part of the site preparation and construction phase of the project. The removal of these buildings will displace approximately 3 to 5 breeding pairs of Barn Swallow.

Mortality as a result of vehicle collisions is a serious risk to Barn Swallows, as their behaviour is directly linked to anthropomorphic structures and activities. Barn Swallows are aerial insectivores, and this behaviour puts them at high risk for collisions with vehicles.

Ungulates

White-tailed deer and moose both occur within the LSA and the RSA, however, both are rare occurrences within the LSA due to a low amount of suitable habitat. Moose were chosen as the indicator for representing ungulates because of the greater availability of moose habitat compared to deer habitat. There is an extremely low amount of summer or winter deer habitat located within the LSA. Moose populations have benefitted from anthropogenic alterations to the landscape, primarily forestry operations and forest management planning.

Moose are the primary ungulate which is managed for by the MNRF in this area through the emphasis of moose habitat management and through a lack of management for deer habitat. The project area is located in the OMNRFs Cervid Ecological Zone (CEZ) C1. The management direction for this zone is to maintain moderate to high density populations of moose through the provincial moose management program. The management direction for White-tailed deer for CEZ C1 is to maintain low density populations through the provincial deer management program (MNRF 2009).

Areas of potential moose densities >0.3/km^2 were modelled for the LSA and RSA through the use of the Ontario Landscape Tool (OLT). The OLT uses Landscape Scripting Language, which is a proprietary tool for Geographic Information Systems (GIS) developed by the OMNR (Elliot et al., 2010). Potential moose densities were estimated by accessing standard forest unit classifications found in Forest Resource Inventory (FRI) data, biogeoclimatic models, and a moose habitat suitability index. A full description of the models and inputs can be found in Elkie et al. (2013).

The total area of potential moose densities >0.3/km^2 for the RSA is 22,632 ha (7% of the RSA), and 220 ha for the LSA (4% of the LSA). It is estimated that a total of 84 ha of moose habitat with the potential to support densities of >0.3/km^2 will be displaced during site preparation and construction phase. This could result in loss of habitat with the potential to support 0.25 moose within the LSA. An additional 57 ha of habitat could be affected during construction through noise levels above 50 dBA. This could result in loss of habitat with the potential to support an additional 0.17 moose within the LSA. This would result in an overall potential loss of 0.42 moose within the LSA throughout this phase of the project.

Increased traffic during the site preparation and construction phase may increase vehicle collisions with ungulates. This may affect local moose populations as well as humans. It is not anticipated that the increased traffic will affect any moose habitat linkages, as the existing site is already highly fragmented through harvesting, anthropogenic developments, utility corridors and access roads, and is not currently used as a travel corridor by moose.

Furbearers

American Marten are currently managed through the forest management planning process, whereby forest management planning teams develop long-term marten core areas in order to support marten populations. By managing for the habitat requirements of this species, many other

boreal species are also provided suitable habitat. American Marten can be considered an umbrella species. Marten habitat was mapped for the RSA, LSA and Project footprint using the OLT. American Marten habitat appears to be abundant throughout the RSA (30,552 ha), and the LSA (1,297 ha). Site preparation and construction will remove approximately 62 ha of American Marten habitat. American Marten densities tend to be between 0.4 and 1.2/km^2 (Watt et al 1996), therefore, this phase of the Project would potentially displace 0.25 to 0.74 individuals. An additional 14 ha of habitat could be affected during construction through noise levels above 50 dBA. Increased noise levels can cause habitat to become unsuitable resulting in avoidance. Sound disturbance can also mask the sound of nearby predators or prey; affecting predation avoidance and hunting success (Blickley and Patricelli 2010). This could result in loss of habitat with the potential to support an additional 0.06 to 0.17 individuals within the LSA. This would result in an overall potential displacement of 0.31 to 0.91 American Marten within the LSA throughout this phase of the project.

Project site preparation and construction may also affect American Marten through the unintended provision of attractants such as plastics and garbage. This can result in mortalities through the consumption of non-edible materials, and the need to trap and relocate or destroy nuisance animals. Although traffic volume is expected to increase during this phase of the project, marten vehicle collisions are not expected to increase, as the effects of traffic mortality on mid-sized mammals has been shown to be neutral (Fahrig and Rytwinski 2009).

Upland Birds

For the purposes of this Project, upland habitat was considered to be all ecosites with a dry to fresh moisture regime, that also have well drained soils (northwestern Ontario ecosites: ES1 to ES17) and all developed areas (as these are generally agricultural or meadow type habitats). Upland habitats constitute 34,710 ha within the RSA, and 448 ha within the LSA. Common bird species associated with the upland habitats during point count surveys included many of the warblers and thrushes, as well as some sparrows (Clay-coloured sparrow, Savannah sparrow, LeConte's sparrow) and northern harrier as examples.

The site development and construction phase of this project will result in the loss of 95 ha of upland habitat (all of which is currently considered developed areas). Some upland avian species have been shown to decline at sound thresholds above 48 dBA, while other studies (Dooling and Pooper 2007) have shown that sound masking for avian species can occur at 50 dBA. Modelling for this project indicated that site preparation and construction sounds greater than 50 dBA will disturb 3.21 ha of habitat. The most common adverse effect of sound includes masking important communication signals which reduces the chances of breeding males to attract mates and to defend their territories. Sound disturbance can also mask the sound of nearby predators; increasing mortality through predation (Blickley and Patricelli 2010).

Increased traffic volume also has the potential to increase avian mortality of upland species through increased collisions with vehicles.

Wetland Birds

Despite the name “Marsh Birds”, these species are not exclusively associated with marshes, but can be associated with any wetland area provided it has suitable vegetative habitat (primarily robust emergent vegetation). Between 2011 and 2016, Marsh Bird Surveys took place at 11 locations throughout the LSA. Although many wetland associated bird species were observed or heard during the surveys, on one Marsh Bird target species was heard (a single Sora in 2012).

The site preparation and construction phase of the project will require the removal of 33 total ha of wetlands, which in turn will eliminate the associated Marsh Bird habitat. During the site preparation and construction phase, an additional 2.9 ha of Marsh Bird habitat may be affected by noise levels above 50 dBA.

Small Mammals

Small mammal trapping occurred throughout the LSA in 2012 and 2016, with 32 and 11 individuals captured respectively. Six species were captured including southern red-backed voles, deer mice, northern short-tailed shrew, red squirrel, least chipmunks, and a meadow jumping mouse.

For the purposes of this Project, potential small mammal habitat was considered to be the entire LSA with the exception of any waterbody. Potential small mammal habitat constitutes 226,164 ha of the RSA, and 4,401 ha of the LSA.

The site development and construction phase of the Project will result in small mammal habitat alteration, opposed to habitat loss, as seen for other species. This is due to the fact that small mammals occupy many niches in the ecosystem. Some require mature undisturbed forest, while others thrive in anthropogenically altered landscapes. A total of 400 ha will altered as a result of this phase of the Project. Few studies have investigated the effects of noise on small mammals, and in fact, the range of sound frequencies heard by small mammals is unknown (Bissonette and Rosa 2009). For the purposes of this project, and to potentially err on the side of caution, we have assumed that noise levels of 50 dBA or greater may have a negative impact on small mammal communities. Modelling for this project indicated that site preparation and construction sounds greater than 50 dBA will disturb 181 ha of habitat. Sound disturbance can also mask the sound of nearby predators; increasing mortality of some species through predation (Blickley and Patricelli 2010).

Collisions with vehicles can impact a significant number of small mammals breeding and dispersion periods. Given that small mammals commonly attempt to cross roads, increased vehicular traffic will likely cause increased mortality in the LSA during site development and construction, particularly in the fall, when dispersion of young small mammals is highest.

Reptiles and Amphibians

A total of seven amphibian species were observed in the LSA during baseline surveys between 2011 and 2012. None of these species are considered SAR. Two reptile species, the Western Painted Turtle (*Chrysemys picta belli*) and the Eastern Garter Snake (*Thamnophis sirtalis sirtalis*) were observed during the 2011, 2012, and 2016 field programs, neither of which are SAR. These two reptile species were frequently seen in the LSA.

For the purposes of this project, potential reptile and amphibian habitat was considered to be wetlands and the adjacent forested habitat up to 120 m from the wetland edge. Potential reptile and amphibian habitat constitutes a total of 216,568 ha in the RSA, and 3,538 ha in the LSA.

The site development and construction phase of this project will result in the loss of 162 ha of potential reptile and amphibian habitat. Few studies have investigated the effects of noise on reptiles and amphibians, with most studies to date looking at the effects of low flying aircraft. Of the few investigations to be completed, a variety of effects have been determined. Minton (1968) found suburban noise to have no significant effect on calling anurans, and Brattstrom and Bondello (1983) found that sustained traffic noise of 98 dBA caused adverse effects to some species. For the purposes of this project, and to potentially err on the side of caution, we have assumed that noise of 50 dBA or greater may have a negative impact on the ability of calling amphibians to attract mates and to defend their territories. Modelling for this project indicated that site preparation and construction sounds greater than 50 dBA will disturb 89 ha of habitat. Sound disturbance can also mask the sound of nearby predators; increasing mortality through predation (Blickley and Patricelli 2010).

Collisions with vehicles can impact a significant number of amphibians and reptiles during seasonal movements between breeding and wintering habitats, and during reptile nesting periods. Given that amphibians and reptiles commonly attempt to cross roads, increased vehicular traffic will likely cause increased mortality in the LSA during site development and construction, particularly in the spring and fall. No distinct locations of significant movements of reptiles or amphibians across roads was observed during field surveys.

Terrestrial Invertebrates

Field observations of invertebrates focused on dragonflies, damselflies, and butterflies. For the purposes of this project, invertebrate habitat was considered to be the entire LSA with the exception of waterbodies and watercourses (i.e., all terrestrial areas).

The site development and construction phase of the Project will result in invertebrate habitat alteration, opposed to habitat loss, as seen for other species. This is due to the fact that invertebrate occupy many niches in the ecosystem. A total of 400 ha of invertebrate habitat will be altered as a result of this phase of the Project. Few studies have investigated the effects of noise on invertebrates. For the purposes of this project, it is being assumed that noise will not have any negative effect on terrestrial invertebrates.

Collisions with vehicles can impact a significant number of terrestrial invertebrates. Given that many invertebrates, particularly flying invertebrates, are commonly found on roads, increased vehicular traffic will likely cause increased mortality in the LSA during site development and construction, particularly in the spring and early summer, when flying insects are most abundant.

6.12.4.2 Operations Phase

Wildlife Species at Risk

The operations phase of the Project is anticipated to occur both day and night, and therefore will require artificial lighting. Common nighthawk have exceptional eye sight, therefore, bright, artificial lights may negatively impact this species, causing them to avoid habitat in or adjacent to the Project site. This, in turn, may affect their foraging efficiency and overall reproductive success. Similar to the site preparation and construction phase, sound disturbance may also have a negative impact on this species. The total area that may be affected by increased noise levels during this phase of the project is 122 ha of potential habitat. None of the affected habitat lies in the areas where Common Nighthawks have been heard.

It is not anticipated that the sound levels generated by operations will interfere with the echolocation, and therefore the hunting success, of these bat species. Although vehicle/bat collisions are uncommon, collisions with vehicles will be a risk to bats found in the project area, and this risk will continue during this phase of the project. The use of lights during operations may produce artificial sources of high insect densities, as nocturnal insects are commonly attracted to artificial light sources at night.

As previously mentioned, Barn swallow are known to nest in human-built structures such as barns, sheds and the overhangs of houses. They will also nest in culverts and under bridges, as well as natural rock faces. Mortality as a result of vehicle collisions will continue to be a risk to Barn Swallow.

Ungulates

The potential effects to moose as a result of direct habitat loss will continue through the operation phase of this Project. An additional 34 ha of habitat could be affected during construction through noise levels above 50 dBA. This could result in loss of habitat with the potential to support an additional 0.10 moose within the LSA.

Increased traffic during the operations phase of the project will continue to have the potential for increased vehicle collisions with ungulates. This may affect local moose populations as well as humans. It is not anticipated that the increased traffic will affect any moose habitat linkages, as the effects of the site preparation and construction phase will persist.

Furbearers

Effects from the site preparation and construction phase of this Project will persist throughout the Operations phase. During this phase, 8 ha of habitat could be affected during operations through noise levels above 50 dBA. This could result in loss of habitat with the potential to support an additional 0.02 to 0.06 individuals within the LSA.

Project operations may also affect American Marten through the unintended provision of attractants such as plastics and garbage. This can result in mortalities through the consumption of non-edible materials, and the need to trap and relocate or destroy nuisance animals. Although traffic volume is expected to increase during this phase of the project, marten vehicle collisions are not expected to increase, as the effects of traffic mortality on mid-sized mammals has been shown to be neutral (Fahrig and Rytwinski 2009).

Upland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the operations phase. Modelling for this Project indicated that operations phase sounds greater than 50 dBA will disturb 4.3 ha of habitat. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

Wetland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the operations phase. During this phase of the project, a total of 7.5 ha of potential wetland habitat may be affected by noise levels above 50 dBA. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

Small Mammals

Alterations to small mammal habitat discussed in the site preparation and construction phase of this Project will persist through the operations phase. Modelling for this project indicated that site preparation and construction sounds greater than 50 dBA will disturb 109 ha of habitat. The risk of collisions with vehicles will persist during the operations phase, and will be of highest risk in the fall, when dispersion of young small mammals is highest.

Reptiles and Amphibians

Impacts to reptile and amphibian habitat discussed in the site preparation and construction phase of this Project will persist through the operations phase. Modelling for this project indicated that site preparation and construction sounds greater than 50 dBA will disturb 60 ha of potential habitat. The risk of collisions with vehicles will persist during the operations phase, and will be of highest concern in the spring and fall.

Terrestrial Invertebrates

Impacts to terrestrial invertebrate habitat discussed in the site preparation and construction phase of this Project will persist through the operations phase. The risk of collisions with vehicles will persist during the operations phase, and will be highest in the spring and fall.

6.12.4.3 Closure Phase

Wildlife Species at Risk

Similar to the site preparation and construction phase, sound disturbance may continue to have a negative impact on Common Nighthawk. The total area that may be affected by increased noise levels during this phase of the project is 192 ha of potential habitat. None of the affected habitat lies in the areas where Common Nighthawks have been heard.

It is not anticipated that the sound levels generated by closure will interfere with the echolocation, and therefore the hunting success, of the bat species. Although vehicle/bat collisions are uncommon, collisions with vehicles will be a risk to bats found in the project area, and this risk will continue during this phase of the Project.

As previously mentioned, Barn swallow are known to nest in human-built structures such as barns, sheds and the overhangs of houses. They will also nest in culverts and under bridges, as well as natural rock faces. Mortality as a result of vehicle collisions will continue to be a risk to Barn Swallow during the closure phase of this Project.

Ungulates

The potential effects to moose as a result of direct habitat loss will continue through the closure phase of this Project. An additional 53 ha of habitat could be affected during closure through noise levels above 50 dBA. This could result in loss of habitat with the potential to support an additional 0.16 moose within the LSA.

Increased traffic during the closure phase will continue to have the potential for increased vehicle collisions with ungulates. This may affect local moose populations as well as humans. It is not anticipated that the increased traffic will affect any moose habitat linkages, as the effects of the site preparation and construction phase will persist.

Furbearers

Effects from the site preparation and construction phase of this Project will persist throughout the Closure phase. During this phase, 14 ha of habitat could be affected during closure through noise levels above 50 dBA. This could result in loss of habitat with the potential to support an additional 0.06 to 0.17 individuals within the LSA.

Project closure may also affect American Marten through the unintended provision of attractants such as plastics and garbage. This can result in mortalities through the consumption of non-edible materials, and the need to trap and relocate or destroy nuisance animals. Although traffic volume is expected to be increased above current levels during this phase of the project, marten vehicle collisions are not expected to increase, as the effects of traffic mortality on mid-sized mammals has been shown to be neutral (Fahrig and Rytwinski 2009).

Upland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the Closure phase. Modelling for this project indicated that closure sounds greater than 50 dBA will disturb 2.6 ha of habitat. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

Wetland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the closure phase. During this phase of the project, a total of 0.7 ha of potential wetland habitat may be affected by noise levels above 50 dBA. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

Small Mammals

Alterations to small mammal habitat discussed in the site preparation and construction phase of the Project will persist through the closure phase. Modelling for this project indicated that closure sounds greater than 50 dBA will disturb 172 ha of habitat. The risk of collisions with vehicles will persist during the closure phase, and will continue to be of highest risk in the fall, when dispersion of young small mammals is highest.

Reptiles and Amphibians

Effects to reptile and amphibian habitat discussed in the site preparation and construction phase of this Project will persist through the closure phase. Modelling for this Project indicated that site preparation and construction sounds greater than 50 dBA will disturb 88 ha of potential habitat. The risk of collisions with vehicles will persist during the closure phase, and will be of highest concern in the spring and fall.

Terrestrial Invertebrates

Effects to terrestrial invertebrate habitat discussed in the site preparation and construction phase of this Project will persist through the closure phase. The risk of collisions with vehicles will persist during the closure phase, and will be highest in the spring and early summer.

6.12.4.4 Post-closure Phase

Once the closure activities are complete there will be no further disturbance of habitat or habitat function at the site. With time, the reclaimed closure landscape will begin to replace the loss of habitat and habitat function. The potential effects of the Project on wildlife and wildlife habitat during the post-closure phase includes the following:

- The effects of direct habitat loss and alteration will continue for all species until the reclaimed landscape is able to provide replacement habitat;
- The effects of the of habitat function as a result of fragmentation will continue until the reclaimed landscape can return habitat functionality; and
- Wildlife exposure to compounds present in the reclaimed landscape (e.g., reclaimed TSF and WRSA).

6.12.4.5 Predicted Adverse Effects

The predicted effects of the Project on wildlife and wildlife habitat were set out by phase of the Project in Sections 6.12.4.1 through 6.12.4.4. Adverse effects of the Project on wildlife and wildlife habitat were predicted for each of eight wildlife and wildlife habitat VCs (Section 6.1.3.11), but varied by VC, measures and phase of the Project. Adverse effects of the Project on wildlife and wildlife habitat were predicted during the site preparation and construction, operations, and closure phases of the Project. No adverse effects were predicted during the post-closure phase. A summary of the predicted adverse effects of the Project wildlife and wildlife habitat is provided in Table 6.15.4.5-1.

Table 6.12.4.5-1: Summary of Adverse Effects for Wildlife and Wildlife Habitat

Valued Components (VCs)	Wildlife and Wildlife Habitat Measure		
	Habitat Loss	Habitat Alteration or Displacement	Potential for Mortality
Site Preparation and Construction Phase			
Wildlife Species at Risk	‡	‡	‡
Ungulates	‡	‡	‡
Furbearers	‡	‡	‡
Upland Birds	‡	‡	‡
Wetland Birds	‡	‡	‡
Small Mammals	‡	‡	‡
Reptiles and Amphibians	‡	‡	‡
Invertebrates	‡	—	‡
Operations Phase			
Wildlife Species at Risk	‡(1)	‡	‡
Ungulates	‡(1)	‡	‡
Furbearers	‡(1)	‡	‡
Upland Birds	‡(1)	‡	‡
Wetland Birds	‡(1)	‡	‡

Table 6.12.4.5-1: Summary of Adverse Effects for Wildlife and Wildlife Habitat (continued)

Valued Components (VCs)	Wildlife and Wildlife Habitat Measure		
	Habitat Loss	Habitat Alteration or Displacement	Potential for Mortality
Small Mammals	‡ (1)	‡	‡
Reptiles and Amphibians	‡ (1)	‡	‡
Invertebrates	‡ (1)	—	‡
Closure Phase			
Wildlife Species at Risk	‡ (1)	‡	‡
Ungulates	‡ (1)	‡	‡
Furbearers	‡ (1)	‡	‡
Upland Birds	‡ (1)	‡	‡
Wetland Birds	‡ (1)	‡	‡
Small Mammals	‡ (1)	‡	‡
Reptiles and Amphibians	‡ (1)	‡	‡
Invertebrates	‡ (1)	—	‡
Post-closure Phase			
Wildlife Species at Risk	—	—	—
Ungulates	—	—	—
Furbearers	—	—	—
Upland Birds	—	—	—
Wetland Birds	—	—	—
Small Mammals	—	—	—
Reptiles and Amphibians	—	—	—
Invertebrates	—	—	—

Notes:
The "‡" symbol indicates where adverse effects on wildlife and wildlife habitat were predicted. The "—" symbol indicates where no adverse effects were predicted.
(1) Habitat lost during the site preparation and construction phase will be lost until post-closure.

The predicted adverse effects of the Project on wildlife and wildlife fish habitat have been detailed in Table 6.12.4.5-2, which provided the quantitative predictions for adverse effects. This table only provides the values for the VCs and indicators for which there were predicted adverse effects.

Table 6.12.4.5-2: Predicted Adverse Effects on Wildlife and Wildlife Habitat

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Wildlife SAR	Common Nighthawk	Habitat loss (ha)	300	300	300	—
		Habitat alteration or disruption (ha)	198	122	192	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
	Northern Myotis/ Little Brown Myotis	Habitat loss (ha)	15.85	15.85	15.85	—
		Habitat alteration or disruption (ha)	—	—	—	—
		Potential for Mortality (%)	Low	Low	Low	—
	Barn Swallow	Habitat loss (ha)	Several	Several	Several	—
		Habitat alteration or disruption (ha)	198	122	192	—

Table 6.12.4.5-2: Predicted Adverse Effects on Wildlife and Wildlife Habitat (continued)

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
		Potential for Mortality (%)	Medium	Medium	Medium	—
Ungulates	Moose	Habitat loss (ha)	84	84	84	—
		Habitat alteration or disruption (ha)	57	34	53	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Furbearers	American Marten	Habitat loss (ha)	62	62	62	—
		Habitat alteration or disruption (ha)	14	8	14	—
		Potential for Mortality (%)	Low	Low	Low	—
Upland Birds	Upland Birds	Habitat loss (ha)	95	95	95	—
		Habitat alteration or disruption (ha)	3.21	4.3	2.6	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Wetland Birds	Marsh Birds	Habitat loss (ha)	33	33	33	—
		Habitat alteration or disruption (ha)	2.9	7.5	0.7	—
		Potential for Mortality (%)	Low	Low	Low	—
Small mammals	Small Mammals	Habitat loss (ha)	—	—	—	—
		Habitat alteration or disruption (ha)	400	109	172	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Reptiles and Amphibians	Reptiles and Amphibians	Habitat loss (ha)	162	162	162	—
		Habitat alteration or disruption (ha)	89	60	88	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Invertebrates	Terrestrial Invertebrates	Habitat loss (ha)	—	—	—	—
		Habitat alteration or disruption (ha)	400	400	400	—
		Potential for Mortality (%)	Medium	Medium	Medium	—

Note: (1) The "—" symbol indicates there were no predicted adverse effects.

6.12.5 Identified Mitigation

The following mitigation measures will be implemented as part of the Project to help avoid potential effects on wildlife and wildlife habitat:

- Minimized the amount of habitat clearing required for the Project by optimizing the pit design and siting Project infrastructure in previously disturbed areas [Mit_050, Mit_065].
- Optimized utilization of existing road network [Mit_065].
- Provide vegetated buffers of 120 m along rivers creeks and wetlands wherever feasible [Mit_066].

- Conducting timber clearing outside of the breeding bird window (May 1 to August 15) to avoid potential mortality to birds. This will also protect roosting bats [Mit_067].
- Proper management of WRSA, including covering with a low-permeability dry cover at closure to help manage ARD [Mit_018].
- Restoration of disturbed habitats at closure or encouraging development of habitats capable of supporting a diversity of wildlife species [Mit_068].
- Enforcement of speed limits within the Project area to reduce the potential for wildlife/vehicle collisions [Mit_069].
- Protection of suitable bird breeding habitat, where possible [Mit_070].
- Wildlife awareness training for all staff including SAR identification/legislation and education regarding seasonal changes in animal behaviour and their presence [Mit_071].
- Disposing of food waste generated on site in an appropriate manner to limit wildlife attraction to the area [Mit_072].
- Restricting the clearing of potential terrestrial reptile and amphibian breeding habitats to periods outside the breeding season as directed by MNRF [Mit_073].
- Implementation of noise abatement strategies to limit the negative effects of sound on wildlife [Mit_025, Mit_028, Mit_029, Mit_031].
- Develop a wetland clearing strategy with the local MNRF reduce the effects to overwintering frogs (e.g., draining wetlands to discourage hibernation) [Mit_074].
- Where feasible, direct anthropogenic lighting to reduce excess production of light into the surrounding environment [Mit_034, Mit_035, Mit_036, Mit_037, Mit_038, Mit_039, Mit_040, Mit_041, Mit_042].
- Construct a perimeter ditch around the operations area to prevent the release of runoff from the mine site to adjacent wetlands and watercourses [Mit_008].
- Implement sediment and erosion control during the site preparation and construction phase [Mit_054].

In addition to the above, the following specific mitigation measures will be implemented to address adverse effects should they arise:

- If habitat cannot be avoided, provide alternate nesting habitat as a provision of compensatory habitat for species protected under the ESA (e.g., Barn Swallow) [Mit_075].

- Providing acceptable buffers around any raptor nests identified throughout all Project phases [Mit_076].

6.12.6 Residual Adverse Effects

In the context of the CEAA, 2012, the offsetting of habitat for the Barn Swallow would be considered mitigation that would offset and mitigate the adverse effects of the Project on this indicator. Therefore, following offsetting there are no residual adverse effects due to the Project related to habitat loss for Barn Swallow, an indicator for the Wildlife Species at Risk VC. The adverse effects for wildlife and wildlife that remain after the mitigation are set out in Table 6.12.6-1.

Table 6.12.6-1: Residual Adverse Effects on Wildlife and Wildlife Habitat

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Wildlife SAR	Common Nighthawk	Habitat loss (ha)	300	300	300	—
		Habitat alteration or disruption (ha)	198	122	192	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
	Northern Myotis/ Little Brown Myotis	Habitat loss (ha)	15.85	15.85	15.85	—
		Habitat alteration or disruption (ha)	—	—	—	—
		Potential for Mortality (%)	Low	Low	Low	—
	Barn Swallow	Habitat loss (ha)	—	—	—	—
		Habitat alteration or disruption (ha)	198	122	192	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Ungulates	Moose	Habitat loss (ha)	84	84	84	—
		Habitat alteration or disruption (ha)	57	34	53	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Furbearers	American Marten	Habitat loss (ha)	62	62	62	—
		Habitat alteration or disruption (ha)	14	8	14	—
		Potential for Mortality (%)	Low	Low	Low	—
Upland Birds	Upland Birds	Habitat loss (ha)	95	95	95	—
		Habitat alteration or disruption (ha)	3.21	4.3	2.6	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Wetland Birds	Marsh Birds	Habitat loss (ha)	33	33	33	—
		Habitat alteration or disruption (ha)	2.9	7.5	0.7	—
		Potential for Mortality (%)	Low	Low	Low	—
Small mammals	Small Mammals	Habitat loss (ha)	—	—	—	—
		Habitat alteration or disruption (ha)	400	109	172	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Reptiles and Amphibians	Reptiles and Amphibians	Habitat loss (ha)	162	162	162	—
		Habitat alteration or disruption (ha)	89	60	88	—
		Potential for Mortality (%)	Medium	Medium	Medium	—

Table 6.12.6-1: Residual Adverse Effects on Wildlife and Wildlife Habitat (continued)

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Invertebrates	Terrestrial Invertebrates	Habitat loss (ha)	—	—	—	—
		Habitat alteration or disruption (ha)	400	400	400	—
		Potential for Mortality (%)	Medium	Medium	Medium	—

Note: (1) The "—" symbol indicates there were no residual adverse effects.

The spatial extent of residual effects to wildlife as a result of the Project are presented as the gold shaded areas in Figure 6.12.6-1. During the site preparation and construction phase of the Project, the operations area will be stripped of the majority of vegetation to construct the mine infrastructure, which will remain into the closure phase. It is assumed that the operations area would not be readily accessible to wildlife and any wildlife within this area would be displaced. Additionally, noise levels above 50 dBA have been identified as causing changes in behaviours and avoidance of areas for certain species. Although wildlife may make use of some of the areas shaded on Figure 6.12.6-1, it would be expected that their behaviours may be altered by the proximity to the Project activities. Therefore, the areas shaded in gold would not be considered suitable for traditional harvesting of wildlife.

6.12.7 Information to Address Round 1 Information Requests

The following lists the questions from the Round 1 information requests that relate to the effects of the Project on wildlife and wildlife habitat:

- TMI_145-WL(1)-02: effects of Project on wildlife habitat;
- TMI_148-WL(1)-05: exposure of wildlife to compounds in TSF;
- TMI_181-AE(1)-19: effects of light on wildlife;
- TMI_192-AE(1)-30: effects of noise on wildlife;
- TMI_337-AC(1)-11: exposure of birds to compounds in TSF;
- TMI_359-AC(1)-33: effects on ungulates and furbearers;
- TMI_375-AC(1)-49: effects on moose;
- TMI_527-AC(1)-201: link wildlife effects to Aboriginal peoples;
- TMI_540-AC(1)-214: link wildlife effects to Aboriginal peoples;

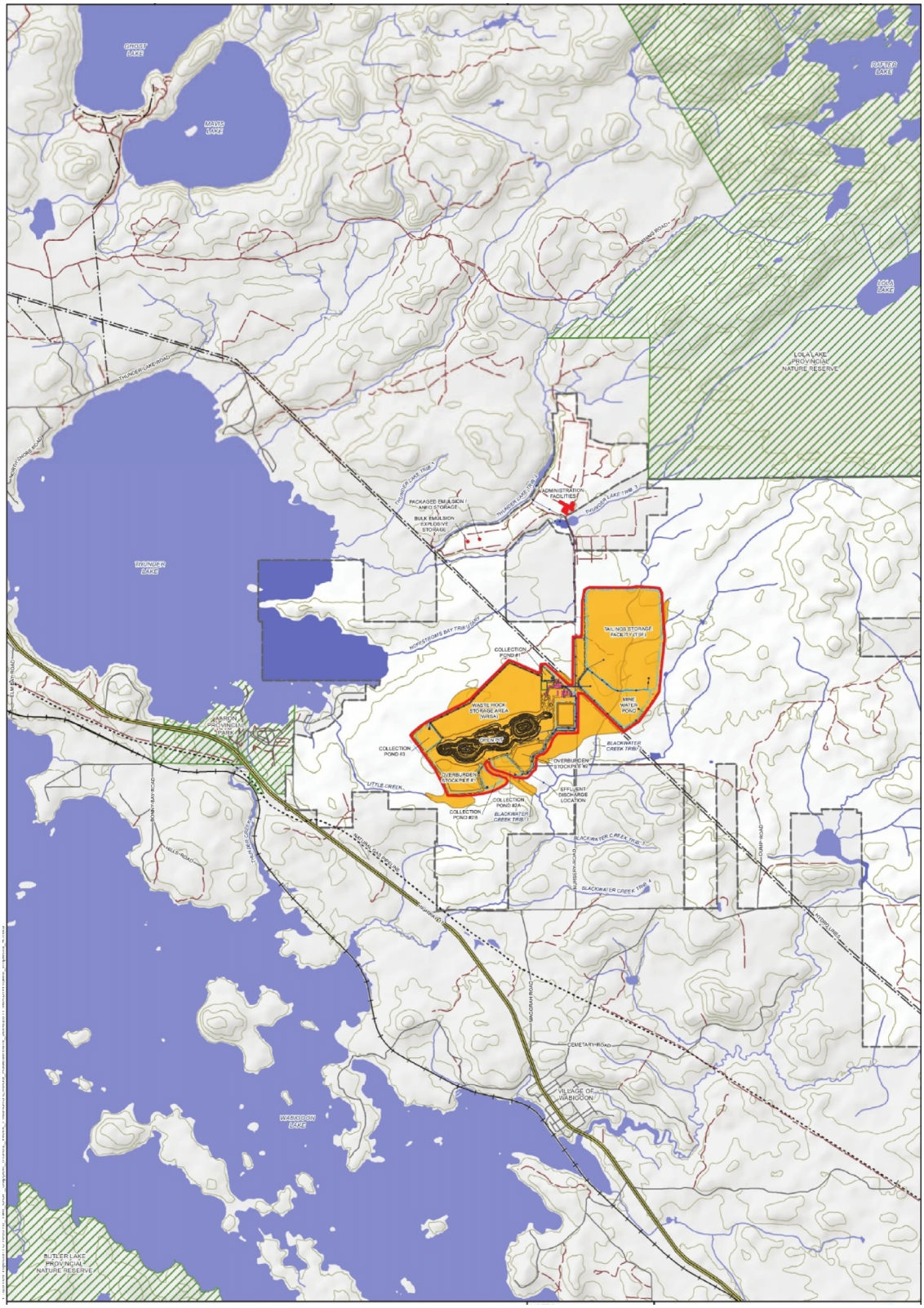


Figure 6.12.6-1: Spatial Extent Wildlife and Wildlife Habitat Residual Effects

- TMI_543-AC(1)-217: effects on SAR and ungulates;
- TMI_546-AC(1)-220: effects on upland birds;
- TMI_547-AC(1)-221: effects on upland birds;
- TMI_548-AC(1)-222: effects on wetland birds;
- TMI_549-AC(1)-223: effects on wetland birds;
- TMI_588-AC(1)-262: effects of blasting noise on wildlife;
- TMI_589-AC(1)-263: effects of noise and blasting on wildlife;
- TMI_615-AC(1)-288: site preparation effects on wildlife habitat;
- TMI_644-AC(1)-317: effects on migratory birds and alienation of wetlands;
- TMI_671-AC(1)-344: effects on moose and migratory bird habitat;
- TMI_716-PC(1)-31: noise effects on wildlife; and
- TMI_748-PC(1)-63: wildlife mortality .

6.13 Migratory Birds

6.13.1 Potential Effects of the Project on the Environment

As part of the Round 1 information request process, the Agency required that a separate discipline be included in the revised EIS to describe the potential effects of the Project on migratory birds. This section is in addition to the assessment on wildlife and wildlife habits (Section 6.12), which also included the effects of the Project on birds, as a part of wildlife and wildlife habitat. The migratory birds VCs used for assessing the effects of the Project were introduced in Section 6.1.3.12. The Project, as proposed, will involve the clearing of lands and vegetation to accommodate the Project structures and facilities (e.g., processing plant, tailings storage facility [TSF]), as well as for the open pit mine. In addition, the mine will include equipment and activities that can have a direct or indirect effect on migratory birds. The potential effects of the Project on the migratory birds VCs for the various Project phase are as follows:

- **Site Preparation and Construction Phase**: Most of the removal of vegetation, displacement of wildlife and disturbance and of soils and overburden will occur during the site preparation and construction phase. The potential effects of these activities on migratory birds includes the following:

- Direct loss of habitat as a result of vegetation clearing and overburden stripping;
- Functional loss of habitat as a result of fragmentation and noise levels;
- Migratory bird exposure to compounds released through from Project activities;
- Direct mortality of migratory birds due site clearing and construction activities; and
- Direct mortality of migratory birds as a result of vehicle collisions.

- **Operations Phase**: Once mining starts, most of the activities at the site will be occurring within the limits of the areas disturbed during the site preparation and construction phase. As operations progress, waste rock will continue to be added to the waste rock storage area (WRSA) until the mined out portions of the open pit can be used. As operations continue, the footprint of the TSF will continue to grow as additional tailings are added to it. The potential effects of these activities on migratory birds includes the following:
  - The effects of direct habitat loss during the site preparation and construction phase will continue through operations;
  - The functional loss of habitat as a result of fragmentation during the site preparation and construction phase will continue through operations;
  - Direct habitat loss due to the expansion of the WRSA and TSF footprints;
  - Functional loss of habitat as a result of light and noise;
  - Migratory bird exposure to compounds released through from Project activities; and
  - Direct mortality of migratory birds as a result of vehicle collisions.

- **Closure Phase**: Following the end of mining activities, the Project facilities will be decommissioned and removed and the site will be re-graded to ensure all runoff drains towards the open pit. The process water covering the TSF will be withdrawn, treated and used to help fill the open pit. The TSF will be covered with a granular layer to isolate the tailings, and then covered with either a dry low permeability cover, or a wet cover with non-process water to prevent acidification. Suitable plant species will be used to help re-vegetate the site and return it to a condition suitable to support a functioning ecosystem. The potential effects of these activities on migratory birds includes the following:
  - The effects of direct habitat loss during the site preparation and construction and operations phase will continue until the reclaimed landscape is able to provide replacement habitat;

- The functional loss of habitat as a result of fragmentation during the site preparation and construction phase will continue until the reclaimed landscape can return some of the habitat functionality;
- Functional loss of habitat as a result of noise;
- Migratory bird exposure to compounds released through from Project activities;
- Direct mortality of migratory birds due reclamation and closure activities; and
- Direct mortality of migratory birds as a result of vehicle collisions.

- **Post-closure Phase**: Once the closure activities are complete there will be no further disturbance of habitat or habitat function at the site. With time, the reclaimed closure landscape will begin to replace the loss of habitat and habitat function. The potential effects of the Project on migratory birds during this phase includes the following:
  - The effects of direct habitat loss will continue until the reclaimed landscape is able to provide replacement habitat;
  - The effects of the of habitat function as a result of fragmentation will continue until the reclaimed landscape can return habitat functionality; and
  - Migratory bird exposure to compounds present in the reclaimed landscape (e.g., reclaimed TSF and WRSA).

The potential effects of the Project on migratory birds habitat have been described using a simple linkage diagram in Figures 6.12.1-1 and 6.12.1-2. The figures illustrate the migratory bird VCs (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. The figure also indicates the other components or VCs (shown in red on the figure) that can be affected by effects to migratory birds. For example, effects on migratory birds could be relied on when evaluating the effects of the Project on Aboriginal peoples. Similarly, other components that provide inputs to the evaluation of the effects of the Project on wildlife and wildlife habitat are shown in red on the figure. For example, the effects of the Project on noise are used in determining the effects on the migratory birds VCs.

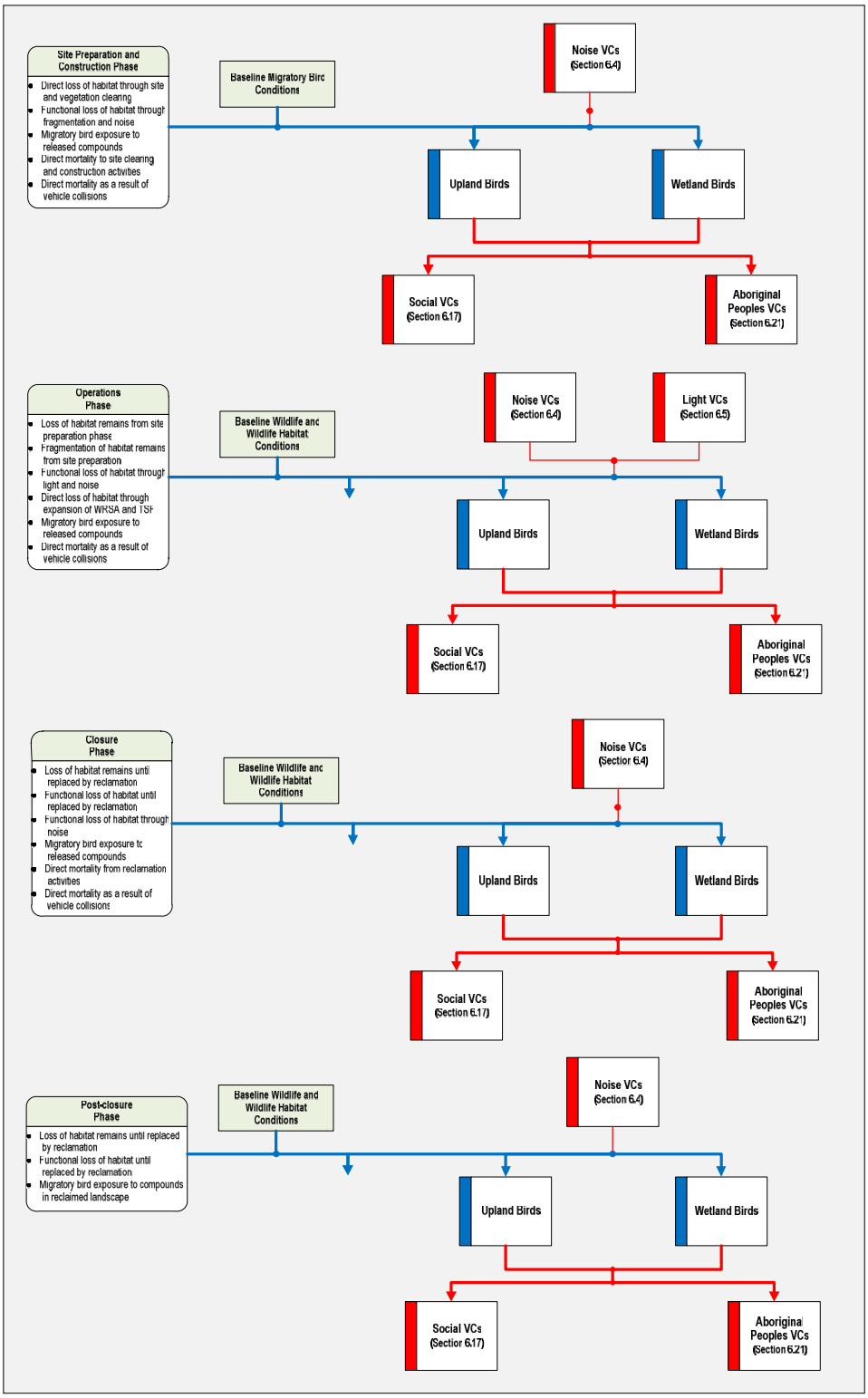


Figure 6.13.1-1: Migratory Birds Linkage Diagram

6.13.2 Effects Prediction Methods

A numerical geographic information system (GIS) approach was used for predicting the effects of the Project on wildlife and wildlife habitat. Modelled wildlife habitat suitability for most VCs using the Ontario Landscape Tool (OLT) (2016, build 3.5.6117), a modeling program developed by the Ontario Ministry of Natural Resources and Forests (MNRF). A variety of habitat suitability models are incorporated into the software (e.g., Holloway, 2004). These models are applied to digital Forest Resources Inventory (FRI) data. Specifically, the OLT overlays a grid of hexagons on the FRI data (as well as built-in datasets with climate information and the location of roads, urban areas, and waterbodies) and determines the suitability of each hexagon as a function of ecosite (forest type) and development stage (forest age class) and — for some species — patch size and climate. Depending on the species, the hexagons are either 0.1 or 0.8 ha in size. These results are then summarized over larger hexagons (normally 1 ha in size) and then averaged and reported for each inventory polygon (Elkie et al., 2013). Where modelled results are not available within the OLT, a habitat suitability models was constructed in ArcGIS (v10.4) using the FRI and other spatial layers available through Land Information Ontario (LIO).

6.13.3 Project Effects Avoidance Measures Used in Predictions

The following are effects avoidance measures that will be utilized to reduce potential adverse effects to migratory birds.

- Minimized the amount of habitat clearing required for the Project by optimizing the pit design and siting Project infrastructure in previously disturbed areas [Mit_050, Mit_065].
- Optimized utilization of existing road network [Mit_065].
- Provide vegetated buffers of 120 m along rivers creeks and wetlands wherever feasible [Mit_066].
- Conducting timber clearing outside of the breeding bird window (May 1 to August 15) to avoid potential mortality to birds. This will also protect roosting bats [Mit_067].
- Restoration of disturbed habitats at closure or encouraging development of habitats capable of supporting a diversity of migratory bird species [Mit_068].
- Enforcement of speed limits within the Project area to reduce the potential for wildlife/vehicle collisions [Mit_069].
- Protection of suitable bird breeding habitat, where possible [Mit_070].
- Wildlife awareness training for all staff including SAR identification/legislation and education regarding seasonal changes in animal behaviour and their presence [Mit_071].

- Implementation of noise abatement strategies to limit the negative effects of sound on wildlife [Mit_025, Mit_028, Mit_029, Mit_031].

- Where feasible, direct anthropogenic lighting to reduce excess production of light into the surrounding environment [Mit_034, Mit_035, Mit_036, Mit_037, Mit_038, Mit_039, Mit_040, Mit_041, Mit_042].

6.13.4 Predicted Effects

The predicted effects of the Project on migratory birds will vary throughout the Project life, depending on the Project phase, and will vary according to specific levels of activity. Project effects will also vary by VC.

6.13.4.1 Site Preparation and Construction Phase

Upland Birds

For the purposes of this Project, upland habitat was considered to be all ecosites with a dry to fresh moisture regime, that also have well drained soils (northwestern Ontario ecosites: ES1 to ES17) and all developed areas (as these are generally agricultural or meadow type habitats). Upland habitats constitute 34,710 ha within the RSA, and 448 ha within the LSA. Common bird species associated with the upland habitats during point count surveys included many of the warblers and thrushes, as well as some sparrows (Clay-coloured sparrow, Savannah sparrow, LeConte's sparrow) and northern harrier as examples.

The site development and construction phase of this project will result in the loss of 95 ha of upland habitat (all of which is currently considered developed areas). Some upland avian species have been shown to decline at sound thresholds above 48 dBA, while other studies (Dooling and Pooper 2007) have shown that sound masking for avian species can occur at 50 dBA. Modelling for this project indicated that site preparation and construction sounds greater than 50 dBA will disturb 3.21 ha of habitat. The most common adverse effect of sound includes masking important communication signals which reduces the chances of breeding males to attract mates and to defend their territories. Sound disturbance can also mask the sound of nearby predators; increasing mortality through predation (Blickley and Patricelli 2010).

Increased traffic volume also has the potential to increase avian mortality of upland species through increased collisions with vehicles.

Wetland Birds

Despite the name "Marsh Birds", these species are not exclusively associated with marshes, but can be associated with any wetland area provided it has suitable vegetative habitat (primarily robust emergent vegetation). Between 2011 and 2016, Marsh Bird Surveys took place at

11 locations throughout the LSA. Although many wetland associated bird species were observed or heard during the surveys, on one Marsh Bird target species was heard (a single Sora in 2012).

The site preparation and construction phase of the project will require the removal of 33 total ha of wetlands, which in turn will eliminate the associated Marsh Bird habitat. During the site preparation and construction phase, an additional 2.9 ha of Marsh Bird habitat may be affected by noise levels above 50 dBA.

6.13.4.2 Operations Phase

Upland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the Operations phase. Modelling for this project indicated that operations sounds greater than 50 dBA will disturb 4.3 ha of habitat. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

Wetland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the operations phase. During this phase of the project, a total of 7.5 ha of potential wetland habitat may be affected by noise levels above 50 dBA. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

6.13.4.3 Closure Phase

Upland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the Closure phase. Modelling for this project indicated that closure sounds greater than 50 dBA will disturb 2.6 ha of habitat. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

Wetland Birds

Effects from the site preparation and construction phase of this Project will persist throughout the closure phase. During this phase of the project, a total of 0.7 ha of potential wetland habitat may be affected by noise levels above 50 dBA. Increased traffic volume may continue to pose a threat to the mortality of upland species through increased collisions with vehicles.

6.13.4.4 Post-closure Phase

Once the closure activities are complete there will be no further disturbance of habitat or habitat function at the site. With time, the reclaimed closure landscape will begin to replace the loss of

habitat and habitat function. The potential effects of the Project on migratory birds during the post-closure phase includes the following:

- The effects of direct habitat loss and alteration will continue for all species until the reclaimed landscape is able to provide replacement habitat;
- The effects of the of habitat function as a result of fragmentation will continue until the reclaimed landscape can return habitat functionality; and
- Migratory bird exposure to compounds present in the reclaimed landscape (e.g., reclaimed TSF and WRSA).

6.13.4.5 Predicted Adverse Effects

The predicted effects of the Project on migratory birds were set out by phase of the Project in Sections 6.13.4.1 through 6.13.4.4. Adverse effects of the Project on migratory birds were predicted for each of the migratory birds VCs (Section 6.1.3.12), but varied by VC, measures and phase of the Project. Adverse effects of the Project on migratory birds were predicted during the site preparation and construction, operations, and closure phases of the Project. No adverse effects were predicted during the post-closure phase. A summary of the predicted adverse effects of the Project migratory birds is provided in Table 6.13.4.5-1.

Table 6.13.4.5-1: Summary of Adverse Effects for Migratory Birds

Valued Components (VCs)	Wildlife and Wildlife Habitat Measure		
	Habitat Loss	Habitat Alteration or Displacement	Potential for Mortality
Site Preparation and Construction Phase			
Upland Birds	‡	‡	‡
Wetland Birds	‡	‡	‡
Operations Phase			
Upland Birds	‡ (1)	‡	‡
Wetland Birds	‡ (1)	‡	‡
Closure Phase			
Upland Birds	‡ (1)	‡	‡
Wetland Birds	‡ (1)	‡	‡
Post-closure Phase			
Upland Birds	—	—	—
Wetland Birds	—	—	—

Notes:
The "‡" symbol indicates where adverse effects on wildlife and wildlife habitat were predicted. The "—" symbol indicates where no adverse effects were predicted.
(2) Habitat lost during the site preparation and construction phase will be lost until post-closure.

The predicted adverse effects of the Project on migratory birds have been detailed in Table 6.13.4.5-2, which provided the quantitative predictions for adverse effects. This table only provides the values for the VCs and indicators for which there were predicted adverse effects.

Table 6.13.4.5-2: Predicted Adverse Effects on Migratory Birds

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Upland Birds	Upland Birds	Habitat loss (ha)	95	95	95	—
		Habitat alteration or disruption (ha)	3.21	4.3	2.6	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Wetland Birds	Marsh Birds	Habitat loss (ha)	33	33	33	—
		Habitat alteration or disruption (ha)	2.9	7.5	0.7	—
		Potential for Mortality (%)	Low	Low	Low	—

6.13.5 Identified Mitigation

The following mitigation measures will be implemented as part of the Project to help avoid potential effects on migratory birds:

- Minimized the amount of habitat clearing required for the Project by optimizing the pit design and siting Project infrastructure in previously disturbed areas [Mit_050, Mit_065].
- Optimized utilization of existing road network [Mit_065].
- Provide vegetated buffers of 120 m along rivers creeks and wetlands wherever feasible [Mit_066].
- Conducting timber clearing outside of the breeding bird window (May 1 to August 15) to avoid potential mortality to birds. This will also protect roosting bats [Mit_067].
- Restoration of disturbed habitats at closure or encouraging development of habitats capable of supporting a diversity of wildlife species [Mit_068].
- Enforcement of speed limits within the Project area to reduce the potential for wildlife/vehicle collisions [Mit_069].
- Protection of suitable bird breeding habitat, where possible [Mit_070].
- Implementation of noise abatement strategies to limit the negative effects of sound on migratory birds [Mit_025, Mit_028, Mit_029, Mit_031].
- Where feasible, direct anthropogenic lighting to reduce excess production of light into the surrounding environment [Mit_034, Mit_035, Mit_036, Mit_037, Mit_038, Mit_039, Mit_040, Mit_041, Mit_042].

- Construct a perimeter ditch around the operations area to prevent the release of runoff from the mine site to adjacent wetlands and watercourses [Mit_008].

- Implement sediment and erosion control during the site preparation and construction phase [Mit_054].

In addition to the above, the following specific mitigation measures will be implemented to address adverse effects should they arise:

- Providing acceptable buffers around any raptor nests identified throughout all Project phases [Mit_076].

6.13.6 Residual Adverse Effects

The residual adverse effects predicted for migratory birds are set out in Table 6.13.6-1.

Table 6.13.6-1: Residual Adverse Effects on Migratory Birds

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Upland Birds	Upland Birds	Habitat loss (ha)	95	95	95	—
		Habitat alteration or disruption (ha)	3.21	4.3	2.6	—
		Potential for Mortality (%)	Medium	Medium	Medium	—
Wetland Birds	Marsh Birds	Habitat loss (ha)	33	33	33	—
		Habitat alteration or disruption (ha)	2.9	7.5	0.7	—
		Potential for Mortality (%)	Low	Low	Low	—

Note:
(1) The "—" symbol indicates there were no residual adverse effects.

The spatial extent of effects to migratory birds as a result of the Project are presented as the gold shaded areas in Figure 6.13.6-1. During the site preparation and construction phase of the Project, the operations area will be stripped of the majority of vegetation to construct the mine infrastructure, which will remain into the closure phase. The construction of the Project is also identified as affecting some wetland areas that are overprinted by the Project footprint. Finally, noise levels above 50 dBA have been identified as causing changes in behaviours and avoidance of areas for certain species of birds. The combination of these areas is expected to define the spatial extent where it would be unsuitable for the traditional harvesting of migratory birds.

6.13.7 Information to Address Round 1 Information Requests

The following lists the questions from the Round 1 information requests that relate to the effects of the Project on migratory birds:

- TMI_145-WL(1)-02: effects of Project on wildlife habitat;

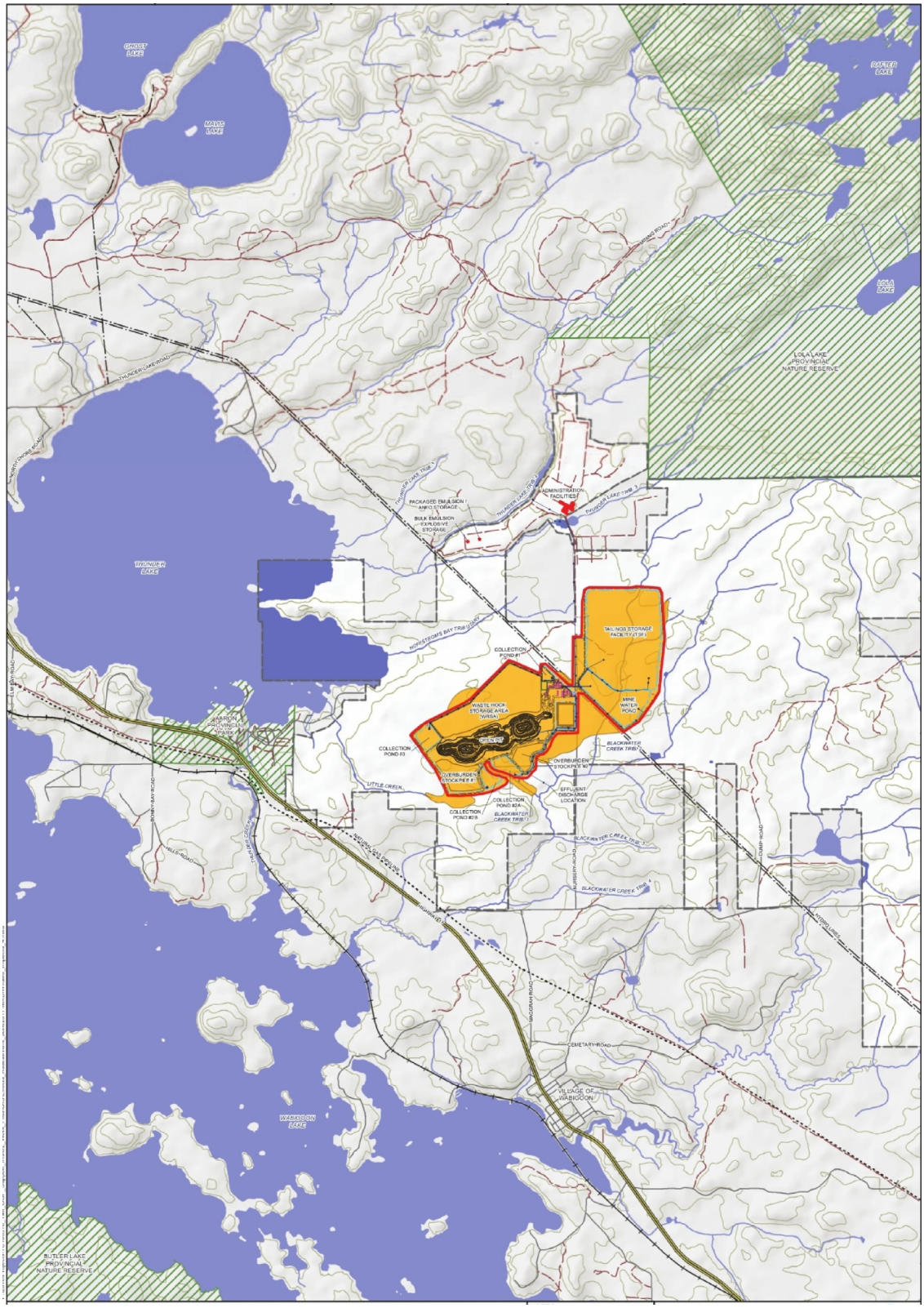


Figure 6.13.6-1: Spatial Extent Migratory Birds Residual Effects

- TMI_148-WL(1)-05: exposure of wildlife to compounds in TSF;
- TMI_181-AE(1)-19: effects of light on wildlife;
- TMI_192-AE(1)-30: effects of noise on wildlife;
- TMI_337-AC(1)-11: exposure of birds to compounds in TSF;
- TMI_546-AC(1)-220: effects on upland birds;
- TMI_547-AC(1)-221: effects on upland birds;
- TMI_548-AC(1)-222: effects on wetland birds;
- TMI_549-AC(1)-223: effects on wetland birds;
- TMI_615-AC(1)-288: site preparation effects on wildlife habitat;
- TMI_644-AC(1)-317: effects on migratory birds and alienation of wetlands; and
- TMI_671-AC(1)-344: effects on moose and migratory bird habitat.

6.14 Fish and Fish Habitat

6.14.1 Potential Effects of the Project on the Environment

The potential effects of the Project on the fish and fish habitat VCs, which were introduced Section 6.1.3.12, will vary by phase of Project and the activities that are occurring. These effects will either effect the fish directly (e.g., mortality of fish during the draining of Blackwater Creek Tributary 1 to allow the construction of the open pit) or indirectly through the loss or alteration of habitat (e.g., overprinting Blackwater Creek Tributary 1 to allow the construction of the open pit and overburden storage piles). The potential effects of the Project on the fish and fish habits VCs for the various Project phases are as follows:

- **Site Preparation and Construction Phase**: Most of the physical disturbance to watercourses and watersheds will occur during the site preparation and construction phase of the Project. The potential effects of these activities on fish and fish habitat includes the following:
    - During mining of the open pit, portions of Blackwater Creek Tributary 1 will be overprinted. The construction of the perimeter ditch will isolate those sections of Blackwater Creek Tributary 1 that will be overprinted and they will be drained. This will result in the direct loss of habitat and the reduction of flows in the downstream reaches of the tributary. Fish mortality could occur when the isolated reaches are drained and flows are reduced in the downstream reaches.

- Construction of the tailings storage facility (TSF) and minewater pond will overprint sections of Blackwater Creek Tributary 2. The construction of the perimeter ditch will isolate those sections of Blackwater Creek Tributary 2 that will be overprinted and they will be drained. This will result in the direct loss of habitat and the effective elimination of flow in the downstream reaches of the tributary. Fish mortality could occur when the isolated reaches are drained and flows are reduced in the downstream reaches.
- Construction of the perimeter ditch will affect the watershed areas in Hoffstrom's Bay Tributary, Little Creek and Blackwater Creek.
- Construction of the water discharge structure in Blackwater Creek will result in habitat alterations.
- Construction of the water intakes in the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3 will result in minor habitat alterations.
- Blasting during site preparation and construction could cause mortality of fish.
- All runoff from the site will be collected during the site preparation and construction phase. There will be no discharges to surface water.

- **Operations Phase:** During the operations phase, mining activities will begin within an open pit, and progress to an underground mine. Mined ore will be processed within the plant to recover ore. Tailings and water from the processing will be treated and discharged to the TSF where the solids will be allowed to settle. A portion of the water from the TSF will be recovered for use, along with collected runoff and water from the dewatering of the open pit and underground mine in the process. Excess water will be treated to meet Provincial Water Quality Objectives (PWQO) prior to being discharged to Blackwater Creek through an engineered structure. There would be no new direct effects on fish habitat during the operations phase. The potential effects of these activities on fish and fish habitat includes the following:
  - Habitat lost during the site preparation and construction phase will remain lost throughout operations.
  - The catchment areas enclosed within the perimeter ditch will continue to result in decreased flows in Hoffstrom's Bay Tributary and Little Creek.
  - Excess water not required in the processing will be treated to meet PWQO and discharged into Blackwater Creek through an engineered structure. These releases could affect both the surface water quality and surface water quantity downstream of the Project.
  - Periodically, fresh water to support the process will be taken from the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3, decreasing the flows in those watercourses.

- Blasting during operations could cause mortality of fish.

- **Closure Phase**: During the closure phase, the facility will be decommissioned, dewatering activities will cease, and the open pit and underground mine will be allowed to start filling with water. Runoff from the operations area will be directed to the open pit. The water within the TSF will be withdrawn, treated and used to help fill the pit. During the closure phase, there will be no discharges of surface water to the surrounding watercourses. There would be no new direct effects on fish habitat during the closure phase. The potential effects of these activities on fish and fish habitat during closure includes the following:

  - Habitat in Blackwater Creek Tributary 2 lost during the site preparation and construction phase will remain lost throughout closure.

  - Habitat in Blackwater Creek Tributary 1 lost during the site preparation and construction phase will remain lost throughout closure. The section of Blackwater Creek Tributary 1 downstream of the open pit will be rehabilitated, but will not have sufficient flow during closure to support fish.

  - The catchment areas enclosed within the perimeter ditch will continue to result in decreased flows in Hoffstrom's Bay Tributary and Little Creek.

  - Decommissioning of the water discharge structure in Blackwater Creek will result in habitat alterations.

  - Decommissioning of the water intakes in the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3 will result in minor habitat alterations.

  - There will be no blasting during the closure phase.

- **Post-closure Phase**: Following closure, all of the runoff from the site will continue to be directed to the open pit. There will be no discharges of surface water until the pit is fully flooded. Groundwater inflow will continue to the open pit during this period. Once the pit is fully flooded, water from the open pit will be released passively into Blackwater Creek Tributary 1 through an engineered spillway. These releases will help to re-establish the flows in this watercourse. Although groundwater will continue to inflow to the pit lake even after it is fully flooded, the groundwater levels will gradually return to near pre-development conditions and seepage from the TSF and waste rock storage area (WRSA) will escape the site and report to surface watercourses near the Project. The potential effects of the Project on fish and fish habitat during post-closure includes the following:

  - Habitat in Blackwater Creek Tributary 2 lost during the site preparation and construction phase will be permanently lost.

  - The decrease in catchment areas for Hoffstrom's Bay Tributary and Little Creek will be permanent, as will be the resulting decrease in flows.

- The open pit is expected to fill between 5 and 9 years after dewatering activities stop, at which point it will be allowed to passively discharge through an engineered spillway into Blackwater Creek Tributary 1. Discharges from the pit lake will affect the surface water quality and quantity downstream of the engineered spillway, as well as re-establishing flows in Blackwater Creek Tributary 1.

- Seepage from the TSF and WRSA could affect surface water quality in the adjacent watercourses.

The potential effects of the Project on fish and fish habitat have been described using a simple linkage diagram in Figure 6.14.1-1. The figure illustrate the fish and fish habitat VCs (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. The figure also indicates the other components or VCs (shown in red on the figure) that can be affected by effects to fish and fish habits. For example, effects on fish and fish habitat will be relied on for evaluating the effects of the Project on Aboriginal peoples. Similarly, other components that provide inputs to the evaluation of the effects of the Project on fish and fish habitat are shown in red on the figure. For example, the effects of the Project on surface water quality are used in determining the effects on the fish and fish habitat VCs.

6.14.2 Effects Prediction Methods

Effects of the Project on fish and fish habitat are predicted based on knowledge of the existing fish habitat and fish communities present and the direct predicted effects of the Project. The predictions of direct effects are primarily qualitative, with quantitative estimates of changes in habitat made where applicable, using GIS. The prediction of effects of the Project on fish and fish habitat also relies on quantitative predictions made for physical disciplines (e.g., surface water quality).

6.14.3 Project Effects Avoidance Measures Used in Predictions

A number of measures have been incorporated into the Project that help avoid or minimize the potential effects to fish and fish habitat, which include the following.

- As part of the refinements to the Project since the filing of the EIS (discussed in Section 3.16), the plant site and laydown area have been relocated to west of Tree Nursery Road, eliminating the need to divert the lower reaches of Blackwater Creek Tributary 2.

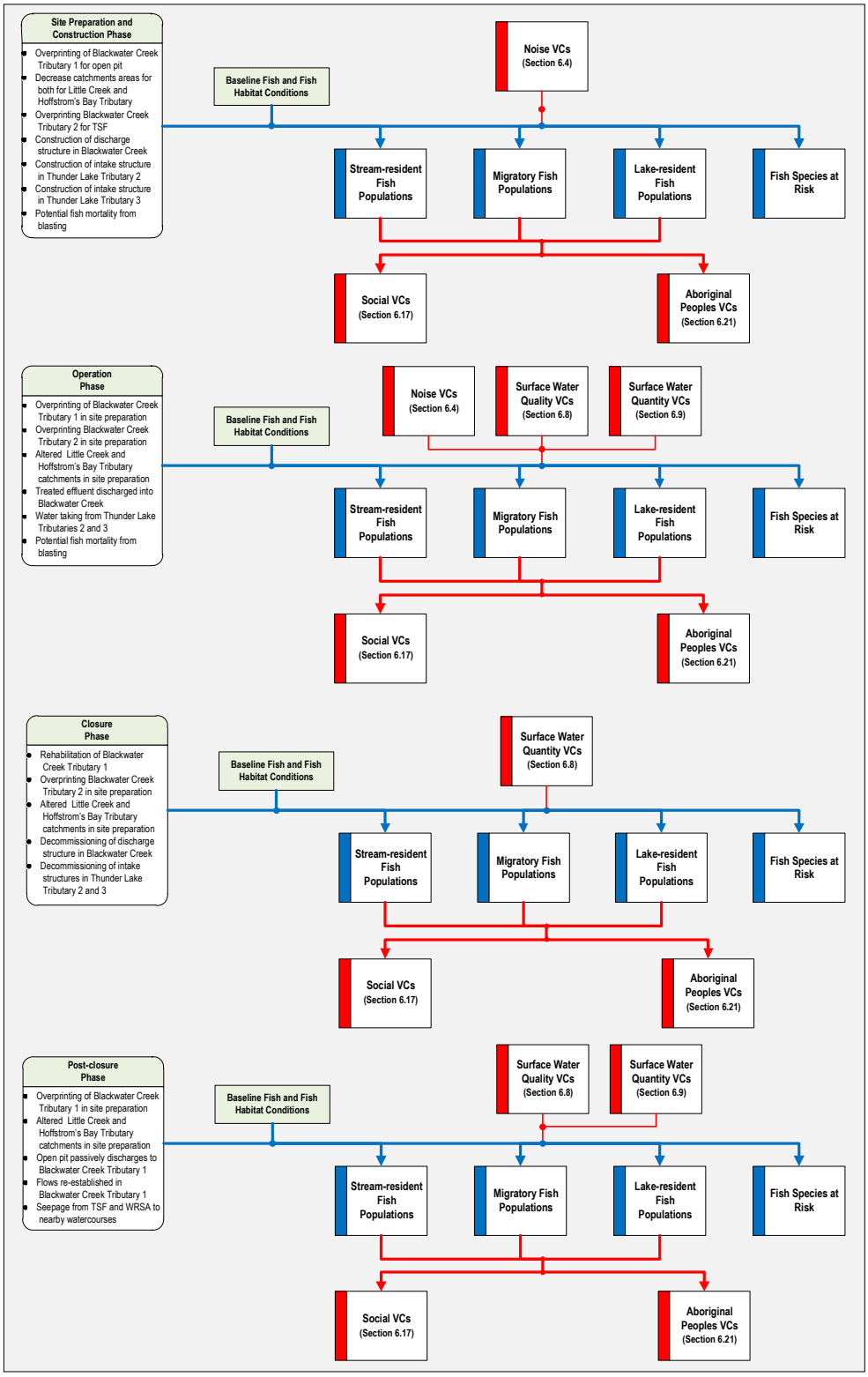


Figure 6.14.1-1: Fish and Fish Habitat Linkage Diagram

- As part of the refinements to the Project since the filing of the EIS (discussed in Section 3.16), the overburden stockpile has been modified to avoid infilling the lower reaches of Blackwater Creek Tributary 1.

- Prior to overburden removal, any beaver dams within the Project footprint will be removed and the impoundments will be allowed to draw down. This will reduce the number of fish that will remain in isolated sections of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2 [Mit_077].

- Activities and the construction of Project components that will impact or overprint watercourses (i.e., the perimeter ditch, the effluent diffuser, water intakes) will occur during the fisheries timing window when in-stream work is permitted [Mit_078].

- To the extent possible, fish in the sections of Blackwater Creek Tributary 1 that will be isolated by the construction of the perimeter ditch and overprinted by the removal of overburden from the open pit will be captured and relocated to the same tributaries downstream from the operations area, or to the main branch of Blackwater Creek [Mit_079].

- To the extent possible, fish in the sections of Blackwater Creek Tributary 2 that will be isolated by the construction of the perimeter ditch and overprinted by the construction of the TSF will be captured and relocated to the same tributaries downstream from the operations area, or to the main branch of Blackwater Creek [Mit_080].

- Optimize the layout of the Project to minimize the footprint, and to the extent possible, minimizing the catchment areas diverted from Little Creek and Hoffstrom's Bay Tributary [Mit_050].

- A perimeter ditch around the operations area will prevent the release of runoff [Mit_008].

- The refined water balance for the Project looks to optimize the use of water collected within the operations area for use in the processing of ore. This limits the effects on surface water quantities by minimizing water taking and providing flexibility regarding the volumes discharged from the Project [Mit_057].

- The fresh water needs for the Project will be met by withdrawals from the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3. The withdrawals will not exceed 5% of the flows in either of the two creeks. Pump intakes will be fitted with fish screens to prevent entrainment [Mit_059, Mit_081].

- Excess water during operations will be treated to meet PWQO prior to being discharged to a single discharge point in Blackwater Creek [Mit_053].

- Treated effluent will be discharged to Blackwater Creek through an engineered structure designed to minimize erosion risks [Mit_058].

- Following operations the dewatering activities will be ceased and the open pit and underground mine will be allowed to fill with water. Treasury Metals will test the water in the open pit as it is filling, and if necessary, batch treatment will be used to ensure that the water to be discharged from the pit lake meets PWQO [Mit_024].

- Once the pit has filled during the post-closure phase, excess water will be allowed to passively discharge through a spillway into the former channel of Blackwater Creek Tributary 1 [Mit_060].

- As the Project advances, detailed engineering will be completed to ensure that all downstream culverts on Blackwater Creek can support any predicted increases in flows. This would include ensuring that the downstream culverts will continue to provide adequate fish passage [Mit_082].

6.14.4 Predicted Effects

Effects of the Project to fish and fish habitat can occur as a result of direct physical alteration of habitat, changes to flow, changes to water quality and blasting. The predicted effects from each phase of the project are presented below.

6.14.4.1 Site Preparation and Construction Phase

Direct Alteration of Habitat

In preparation of for mining the open pit, portions of Blackwater Creek Tributary 1 will be overprinted. The construction of the perimeter ditch will isolate those sections of Blackwater Creek Tributary 1 overprinted by the Project, effectively eliminating flow in the downstream sections of the tributary. This will result in the direct loss of habitat in the overprinted portions and the reduction of flows in the downstream reaches of the tributary. For the purposes of this effects assessment, it has been assumed that the reduction in flow in the downstream sections will render them unsuitable as fish habitat. This construction could also result in direct fish mortality.

Relocation of the fish that remain within the isolated portion of Blackwater Creek Tributary 1 will be undertaken but, given the habitat conditions (soft substrates, dense riparian vegetation) and the difficulty that they will pose to fish capture, mortality of fish will occur after these sections are isolated. In the downstream reaches of Blackwater Creek Tributary 1, most fish are expected to move downstream to Blackwater Creek as flows diminish. This reach will be examined and fish relocation will be undertaken if required, but some mortality of fish that do not leave voluntarily may occur there are well.

Construction of the tailings storage facility (TSF) and minewater pond will overprint sections of Blackwater Creek Tributary 2. The construction of the perimeter ditch will isolate those sections of Blackwater Creek Tributary 2 overprinted by the Project, effectively eliminating flow in the downstream sections of the tributary. This will result in the direct loss of habitat and the effective elimination of flow in the downstream reaches of the tributary. For the purposes of this effects assessment, it has been assumed that the reduction in flow in the downstream sections will render them unsuitable as fish habitat. It is not known for certain if the White Sucker that spawn where Blackwater Creek is crossed by Anderson Road are stream-resident or migratory but is has been assumed for the purposes of the assessment that they are migratory. There is no known White Sucker spawning habitat farther upstream in Tributary 2, so it is assumed that migratory White Sucker would only use the portion of Tributary 2 that is downstream from Anderson Road. This activity will also result in mortality of stream-resident fish in the overprinted section and possibly in the section where flow is eliminated or reduced.

Relocation of the fish that remain within the isolated portion of Blackwater Creek Tributary 2 will be undertaken but, as is the case for Blackwater Creek Tributary 1, the habitat conditions (soft substrates, dense riparian vegetation) will make fish capture difficult and mortality of fish will occur after these sections are isolated. In the downstream reaches of Blackwater Creek Tributary 2 most fish are expected to move downstream to Blackwater Creek as flows diminish. This reach will be examined and fish relocation will be undertaken if required, but some mortality of fish that do not leave voluntarily may occur there are well.

Installation of the effluent discharge structure (the diffuser) in Blackwater Creek will result in localized habitat alterations. This is not expected to cause serious harm to fish or fish habitat.

Construction of the water intakes in the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3 will result in minor habitat alterations. Their installation is not expected to cause serious harm to fish or fish habitat.

Effects of Changes in Flow

Blackwater Creek

A perimeter ditch will be constructed at the start of the site preparation and construction phase to collect all site runoff from the operations area. There will be no releases from the operations area during the site preparation and construction phase as all collected water will be retained to help establish the TSF and provide water once processing starts. There will be diminished flows in Blackwater Creek for this period of time. Based on the drainage area intercepted by the perimeter ditch and directed towards the open pit during operations (Water Report, Table 4-11), a reduction in flow of 20.6% is predicted on Blackwater Creek immediately downstream of the planned discharge point and a reduction in flow of 13.0% is predicted near the point where Blackwater Creek discharges into Wabigoon Lake. These reductions will persist until effluent is discharged, which is expected to begin within 2 years of the after construction of the perimeter ditch. During this period there may be a reduction in the number of stream-resident fish that the stream can

support beginning downstream from the confluence with Blackwater Creek Tributary 2, and increasing downstream from the confluence with Blackwater Creek Tributary 1, and then diminishing as more tributaries enter Blackwater Creek downstream.

Tributaries to Thunder Lake

Portions of the Hoffstrom's Bay Tributary and Little Creek watersheds are overprinted by proposed mine site facilities directed to the water management system. Average annual flows are predicted to decrease 7.8% and 8.7% in Hoffstrom's Bay Tributary and Little Creek, respectively, for all flow conditions. There is no surface feature within the overprinted area and therefore no loss of stream length or area is predicted. The reductions in flow on a continuous basis could cause small decreases in the number of stream-resident fish that these two watercourses can support.

Effects of Changes in Water Quality

During the site preparation and construction phase the water from the operations area will be collected in the perimeter ditch and retained on the site. No effect on water quality is predicted during the site preparations and construction phase.

Blasting

Fish habitat within the operations area will be isolated and fish will be relocated at the outset of the Project. Therefore it is not expected that there will be fish in proximity to blasting. Should this not be the case, DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky, 1998) will be adhered to in order to ensure that no harm to fish occurs.

6.14.4.2 Operations Phase

Direct Alteration of Habitat

There will be no additional direct alterations of habitat during the operations phase.

Effects of Changes in Flow

Flows in the sub-watersheds affected by the Project have been calculated for average, dry, and wet conditions during the operations phase. The operations flows are compared to the existing conditions to quantify expected changes in flows. The resulting flows for the operations phase are provided in Tables 6.9.4.2-1 to 6.9.4.2-3, for the average, dry and wet years, respectively.

Blackwater Creek

During operations, flow in Blackwater Creek is affected by overprinting of portions of the drainage areas of Blackwater Creek Tributaries 1 and Blackwater Creek Tributary 2, and discharge of

treated effluent to the system. Downstream from the confluence with Blackwater Creek Tributary 1 (surface water quantity node BW1), an increase in annual flow of 0.8% and 1.8% is predicted for average and wet conditions, respectively, and a reduction in annual flow of 2.0% is predicted for dry conditions.

In wet and average years the range in average monthly flows in Blackwater Creek is reduced. Generally, in those years, during the months with the lowest discharge (January to April, August and September) the effluent discharge is greater than the reduction due to overprinting and therefore flows are higher. Conversely, in the months with the highest flows (May and June), the reduction in surface flow due to overprinting is more than the effluent discharges and flows are lower. In a dry year the average monthly flows are, similarly, higher in January through April but are lower in all other months except November because the volume of effluent being discharged is also reduced during dry summers.

Overall, during the operations phase little effect on fish and fish habitat is expected in Blackwater Creek due to changes in flow. In some years and some months there will be increases in the amount of habitat available due to higher flows and in others there will be reductions. In all years, peak spring flows will be reduced, and therefore there should be no adverse effects on spawning migrations in the event that existing culverts are barriers or impediments due to high velocities.

Tributaries to Thunder Lake

During operations, water takings from Thunder Lake Tributary 2 and Thunder Lake Tributary 3 will be required for mine process water. No other mechanism that could cause measurable effects to flows in either Thunder Lake Tributary 2 or Thunder Lake Tributary 3 have been identified. The maximum water taking at any given time has been limited to 5% of the available flow. No water taking is anticipated during a wet year, and only during some months in an average year. The reduction in flow during water takings of 5% or less of available flow for limited periods is not expected to have an adverse effect on fish or fish habitat. The pump intakes will be fitted with screens to prevent fish entrainment during operations.

The effects on flow in Hoffstrom's Bay Tributary and Little Creek watersheds which occurred during the site preparation and construction phase due to portions of their drainage areas being overprinted by proposed mine site facilities will persist.

Effects of Changes in Water Quality

During the Operations Phase changes to the concentrations of various compounds will occur in Blackwater Creek and Wabigoon Lake due to the discharge of treated effluent into Blackwater Creek. The effluent will be treated to meet the PWQO for the protection of aquatic life prior to release into Blackwater Creek. Therefore, no adverse effects on fish will occur in the receiving environment. As the entire operations area is enclosed by the perimeter ditch and there is only one point of effluent discharge there are no other locations where changes in water quality will occur during operations.

Blasting

Fish habitat within the operations area will be isolated and fish will be relocated at the outset of the Project. Therefore it is not expected that there will be fish in proximity to blasting. Should this not be the case, DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky, 1998) will be adhered to in order to ensure that no harm to fish occurs.

6.14.4.3 Closure Phase

Direct Alteration of Habitat

During the Closure Phase the effluent diffuser will be removed from Blackwater Creek and the water intakes will be removed from Thunder Lake Tributary 2 and Thunder Lake Tributary 3. No negative impacts to fish or fish habitat will result.

During the Closure Phase the portion of Blackwater Creek Tributary 1 that is downstream from the pit lake outlet will be restored to a form that can accept water and convey it to Blackwater Creek once the pit lake is filled. There will, however, be no fish habitat created there until the pit lake begins to overflow.

The effects on flow in Hoffstrom's Bay Tributary and Little Creek watersheds which occurred during the Construction Phase due to portions of their drainage areas being overprinted by proposed mine site facilities will persist.

Effects of Changes in Flow

Blackwater Creek

During closure there will be no effluent discharged from the site. All runoff from the site will be directed towards the open pit to accelerate the rate of filling and therefore flows in Blackwater Creek will be reduced. Based on the drainage area directed towards the open pit at closure. A reduction in flow of 20.8% is predicted downstream of the confluence of Blackwater Creek Tributary 1 (surface water quantity node (BW1) and 13.1% at upstream from where Blackwater creek enters Wabigoon Lake. It is estimated that it will take between 5 and 9 years to fill the open pit. During this period there will be a reduction in the amount of fish habitat in Blackwater Creek beginning downstream from the confluence with Blackwater Creek Tributary 2. This effects diminishing as more tributaries enter Blackwater Creek farther downstream. During this period there may be a reduction in the number of stream-resident fish that the stream can support.

Tributaries to Thunder Lake

There will be no water withdrawals and no effect on flow in Thunder Lake Tributaries 2 and 3 during the Closure Phase. Therefore there will be no effect on fish and fish habitat in those watercourses.

The effects on flow in Hoffstrom's Bay Tributary and Little Creek watersheds which began during the Construction Phase due to portions of their drainage areas being overprinted by proposed mine site facilities will persist.

Effects of Changes in Water Quality

During the Closure Phase all runoff from the site will be directed towards the open pit to accelerate the rate of filling. There will be no effluent discharged from the site and therefore no effect on fish and fish habitat.

Blasting

No blasting is anticipated during closure. Fish habitat within the operations area will be isolated and fish will be relocated at the outset of the Project. Therefore it is not expected that there will be fish in proximity to blasting in the event that it is necessary. Should this not be the case, DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky, 1998) will be adhered to in order to ensure that no harm to fish occurs.

6.14.4.4 Post-closure Phase

Direct Alteration of Habitat

Once the open pit is fully flooded, there will be a passive overflow from the pit to Blackwater Creek Tributary 1. This will create fish habitat in Blackwater Creek Tributary 1 from the overflow structure downstream to Blackwater Creek.

Effects of Changes in Flow

Expected flows in site sub-watersheds have been calculated for the average, dry, and wet conditions during the post-closure phase. The results using a dry closure cover over the TSF are provided in Tables 6.9.4.4-1 to 6.9.4.4-3. Comparable results for the post-closure phase with a wet TSF cover are provided in Tables 6.9.4.4-4 to 6.9.4.4-6.

Blackwater Creek

The filling of the pit lake will continue into the post-closure phase, resulting in a reduction in the flow in Blackwater Creek downstream of the confluence with Blackwater Creek Tributary 2 due to the continued redirection of flow from the operations area towards the open pit. Once the open pit is fully flooded, there will be a passive overflow from the pit lake to Blackwater Creek Tributary 1, which will flow into Blackwater Creek. Post-closure there will be a reduction in flow in Blackwater Creek between Tributary 1 and Tributary 2. This may result in a reduction in the number of fish that this reach can support. Post-closure, increases in annual flows are predicted for Blackwater Creek downstream from Blackwater Creek Tributary 1, which receives the outflow from the pit lake, under all flow conditions. This is the result of higher runoff from the rehabilitated

mine site (e.g., semi-impervious membrane with vegetated cover). For a dry cover TSF scenario, the increase in annual flow downstream from the confluence with Blackwater Creek Tributary 1 is predicted to be 26.1% in a dry year, 11.1% in an average year, and 12.9% in a wet year. In a dry year the flows are decreased during the June to September period with a predicted maximum reduction of 20% in September; flows are increased during the rest of the year. In an average year, flows are decreased in August by 5.9% and increased in other months. In a wet year flows are predicted to increase in every month. The increase in flow in the lower reaches of Blackwater Creek may increase the number of stream-resident fish that this reach can support.

The changes in average flow in May, which is the month during which upstream migrations of fish is most likely to occur, upstream from where Blackwater Creek enters Wabigoon Lake (surface water quantity node BW2), are 6.6%, 16.3% and 8% for an average, dry and wet year, respectively. There is insufficient information to determine whether the increases in flow could affect upstream fish passage through existing culverts. As part of the detailed engineering for the Project, determinations of the capacity of the downstream culverts to handle changes in flow, which would include the effects on fish passage, will be evaluated. If adverse effects to fish passage due to increased flows will occur, the downstream structures will be mitigated so that there is no negative effect on fish or fish habitat.

For a wet cover TSF scenario, the increase in annual flow at BW1 is predicted to be 19.0% in a dry year, 8.0% in an average year, and 12.4% in a wet year. In a dry year the flows are decreased during the June to September period with a predicted maximum reduction of 20% in September; flows are increased during the rest of the year. In an average year flows are decreased in June, July and August with a maximum reduction of 14.0% in August; flows are increased in other months. In a wet year flows are predicted to increase in every month except August when a small (1.3%) increase is predicted.

For a wet cover TSF scenario, the changes in average flow in May, which is the month during which upstream migrations of fish are most likely to occur, at BW2, are 5.4%, 9.2% and 7.8% for an average, dry and wet year, respectively. This will be evaluated as the project moves forward and if negative effects to fish passage due to increased flows will occur, the downstream structures will be mitigated so that there is no negative effect on fish or fish habitat.

Tributaries to Thunder Lake

There will be no water withdrawals and no effect on flow in Thunder Lake Tributaries #2 and #3 during the post-closure phase. Therefore there will be no effect on fish and fish habitat in those watercourses.

The effects on flow in Hoffstrom's Bay Tributary and Little Creek watersheds, which began during the site preparation and construction phase due to portions of their drainage areas being overprinted by proposed mine site facilities, will persist. However, there are slight reductions in the magnitude of the changes due to the grading of the site during the closure phase that will allow a portion of the Hoffstrom's Bay Tributary catchment overprinted by the perimeter ditch to

be recovered. Average annual flow in Hoffstrom's Bay Tributary (Tables 6.9.4.4-1 to 6.9.4.4-6) is predicted to be reduced by 6.7% in an average year, 5.3% in a dry year, and 6.9% in a wet year. Average annual flow in Little Creek is predicted to be reduced by 7.5% regardless of whether it is an average, wet or dry year. These reductions in flow may cause small reductions in the number of stream-resident fish that these watercourses can support.

Effects of Changes in Water Quality

During the Post-closure Phase there will be a passive overflow from the pit to Blackwater Creek Tributary 1 and via it to Blackwater Creek. Treasury Metals will test the water in the open pit as it is filling and, if necessary, batch treatment will be used to ensure that the water to be discharged from the pit lake meets PWQO. Once the open pit has filled with water and the groundwater table returns to near pre-development conditions, seepage from the TSF and WRSA will be able to escape the site and will eventually reach adjacent surface water courses.

The effects of the releases from the pit lake and the seepage from the TSF and WRSA have been incorporated into the surface water quality modelling presented in Tables 6.8.15.2-1 to 6.8.15.2-9. With a wet cover used for the closure of the TSF, the predicted surface water quality in all of the adjacent watercourses would be the same or improved from existing conditions, or would meet the PWQO. Consequently there would be no adverse effects on fish or fish habitat.

Blasting

No blasting will occur during the Post-closure Phase.

6.14.4.5 Predicted Adverse Effects

The predicted effects of the Project on fish and fish habitat for the various phases on the Project are provided in Sections 3.14.4.1 through 6.14.4.4, were determined using four VCs; namely stream-resident fish populations, migratory fish populations, lake-resident fish populations, and fish species-at-risk. As there are no fish species at risk present in the RSA, no adverse effects were predicted for this VC. There were also no predicted adverse effects on lake-resident fish populations. There are predicted adverse effects for both the stream-resident fish populations and the migratory fish populations. The predicted adverse effects of the Project on fish and fish habitat were predicted during the site preparation and construction, operations, closure, and post-closure phases of the Project. Table 6.14.4.5-1 provides a summary showing the VCs and measures for which adverse effects were predicted in each of the Project phases.

Table 6.14.4.5-1: Summary of Adverse Effects for Fish and Fish Habitat

Valued Components (VCs)	Fish and Fish Habitat Measure		
	Habitat Lost	Habitat Alteration or Disruption	Fish Mortality
Site Preparation and Construction Phase			
Stream-based fish populations	‡	‡	‡

Table 6.14.4.5-1: Summary of Adverse Effects for Fish and Fish Habitat (continued)

Valued Components (VCs)	Fish and Fish Habitat Measure		
	Habitat Lost	Habitat Alteration or Disruption	Fish Mortality
Migratory fish populations	‡	‡	‡
Lake-based fish populations	—	—	—
Fish species at risk	—	—	—
Operations Phase			
Stream-based fish populations	‡	‡	—
Migratory fish populations	‡	—	—
Lake-based fish populations	—	—	—
Fish species at risk	—	—	—
Closure Phase			
Stream-based fish populations	‡	‡	—
Migratory fish populations	‡	‡	—
Lake-based fish populations	—	—	—
Fish species at risk	—	—	—
Post-closure Phase			
Stream-based fish populations	‡	—	—
Migratory fish populations	‡	—	—
Lake-based fish populations	—	—	—
Fish species at risk	—	—	—

Notes:
The "‡" symbol indicates where adverse effects on fish and fish habitat were predicted
The "—" symbol indicates where no adverse effects were predicted

The predicted adverse effects of the Project on fish and fish habitat have been detailed in Table 6.14.4.5-2, which provided the quantitative predictions for adverse effects. This table only provides the values for the VCs and indicators for which there were predicted adverse effects.

Table 6.14.45-2: Predicted Adverse Effects for Fish and Fish Habitat

Valued Components (VCs) [1]	Indicators [1]	Blackwater Creek Main Branch	Blackwater Creek Tributary 1	Blackwater Creek Tributary 2	Hoffstom's Bay Tributary	Little Creek
Site Preparation and Construction Phase						
Stream-resident fish populations	Habitat Loss (km)	0	1.34	5.67	0	0
	Habitat Alteration or Disruption (km)	4.5	0	0	2.58	1.94
	Potential for Mortality (%)	0	50%	50%	0	0
Migratory fish populations	Habitat Loss (km)	0	0	0.05	0	0
	Habitat Alteration or Disruption (km)	4.5	0	0	2.58	1.94
Operations Phase						
Stream-resident fish populations	Habitat Loss (km)	0	1.34	5.67	0	0
	Habitat Alteration or Disruption (km)	0	0	0	2.58	1.94
Migratory fish populations	Habitat Loss (km)	0	0	0.05	0	0
Closure Phase						
	Habitat Loss (km)	0	1.34	5.67	0	0

Table 6.14.45-2: Predicted Adverse Effects for Fish and Fish Habitat (continued)

Valued Components (VCs) (1)	Indicators (1)	Blackwater Creek Main Branch	Blackwater Creek Tributary 1	Blackwater Creek Tributary 2	Hoffstom's Bay Tributary	Little Creek
Stream-resident fish populations	Habitat Alteration or Disruption (km)	4.5	0	0	2.58	1.94
Migratory fish populations	Habitat Loss (km)	0	0	0.05	0	0
	Habitat Alteration or Disruption (km)	4.5	0	0	0	0
Post-closure Phase						
Stream-resident fish populations	Habitat Loss (km)	0	1.00 (2)	5.67	0	0
	Habitat Alteration or Disruption (km)	0.69	0	0	2.58	1.94
Migratory fish populations	Habitat Loss (km)	0	0	0.05	0	0

Note: (1) Only those valued components (VCs) and indicators for which adverse effects have been predicted are shown in the table

6.14.5 Identified Mitigation

The following mitigation measures are incorporated into the design and planned implementation of the Project to avoid the effects to fish and fish habitat:

- Prior to overburden removal, any beaver dams within the Project footprint will be removed and the impoundments will be allowed to draw down. This will reduce the number of fish that will remain in isolated sections of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2 [Mit_077].

- Activities and the construction of Project components that will impact or overprint watercourses (i.e., the perimeter ditch, the effluent diffuser, water intakes) will occur during the fisheries timing window when in-stream work is permitted [Mit_078].

- To the extent possible, fish in the sections of Blackwater Creek Tributary 1 that will be isolated by the construction of the perimeter ditch and overprinted by the removal of overburden from the open pit will be captured and relocated to the same tributary downstream from the operations area, or to the main branch of Blackwater Creek [Mit_079].

- To the extent possible, fish in the sections of Blackwater Creek Tributary 2 that will be isolated by the construction of the perimeter ditch and overprinted by the construction of the TSF will be captured and relocated to the same tributary downstream from the operations area, or to the main branch of Blackwater Creek [Mit_080].

- Optimize the layout of the Project to minimize the footprint, and to the extent possible, minimizing the catchment areas diverted from Little Creek and Hoffstrom's Bay Tributary [Mit_050].

- A perimeter ditch around the operations area will prevent the release of runoff [Mit_008].

- The refined water balance for the Project looks to optimize the use of water collected within the operations area for use in the processing of ore. This limits the effects on surface water quantities by minimizing water taking and providing flexibility regarding the volumes discharged from the Project [Mit_057].

- The fresh water needs for the Project will be met by withdrawals from the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3. The withdrawals will not exceed 5% of the flows in either of the two creeks. Pump intakes will be fitted with fish screens to prevent entrainment [Mit_059, Mit_081].

- Excess water during operations will be treated to meet PWQO prior to being discharged to a single discharge point in Blackwater Creek [Mit_053].

- Treated effluent will be discharged to Blackwater Creek through an engineered structure designed to minimize erosion risks [Mit_058].

- Following operations the dewatering activities will be ceased and the open pit and underground mine will be allowed to fill with water. Treasury Metals will test the water in the open pit as it is filling, and if necessary, batch treatment will be used to ensure that the water to be discharged from the pit lake meets PWQO [Mit_024].

- Once the pit has filled during the post-closure phase, excess water will be allowed to passively discharge through a spillway into the former channel of Blackwater Creek Tributary 1 [Mit_060].

- As the Project advances, detailed engineering will be completed to ensure that all downstream culverts on Blackwater Creek can support any predicted increases in flows. This would include ensuring that the downstream culverts will continue to provide adequate fish passage [Mit_083].

In addition, the Project will require a *Fisheries Act* authorization and will likely require Treasury Metals to mitigate the losses of fish habitat that it causes as a condition of that authorization. Typically, the offsetting involves the creation of new habitat or the enhancement of existing habitat that is commensurate with the habitat losses. The *Fisheries Act* authorization, which is issued by DFO, details the offsetting measures to be completed and, typically also specifies monitoring to be conducted. DFO uses a letter of credit to provide a financial assurance mechanism in the event that an offsetting plan is not completed [Mit_083].

6.14.6 Residual Adverse Effects

In the context of the CEAA, 2012, the fisheries offsetting would be considered mitigation that would offset and mitigate the adverse effects of the Project on fish habitat. Therefore, following

offsetting there are no residual adverse effects due to the Project on either the "habitat loss" or "habitat alteration" indicators. Residual adverse effects would remain, even after mitigation, for the "potential for mortality" indicator the stream-based fish populations VC, as shown in Table 6.14.6-1.

Table 6.14.6-1: Predicted Residual Adverse Effects for Fish and Fish Habitat

Valued Components (VCs) (1)	Indicators (1)	Blackwater Creek Main Branch	Blackwater Creek Tributary 1	Blackwater Creek Tributary 2	Hoffstom's Bay Tributary	Little Creek
Site Preparation and Construction Phase						
Stream-resident fish populations	Potential for Mortality (%)	0	50%	50%	0	0
Operations Phase						
No residual adverse effects would remain after consideration of the mitigation provided through fish habitat offsetting						
Closure Phase						
No residual adverse effects would remain after consideration of the mitigation provided through fish habitat offsetting						
Post-closure Phase						
No residual adverse effects would remain after consideration of the mitigation provided through fish habitat offsetting						

Notes: (1) Only those valued components (VCs) and indicators for which adverse effects have been predicted are shown in the table

The predictions of surface water quality focussed on predicting changes in the watercourses surrounding the Project. A spatial representation of the watercourses affected has been provided in Figure 6.9.6-1. The figure highlights those watercourses where changes in surface water flows were predict to result from the Project. The watercourses where changes in flow may be measurable have been shaded in green in the figure. The green shading indicated that the flows will change, but that those changes would be small enough that fish populations would not be impacted, and the streams would continue to provide Aboriginal peoples opportunities to practice traditional uses of the land. The operations area for the Project is shaded gold, as surface water quantities within this area will be managed by Treasury Metals through the site preparation and construction, operations, and closure phases. Once the pit lake fills during the post-closure phase (approximately 6 to 8 years following the cessation of dewatering) natural surface water flows within the operations area will be established. This area would be shaded green once the natural surface water flows are re-established.

6.14.7 Information to Address Round 1 Information Requests

The following lists the questions from the Round 1 information requests that relate to the effects of the Project on fish and fish habitat:

- TMI_520-AC(1)-194: effects of liquid discharges on fish and fish habitat;
- TMI_121-SW(1)-35: effect of flows on fish and fish habitat;
- TMI_123-FH(1)-02: effects of laydown area on fish and fish habitat;
- .

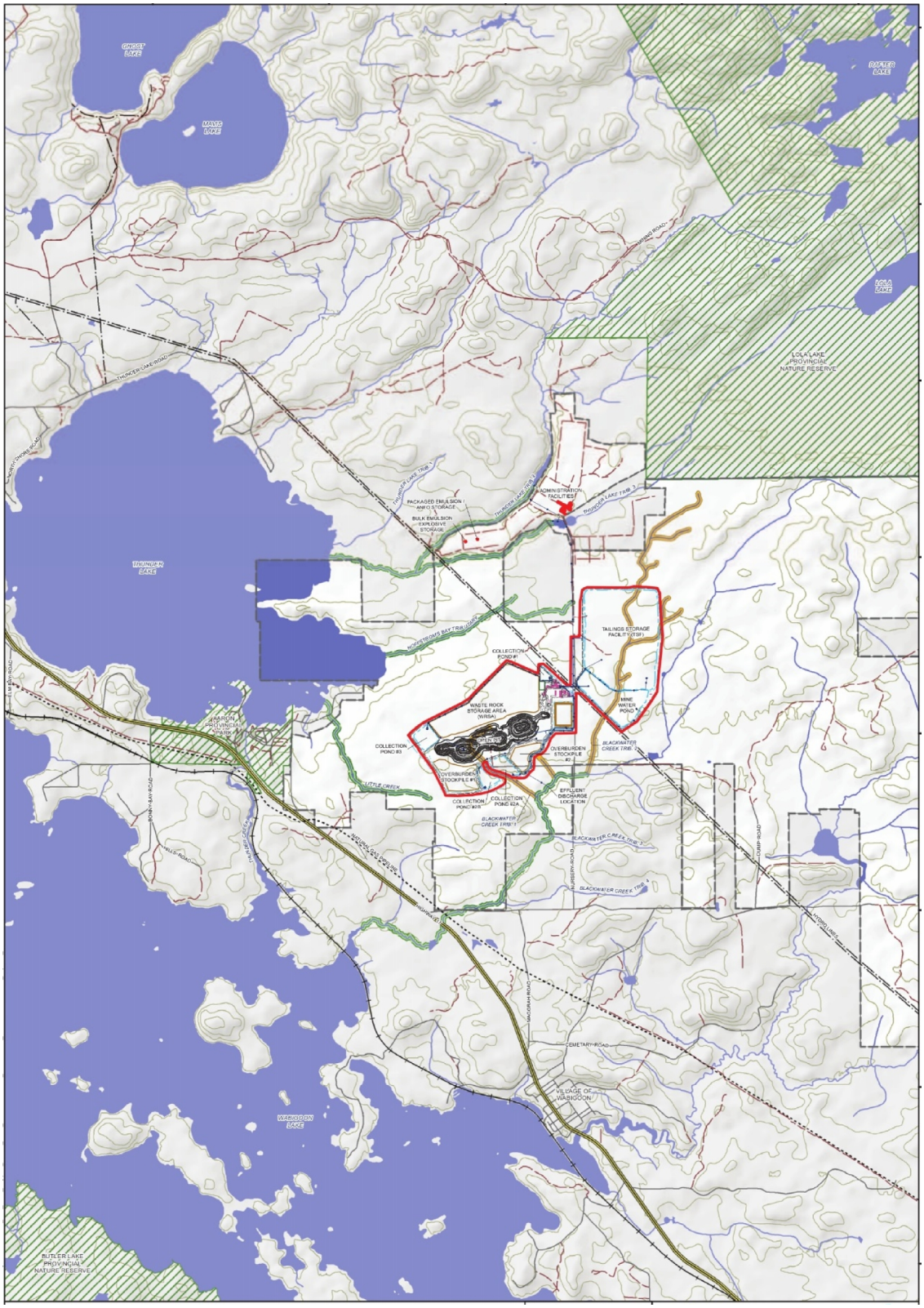


Figure 6.14.6-1: Spatial Extent of Fish and Fish Habitat Effects

- TMI_126-FH(1)-05: effects of groundwater reductions to fish and fish habitat;
- TMI_14-PD(1)-01: effects of dewatering on fish and fish habitat;
- TMI_331-AC(1)-05: effects to fish in Wabigoon and Thunder Lakes; and
- TMI_332-AC(1)-06: potential effects to fish and fish habitat

6.15 Wetlands and Vegetation

6.15.1 Likely Effects of the Project on the Environment

As described in Section 6.1.3.14 of this Revised EIS, a total of two VCs were used for evaluating the effects of the Project; wetland extent and vegetation communities and species. The potential effects of the Project on these VCs are described below by Project phase:

- **Site Preparation and Construction Phase**: Most of the physical disturbance, clearing of land and alteration to watercourses will occur during the site preparation and construction phase of the Project. Activities and equipment associate with the site preparation and construction will create dust. The potential effects of these activities on wetlands and vegetation includes the following:
  - Direct loss of wetlands as a result of draining and infrastructure development;
  - Discharge of sediments in watercourses;
  - Alteration of natural flows and water levels; and
  - Deposition of dust from equipment and vehicles on roadside vegetation.
- **Operations Phase**: During the operations phase, mining activities will begin within an open pit, and progress to an underground mine. The open pit and underground mine will be dewatered to provide a safe work environment, which will result in a development of a drawdown zone in the local water table. Mining operations will create dust. The potential effects of these activities on wetlands and vegetation includes the following:
  - Continued loss of wetlands affected during site preparation and construction;
  - Discharge of sediments in watercourses;
  - Alteration of natural flows and water levels; and
  - Deposition of dust from equipment and vehicles on roadside vegetation

- **Closure Phase**: During the closure phase, the facility will be decommissioned, dewatering activities will cease, and the open pit and underground mine will be allowed to start filling with water. The site will be reclaimed and graded so all runoff will drain towards the open pit. The potential effects of these activities on wetlands and vegetation includes the following:
    - Continued loss of wetlands affected during site preparation and construction;
    - Discharge of sediments in watercourses;
    - Alteration of natural flows and water levels; and
    - Deposition of dust from equipment and vehicles on roadside vegetation
- **Post-closure Phase**:
    - No anticipated effects

The potential effects of the Project on wetlands and vegetation have been described using a simple linkage diagram in Figure 6.15.1-1. The figure illustrate the vegetation and wetlands VCs (shown in blue on the figure) and how it can be potentially affected during each phase of the Project life. The figure also indicates the other components or VCs (shown in red on the figure) that can be affected by effects to wetlands and vegetation. For example, effects on vegetation and wetlands will provide input for evaluating the effects of the Project on Aboriginal peoples. Similarly, other components that provide inputs to the evaluation of the effects of the Project on vegetation and wetlands are shown in red on the figure. For example, the effects of the Project on surface water quality are used in determining the effects on the vegetation and wetlands VCs.

6.15.2 Effects Prediction Methods

A footprint analysis was used to identify which Project areas and components would interact with wetlands and vegetation. A background research was conducted to identify public sources of information regarding plant communities, wetlands, significant ecological features, Natural Heritage areas and provincially rare or SAR. Standard spatial provincial data from the Land Information Ontario (LIO) website was used as the basis of all existing wetlands and vegetation in the LSA and RSA. Field surveys were completed to confirm vegetation communities, conduct plant inventories, verify ecosites, characterize and evaluate wetlands, and to conduct SAR and rare plant surveys.

To determine the Project effects on wetlands and vegetation, the information gathered through database searches and field inventories was coupled with the provincial spatial data and overlain with the Project footprint. This was done using the Project footprint to assess the maximum extent of disturbance.

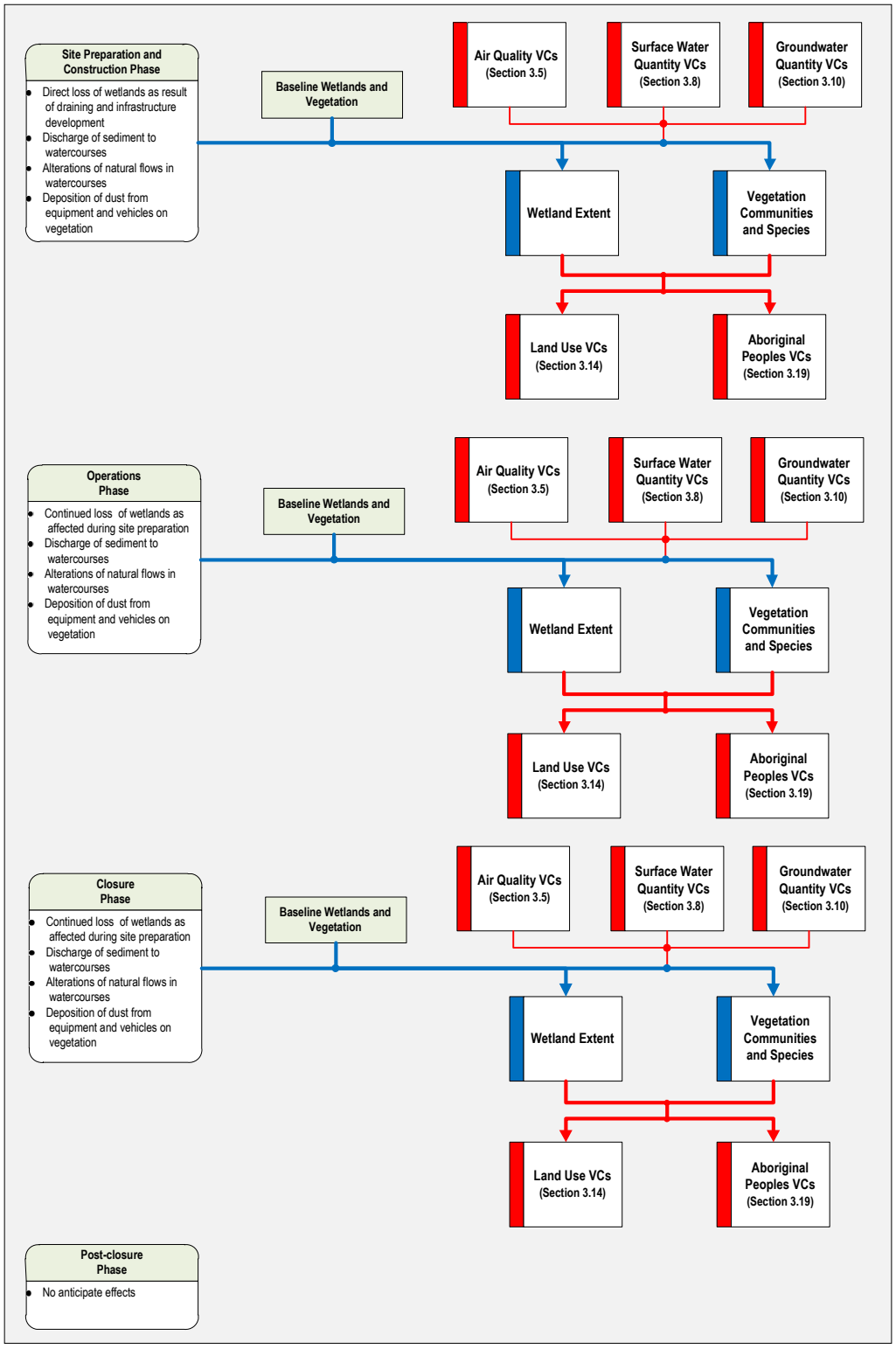


Figure 6.15.1-1: Wetlands and Vegetation Linkage Diagram

Where interactions were identified during the site preparation and construction phase they were carried through to the closure. Site reclamation will include wetland construction and revegetation, however, this is not expected to occur until the closure phases, so certain effects identified on wetlands and vegetation during the site preparation and construction phase will remain through until reclamation activities occur. The assessment looked at the maximum possible extent of disturbance, but also considered the phase at which the effects were expected to occur.

6.15.3 Project Effects Avoidance Measures Used in Predictions

The following effects avoidance measures have been considered when determining the potential effects of the Project on vegetation and wetlands:

- Minimized the amount of wetland and vegetated area clearing required for the Project by optimizing the pit design and siting Project infrastructure in previously disturbed areas [Mit_050, Mit_065].
- Retention of forested areas wherever feasible [Mit_084].
- Identification and protection of known vegetative SAR locations [Mit_085].
- Construction of a perimeter ditch around the operations area, which will collect all of the site runoff for use in the processing [Mit_008].
- During operations, excess site water will be treated to meet Provincial Water Quality Objectives (PWQO) prior to discharge into Blackwater Creek. There will be no other discharges to surface water during operations [Mit_053].
- Avoid broadcast spraying of herbicides for vegetation management [Mit_086].
- Ensure proper culvert sizing for all new water crossing installations, allowing for maintenance of existing flows and water levels [Mit_082].
- Develop slope dependent vegetated buffers along rivers creeks and wetlands in conjunction with the MNRF [Mit_066].
- Develop sediment and erosion plans which will reduce sedimentation into wetlands and reduce the potential for dust cover on roadside vegetation [Mit_008, Mit_046, Mit_054].
- Restoration of all disturbed habitats upon closure to the extent feasible [Mit_068].
- Develop a wetland clearing strategy with the local MNRF reduce the effects to overwintering frogs (i.e., draining wetlands to discourage hibernation) [Mit_074].

- Re-vegetation of all slopes after closure with a focus on riparian habitat in the open pit [Mit_068, Mit_087].

- Reclamation and re-vegetation of the mining footprint to be carried out in accordance with O.Reg. 240/00 [Mit_088].

- Seeding or hydro-seeding of the reclaimed areas with native seed mix [Mit_089].

6.15.4 Predicted Effects

The predicted effects of the Project on wetlands and vegetation will vary throughout the Project life, depending on the Project phase, and will vary according to specific levels of activity. Project effects will also vary for each VC. The potential effects of the Project on wetlands and vegetation include one of two aspects: (1) Project component interaction with wetland extent, resulting in a loss of wetland area; and, (2) Project component interaction with vegetation, resulting in impacts to or loss of vegetation. The following lists the potential effects to each VC by Project phase.

6.15.4.1 Site Preparation and Construction Phase

Wetland Extent

The effects to wetland extent will occur primarily during the site preparation and construction phase of the Project. A total of 33 ha of wetland (marsh and swamp ecosites) will experience direct effects from the site preparation and construction phase, as shown in Table 6.15.4.1-1.

Table 6.15.4.1-1: Direct Effects on Wetlands during Site Preparation and Construction Phase

Wetland Type	Extent of Wetland in LSA (ha)	Project Affected Wetland (ha)	% of Wetland Affected
Fen	817.2	0.2	0
Marsh	145.3	6.3	4.3
Swamp	476.6	26.1	5.5

Loss of wetland extent may affect wetland habitat functions through direct loss, fragmentation and edge effects. In this case the losses are relatively small, representing 4.3% of total marsh and 5.5% of total swamp area present in the LSA. Wetland hydrological functions may be altered where roads change surface and groundwater flow. Dust inputs and sedimentation from road operation, upgrades, and maintenance may alter biochemical and habitat functions and could result in changes to functional diversity as ecosystem changes occur. Adjacent to the road are extensive windrows of exposed soil; these may, until successfully re-vegetated, erode, and sediment will be delivered to adjacent wetlands, streams, waterbodies, and terrestrial vegetation.

Vegetation Communities

Vegetation may also be affected during the site preparation and construction phase through dust loading from vehicles driving on access roads. The site preparation and construction phase will result in the direct loss of 208 ha of vegetation cover. This represents a 5.9% loss of coniferous forest, a 5.9% loss of deciduous forest, and a 21.9% loss of successional areas within the LSA. The results are provided in Table 6.15.4.1-2 site preparation and construction phase of this project will result in the removal of 95 ha of coniferous forest, 43 ha of deciduous forest, and 70 ha of successional areas. Floral invasive species can also be a concern in areas adjacent to the roads.

Table 6.15.4.1-2: Direct Effects on Vegetation during Site Preparation and Construction Phase

Vegetation Type	Extent of Vegetation Type LSA (ha)	Project Affected Vegetation (ha)	% of Vegetation Affected
Coniferous forest	1,610	95	5.9
Deciduous forest	730	43	5.9
Successional areas	320	70	21.9

Marsh marigold was found at the mouth of Thunder Creek at Wabigoon Lake in 2011. Floating marsh marigold is considered provincially rare (ranked S2 by the NHIC) and has documented occurrences throughout the RSA. No site preparation and construction phase activities are expected in close proximity to the known location of the Floating marsh marigold.

Floating marsh marigold is found in shallow water in creeks, pools, ditches and sheltered lake margins. It also tends to be found at slow flowing stream mouths, especially those influenced by beaver activities. It typically roots in mud, sild or clay. Floating marsh marigold is sensitive to water quality and eutrophication, as well as fluctuations in water levels and soil disturbance, particularly from rutting (WDNR 2016). Potential impacts to floating marsh marigold include degradation of water quality during the site preparation and construction phase of the Project, as well as fluctuations in water levels.

6.15.4.2 Operations Phase

During the operations phase of the Project, the effects of site preparation and construction will persist on wetlands and vegetation communities. There will be an increased potential for degradation of water quality as ore is stockpiled and effluent is discharged. However, treasury Metals has committed to treat all effluent released from the site during operations to meet PWQO before discharge. As a result of being found in topographical depressions, wetlands may become the endpoint for contaminated runoff from mine operations. As waterfowl and wildlife are attracted to wetlands for foraging and breeding, concentrations of contaminants could constitute an attractive nuisance to such species. Potential direct effects to floating marsh marigold include habitat loss due to habitat destruction. Indirect effects include the potential change in the abundance and health of any populations that are downstream from the Project resulting from changes to outflow water quality.

6.15.4.3 Closure Phase

During the closure phase of the Project, the effects of site preparation and construction will persist on wetlands and vegetation communities. During Closure, the Project infrastructure will be decommissioned and disturbances reclaimed. As such, effects are no longer considered for major project components as presented above. No additional loss of wetland or vegetation extent and function should occur during this time, however, flows and water quality may continue to be impacted, resulting in potential effects to wetlands and vegetative communities.

6.15.4.4 Post-closure Phase

It is not anticipated that wetland extent or vegetative communities will be further affected in the Post-closure Phase. In fact, wetland functions should begin to recover following the implementation of reclamation activities that will assist wetland restoration objectives. While some wetland areas lost during the site preparation and construction phase, such as the wetlands along Blackwater Creek tributary 2 overprinted by the TSF will not recover, new wetlands will be generated around the pit lake. Additionally, some wetlands affected during the active Project life will recover once surface flows are re-established following closure. For example, those portions of Blackwater Creek Tributary 1 that were without flow from the start of site preparation through to the filling of the open pit, are expected to recover once flows are re-0established. Habitat features and functions associated with wetlands will begin to recover and continue to develop as wetland vegetation moves along its successional trajectory.

6.15.4.5 Predicted Adverse Effects

The predicted effects of the Project on wetlands and vegetation for each phase of the Project are were set out in Sections 6.15.4.1 through 6.15.4.4. Adverse effects of the Project on wetlands and vegetation were predicted for the wetlands extent VC. Adverse effects of the Project on wetlands and vegetation were predicted during the site preparation and construction, operations, and closure phases of the Project. No adverse effects were predicted during the post-closure phase. A summary of the predicted adverse effects of the Project on wetlands and vegetation is provided in Table 6.15.4.5-1

Table 6.15.4.5-1: Predicted Adverse Effects for Wetlands and Vegetation

Valued Components (VCs)	Predicted Adverse Effects for Wetlands and Vegetation			
	Site Preparation and Construction	Operations	Closure	Post-Closure
Wetlands extent	‡	‡(1)	‡(1)	—
Vegetation Communities and species	—	—	—	—

Notes:
The "‡" symbol indicates where adverse effects on wetlands and vegetation were predicted
The "—" symbol indicates where no adverse effects were predicted
(1) The areas lost during the site preparation and construction phase will not recover until post-closure.

6.15.5 Identified Mitigation

The following mitigation measures will be implemented as part of the Project to help avoid potential effects on wetlands and vegetation:

- Minimized the amount of wetland and vegetated area clearing required for the Project by optimizing the pit design and siting Project infrastructure in previously disturbed areas [Mit_050, Mit_065].
- Retention of forested areas wherever feasible [Mit_084].
- Identification and protection of known vegetative SAR locations [Mit_085].
- Avoid broadcast spraying of herbicides for vegetation management [Mit_086].
- Ensure proper culvert sizing for all new water crossing installations, allowing for maintenance of existing flows and water levels [Mit_082].
- Develop slope dependent vegetated buffers along rivers creeks and wetlands in conjunction with the MNRF [Mit_066].
- Develop sediment and erosion plans which will reduce sedimentation into wetlands and reduce the potential for dust cover on roadside vegetation [Mit_008, Mit_046, Mit_054].
- Restoration of all disturbed habitats upon closure to the extent feasible [Mit_068].
- Develop a wetland clearing strategy with the local MNRF reduce the effects to overwintering frogs (i.e., draining wetlands to discourage hibernation) [Mit_074].
- Re-vegetation of all slopes after closure with a focus on riparian habitat in the open pit [Mit_068, Mit_087].
- Reclamation and re-vegetation of the mining footprint will be carried out in accordance with O.Reg. 240/00 [Mit_088].
- Seeding or hydroseeding with native seed mix [Mit_089].

In addition, Treasury Metals will:

- Identify and protect the locations of any known SAR or provincially significant plant [Mit_085].

6.15.6 Residual Adverse Effects

The adverse effects for wetlands and vegetation that remain after the implementation of mitigation and avoidance measures are set out in Table 6.15.6-1.

Table 6.15.6-1: Residual Adverse Effects on Wetlands and Vegetation

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Wetland Extent	Wetland area	Wetland area lost (ha)	33 (1)	33 (1)	33 (1)	—
Vegetation Communities and Species	Floating Marsh Marigold	Area of potential habitat lost (ha)	—	—	—	—

Notes:
The "—" symbol indicates there were no residual adverse effects
(1) The areas lost during the site preparation and construction phase will not recover until post-closure

The predicted spatial extent of effects to wetlands as a result of the Project is limited to the wetlands that are directly overprinted by the Project, or have their entire catchment area overprinted by the Project (orange shaded areas of Figure 6.15.6-1). As wetlands have inherently poor drainage that allows for saturated conditions at the surface, the remaining wetlands within the drawdown zone of the Project are not anticipated to be effected as the poor drainage should isolate them from the mine dewatering effects.

A spatial representation of the area where vegetation will be affected has been provided in Figure 6.15.6-2. The figure highlights those areas where changes in vegetation communities and abundance were predict to result from the Project. During site preparation and construction of the Project, the operations area will be stripped and vegetation for the construction of site infrastructure, and will have limited if any vegetation growing in the operations area until the closure phase. Additionally, Figure 6.15.6-2 shows the wetlands that will be drained as a result of the Project, as these wetlands are not anticipated to recover following closure of the mine. It is therefore expected that a change in vegetation communities will establish in the area where the wetlands were from pre-development, causing a change.

6.15.7 Information to Address Round 1 Information Requests

The following lists the Round 1 IRs related to the assessment of potential effects to wetlands and vegetation:

- TMI_282-RG(1)-17: hydrology of Lola Lake;
- TMI_283-RG(1)-18: fen inventories, vegetation, and SAR surveys;
- TMI_333-AC(1)-07: water quality impacts to Lola Lake;
- TMI_478-AC(1)-152: define spatial boundary for wetlands; and
- TMI_534-AC(1)-208: better identification of wetland and vegetation VCs.

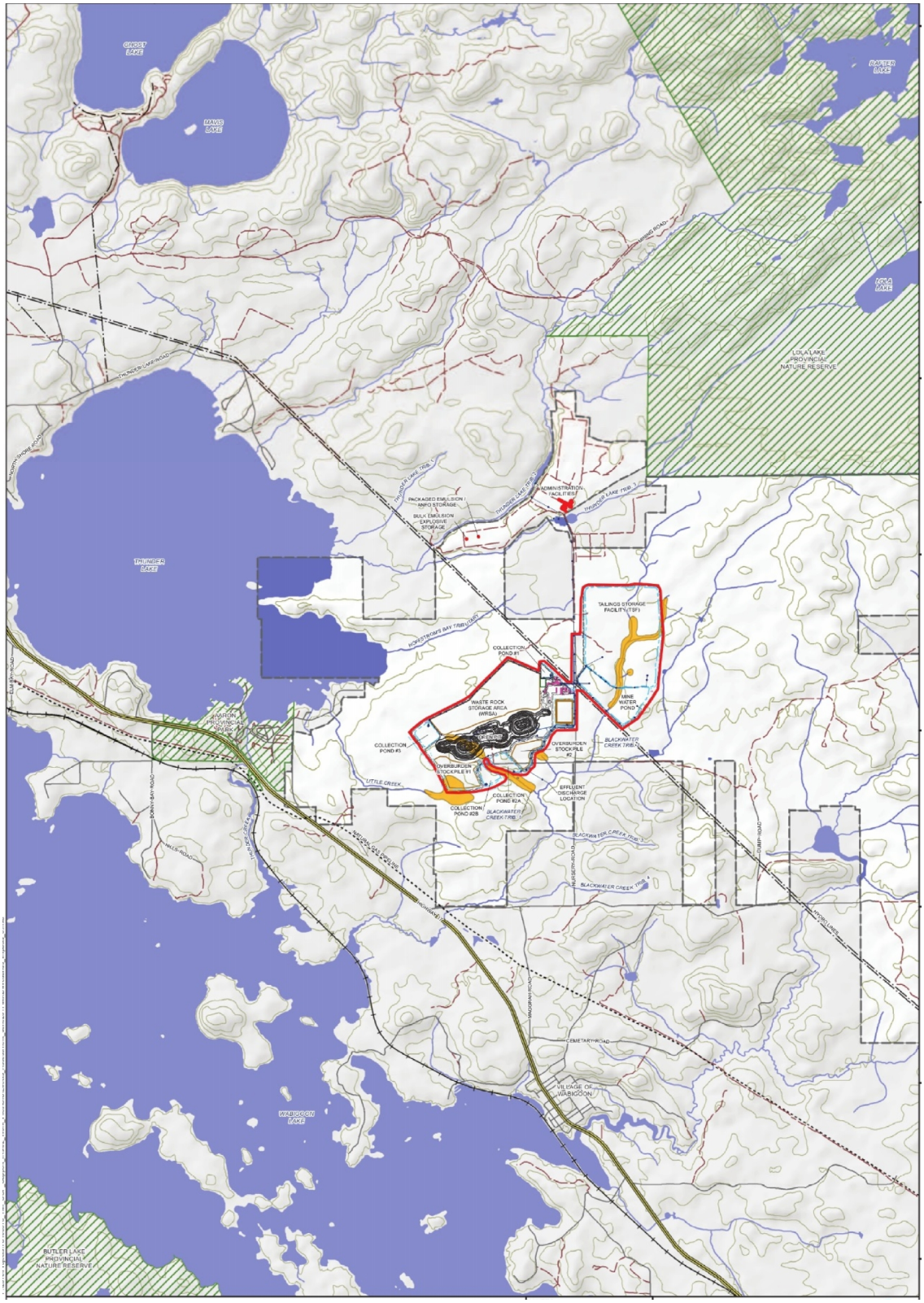


Figure 6.15.6-1: Spatial Extent of Wetland Residual Effects

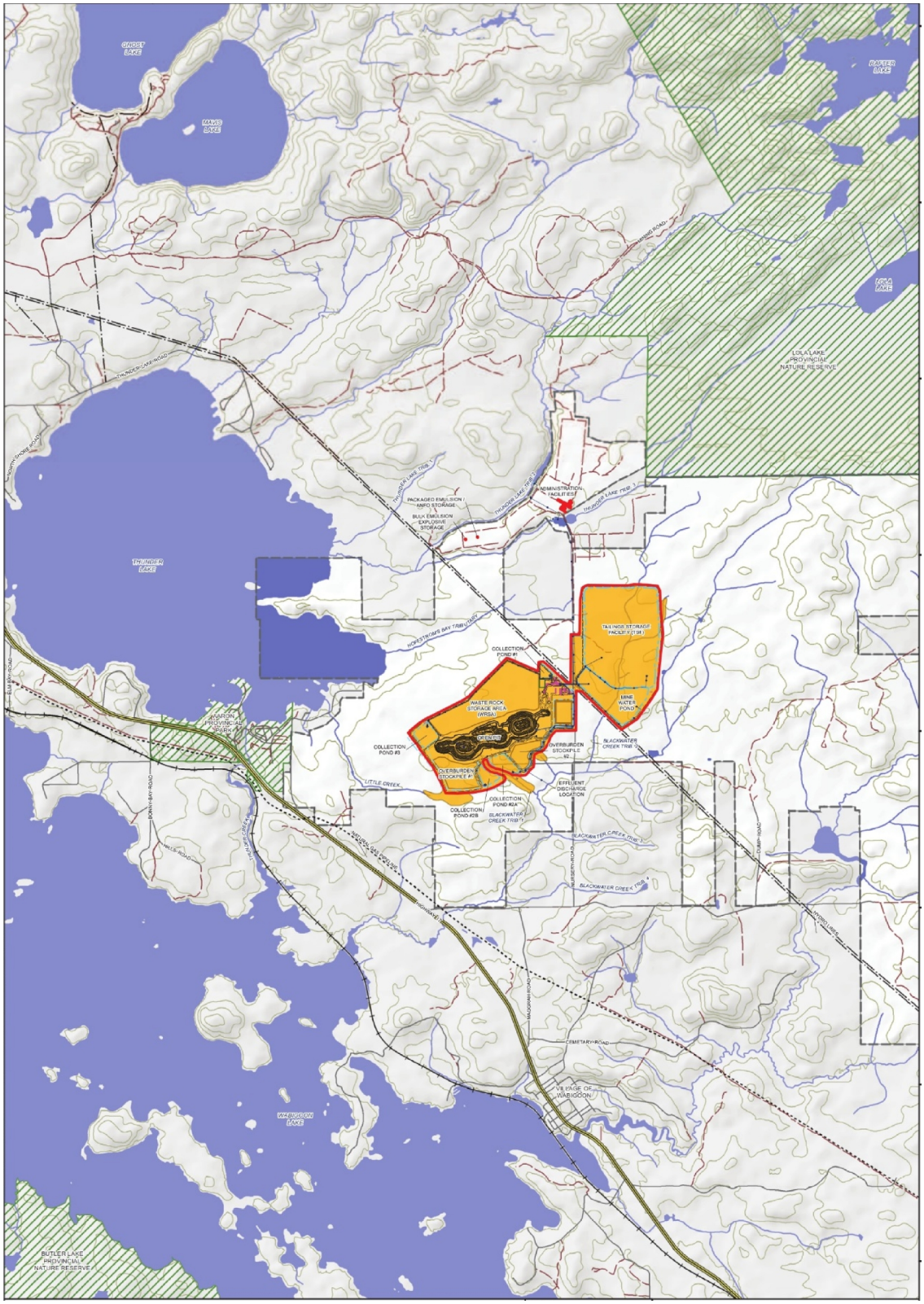


Figure 6.15.6-2: Spatial Extent of Vegetation Effects

6.16 Land Use

6.16.1 Potential Effects of the Project on the Environment

The potential impacts of the Project on land use will vary from one phase of the Project have been described using the nine VCs introduced in Section 6.1.3.15. These potential effects are listed in Table 6.16.1-1.

Table 6.16.1-1: Potential Effects on Land and Resource Use

Valued Component	Predicted Effect	Project Phase	Described Effect
Land Use Planning and Policies	Potential for conflict with approved and existing land use plans and polices.	Site preparation and construction Operations	Existing land use planning and policies could conflict with the Project's use of the land. Specific requirements or information related to these existing planning and policies may require consideration in the Project planning and operation.
		Closure	Existing land use planning and policies may have specific requirements or information related to closure.
		Post closure	Existing land use planning and policies could have specific requirements or information related to future use of the land.
Aggregate Operations	Potential for change in demand for aggregate resources.	Site preparation and construction	The construction of the Project could place increased demand on area aggregate resources.
Forestry	Potential for a change in access to forestry resources for management.	Site preparation and construction Operations Closure Post-closure	A change in access to forestry resources could limit access to those resources that are currently being managed under a Sustainable Forest Licence.
Mineral Exploration	Potential change in access to mineral claims for exploration and production.	Site preparation and construction Operations Closure Post-closure	Change in access to mineral claims for exploration or production could impact the claims holder by limiting or stopping exploration and/or production.
Fishing - Recreational and Commercial	Loss of habitat and displacement of fish species.	Site preparation and construction Operations Closure Post-closure	The loss of habitat and displacement of fish species could reduce fishing success and reduce food or income source.
	Potential change in access to fishing areas.	Site preparation and construction Operations Closure	Change in access to fishing areas could reduce fishing success and reduce food or income source.
	Contamination of fish making them unsuitable for harvesting.	Site preparation and construction Operations	Contamination of could reduce the amount of fish consumed.

Table 6.16.1-1: Potential Effects on Land and Resource Use (continued)

Valued Component	Predicted Effect	Project Phase	Described Effect
		Closure	
Hunting	Loss of habitat and displacement of wildlife species.	Site preparation and construction Operations Closure Post-closure	The loss of habitat and displacement of wildlife species could reduce hunting success and reduce food or income source.
	Potential change in access to hunting areas.	Site preparation and construction Operations Closure Post-closure	Change in access to hunting areas could reduce hunting success and reduce food or income source.
	Increased noise, vibration, and light could diminish the experience of being on the land and conducting hunting activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience and reduce the amount of hunting activities.
Trapping	Loss of habitat and displacement of wildlife species.	Site preparation and construction Operations Closure Post-closure	The loss of habitat and displacement of wildlife species could reduce trapping success and reduce income source.
	Potential change in access to trapline areas.	Site preparation and construction Operations Closure Post-closure	Change in access to hunting areas could reduce hunting success and reduce income source.
	Increased noise, vibration, and light could diminish the experience of being on the land and conducting trapping activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience and reduce the amount of trapping activities.
Cottagers and Outfitters	Increased noise, vibration, and light could diminish the experience of being on the land and conducting related activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience and reduce the amount of related activities.
	Potential change in the access to areas outfitters had previously used.	Site preparation and construction Operations Closure Post-closure	Change in access to areas used by outfitters could reduce hunting and fishing success and reduce income source.
	Potential changes for outfitters with lodges located in near the Project site that may experience an increase in clientele related to accommodations for temporary visitors/workers/contractors at the Project site.	Site preparation and construction Operations Closure	Outfitters may experience an increase in clientele related to the need for accommodations. An effect that could be viewed as positive or negative by the outfitter.

Table 6.16.1-1: Potential Effects on Land and Resource Use (continued)

Valued Component	Predicted Effect	Project Phase	Described Effect
Other Recreational Uses	Potential change in access to Project site where other recreational uses may occur.	Site preparation and construction Operations Closure	Other recreational users that may have previously used the area may no longer have access to these areas.
	Increased noise, vibration, and light could diminish the experience of being on the land and conducting related activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience and reduce the amount of related activities.
	Potential change in the abundance of consumptive foods.	Site preparation and construction Operations Closure Post-closure	The Project may directly remove consumptive foods or may affect their quality and abundance due to dust.

The aspects of the Project that contribute to these potential effects are described below, by the various phases of the Project:

- **Site preparation and construction phase:**
  - Physical alteration of the Project area landscape;
  - Removal of usage of land based resources;
  - Change in access to Project area; and
  - Change in land use.
- **Operations phase:**
  - Physical alteration of the Project area landscape;
  - Removal of usage of land based resources;
  - Change in access to Project area; and
  - Change in land use.
- **Closure phase:**
  - Physical alteration of the Project area landscape;

- Removal of usage of land based resources;
- Change in access to Project area; and
- Change in land use.

- **Post-closure phase:**
  - Physical alteration of the Project area landscape;
  - Removal of usage of land based resources;
  - Change in access to Project area; and
  - Change in land use.

The relationship between the Project and potential effects on land and resource use have been described using a simple linkage diagram (Figures 6.16.1-1a and 6.16.1-1b). The figures illustrate the land and resource use VCs (shown in blue on the figure) that are potentially affected during each phase of the Project. The figures also indicate other components of the environment (shown in red in the figure) where the predicted effects of the Project on land and resource use will be used as an input for determining the effects on other VCs. Other VCs that provide inputs to the assessment of land and resource use effects are shown in red in the figure. The figures illustrate that land and resource use is closely related to, and dependent on those effects predicted for the physical and biological components of the environment.

6.16.2 Effects Prediction Methods

The qualitative effects predictions, as they relate to the land and resource use VCs outlined in Section 6.1.3.14, were based upon:

- EIS guidelines for the Project;
- Baseline data collected for Aboriginal and non-Aboriginal communities within the study areas;
- Information gathered from other environmental disciplines (such as wildlife, vegetation, aquatics, noise, air quality and human health);
- Elements of the Goliath Gold Project description that may potentially interact with land and resource uses within the study areas;
- Information gathered through Aboriginal engagement and stakeholder consultation pre-EIS and post-EIS submission; and

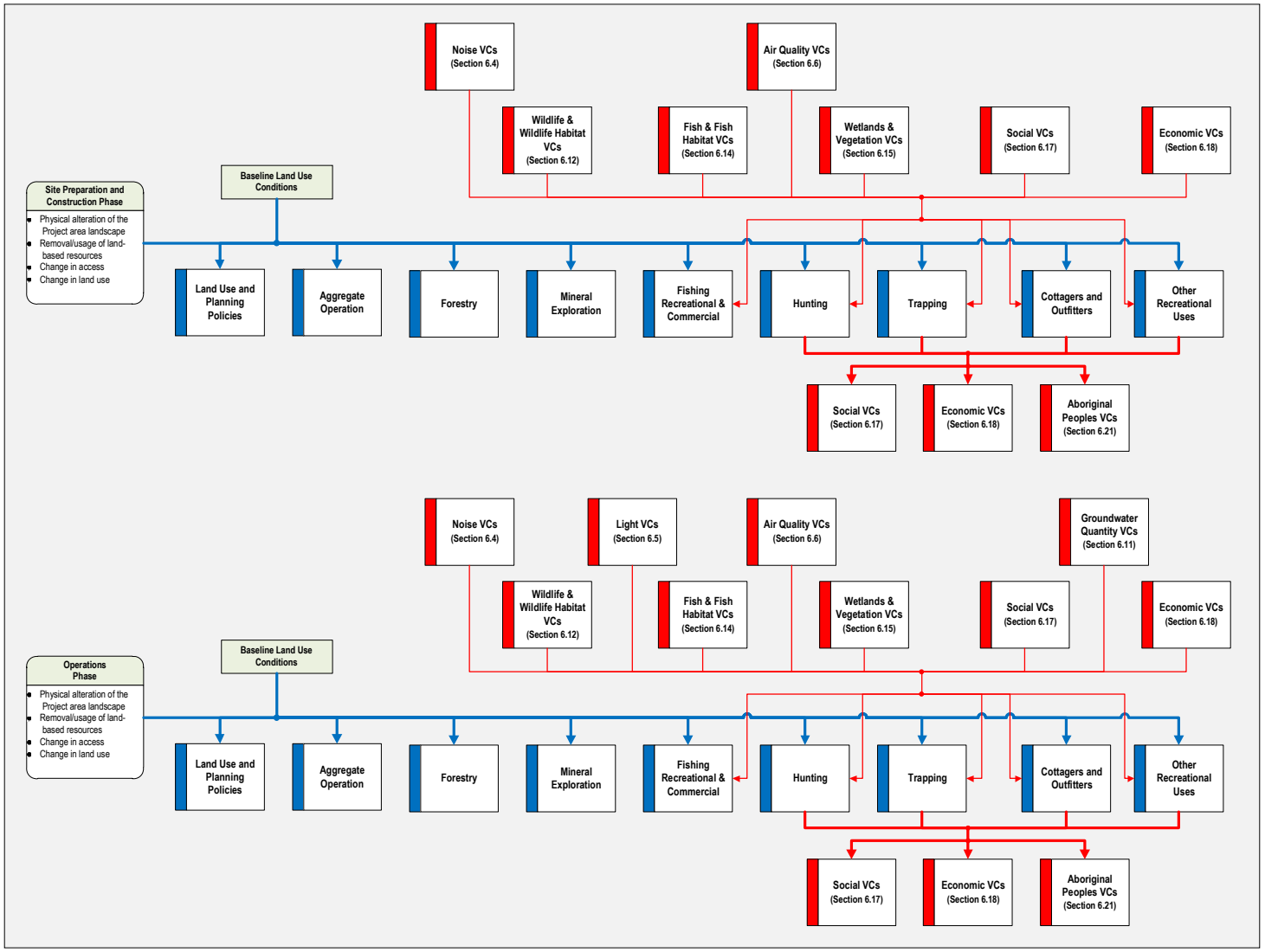


Figure 6.16.1-1: Land and Resource Use Linkage Diagram

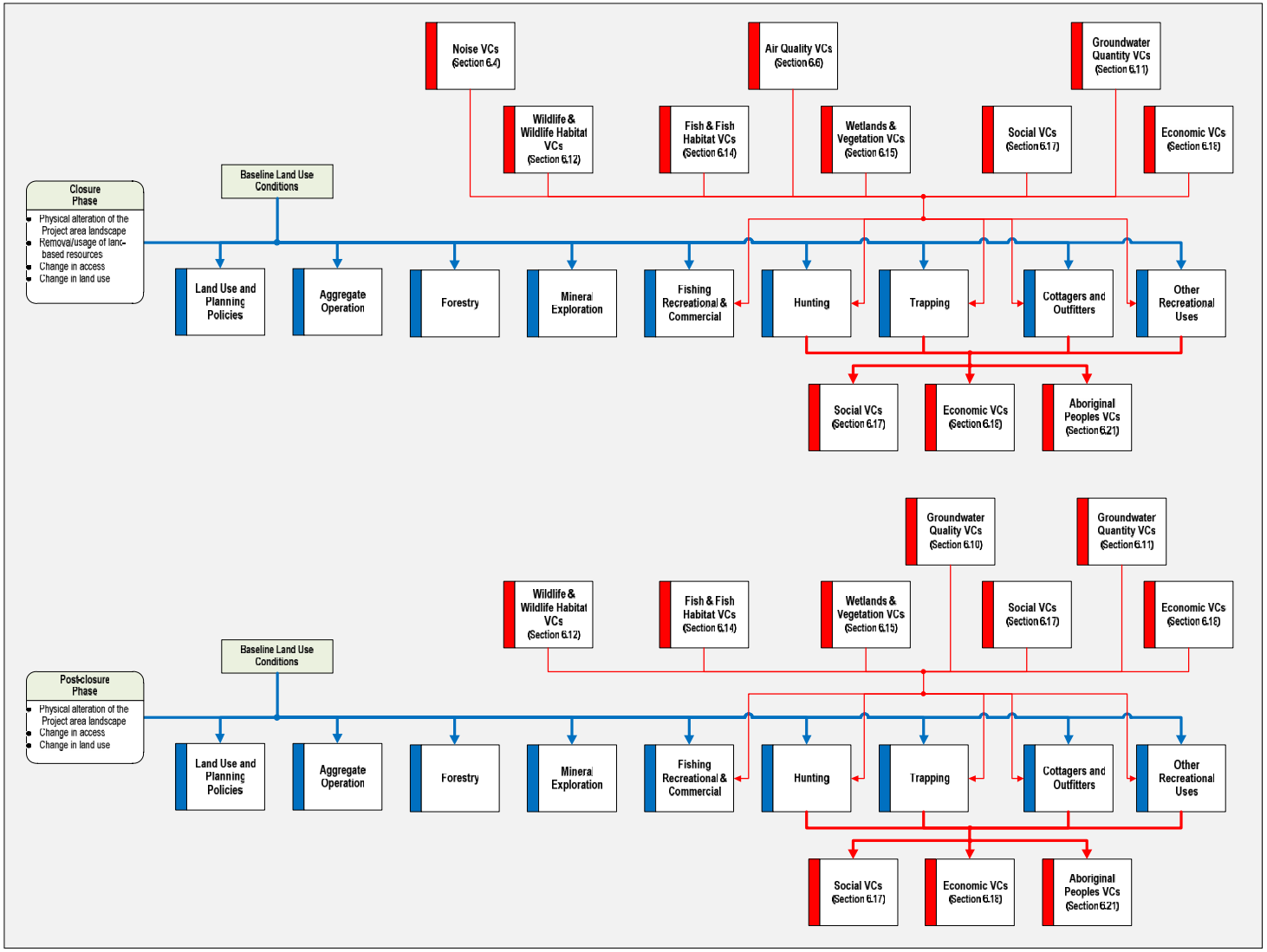


Figure 6.16.1-2: Land and Resource Use Linkage Diagram (continued)

- Industry knowledge and understanding of the interactions of land and resources uses and mining projects in Canada and Ontario, including northwestern Ontario.

The prediction of effects is constrained by some gaps in EIS of land and resource uses baseline conditions and these were compensated for by industry knowledge and application of global best practices.

6.16.3 Project Effects Avoidance Measures Used in Predictions

Aspects of the Project design, as well as the mitigation and avoidance measures incorporated into the assessment of effects for the various physical and biologic disciplines that affect land use will have the benefit of helping avoid potential land use effects of the Project. The avoidance measures used in predicting the effects of the Project on land and resources use are presented in Table 6.16.3-1.

Table 6.16.3-1: Land and Resource Use Effects Avoidance Measures

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
Land Use Planning and Policies	Potential for conflict with approved and existing land use plans and polices.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091]
Aggregate Operations	Potential for a change in access to aggregate resources.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091]
	Potential for change in demand for aggregate resources.	Site preparation and construction	None
Forestry	Potential for a change in access to forestry resources for management.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091]
Mineral Exploration	Potential change in access to mineral claims for exploration and production.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091]
Fishing - Recreational and Commercial	Loss of habitat and displacement of fish species.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Construction that isolates or overprints watercourses will be done to minimize effects on fish [Mit_077, Mit_078]

Table 6.16.3-1: Land and Resource Use Effects Avoidance Measures (continued)

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
			Relocate fish from the watercourses to be isolated or overprinted [Mit_079, Mit_080]
	Potential change in access to fishing areas.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Aboriginal peoples will be able to arrange for accompanied access to the former MNRF tree nursery during operations for traditional activities such as bait fish harvesting [Mit_092]
	Contamination of fish making them unsuitable for harvesting.	Site preparation and construction Operations Closure Post-closure	Discharges from the Project will meet PWQO [Mit_024, Mit_053] Construct a perimeter ditch and seepage collection system around the operations area to capture and direct all runoff from the site to the water management system [Mit_008]
Hunting	Loss of habitat and displacement of wildlife species.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Reclaim and revegetate the operation during closure [Mit_068]
	Potential change in access to hunting areas.	Site preparation and construction Operations Closure Post-closure	Aboriginal peoples will be able to arrange for accompanied access to the former MNRF tree nursery during operations for traditional activities such as bait fish harvesting [Mit_092]
	Increased noise, vibration, light and dust, as well as changes in the views could could diminish the experience of being on the land and conducting hunting activities.	Site preparation and construction Operations Closure Post-closure	Noise mitigation measures will minimize the areas where noise from the Project will be noticeable [Mit_025, Mit_028, Mit_031, Mit_031] Mitigation measures employed for blasting will ensure vibrations are only noticeable in the immediate vicinity of the operation area [Mit_029, Mit_043] Light mitigation will ensure effects do not extend beyond the operations area [Mit_036, Mit_036, Mit_037, Mit_038, Mit_039, Mit_040, Mit_041] Dust mitigation will be implemented to avoid impacts [Mit_046] The WRSA will be constructed to present a minimal provile, and will be progressively reclaimed to blend with the

Table 6.16.3-1: Land and Resource Use Effects Avoidance Measures (continued)

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
			surroundings [Mit_001, Mit_002, Mit_003, Mit_004, Mit_005]
Trapping	Loss of habitat and displacement of wildlife species.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Reclaim and revegetate the operation during closure [Mit_068]
	Potential change in access to trapline areas.	Site preparation and construction Operations Closure Post-closure	Aboriginal peoples will be able to arrange for accompanied access to the former MNRF tree nursery during operations for traditional activities such as bait fish harvesting [Mit_092]
	Increased noise, vibration, light and dust, as well as changes in the views could could diminish the experience of being on the land and conducting trapping activities.	Site preparation and construction Operations Closure Post-closure	Noise mitigation measures will minimize the areas where noise from the Project will be noticeable [Mit_025, Mit_028, Mit_031, Mit_031] Mitigation measures employed for blasting will ensure vibrations are only noticeable in the immediate vicinity of the operation area [Mit_029, Mit_043] Light mitigation will ensure effects do not extend beyond the operations area [Mit_036, Mit_036, Mit_037, Mit_038, Mit_039, Mit_040, Mit_041] Dust mitigation will be implemented to avoid impacts [Mit_046] The WRSA will be constructed to present a minimal provile, and will be progressively reclaimed to blend with the surroundings [Mit_001, Mit_002, Mit_003, Mit_004, Mit_005]
Cottagers and Outfitters	Potential change in traffic volumes, air quality, and noise and vibration levels.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Reclaim and revegetate the operation during closure [Mit_068]Regulatory and cautionary signage [Mit_092] Blasting practices will employ measures to minimize effects and disruption [Mit_026, Mit_027, Mit_029, Mit_043] Noise mitigation measures will minimize the areas where noise from the Project will be noticeable [Mit_025, Mit_028, Mit_031, Mit_031]

Table 6.16.3-1: Land and Resource Use Effects Avoidance Measures (continued)

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
			Dust mitigation will be implemented to avoid impacts [Mit_046]
	Potential change in the access to areas outfitters had previously used.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Reclaim and revegetate the operation during closure [Mit_068]
	Potential changes for outfitters with lodges located in near the Project site that may experience an increase in clientele related to accommodations for temporary visitors / workers / contractors at the Project site.	Site preparation and construction Operations Closure	
Other Recreational Uses	Potential change in access to Project site where other recreational uses may occur.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Minimize Crown land used in Project footprint [Mit_090] Minimize activities on eastern portion of property [Mit_091] Reclaim and revegetate the operation during closure [Mit_068]
	Potential change in the abundance of consumptive foods.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint [Mit_050] Reclaim and revegetate the operation during closure [Mit_068] Dust mitigation will be implemented to avoid impacts [Mit_046]

6.16.4 Predicted Effects

The predicted effects on land and resource uses summarized in Table 6.16.4-1.

Table 6.16.4-1: Summary of Predicted Land and Resource Use Effects

Valued Components (VCs)	Indicators	Measures	Predicted Land and Resource Use Effects			
			Site Preparation and Construction	Operations	Closure	Post-Closure
Land Use Planning and Policies	Conflict with accepted land uses as stipulated in approved land use plans. Overlap with protected areas.	Overlap of land (%/ha) Change in access Conflict with policies	Conflict with approved land use plans or protected areas	Conflict with approved land use plans or protected areas	Conflict with approved land use plans or protected areas	Conflict with approved land use plans or protected areas
Aggregate Operations	Change in access to aggregate resources. Change in demand of aggregate resources extraction.	Overlap of aggregate operations (#) Change in access	Increased demand for third-party aggregate supplies	Increased demand for third-party aggregate supplies	Increased demand for third-party aggregate supplies	
Forestry	Change in access to forestry resources for management.	Overlap of FMUs (%/ha) Change in access	Reduced access to forestry resources	Reduced access to forestry resources	Reduced access to forestry resources	
Mineral Exploration	Change in access to mineral claims for exploration and production.	Overlap of mineral claims (%/ha) Change in access	Reduced access to mineral claims	Reduced access to mineral claims	Reduced access to mineral claims	
Fishing - Recreational and Commercial	Change in access to and abundance of fisheries resources, and therefore, the ability to fish.	Overlap of FMZs, bait harvest areas or other important management areas as well as commercial fisheries and/or popular sport fishing areas (%/ha) Change in access	Reduced ability to conduct fishing activities due changes in abundance or access	Reduced ability to conduct fishing activities due changes in abundance or access	Reduced ability to conduct fishing activities due changes in abundance or access	
Hunting	Change in access to and abundance of wildlife resources, and therefore, the ability to hunt.	Overlap of WMU and BMA (%/ha) Change in access	Reduced ability to conduct hunting activities due changes in abundance or access	Reduced ability to conduct hunting activities due changes in abundance or access	Reduced ability to conduct hunting activities due changes in abundance or access	

Table 6.16.4-1: Summary of Predicted Land and Resource Use Effects (continued)

Valued Components (VCs)	Indicators	Measures	Predicted Land and Resource Use Effects			
			Site Preparation and Construction	Operations	Closure	Post-Closure
Trapping	Change in access to and abundance of wildlife resources, and therefore, the ability to trap.	Overlap of traplines (%/ha) Overlap of trap cabins (#) Change in access	Reduced ability to conduct trapping activities due changes in abundance or access	Reduced ability to conduct trapping activities due changes in abundance or access	Reduced ability to conduct trapping activities due changes in abundance or access	
Cottagers and Outfitters	Change in access to cottage and/or outfitter areas. Alteration in the enjoyment of properties, their surroundings and their property, or intrinsic values.	Overlap of land (%/ha) Overlap of specific locations (#) Change in access	Reduced enjoyment of cottage and outfitter activities due to changed access and / or changes to aesthetic conditions	Reduced enjoyment of cottage and outfitter activities due to changed access and / or changes to aesthetic condition	Reduced enjoyment of cottage and outfitter activities due to changed access and / or changes to aesthetic condition	
Other Recreational Uses	Change in access for residents and visitors to public lands for non-consumptive outdoor activities and for berry and mushroom picking,	Overlap of locations utilized %/ha Change in access	Reduced utilization of public recreation areas	Reduced utilization of public recreation areas	Reduced utilization of public recreation areas	

6.16.5 Identified Mitigation

The Project measures identified to mitigate the potential adverse effects or enhance positive effects on land and resource uses are listed in Table 6.16.6-1. Some mitigation measures are applicable to more than one predicted effect.

Table 6.16.6-1: Mitigation Measures Applicable to Land and Resource Use Effects

Mitigation Measure Title	Mitigation Measure Description
Air quality	• For specific measures, see the air quality mitigation in Section 6.6.5.
Communications Management Plan	• Implement a Communications Management Plan to address ongoing engagement with potentially affected stakeholders and Aboriginal peoples throughout the life of the Project. The plan should include a transparent grievance process [Mit_093].
Environmental Management Plan	• See Section 12.1.
Land and resources baseline	• Treasury Metals will undertake a land and resources use baseline to establish a pre-construction baseline of the land and resource users. This will serve as the basis for future monitoring and management of land and resources uses effects throughout the life of the Project [Mit_094].
Light	• For specific measures, see light mitigation in Section 6.5.5.
Noise and vibration	• For specific measures, noise and vibration mitigation in Section 6.4.5.
Vegetation and wetlands	• For specific measures, see wetlands and vegetation mitigation in Section 6.15.5.
Socio-economic Management Plan	• Plan to ensure socio-economic commitments are implemented, adverse socio-economic effects are minimized, results are monitored, and effects are adaptively managed [Mit_095].
Traditional land use information collection	• Collect traditional land use information for the Project area through meetings and traditional land use studies to identify areas of plant gathering, hunting, trapping, fishing, and cultural activities [Mit_096].
Traffic	• For specific measures, see the social mitigation in Section 6.17.5.
Visual effects	• The waste rock storage area (WRSA) will be constructed starting in the west to provide a visual barrier [Mit_003]. • The slopes of the WRSA will be limited to a 3:1 (horizontal to vertical) grade to present a natural appearance [Mit_002]. • The west face of the WSRA will be re-vegetated as soon as possible to blend with the surrounding area [Mit_004].
Water quality	• For specific measures, see surface water quality mitigation in Section 6.8.5, and groundwater quality mitigation in Section 6.10.5.
Wildlife habitat	• Minimize Project footprint [Mit_050]. • Minimize Crown land used in Project footprint [Mit_090]. • Minimize activities on eastern portion of property [Mit_091]. • The site will be reclaimed and the land restored to a naturalized state per the mine closure plan to be approved by the Ministry of Northern Development and Mines [Mit_068]. • For other specific measures, see wildlife and wildlife habitat mitigation in Section 6.12.5.
Wildlife harvesting access	• Minimize Project footprint [Mit_050]. • Minimize Crown land used in Project footprint [Mit_090]. • Minimize activities on eastern portion of property [Mit_091].

Table 6.16.6-1 Mitigation Measures Applicable to Land and Resource Use Effects (continued)

Mitigation Measure Title	Mitigation Measure Description
	• During the operating life of the Project, the operations area will be fenced and no access will be permitted for security and safety reasons. Access to the former MNRF tree nursery will be controlled. Aboriginal peoples will be able to arrange for accompanied access to these areas with Treasury Metals. Appropriate signage will be placed around areas where access is limited [Mit_092].

6.16.6 Residual Effects

Despite the implementation of the mitigation measures described in Section 6.15.5, residual effects will remain for the land and resource use VCs. Table 6.16-1 summarizes the residual effects for each of the VC introduced in Section 6.1.3.15.

Several of the residual effects for land and resource use are regional in nature, and could occur anywhere within the terrestrial and aquatic study areas presented on Figures 6.1.4.16-1 and 6.1.4.16-2, respectively. There are some effects that will be spatially tied to the effects of the Project on the biophysical environment. This is the case for VC such as “fishing - recreational and commercial” and “other recreational uses”. For these VC, the spatial effects of the Project can be characterized by identifying the areas where harvesting or traditional uses of the land may be affected. Figure 6.16.6-1 provides a compilation of the areas identified as being affected for one, or more, of the biophysical disciplines. The areas shaded in gold represent those areas where one or more of the biophysical disciplines are affected to the point where harvesting or traditional uses may be affected. The areas shaded in green represent areas where harvesting and traditional practices can continue unaffected, but the users may notice a change in the experience on the land (e.g., noise levels are noticeable).

6.16.7 Information to Address Round 1 Information Requests

Several IRs were received (2015) related to the VCs identified. These are categorized below by VC and organization.

Land Use Planning and Policies

- Government Agency - CEA Agency:
  - TMI_194.2-HE(1)-01 – Land use
  - TMI_235-HE(1)-42 – Land use
  - TMI_237-HE(1)-44 – Land use
  - TMI_112-SW(1)-26 – Provincial Park
  - TMI_84-GW(1)-21 – Provincial Park

Table 6.16.9-1: Residual Effects for Land and Resource Use

Predicted Effect	Project Phase	Avoidance and Mitigation Measure	Residual Effect	Direction
Land Use Planning and Policies				
Potential for conflict with approved and existing land use plans and polices.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Land and resources baseline	Existing land use planning and policies could conflict with the Project's use of the land. Specific requirements or information related to these existing planning and policies may require consideration through the Project approval and permitting process.	Adverse or neutral depending on the conflict
Aggregate Operations				
Potential for change in demand for aggregate resources.	Site preparation and construction	Communications Management Plan Land and resources baseline Socio-economic Management Plan	The construction of the Project could place increased demand on area aggregate resources. The Project will acquire any required aggregate from existing third-party suppliers.	Neutral
Forestry				
Potential for a change in access to forestry resources for management.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Communications Management Plan Land and resources baseline	Site preparation, construction and operation of the Project could potentially limited access to forestry resources currently managed under a Sustainable Forest Licence. Communications with forestry operators will facilitate addressing access issues.	Adverse
Mineral Exploration				
Potential change in access to mineral claims for exploration and production.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Communications Management Plan Land and resources baseline	Site preparation and construction and operation of the Project could limit access for mineral exploration and/or production in the immediate area of the Project. Communication with mineral claim owners will facilitate addressing access issues.	Adverse
Fishing - Recreational and Commercial				
Loss of habitat and displacement of fish species.	Site preparation and construction Operations Closure	Minimize Project footprint Minimize Crown land used in Project footprint	Project site preparation and construction, operation, and closure could potentially reduce fish habitat and displace fish species at the Project site resulting in reduced fishing	Adverse

Predicted Effect	Project Phase	Avoidance and Mitigation Measure	Residual Effect	Direction
	Post-closure	Minimize activities on eastern portion of property Regulatory and cautionary signage Communications Management Plan Traditional land use information collection Wildlife habitat and plant habitat measures	success and reduced food or income source. There is little or no fish harvesting on the Project site.	
Potential change in access to fishing areas.	Site preparation and construction Operations Closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Regulatory and cautionary signage Communications Management Plan Land and resources baseline Traditional land use information collection Wildlife habitat and plant habitat measures	Project site preparation and construction, operation, and closure could potentially reduce access to fishing area and reduce fishing success and reduced food or income source, however, there is little or no fishing in the Project site.	Adverse
Contamination of fish making them unsuitable for harvesting.	Site preparation and construction Operations Closure	Water Quality measures Communications Management Plan	Contamination of fish could reduce the amount of fish consumed. Potential release of contaminants could occur during site preparations and construction, operations, and closure but is expected to be low in probability and infrequent through environmental management.	Adverse
Hunting				
Loss of habitat and displacement of wildlife species.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Regulatory and cautionary signage Noise and vibration measures Communications Management Plan Traditional land use information collection Wildlife habitat and plant habitat measures	There could be a potential reduction in hunting success and reduced food or income source due to the loss of wildlife habitat. Effects would be limited to the Project site and the wildlife impact assessment determined there would be no impacts on wildlife abundance or habitat.	Adverse

Predicted Effect	Project Phase	Avoidance and Mitigation Measure	Residual Effect	Direction
Potential change in access to hunting areas.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Wildlife habitat and plant habitat measures Regulatory and cautionary signage Communications Management Plan Land and resources baseline	Potential reduction in hunting success and reduced food or income source. Access will be restricted during all Project phases but just to the Project site; access to adjacent areas will remain available.	Adverse
Increased noise, vibration, and light could diminish the experience of being on the land and conducting hunting activities.	Site preparation and construction Operations Closure Post-closure	Noise and vibration measures Communications Management Plan Traditional land use information collection Wildlife habitat measures	Diminished experience of spending time on the land and reduced participation in hunting activities. Noise and vibration effects will be restricted to the Project site and light effects will be controlled to minimize impacts of areas around the Project site.	Adverse
Trapping				
Loss of habitat and displacement of wildlife species.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Noise and vibration measures Communications Management Plan Traditional land use information collection Wildlife habitat and plant habitat measures	Potential reduction in trapping success and reduced income source due to the loss of wildlife habitat. Effects would be limited to the Project site and the wildlife impact assessment determined there would be no impacts on wildlife abundance or habitat..	Adverse
Potential change in access to trapline areas.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Wildlife habitat measures Regulatory and cautionary signage Communications Management Plan Land and resources baseline	Potential reduction in trapping success and reduced income source. Access will be restricted during all Project phases but just to the Project site; access to adjacent areas will remain available.	Adverse

Predicted Effect	Project Phase	Avoidance and Mitigation Measure	Residual Effect	Direction
Increased noise, vibration, and light could diminish the experience of being on the land and conducting trapping activities.	Site preparation and construction Operations Closure Post-closure	Noise and vibration measures Communications Management Plan Traditional land use information collection Wildlife habitat and plant habitat measures	Diminished experience of spending time on the land and reduced participation in trapping activities. Noise and vibration effects will be restricted to the Project site and light effects will be controlled to minimize impacts of areas around the Project site.	Adverse
Cottagers and Outfitters				
Increased noise, vibration, and light could diminish the experience of being on the land and conducting related activities.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Wildlife habitat measures Regulatory and cautionary signage Noise and vibration measures Communications Management Plan Visual effects – contouring of waste storage areas	Diminished experience of spending time at cottages and/or on the land and reduced participation in related activities. Noise and vibration effects will be restricted to the Project site and light effects will be controlled to minimize impacts of areas around the Project site.	Adverse
Potential change in the access to areas outfitters had previously used.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Regulatory and cautionary signage Communications Management Plan Land and resources baseline	Potential reduction in fishing and hunting success and reduced income source. Access will be restricted during all Project phases but just to the Project site; access to adjacent areas will remain available.	Adverse
Potential changes for outfitters with lodges located in near the Project site that may experience an increase in clientele related to accommodations for temporary visitors /	Site preparation and construction Operations Closure	Communications Management Plan Land and resources baseline Socio-economic Management Plan	Outfitters may experience an increase in clientele related to the need for accommodations. The Project will communicate information about the potential demand for accommodations by Project workers and will monitor for impacts on accommodations.	Adverse or positive depending on the how it is experience by the outfitter.

Predicted Effect	Project Phase	Avoidance and Mitigation Measure	Residual Effect	Direction
workers / contractors at the Project site.				
Other Recreational Uses				
Potential change in access to Project site where other recreational uses may occur.	Site preparation and construction Operations Closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Regulatory and cautionary signage Communications Management Plan Environmental management plan Traditional land use information collection Wildlife habitat and plant habitat measures	Potential reduction in the success and reduced food and income source as related to picking of consumptive foods. Access will be restricted during all Project phases but just to the Project site; access to adjacent areas will remain available. Other recreational activities are expected to be low due to the large proportion of private land within the Project site,	Adverse
Increased noise, vibration, and light could diminish the experience of being on the land and conducting related activities.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Wildlife habitat measures Regulatory and cautionary signage Noise and vibration measures Communications Management Plan Land and resources baseline Socio-economic Management Plan Visual effects – contouring of waste storage areas water treatment	Diminished experience of spending time on the land and reduced participation in related activities. Noise and vibration effects will be restricted to the Project site and light effects will be controlled to minimize impacts of areas around the Project site.	Adverse
Potential change in the abundance of consumptive foods.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Air quality measures Communications Management Plan Land and resources baseline	Potential reduction in the success and reduced food and income source as related to picking of consumptive foods. Effects will be limited to the Project site which is comprised of mainly private land.	Adverse

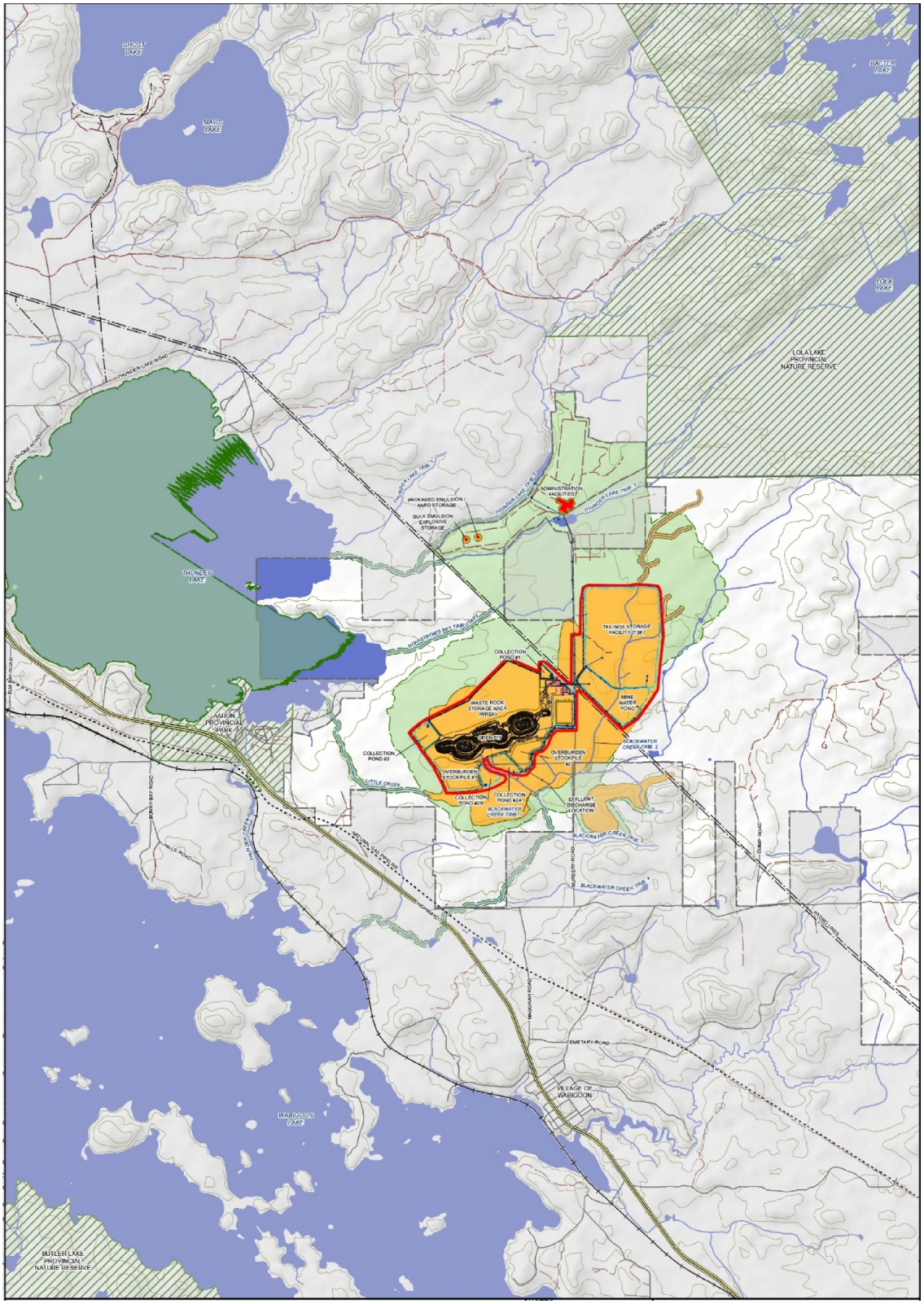


Figure 6.16.6-1: Spatial Extent for Residual Effects on Harvesting

- Government Agency - MNRF:
    - TMI_282-RG(1)-17 – Provincial Park
    - TMI_283-RG(1)-18 – Provincial Park
- Government Agency - City of Dryden residents
    - TMI_736-PC(1)-51 – Provincial Park
- Government Agency - Thunder Lake residents
    - TMI_736-PC(1)-51 – Provincial Park
- Eagle Lake First Nation:
    - TMI_615-AC(1)-288 – Provincial Park
    - TMI_618-AC(1)-291 – Provincial Park
    - TMI_619.1-AC(1)-292 – Provincial Park, hunting, trapping, fishing, other recreational uses
    - TMI_350-AC(1)-24 – Provincial Park
    - TMI_615-AC(1)-288 – Provincial Park, hunting, trapping, fishing
- Métis Nation of Ontario:
    - TMI_415-AC(1)-90 - Crown land
    - TMI_535-AC(1)-209 – Land use
    - TMI_536-AC(1)-210 – Land use
    - TMI_539-AC(1)-213 – Land use
    - TMI_554-AC(1)-228 – Land use
    - TMI_582-AC(1)-256 – Crown land
    - TMI_582-AC(1)-257 – Crown land, trapping
    - TMI_582-AC(1)-258 – Crown land, hunting, trapping

  - TMI_593-AC(1)-267 – Land use
  - TMI_584-AC(1)-258 – Crown land, hunting, trapping
  - TMI_597-AC(1)-271 - Crown land
  - TMI_599-AC(1)-272 – Land use
- Naotkamegwanning First Nation:
  - TMI_677-AC(1)-349 – Hunting, other recreational uses
- Wabigoon Lake Ojibway Nation:
  - TMI_352-AC(1)-26 – Land use
  - TMI_360-AC(1)-34 – Land use
  - TMI_363-AC(1)-37 – Land use
  - TMI_351-AC(1)-25 – Provincial Park
  - TMI_355-AC(1)-29 – Provincial Park
  - TMI_405-AC(1)-80 – Provincial Park

Aggregate Operations

- Government Agency - CEA Agency:
  - TMI_46-MW(1)-08 – Aggregates
  - TMI_252.1-CE(1)-02 – Aggregates, forestry, cumulative effects
- Government Agencies – MNRF:
  - TMI_278-RG(1)-13 – Aggregates
  - TMI_279-RG(1)-14 – Aggregates

Forestry

- Government Agency - CEA Agency:

- TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping
- TMI_252.1-CE(1)-02 – Aggregates, forestry, cumulative effects

- Aboriginal People of Wabigoon:
  - TMI_365-AC(1)-39 – Forestry, fishing, hunting, trapping, other recreational uses
- Wabigoon Lake Ojibway Nation:
  - TMI_375-AC(1)-49 – Forestry, moose, cumulative effects
  - TMI_360-AC(1)-34 – Land use, fishing, hunting, trapping, other recreational uses

Mineral Exploration

- Government Agency - CEA Agency:
  - TMI_253-CE(1)-03– Exploration, cumulative effects
- Thunder Lake residents:
  - TMI_715-PC(1)-30 – Surface mining rights
  - TMI_760-PC(1)-75 – Claims
- City of Dryden resident:
  - TMI_760-PC(1)-75 – Claims
- Sundry:
  - TMI_318-SD(1)-13 – Patent and leases
- Village of Wabigoon residents:
  - TMI_760-PC(1)-75 – Claims

Fishing - Recreational and Commercial

- Government Agency - CEA Agency:
  - TMI_8-EA(1)-08 – Non-Aboriginal

  - TMI_127.1-FH(1)-06 – Fishing
  - TMI_194.1-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
  - TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping

- City of Dryden residents:
  - TMI_687-PC(1)-02 – Fishing
  - TMI_721-PC(1)-36 – Fishing
  - Thunder Lake residents:
  - TMI_687-PC(1)-02 – Fishing
  - TMI_721-PC(1)-36 – Fishing

- Village of Wabigoon residents:
  - TMI_687-PC(1)-02 – Fishing

- Member of the public:
  - TMI_688-PC(1)-03 – Fishing

- Métis Nation of Ontario:
  - TMI_505-AC(1)-179 – Fishing, fish sanctuary

- Eagle Lake First Nation:
  - TMI_349-AC(1)-23 – Fish
  - TMI_362-AC(1)-36 – Fishing, other recreational uses
  - TMI_619.1-AC(1)-292 – Provincial Park, hunting, trapping, fishing, other recreational uses

- Naotkamegwanning First Nation:
  - TMI_349-AC(1)-23 – Commercial fishing
  - TMI_652-AC(1)-325 – Commercial fishing

- Wabigoon Lake Ojibway Nation:
    - TMI_360-AC(1)-34 – Baitfishing
    - TMI_348-AC(1)-22 – Fishing, hunting, trapping, other recreational uses, and outfitters

Hunting

- Government Agency - CEA Agency:
    - TMI_8-EA(1)-08 – Non-Aboriginal
    - TMI_151-WL(1)-08 – Hunting
    - TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping , Bear Management Area
    - TMI_194.1-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
- Eagle Lake First Nation:
    - TMI_619.1-AC(1)-292 – Provincial Park, hunting, trapping, fishing, other recreational uses
- Métis Nation of Ontario
    - TMI_581-AC(1)-255 – Hunting, trapping
    - TMI_582-AC(1)-258 – Crown land, hunting, trapping
    - TMI_584-AC(1)-258 – Crown land, hunting, trapping

Trapping

- Government Agency - CEA Agency:
    - TMI_8-EA(1)-08 – Non-Aboriginal
    - TMI_194.1-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
    - TMI_252.1-CE(1)-02 – Fishing, hunting, trapping, cumulative effects

  - TMI_257-CE(1)-07 – Fishing, hunting, trapping, other recreational uses, cumulative effects

- Government Agency – MNRF:
  - TMI_281-RG(1)-16 – Trapping
- Eagle Lake First Nation:
  - TMI_619.1-AC(1)-292 – Provincial Park, hunting, trapping, fishing, other recreational uses
- Métis Nation of Ontario
  - TMI_581-AC(1)-255 – Hunting, trapping
  - TMI_582-AC(1)-257 - Crown land, trapping
  - TMI_582-AC(1)-258 – Crown land, hunting, trapping
  - TMI_584-AC(1)-258 – Crown land, hunting, trapping

Cottagers and Outfitters

- Government Agency - CEA Agency:
  - TMI_8-EA(1)-08 – Non-Aboriginal
  - TMI_194.1-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
  - TMI_172.1-AE(1)-10 – Sensitive receptors
  - TMI_228-HE(1)-35 – Forestry, fishing, hunting, trapping , Bear Management Area
  - TMI_302-RG(1)-37 – Noise-sensitive land uses
  - TMI_302-RG(1)-39 – Noise-sensitive land uses
- Thunder Lake residents:
  - TMI_712-PC(1)-27 – Residence, noise
  - TMI_715-PC(1)-30 – Cottage

Other Recreational Uses

- Government Agency - CEA Agency:
  - TMI_8-EA(1)-08 – Non-Aboriginal

  - TMI_194.1-HE(1)-01 – Fishing, hunting, trapping, other recreational uses, cottages and outfitters
  - TMI_231.1-HE(1)-38 – Mushroom, berry
- City of Dryden residents:
  - TMI_731-PC(1)-46 – Mushroom
  - TMI_732-PC(1)-47 – Wild rice
- Member of the public:
  - TMI_745-PC(1)-60 – Berry
- Eagle Lake First Nation:
  - TMI_362-AC(1)-36 – Fishing, other recreational uses
  - TMI_619.1-AC(1)-292 – Provincial Park, hunting, trapping, fishing, other recreational uses
- Wabigoon Lake Ojibway Nation:
  - TMI_360-AC(1)-34 – Harvest

6.17 Social

6.17.1 Potential Effects of the Project on the Environment

The potential effects of the Project on the Social environment will vary by Project phase, and with varying levels of activity. The following lists the potential social effects by Project phase:

- **Site preparation and construction phase:**
  - Direct employment;
  - Indirect employment; and
  - Use of municipal services.
- **Operations phase:**
  - Direct employment;
  - Indirect employment; and
  - Use of municipal services.

- **Closure phase:**
  - Decreased direct employment;
  - Decreased indirect employment; and
  - Use of municipal services.
- **Post-closure phase:**
  - Loss of direct employment; and
  - Loss of indirect employment.

The potential effects of the Project on the Social environment have been described using a simple linkage diagram (Figure 6.17.1-1). The figure illustrates the Social VCs (shown in blue on the figure) that are potentially affected during each phase of the Project. Additionally, the figure indicates those other components of the environment (shown in red in the figure) where the predicted effects of the Project on the Social environment will be used as an input for determining the effects on other VCs. Other VCs that provide inputs to the assessment of Social effects are shown in red in the figure.

6.17.2 Effects Prediction Methods

The qualitative social effects predictions, as they relate to the social VCs outlined in Section 6.1.3.16, were based upon:

- EIS guidelines for the Project;
- Baseline data collected for Aboriginal and non-Aboriginal communities within the socio-economic study area (EIS Appendix T);
- Elements of the Project description that may intersect with social conditions in the socio-economic study area;
- Information gathered through Aboriginal engagement and stakeholder consultation pre-EIS and post-EIS submission; and
- Industry knowledge and understanding of social interactions of mining projects in Canada and Ontario, including northwestern Ontario.

It is recognized that there are some gaps in the baseline social conditions and these were compensated for by industry knowledge and application of global best practices.

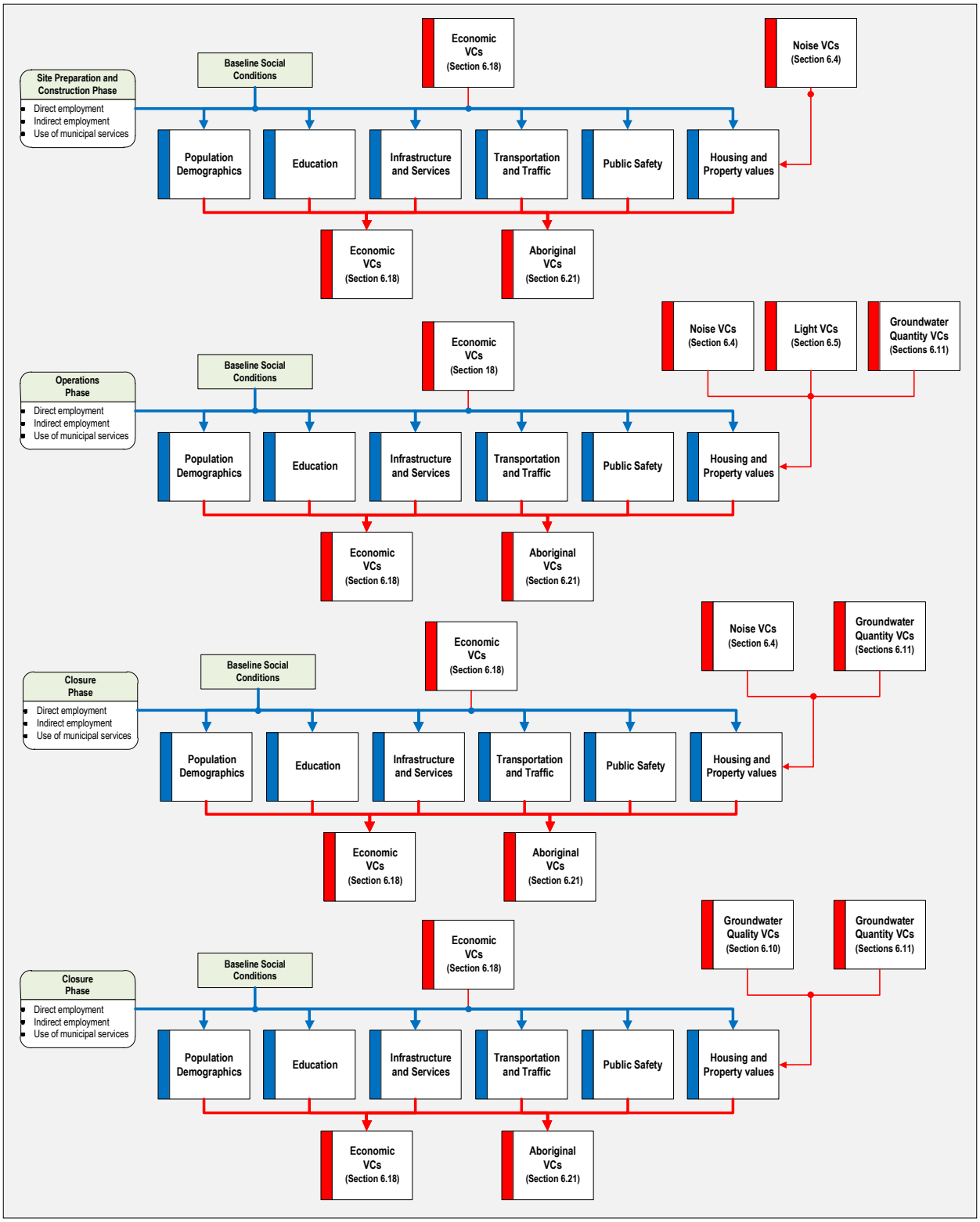


Figure 6.17.1-1: Social Linkage Diagram

6.17.3 Project Effects Avoidance Measures Used in Predictions

Avoidance measures used in predicting potential Project-related social effects are presented in Table 6.17.3-1.

Table 6.17.3-1: Social Effects Avoidance/Enhancement Measures Considered

Valued Component	Potential Effect	Project Phase	Avoidance/Enhancement Measure Considered
Population demographics	Potential for increase in demand on existing infrastructure and services such as utilities, municipal infrastructure, communication services and recreation facilities	Site preparation and construction Operations	None
Education	Increased demand for education services at all levels	Site preparation and construction Operations	None
	Motivation to stay in or leave school	Site preparation and construction Operations	None
Housing	Increased demand for temporary accommodations	Site preparation and construction	None
	Increased demand for permanent accommodation due to in-migration	Site preparation and construction Operations	None
	Positive and negative changes in real estate values due to in-migration and proximity to Project location	Site preparation and construction Operations Closure	• Mobile equipment will be equipped with appropriate sound suppression devices • Process plant will be enclosed and insulated to ensure that operational noise levels are kept to a minimum • Blasting undertaken at the mine site will be conducted in a manner that will not result in impacts to private properties. Blasting will be conducted on a regular schedule and at a time that will not be disruptive • Waste rock storage area and overburden piles will be situated to act as noise berms
Public safety	Potential for increase in demand for public safety services due to increased traffic volumes related to the Project and population increases	Site preparation and construction Operations Closure	None
	Potential increase in crime rate related to the behaviour of a non-local labour force and increased income and spending levels due to Project-related employment	Site preparation and construction Operations	• Include contracted security services to help promote a secure and safe worksite environment • Develop a mine closure plan that identifies strategies and actions to aid residents

Table 6.17.3-1: Social Effects Avoidance/Enhancement Measures Considered (continued)

Valued Component	Potential Effect	Project Phase	Avoidance/Enhancement Measure Considered
Transportation and traffic	Potential impact on transportation infrastructure due to potential population increases and transportation of goods and services throughout the life of the Project	Site preparation and construction Operations Closure	• Regulatory and cautionary signage • Best management practices plan for dust control will be implemented on the site during construction, operations and closure

6.17.4 Predicted Effects

The predicted social effects of the Project for each of the Project phases are listed in Table 6.17.4-1. It is anticipated that Project-related social effects will be most noticeable within the socio-economic study area communities considered to be within commuting distance from the Project site (estimated 100 km).

Table 6.17.4-1: Predicted Social Effects by Project Phase

Valued Component	Predicted Effect	Project Phase	Description of Effect
Population demographics	Changes to population demographics – population increase	Site preparation and construction	• In-migration could occur in the socio-economic study area associated with site preparation and site preparation and construction-related employment opportunities. This may help to reverse the pattern of out-migration in the socio-economic study area; however, it is expected that not all in-migrants will permanently locate to the area. Effects will be influenced by factors including, but not limited to: location, availability of housing, personal decision-making and location of origin of workers.
	Changes to population demographics – population increase	Operations	• In-migration could occur in the socio-economic study area associated with site preparation and construction-related employment opportunities. This may help to reverse the trend of out-migration in the socio-economic study area, positively affect the aging demographic profile and promote retention of the area's younger population. Effects will be influenced by factors including, but not limited to: location, availability of housing, personal decision-making and location of origin of workers.
	Changes to population demographics – population decline	Closure	• Out-migration could occur as the mine moves towards closure and the workforce composition and size change to align with

Table 6.17.4-1: Predicted Social Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
			closure activities and associated workforce requirements.
	Changes to population demographics – population decline	Post-closure	• Out-migration effects are expected to be most prominent once workforce requirements are confined to post-closure monitoring activities.
Education	Increased demand for education services at all levels	Site preparation and construction Operations	• Project-specific training requirements may positively affect demand for education and training services. Skills acquired through Project-specific pre-employment and on-the-job training may be transferrable to other economic sectors and will help to diversify and strengthen the local economy. • In-migration of working age population in response to Project-related employment opportunities may bring school-aged children to the area, increasing enrollments.
	Decreased demand for education services at all levels	Closure Post-closure	• Out-migration of working age population may result in decreased school enrollments.
	Motivation to stay in or leave school	Site preparation and construction Operations	• Individuals may be motivated to stay in school to further their education related to Project-related employment opportunities. Conversely, individuals may decide to leave or postpone their studies to pursue direct or indirect employment related to the Project.
Infrastructure and services	Potential for increase in demand on existing infrastructure and services such as utilities, municipal infrastructure, communication services and recreation facilities	Site preparation and construction Operations	• In-migration of workers and their families may increase the demand on existing infrastructure and services.
Housing	Increased demand for temporary accommodations	Site preparation and construction	• Due to the proximity of local communities, an accommodation camp is not included in the Project design. In-migration during Project site preparation and construction may put pressure on availability of temporary accommodations in the socio-economic study area. Effects will be influenced by factors including, but not limited to: location, availability of housing, personal decision-making and location of origin of workers.

Table 6.17.4-1: Predicted Social Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
	Increased demand for permanent accommodation due to in-migration	Site preparation and construction Operations	• It is anticipated that much of the needed workforce required during operations will be sourced from within the socio-economic study area communities, apart from highly specialized positions whose experience requirements exceed local labour force capabilities. Some non-local workers who take up employment during site preparation and construction may permanently locate to the socio-economic study area and continue employment through operations. Effects will be influenced by factors including, but not limited to: location, availability of housing, personal decision-making and location of origin of workers.
	Positive and negative changes in real estate values due to in-migration and proximity to Project location	Site preparation and construction Operations	• Real and perceived effects of Project-related activities (e.g., traffic, blasting) could negatively affect the value of houses that are closest to the Project's property boundary. • Increased demand for housing because of in-migration to the area may lead to an increase in real estate values.
		Closure	• Real estate values may be negatively affected by mine closure if individuals and families leave the area to pursue other employment, resulting in increased housing availability and decreased demand.
Public Safety	Potential for increase in demand for public safety services due to increased traffic volumes related to the Project and population increases	Site preparation and construction Operations	• Potential changes within the population and increased traffic volumes may increase pressure and demand on fire protection services, emergency services and police services.
		Closure	• Although potential out-migration of population following mine closure may occur, decreases in income levels due to mine closure and personal decision-making and behaviours could result in a continued increased demand for public safety services.
	Potential increase in crime rate related to the behaviour of a non-local labour force and increased income and spending levels due to Project-related employment	Site preparation and construction Operations	• Behaviour of non-local labour force during Project site preparation and construction could lead to an increased demand for public safety services. • Personal decision-making related to spending Project-related income may

Table 6.17.4-1: Predicted Social Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
			positively or negatively affect public safety within the affected communities.
		Operations	• Personal decision-making related to spending Project-related income may positively or negatively affect public safety within the affected communities.
		Closure	• Although potential out-migration of population following mine closure may occur, decreases in income levels due to mine closure and personal decision-making and behaviours could negatively affect the crime rate within the affected socio-economic study area communities.
Transportation and Traffic	Increased traffic on the roads leading to the Project site	Site preparation and construction	• Increased traffic during site preparation and construction could lead to higher incidences of traffic collisions involving other vehicles or wildlife. • Peak hours for traffic flow to/from the Project site will not overlap with existing baseline peak hours for Highway 17 traffic flows; the existing levels of service will be maintained on both Highway 17 and Anderson Road with additional anticipated Project-related traffic. • The current projected peak traffic volume during site preparation and construction will include approximately 469 daily trips down Anderson Road and Tree Nursery Road.
		Operations	• Increased traffic will be due mostly to shift changes and will involve smaller vehicles. • Regular transport of supplies and services to support mine operations will occur but on a much less noticeable scale than during site preparation and construction. • Vehicle traffic to and from the site during operations will be predominantly small vehicle traffic (94-96% of the annual trips are employee traffic and office supply trips), with larger vehicles accounting for 4 to 6% of the total annual traffic, which is approximately 15 to 19 trips per 24-hour period. The finished product leaving the mine site will be infrequent (less than once daily).
	Potential impact on transportation infrastructure due to potential population increases and transportation of	Site preparation and construction Operations Closure	• Increased traffic through all phases of the Project could result in increased wear of road surfaces.

Table 6.17.4-1: Predicted Social Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
	goods and services throughout the life of the Project		

6.17.5 Identified Mitigation

The Project measures identified to mitigate the potential adverse social effects and/or enhance positive social effects are listed in Table 6.17.5-1.

Table 6.17.5-1: Mitigation Measures Applicable to Social Effects

Mitigation Measure Title	Mitigation Measure Description
Communications	• Ongoing engagement with potentially affected stakeholders and Aboriginal peoples throughout the life of the Project.
Socio-economic monitoring and management	• Treasury Metals will work with potentially affected stakeholders and Aboriginal peoples to develop a socio-economic monitoring and management plan designed to address potential Project-related socio-economic effects, including optimization of benefits, identified through the environmental assessment process and/or at later stages of the Project.
Socio-economic baseline	• Treasury Metals will undertake an update of the socio-economic baseline (GCK Consulting 2014) to establish a pre-construction baseline of the affected communities prior to commencing Project site preparation and construction. This will serve as the basis for future monitoring and management of socio-economic effects throughout the life of the Project.
Local hiring	• Treasury Metals will develop and implement employment practices that give preference to local and regional labour to the extent possible.
Workforce development	• Treasury Metals will develop training policies and job transfer plans to support workforce development in the socio-economic study area.
	• Treasury Metals will develop training programs for unemployed and under employed residents and non-workers.
Education enrollments	• Treasury Metals will communicate appropriate information (e.g., the timing and communities in which new residents may locate) to the school district(s) to assist with their resource planning process. • Treasury Metals will communicate education requirements needed for employment on the site to discourage dropouts. • Treasury Metals will work with specific affected homeowners to ensure that their concerns about potential Project-related effects are addressed.
Infrastructure and services	• Treasury will work with local and regional governments to minimize the effects of in-migration and out-migration, as appropriate, communicating with government agencies as appropriate, including but not limited to: Project plans, proposed transportation volumes and workforce requirements.
Public safety	• Include contracted security services to help promote a secure and safe worksite environment.
	• Treasury will work with public safety services to develop safety and work policy guidelines for mine workers, including a policy of no alcohol or drugs onsite and policies and guidelines to support a respectful work environment.

Table 6.175-1 Mitigation Measures Applicable to Social Effects (continued)

Mitigation Measure Title	Mitigation Measure Description
	• Develop a mine closure plan that identifies strategies and actions to aid residents.
	• Included in the development of a socio-economic monitoring and management plan, Treasury will work with local agencies to assist in monitoring community wellbeing and take corrective actions where appropriate.
	• The need to engage local fire services from the socio-economic study area communities will be mitigated through onsite fire suppression equipment will be provided to support trained responders in extinguishing and/or ensuring exposure protection from natural fires. Site hydrants will ensure that cooling water can be applied if threatened by external fire source.
Transportation infrastructure	• Best management practices plan for dust control will be implemented on the site during site preparation and construction, operations and closure. • Treasury Metals will engage the Local Services Board in Wabigoon to acquire Tree Nursery Road in its entirety from north of Normans Road.
Traffic safety	• Treasury Metals will establish and enforce traffic safety protocols, regulatory and cautionary signage, road maintenance and emergency response plans on all Project roads to prevent collisions and accidents. • As part of the traffic and site control policy, Treasury Metals will continue to evolve its current practices and take into consideration all comments from the public, Aboriginal peoples and stakeholders. • Treasury Metals as part of the suitability assessment associated with CSAS-23 standards for Anderson Road and Highway 17 will discuss the options presented within Appendix E for the snow plough turnaround with MTO. Treasury Metals will move forward with the change suggested by MTO if deemed necessary, to ensure that snow removal equipment can use the turn-around in a safe efficient manner. • Treasury Metals will work with MTO to ensure that the proper lighting structures are in place to support the projected traffic volumes associated with the Project. • Treasury Metals will clear shrubbery, trees, soil mounds, etc. that could cause a visual obstruction between vehicles on Anderson Road and Highway 17.

6.17.6 Residual Effects

The residual social effects are presented in Table 6.17.6-1 together with the applicable avoidance and mitigation measures. The social effects associated with the Project will be occur to varying degrees across the socio-economic study area introduced in Section 6.1.4.17. There would not be a spatial pattern associated with the social effects.

Table 6.17.9-1 Social Residual Effects

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
Population Demographics				
Increased demand on existing community housing, infrastructure and services due to in-migration of Project workers	Site preparation and construction Operations Closure Post-closure	Socio-economic monitoring and management Traffic safety Socio-economic baseline	Potential increased demand on existing community housing, infrastructure and services. A noticeable change may result but it is expected that the current infrastructure within the communities most likely to be affected (City of Dryden and Village of Wabigoon) would be able to accommodate increased population. Population levels may decline to pre-Project conditions during Closure and Post-closure.	• Adverse during Site preparation and construction and operations. • Positive during closure and post-closure.
Education				
Increased training opportunities	Site preparation and construction Operations Closure	Education and training policies and plans	Increased training and education opportunities for unemployed and under-employed residents and non-resident workers. It is anticipated that any increase in training would be able to be accommodated within existing education and training facilities.	• Positive during Site preparation and construction, operations and closure. • Adverse during post-closure.
Increased education enrollment	Site preparation and construction Operations	Communication with school districts Socio-economic baseline	Potential increased demand on education services. It is anticipated that any increase in enrollments could be accommodated within existing education system.	• Adverse during Site preparation and construction and operations. • Positive during closure and post-closure.
Infrastructure and Services				
Increased demand on various infrastructure and services	Site preparation and construction Operations Closure	Communicate with government agencies as appropriate, including but not limited to: Project plans, proposed transportation volumes and workforce requirements. Socio-economic monitoring and management plan	Potential increased demand on infrastructure and services may be noticeable but are anticipated to be within the current capacity.	• Adverse during Site preparation and construction and operations. • Positive during closure and post-closure.

Table 6.17.9-1 Social Residual Effects (continued)

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
		Socio-economic baseline		
Housing and Property Values				
Increased demand for temporary accommodations	Site preparation and construction	Socio-economic monitoring and management plan Socio-economic baseline	Potential for demand to limit supply or lead to price increases for temporary accommodations. It is anticipated that this effect will be noticeable during Site preparation and construction but is unlikely to exceed current capacity.	• Adverse during Site preparation and construction.
Increased demand for permanent accommodation	Site preparation and construction Operations	Socio-economic monitoring and management plan Socio-economic baseline	Potential for increase in property values may be noticeable.	• Adverse or positive during Site preparation and construction and operations depending on whether effect is experienced by potential buyers or sellers of real estate.
Change in property values	Site preparation and construction Operations Closure Post-closure	Socio-economic monitoring and management plan Socio-economic baseline Noise and vibration measures Treasury Metals will work with specific affected homeowners to ensure that their concerns about potential Project-related effects are addressed	Real and perceived effects of Project-related activities (e.g., traffic, blasting) could negatively affect the value of houses that are closest to the Project's property boundary. Increased demand for housing because of in-migration to the area may lead to an increase in real estate values.	• Adverse during Site preparation and construction and operations. • Positive and adverse during closure and post-closure.
Public Safety				
Potential for increase in demand for public safety services due to increased traffic volumes related to	Site preparation and construction Operations Closure	Contracted security services onsite Safety and work policy guidelines	Project-related effects may be noticeable during Site preparation and construction and Operations phases, less noticeable during Closure and are expected to cease following Closure.	Adverse.

Table 6.17.9-1 Social Residual Effects (continued)

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
the Project and population increases		Mine closure planning Socio-economic monitoring and management plan Socio-economic baseline Onsite fire suppression Traffic safety		
Potential increase in crime rate related to the behaviour of a non-local labour force and increased income and spending levels due to Project-related employment	Site preparation and construction Operations Closure Post-closure	Socio-economic monitoring and management plan	Personal decision-making related to spending Project-related income may positively or negatively affect public safety within the affected communities. Although potential out-migration of population following mine closure may occur, decreases in income levels due to mine closure and personal decision-making and behaviours could negatively affect the crime rate within the affected socio-economic study area communities.	Adverse.
Transportation and Traffic				
Increased level of traffic	Site preparation and construction Operations Closure Post-closure	Socio-economic monitoring and management plan Acquisition of Tree Nursery Road Traffic safety protocols, regulatory and cautionary signage, road maintenance and emergency response plans	The existing levels of service will be maintained on both Highway 17 and Anderson Road with additional anticipated Project-related traffic. There is no anticipated residual effect.	• Adverse during Site preparation and construction and operations. • Positive during closure and post-closure.

Note:
For additional avoidance and mitigation measures related to potential effects on housing (e.g., noise, water, light), please refer to the noise, water and light sections of this report

6.17.7 Information to Address Round 1 Information Requests

The following lists the Round 1 IRs related to the assessment of social effects:

Population Demographics

- Government Agencies:
    - TMI_227-HE(1)-34: Potential for population increases.

Housing

- Métis Nation of Ontario:
    - TMI_590- AC(1)-264: Property values.
- Eagle Lake First Nation:
    - TMI_611-AC(1)-284: Property damage.
- Other Stakeholders:
    - TMI_708-PC(1)-23: Property values.
    - TMI_715-PC(1)-30: Noise.
    - TMI_716-PC(1)-31: Noise and vibration.
    - TMI_716-PC(1)-31: Noise and vibration / property damage.
    - TMI_722-PC(1)-37: Property values.
    - TMI_724-PC(1)-39: Property values.

Public Safety

- Métis Nation of Ontario:
    - TMI_492-AC(1)-166: Inadequate baseline to determine crime effects.

Transportation and Traffic

- Government Agencies:

- TMI_227-HE(1)-34: Potential for increased traffic.
- TMI_17-PD(1)-04: Redirection of Tree Nursery Road.
- TMI_186-AE(1)-24: Noise from vehicle traffic.

6.18 Economic Factors

6.18.1 Potential Effects of the Project on the Environment

The potential effects of the Project on the economy will vary by Project phase, and with varying levels of activity. The following lists the potential economic effects by Project phase:

- **Site preparation and construction phase:**
  - Direct employment;
  - Indirect employment;
  - Project expenditures; and
  - Training for employment.
- **Operations phase:**
  - Direct employment;
  - Indirect employment;
  - Project expenditures; and
  - Training for employment.
- **Closure phase:**
  - Decreased direct employment;
  - Decreased indirect employment;
  - Decreased Project expenditures; and
  - Decreased training for employment.

- **Post-closure phase:**
  - Loss of direct employment;
  - Loss of indirect employment;
  - Loss of Project expenditures;
  - Loss of Project-related training.

The potential effects of the Project on Economics have been summarized in Table 6.18-1, and described using a simple linkage diagram (Figure 6.18.1-1). The figure illustrates the Economic VCs (shown in blue on the figure) that are potentially affected during each phase of the Project. Additionally, the figure indicates those other components of the environment/human environment (shown in red in the figure) where the predicted effects of the Project on Economics will be used as an input for determining the effects on other VCs. For example, Economic effects will be used as an input for determining the effects of the Project on social and Aboriginal VCs.

Table 6.18-1: Potential Economic Effects by Project Phase

Valued Component	Potential Effect	Project Phase
Labour force, labour participation and employment	The Project will affect labour income, change labour participation and change employment opportunities in the region.	Site preparation and construction Operations Closure and post-closure
Income levels	The Project affect income levels in the region.	Site preparation and construction Operations Closure and post-closure
Cost of living	The Project through employment and contacting opportunities will affect cost of living.	Site preparation and construction Operations Closure and post-closure
Real estate	The Project through employment and contacting opportunities will affect real estate prices.	Site preparation and construction Operations Closure and post-closure
Economic development	The Project will change government taxes which will affect economic development in the region.	Site preparation and construction Operations Closure and post-closure
Existing businesses	The Project through employment and contacting opportunities will affect existing businesses.	Site preparation and construction Operations Closure and post-closure
Government revenues	The project through expenditures and employment will affect government revenues.	Site preparation and construction Operations Closure and post-closure

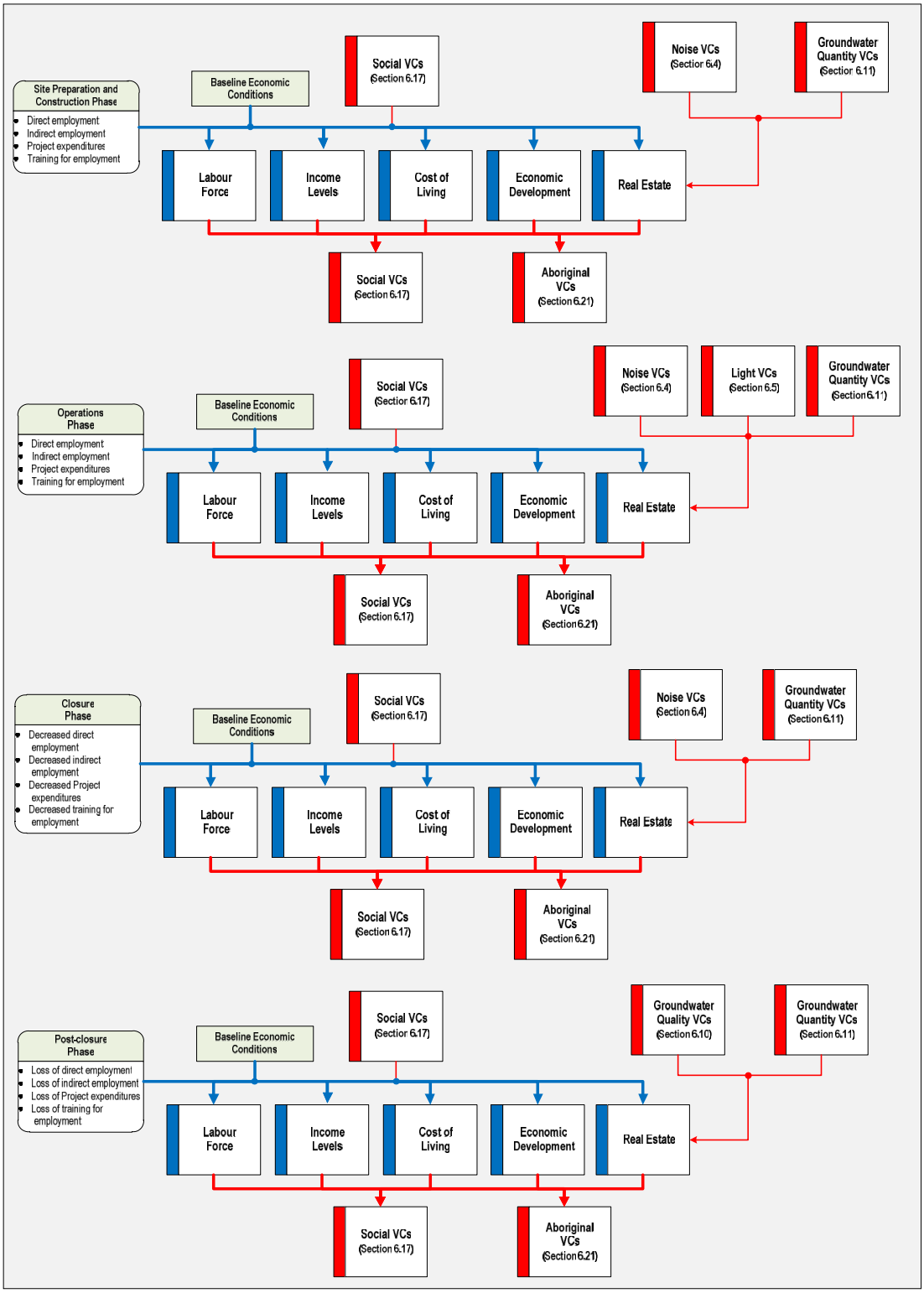


Figure 6.18.1-1: Economic Linkage Diagram

6.18.2 Effects Prediction Methods

The methods used to identify the economic effects are similar to the methods identified in the EIS particularly those under Social Factors. Quantitative methods to calculate the economic effects of the Project are explained below.

6.18.2.1 Methods Used in the Economic Effects Assessment

The Model used to estimate the economic effects of the Project is derived from Dungan and Murphy (2014) 'Representative' project: *An Au-thentic Opportunity: The Economic Impacts of a New Gold Mine in Ontario.* Dungan and Murphy estimated, using conservative assumptions, the impact on GDP, employment and government revenues of both the construction and the ongoing operation of a new gold mine in a relatively remote region of Northern Ontario.

The results of their assessment represent the impacts for the Ontario economy as a whole and, more generally, for the region in which the project is sited. Impacts are also shown for Canada and selected other provinces. These results are of particular importance to all stakeholders including miners, Aboriginal and other local communities, governments and developer.

6.18.2.2 Reference for the Selected Model

The 'Representative' project considered a new open pit gold mine with a construction cost of $750 million spread over three years (after and excluding all exploration, planning, permitting and other preconstruction expenditures). The mine then generates sales of $300 million per year, potentially for over 20 years into the future, and employs 440 persons on site with total compensation of $142,200 per worker. The combined direct, indirect and induced economic impacts of an open pit gold mine are extremely large. In its construction phase the mine adds about $183 million to Ontario GDP and generates over 1,900 jobs annually. In its production phase, for each year of operation, the mine adds approximately $300 million to Ontario GDP and increases Ontario's employment by over 1,800 at a rate of compensation per employee well above the provincial average.

The combined impact on government revenues of a new open pit gold mine is also large. In the construction phase governments collect a total of $60 million a year from the mine's direct, indirect and induced activity, while in the production phase this rises to $95 million per year. The provincial government's share is $25 million in the construction phase, and over $38 million in the production phase.

The 'Representative' project also considered a new underground gold mine with a construction cost of $600 million also spread over three years. This mine also generates $300 million in sales per year over an extended period with on-site employment of 620 and total compensation per worker of $145,500. The combined direct, indirect and induced impacts of an underground mine are also very large. In the construction phase the mine adds almost $150 million to Ontario GDP and generates over 1,500 jobs in each of the three years.

In production, the mine contributes over $330 million per year to Ontario GDP and generates 2,200 additional jobs annually, again with a very high average rate of labour compensation.

In the construction phase of a new underground gold mine, governments collect just under $50 million a year from the direct, indirect and induced impacts, with the provincial government receiving $20 million. In the production phase, all governments receive over $100 million per year, with over $40 million going to the provincial government (Dungan and Murphy 2014).

6.18.2.3 Justification for the Selected Model

The 'Representative' project is used in this economic effect assessment to calculate the economic effects of a new gold mine during both the Construction and Operations phases of the Project. Both the Project and the 'Representative' project are geographically located in Northern Ontario. The 'Representative' project includes estimates of economic effects for both an open pit mine and an underground mine. This is of specific importance and relevance to the Project which plans to operate an open pit mine in the first five years of operations followed by an underground mine in the second 5 to 7 years of operations.

6.18.2.4 Assumptions for the Project Economic Model

The following assumptions were built into the development of the Project economic model:

- Treasury will initiate the construction phase of the Project once the site preparation activities are completed. Some of the construction activities may overlap with the site preparation phase. Construction activities will be coordinated according to manpower and equipment availability, scheduling constraints, and site conditions. Some activities, particularly those involving work in wet or poorly accessible terrains, are best carried out under frozen ground conditions. The duration of the construction phase is expected to be 1 year;

- The Project operations phase commences with an open pit mine with an expected mine life of 5 years. During years 3 to 5, underground development and mining will commence and continue to the end of the total 10 to 12-year mine life (11 on average). The underground and open pit mines will be running simultaneously during years 3 to 5. Accordingly, two assessments were done; one for an Open Pit and one for an Underground mine:

    - Economic effects assessment for an Open pit during Construction and Operations; and

    - Economic effects assessment for an Underground Mine during Operations;

- The impacts from Dungan and Murphy's 'Representative' mines are largely 'scalable', meaning that if twice as much were spent to construct the new mine then the impacts

would be roughly twice as big. The same would be true for the operations of the new mine (Dungan and Murphy 2014).

6.18.2.5 Project Inputs for the Economic Effects Assessment

The following Project inputs were used for the economic effects assessment:

Site preparation and construction: In the economic effects assessment of the Project, Treasury Metals estimated that total site preparation and construction expenditure is approximately $200 M ($100 M in capital construction and $100 M in sustaining capital over the life of the mine; sustaining capital is less than $10 M/year during operations). Mine construction expenditure is $100 M; this represents 40% of the 'Representative' project capital expenditures (100/250*100=40%). Accordingly, construction economic effects of the Treasury Metals Project are 40% of the 'Representative' project identified economic effects during construction, for both open pit and underground mines. Construction of the underground operation is integrated into the operation of the operation of the open pit. There are no separate estimates for the construction of the underground operation.

- *Operations:* Treasury Metals estimated that total mine operations expenditure is $579 M over 11 years (approximately $53M/year). This represents 17.5% of the 'Representative' project operations expenditures (53/300*100=17.5%). Accordingly, the Project operations economic effects are 17.5% of the 'Representative' project identified economic effects during operations, for both open pit and underground mines.

- *Closure and post closure:* During closure and post closure and decommissioning, up to $20 M will be spent. Given that nature of work that will be done during Closure and Post Closure and decommissioning and lack of estimates from the 'Representative' project on economic effects during Closure and Post Closure, a qualitative assessment is included only.

6.18.2.6 Outputs of the Project Economic Effects Assessment

The outputs are presented for each component (open pit and underground) and each phase below:

Open Pit Mine

- Site preparation and construction Phase:
  - Annual Economic Impacts
  - Annual Employment Impacts by Skill Category

- Annual Government Revenues

- Operations Phase:
  - Annual Economic Impacts
  - Annual Employment Impacts by Skill Category
  - Annual Government Revenues

Underground Mine

- Operations Phase:
  - Annual Economic Impacts
  - Annual Employment Impacts by Skill Category
  - Annual Government Revenues

6.18.2.7 Confidence and Uncertainty Related to the Modelling Approach

In the 'Representative' project Model by Dungan and Murphy, the authors included a discussion of confidence/uncertainty; this discussion is summarized below. It is noted here that with the identified confidence/uncertainty in the modeling approach, the Model is still appropriate to use in the economic impact assessment of the Project.

- The Model uses information from the Mining Industry Human Resources Council (MiHR) and the National Occupational Classification (NOC) system of Human Resources and Skills Development Canada, it captures the skill mix required to perform the jobs from the creation of a new gold mine.

- Given the difficult nature of trying to measure the skills required in jobs across all of the sectors that are inputs into the new gold mine, the results should be viewed as reasonable estimates.

- The Model estimates provide an important input for all parties to utilize in understanding the type of training required for local Aboriginals to participate in a new mine.

- The Model estimates the economic impact on output, employment and earnings, and also on tax revenues of the various levels of government, on an annualized basis. The Model attempts, in more cautious, to isolate the local impacts within a region of Ontario surrounding the new mine.

- During the Model development, determining a 'Representative' size of mine was difficult because the size of mines in production, as well as those that have been proposed to be opened in northern Ontario, ranged from tens of millions of dollars in investment to more than $1.5 billion.

- Both the open pit and underground gold mines are meant to be 'Representative', and as such, do not reflect any company's existing or announced future operations. The ultimate choice between open-pit or underground gold mining will be determined by geology.

- During the Model development, to maintain reliability, cautious assumptions have been used where necessary in determining elements such as tax take at the various levels, or production and re-spending by consumers. Estimates presented in the Model are reliable and conservative as possible.

- Third level of impacts, within a region of Ontario surrounding the new mine are limited to a province-wide basis. However, some techniques estimated how much of the economic activity spun off from the new mine actually stays within the region or community surrounding the mine. Because the Model assumes that the new gold mine will be built in a relatively remote area of Northern Ontario, third level impacts are more regional in nature than local (Dungan and Murphy 2014).

6.18.2.8 Key Model Inputs by Phase

Site preparation and construction

- Site preparation and construction of the mine will require an average of 400 (peak of 450) workers. The majority of the mine construction workforce is anticipated to be recruited from within the socio-economic study area which will increase employment in the region.

- The Project is anticipated to require a wide range of workers with varying levels of education and skills; it expects to implement a training program for open pit and underground miners as a significant part of the Project labour recruitment program. This training will enhance labour force skills in the region.

- Mine workers from within the socio-economic study area will have access to additional labour income that they can use to either improve housing and style of living or to invest in the economic development of the region. Additional income could have positive effects when used to enhance and improve style of living or negative effects depending on spending decisions.

- The Project expenditures will create economic effects in the regional and local communities, which may in turn stimulate some demographic changes in these communities. Possible population changes and additional demand for goods and services

by Project and along with additional labour income generated by Project's employment could increase current cost of living and lead to some inflation.

- Municipal government will receive additional income through taxes. Taxes may be used for the development or rehabilitation of residential and/or commercial land and buildings within the Municipality, community downtowns, and business improvement areas and other opportunities identified by the Municipality.

- Site preparation and construction expenditures are estimated to occur over a one-year period. The majority of the goods and services required for the Project are expected to be procured within the local and regional communities. This is expected to improve existing business and allow them to grow to supply the required goods and services.

- No on-site camp is proposed. Non-resident workers are expected to stay in houses and temporary accommodation within the socio-economic study area. This will create positive economic effects on existing local and regional businesses.

- The Project will generate additional taxes to all three levels of government: federal, provincial and municipal. Additional government revenues can improve community services and infrastructure and creates additional jobs and labour income.

Operations

- Operations of the mine will require an average of 200 workers annually for 11 years. The majority of the mine operations workforce is anticipated to be recruited from within the socio-economic study area.

- The Project is anticipated to require a wide range of workers with varying levels of education and skills; it expects to implement a training program for open pit and underground miners as a significant part of the Project labour recruitment program. This training will enhance labour force skills in the region.

- Mine workers from within the socio-economic study area will have access to additional labour income that they can use to either improve housing and style of living or to invest in the economic development of the region. Additional income could have positive effects when used to enhance and improve style of living or negative effects depending on spending decisions.

- The Project expenditures will create economic effects in the regional and local communities, which may in turn stimulate some demographic changes in these communities. Possible population changes and additional demand for goods and services by Project and along with additional labour income generated by Project's employment could increase current cost of living and lead to some inflation.

- Municipal government will receive additional income through taxes. Taxes may be used for the development or rehabilitation of residential and/or commercial land and buildings within the Municipality, community downtowns, and business improvement areas and other opportunities identified by the Municipality.

- Operations are expected to last 11 years. During those 11 years, there will regular demand to supply goods and services required for operations including regular maintenance. This is expected to improve existing business and allow them to grow to supply the required goods and services.

- No on-site camp is proposed. Non-resident workers are expected to stay in houses and temporary accommodation within the socio-economic study area. This will create positive economic effects on existing local and regional businesses.

- The Project will generate additional taxes to all three levels of government: Federal, Provincial and Municipal. Additional government revenues can improve community services and infrastructure and creates additional jobs and labour income.

Closure

- During the closure phase the expenditures and employment by the Project will be reduced. This will have effects on other economics VCs.
- There will be loss in employment and labour income as well as loss in the demand for local goods and services. This may result in a potential reduction to cost of living.

- Demand for housing is expected to drop and housing prices are expected to drop if workers choose to sell their houses and leave the socio-economic study area to move elsewhere. Project taxes will drop which may affect economic development in the socio-economic study area.

- Project taxes will decline and then stop completely which may affect economic development within the socio-economic study area.

- Project demand for goods and services will decrease slowly. This will affect existing businesses.

- Project taxes will decrease slowly. This will affect government revenues.

Post Closure

- During the post closure phase the expenditures and employment by the Project will stop. This will have effects on other economics VCs.

- There will be permanent loss in employment and labour income as well as loss in the demand for local goods and services. This may result in a potential reduction to cost of living.

- Demand for housing by the Project will stop. Housing prices are expected to drop if workers choose to sell their houses and leave the socio-economic study area to move elsewhere.

- Project taxes will stop which may affect economic development within the socio-economic study area.

- Project demand for goods and services will stop. This may affect existing businesses.

- Project taxes will stop. This will affect government revenues.

- Project training during construction and operations will enhance labour force skills in the region and improve their participation in other employment opportunities during the Project post closure.

6.18.3 Effects Avoidance/Enhancement Measures Used in Predictions

There are no avoidance or enhancement measures as part of the physical design of the Project applicable to economic effects.

6.18.4 Predicted Effects

6.18.4.1 Economic Effects

The economic impacts of the open pit mine during construction and operations as well as the underground mine operations are presented in Table 6.18.7.1-1.

Table 6.18.4.1-1 Economic Effects

Parameter	Open Pit Construction	Open Pit Operations	Underground Operations
Mine Construction Expenditure	$100.0	$53.0	$53.0
Direct Impacts			
Employment	400	200	200
Total Labour Compensation	$26.2	$11.0	$15.7
Gross Domestic Product	$36.6	$26.9	$31.5
Labour Compensation/Employee ($ '000)	$65.9	$142.2	$145.5
Indirect Impacts			
Employment	202	385	288
Total Labour Compensation	$11.2	$10.3	$9.6
Gross Domestic Product	$19.2	$16.4	$14.7
Labour Compensation/Employee ($ '000)	$55.9	$69.1	$60.9

Table 6.18.4.1-1 Economic Effects (continued)

Parameter	Open Pit Construction	Open Pit Operations	Underground Operations
Induced Impacts			
Employment	165	244	223
Total Labour Compensation	$7.2	$4.1	$5.2
Gross Domestic Product	$17.2	$9.8	$12.5
Labour Compensation/Employee ($ '000)	$43.6	$43.5	$43.5
Total - Direct, Indirect and Induced Impacts			
Employment	765	828	711
Total Labour Compensation	$44.7	$25.5	$30.6
Gross Domestic Product	$73.0	$53.3	$58.8
Labour Compensation/Employee ($ '000)	$58.5	$84.9	$79.3
Local Area Impacts			
Employment	539	621	545
Total Labour Compensation	$31.5	$20.1	$25.3
Gross Domestic Product	$46.7	$42.8	$48.0
Labour Compensation/Employee ($ '000)	$58.6	$83.6	$85.3

Notes:
All dollar amounts are in millions of 2014 Canadian dollars, unless otherwise stated
Employment is in person-years

Open Pit Construction

Direct employment generated during the open pit construction is 400 person-years of employment, with total labour compensation of almost $26.2 M. The annual labour compensation per employee is about $66,000 – considerably above the provincial average rate of roughly $55,000. Ontario GDP is directly increased by $36.6 M during the one year construction phase.

The total direct, indirect and induced impacts generated during the open pit construction includes 765 persons-years of employment, $44.7 M in labour compensation with an average annual labour compensation of $58,500 annually and up to $73 M in additional Ontario GDP. Of that total economic impacts up to 539 person-years of employment and up to $31.5 M in labour compensation are expected to be local/regional.

Open Pit Operations

Direct employment generated during the open pit operations is 200 persons-years of employment annually, with total labour compensation of almost $11 M. The annual labour compensation per employee is about $142,200 (this includes employee benefits, pension contributions, WSIB premiums and the employer portion of Canada Pension Plan contributions and Employment Insurance premium). Ontario GDP is directly increased by $26.9 M annually during the operations phase.

The total direct, indirect and induced impacts generated during the open pit operations includes 828 person-years of employment, $25.5 M in labour compensation with an average annual labour compensation of $84,900 annually and up to $53.3 M in additional Ontario GDP. Of the total

economic impacts, up to 621 person-years of employment and up to $20.1 M in labour compensation are expected to be local/regional.

Underground Operations

Direct employment generated during the underground operations is 200 persons-years of employment annually, with total labour compensation of almost $15.7 M. The annual labour compensation per employee is about $142,500 (this includes employee benefits, pension contributions, WSIB premiums and the employer portion of Canada Pension Plan contributions and Employment Insurance premium). Ontario GDP is directly increased by $31.5 M annually during the operations phase.

The total direct, indirect and induced impacts generated during the underground operations includes 711 persons-years of employment, $30.8 M in labour compensation with an average annual labour compensation of $79,300 annually and up to $58.8 M in additional Ontario GDP. Of the total economic impacts, up to 545 person-years of employment and up to $52.3 M in labour compensation are expected to be local/regional.

6.18.4.2 Employment Effects

Using the annual job creation numbers generated in 6.18.7.1-1 and using the NOC measures of 'skills' required to perform persons-years of employment in the Ontario economy, Table 6.18.7.2-1 includes the measure of the 'skill mix' for the direct job impacts from the construction of a new open pit mine, the operations of a new open pit mine and the operations of a new underground mine.

Table 6.18.7.2-1 Employment Effects

Parameter	Open Pit Construction	Open Pit Operations	Underground Operations
Direct Impacts			
Total Employment	400	200	200
Management	54	9	9
Skill Level A - University Degree	10	19	19
Skill Level B - College or Apprenticeship Certification	216	116	116
Skill Level C - Secondary School and/or Specific Occupation Training	83	41	41
Skill Level D - On-the-Job Training Usually Provided	37	15	15
Indirect Impacts			
Total Employment	202	385	288
Management	15	37	27
Skill Level A - University Degree	40	45	44
Skill Level B - College or Apprenticeship Certification	72	161	111
Skill Level C - Secondary School and/or Specific Occupation Training	56	106	72
Skill Level D - On-the-Job Training Usually Provided	19	35	34
Induced Impacts			

Table 6.18.7.2-1 Employment Effects (continues)

Parameter	Open Pit Construction	Open Pit Operations	Underground Operations
Total Employment	165	244	223
Management	17	25	23
Skill Level A - University Degree	21	31	28
Skill Level B - College or Apprenticeship Certification	51	75	68
Skill Level C - Secondary School and/or Specific Occupation Training	50	74	68
Skill Level D - On-the-Job Training Usually Provided	26	39	36
Total - Direct, Indirect and Induced Impacts			
Total Employment	765	829	711
Management	86	71	59
Skill Level A - University Degree	71	96	92
Skill Level B - College or Apprenticeship Certification	338	351	294
Skill Level C - Secondary School and/or Specific Occupation Training	189	221	181
Skill Level D - On-the-Job Training Usually Provided	81	89	85
Local Area Impacts			
Total Employment	539	619	546
Management	66	54	46
Skill Level A - University Degree	47	71	68
Skill Level B - College or Apprenticeship Certification	246	271	234
Skill Level C - Secondary School and/or Specific Occupation Training	116	152	132
Skill Level D - On-the-Job Training Usually Provided	64	71	66

Note: Employment is in person-years

Open Pit Construction

Direct employment impacts during the open pit construction show that over half (216) of the annual 400 jobs directly created by the construction of the open pit mine require the equivalent of college or apprenticeship accreditation (Level B). About 83 jobs (21%) need secondary school or specific occupation training (Level C) and approximately 37 jobs require only on-the-job training (Level D).

Total direct, indirect and induced employment impacts during the open pit construction show that up to 338 jobs require college or apprenticeship certification (Level B), up to 189 jobs require secondary school and/or specific occupation training (Level C) and 81 jobs require on-the-job training (Level D). Of that total employment (765 jobs), up to 539 jobs are expected to be local/ regional; 45% of these jobs require college or apprenticeship certification (Level B), 116 jobs require secondary school and/or specific occupation training (Level C) and 64 jobs require on-the-job training (Level D).

Open Pit Operations

Direct employment impacts during the open pit operations show that over half (116) of the annual 200 jobs directly created by the operations of the open pit mine require the equivalent of college or apprenticeship accreditation (Level B). About 41 jobs (20%) need secondary school or specific occupation training (Level C) and approximately 15 jobs require only on-the-job training (Level D).

Total direct, indirect and induced employment impacts during the open pit operations show that up to 351 jobs require college or apprenticeship certification (Level B), up to 212 jobs require secondary school and/or specific occupation training (Level C) and 89 jobs require on-the-job training (Level D). Of that total employment (829 jobs), up to 619 jobs are expected to be local/regional; 271 jobs (43%) require college or apprenticeship certification (Level B), 152 jobs require secondary school and/or specific occupation training (Level C) and 71 jobs require on-the-job training (Level D).

Underground Operations

Direct employment impacts during the underground operations show that over half (116) of the annual 200 jobs directly created by the operations of the open pit mine require the equivalent of college or apprenticeship accreditation (Level B). About 41 jobs (20%) need Secondary school or specific occupation training (Level C) and approximately 15 jobs require only on-the-job training (Level D).

Total direct, indirect and induced employment impacts during the underground operations show that up to 294 jobs require college or apprenticeship certification (Level B), up to 181 jobs require secondary school and/or specific occupation training (Level C) and 85 jobs require on-the-job training (Level D). Of that total employment (711 jobs), up to 546 jobs are expected to be local/regional; 234 jobs (43%) require college or apprenticeship certification (Level B), 132 jobs require secondary school and/or specific occupation training (Level C) and 66 jobs require on-the-job training (Level D).

6.18.4.3 Government Revenues

Table 6.18.6.3-1 summarizes the revenue impacts by level of government for the construction of a new open pit mine and the operations of an open pit and an underground mine.

Table 6.18.6.3-1: Government Revenues

Parameter	Open Pit Construction	Open Pit Operations	Underground Operations
Total Annual Mine Construction Expenditure	$100.0	$53.0	$53
Federal Government			
Personal Income Tax	$4.6	$2.9	$3.5
Corporate Income Tax	$1.4	$2.4	$1.8
Employment Insurance Premiums	$1.0	$0.5	$0.6

Table 6.18.6.3-1: Government Revenues (continued)

Parameter	Open Pit Construction	Open Pit Operations	Underground Operations
Other Federal Taxes	$1.5	$0.8	$0.9
Total:	$8.7	$6.7	$6.9
Provincial Government			
Personal Income Tax	$2.2	$1.4	$1.8
Corporate Income Tax	$1.0	$2.0	$1.6
of which: Mining Tax		$0.4	$0.4
Workplace Safety (WSIB) Premiums	$1.1	$0.8	$1.1
Employer Health Tax	$0.6	$0.3	$0.4
Other Provincial Taxes	$4.9	$2.0	$2.5
Total:	$10.0	$6.7	$7.5
Local Governments			
All Local Taxes	$2.7	$2.0	$2.2
(Taxes in Mine Locality)	$1.7	$1.6	$1.8
Canada Pension Plan Contributions	$2.5	$1.9	$1.4
Ontario Total - All Governments	$24.0	$16.3	$17.9

Note: All dollar amounts are in millions of 2014 Canadian dollars

Open Pit Construction

From the $100 M expenditure on the open pit mine's construction, the federal government earns about $8.7 M in revenue, with over half coming from the personal income tax, and the remainder spread almost evenly across the corporate income tax, Employment Insurance premiums and all other federal taxes.

The provincial government is estimated to take in about $10 M in revenue and the local governments in the province should derive about $2.7 M in revenue. The Canada Pension Plan gains $2.5 M in Ontario in new contributions while the mine construction is occurring. The total Ontario impact on government revenues through all levels of activity is about $24 M.

Open Pit Operations

From the $53 M expenditure on the open pit mine's operations, the federal government earns about $6.7 M in revenue, with $2.9 M coming from the personal income tax, and 2.4 M from corporate tax. The remainder is Employment Insurance premiums ($0.5 M) and all other federal taxes ($0.8 M).

The provincial government is estimated to take in about $6.7 M in revenue and the local governments in the province should derive about $2 M in revenue. The Canada Pension Plan gains $1.9 M in Ontario in new contributions while the mine operations is occurring. The total Ontario impact on government revenues through all levels of activity is about $16.3 M.

Underground Operations

From the $53 M expenditure on the underground mine's operations, the federal government earns about $6.9 M in revenue, with $3.5 M coming from the personal income tax, and 1.8 M from corporate tax. The remainder is Employment Insurance premiums ($0.6 M) and all other federal taxes ($0.9 M).

The provincial government is estimated to take in about $7.5 M in revenue and the local governments in the province should derive about $2.2 M in revenue. The Canada Pension Plan gains $1.4 M in Ontario in new contributions while the mine operations is occurring. The total Ontario impact on government revenues through all levels of activity is about $17.9 M.

6.18.5 Identified Mitigation

Treasury Metals is committed to the following mitigation measures that maximise the local/ regional positive economic effects of the Project and reduce the negative ones, such as job loss during closure. These measures include but are not limited to the following:

- *Site preparation and construction phase and operations phase:* To promote the participation of local residents in employment and contacting opportunities, Treasury has policies for hiring and purchasing locally. Treasury has demonstrated deep commitment to both of these policies as evidenced by the makeup of its local workforce and purchasing record.

- *Site preparations and construction and operations phase:* To promote the use of local goods, services and businesses, Treasury purchases the majority of its goods and services locally and within the Province of Ontario (Appendix CC of the EIS).

- *Site preparation and construction phase and operations phases:* To promote the participation of local residents in the economic activities of the Project, multiple skill category/level training including on the job training will be provided.

- *Closure and post closure phase:* Training work experience and additional skills gained through involvement in the Project are expected to result in abilities that are transferrable to other economic sectors including forestry and manufacturing. This will be of value to Treasury and its employees for the life of mine and post-Closure.

- *Closure and post closure phase:* Many of the skills developed while working at Treasury will be transferrable to other mining operations and industries, should people either choose to move or be compelled to move following Closure and/or Post Closure. The skill building associated with the Project will thereby allow the region's economic base to take advantage of other future employment and business opportunities well beyond the life of the Project.

- *Post Closure:* The Project will help encourage other mineral development projects in the region, and enhance Dryden's economic role a support service and supply hub for other similar regional exploration and mining projects.

A listing of the mitigation measures for the economic factor VCs is provided in Table 6.18.5-1.

Table 6.18.5-1 Mitigation Measures Applicable to Economic Effects

Mitigation Measure Title	Mitigation Measure Description
Employment – local hiring policy	• Develop and implement employment practices that give preference to local and regional labour where possible, including Aboriginal and non-Aboriginal communities. The application of this policy is dependent upon the skills and workforce being available locally.
Purchasing – local purchasing policy	• Treasury will maintain, where applicable, a local purchasing policy to purchase goods and services from local suppliers. This policy has the expectation that goods and services will be purchased locally assuming price, delivery and service is competitive with outside suppliers.
Socio-economic Management Plan	• Plan to ensure socio-economic commitments are implemented, adverse socio-economic effects are minimized, positive effects are optimized, results are monitored, and effects are adaptively managed.
Education and training plans	• Develop training programs for unemployed and under employed resident and non-resident workers. • Training would be done through in-house programs and in conjunction with local and regional educational institutes. • Make educational attainment or the equivalent competencies a hiring requirement for the mine workers. • At closure, ensure ongoing training opportunities to help residents to increase their competitiveness and chances to get employment elsewhere.
In-migration effects	• Closely and frequently communicating with government agencies and service providers to ensure that the appropriate information (e.g. proposed transportation volumes, potential variation to the local population) are considered in the planning of future services and response capabilities. • Work with local and regional governments to minimize the effects of in-migration where possible.
Employment at closure	• Closure mitigation measures will focus on working with the affected communities and government agencies to develop a mine closure plan that includes a strategy for buffering the effects of eventually losing direct mine-related jobs and assist in the placement of potentially affected employees.

6.18.6 Residual Effects

The economic residual effects are described in Table 6.18.6-1. The economic effects associated with the Project will be occur to varying degrees across the socio-economic study area introduced in Section 6.1.4.17. There would not be a spatial pattern associated with the economic effects.

Table 6.18.6-1: Economic Residual Effects

Predicted Effect	Project Phase	Enhancement and Mitigation Measures	Residual Effect	Direction
The Project will affect labour income, change labour participation and change employment opportunities in the region.	Site preparation and construction Operations Closure and post-closure	Site Preparations and Construction and Operations: • Treasury will have policies for hiring and purchasing locally. • Treasury will purchase a majority of its goods and services locally and within the Province of Ontario • Treasury will offer training including on the job training. Closure and Post Closure: • Upon mine closure and loss of jobs, Treasury's employees will be able to utilize their experience and training skills gained from the Project in other economic sectors in the region including forestry and manufacturing.	Site Preparation and construction and Operations will create a demand for workers and increase in employment and labour income in the Project area. Closure and Post Closure will cause a reduction in Project area employment and labour income as Project employees are laid off.	Construction and Operations: Positive Closure and Post Closure: Negative
The Project will affect income levels in the region.	Site preparation and construction Operations Closure and post-closure	Construction and Operations: • Treasury will have policies for hiring and purchasing locally. • Treasury will purchase a majority of its goods and services locally and within the Province of Ontario • Treasury will offer training including on the job training. Closure and Post Closure: • Upon mine closure and loss of jobs, Treasury's employees will be able to utilize their experience and training skills gained from the Project in other economic sectors in the region including forestry and manufacturing	Site Preparation and Construction and Operations employment will Increase in labour income in the Project area. Closure and Post Closure and the reduction in Project employees will cause a reduction in labour income in the Project area	Construction and Operations: Positive Closure and Post Closure: Negative
The Project through employment and contacting opportunities will affect cost of living	Site preparation and construction Operations Closure and post-closure	Construction and Operations: • Treasury will have policies for hiring and purchasing locally. • Treasury will purchase a majority of its goods and services locally and within the Province of Ontario	During Site Preparation and Construction and Operations demand for labour, goods and services by the Project and by	Construction and Operations: Positive Closure and Post Closure: Neutral

Table 6.18.6-1: Economic Residual Effects (continued)

Predicted Effect	Project Phase	Enhancement and Mitigation Measures	Residual Effect	Direction
		• Treasury will offer training including on the job training. Closure and Post Closure: • Upon mine closure and loss of jobs, Treasury's employees will be able to utilize their experience and training skills gained from the Project in other economic sectors in the region including forestry and manufacturing	workers moving into the Project area will could increase prices and the cost of living. During Closure and Post Closure, the Project demand for labour, goods and services will decline and reduce the cost of living	
The Project through employment and contacting opportunities will affect real estate prices	Site preparation and construction Operations Closure and post-closure	Construction and Operations: • Treasury will have policies for hiring locally to the extent possible. Workers recruited from elsewhere and workers with additional income who like to improve their housing are expected to create additional demands for housing and therefore affect real estate prices. See additional discussion on housing and temporary housing capacity in the Social Factors. Closure and Post Closure: • Workers from outside the region may choose to leave and move elsewhere and sell their properties. This is a life style decision and its mitigation is beyond the control of the Project.	Site Preparation and Construction and Operations will cause workers to move into the Project area and cause an increase in the demand for housing At Closure and Post Closure former Project employees may move away from the area causing a reduction in demands for housing	Construction and Operations: Positive Closure and Post Closure: Neutral-Negative
The Project will change government taxes which will affect economic development in the region	Site preparation and construction Operations Closure and post-closure	Construction and Operations: • Treasury will have policies for hiring and purchasing locally. • Treasury will purchase a majority of its goods and services locally and within the Province of Ontario • Treasury will offer training, including on the job training. Closure and Post Closure:	During Site Preparation and Construction and Operations the Project employment, purchases and operation will increase in government taxes which could be used for local development	Construction and Operations: Positive Closure and Post Closure: Negative

Table 6.18.6-1: Economic Residual Effects (continued)

Predicted Effect	Project Phase	Enhancement and Mitigation Measures	Residual Effect	Direction
		• During Project closure and post closure, there will be a decrease in government revenues from the Project; but since this drop is expected after 12 of years of Project operations in the region and given market uncertainty it is hard to determine whether other projects will be proposed and or operational in the region to substitute that loss in government tax. This is driven by the market and is outside Project control.	At Closure and Post Closure, there will be reduction in government taxes and funds for local development as Project expenditures decrease.	
The Project, through employment and contacting opportunities, will affect existing businesses	Site preparation and construction Operations Closure and post-closure	Construction and Operations: • Treasury will have policies for hiring and purchasing locally. • Treasury will purchase a majority of its goods and services locally and within the Province of Ontario • Treasury will offer training, including on the job training. Closure and Post Closure: • During the Project's Closure and Post Closure, there will be a decrease in labour income, employment opportunities and Project purchase to goods and services; this may affect local businesses. However, Treasury's employees training work experience and additional skills gained through involvement in the Project are transferrable to other economic sectors and will benefit local businesses either directly or indirectly. Other factors that determine Project's Closure and Post Closure effects and required mitigation are driven by the market and are outside Treasury's control.	During Site Preparation and Construction and Operations, the Project will increase the Project area demand for goods and services from local businesses At Closure and Post Closure, there will be a reduction in Project demand for local goods and services	Construction and Operations: Positive Closure and Post Closure: Negative
The project through expenditures and employment will affect government revenues	Site preparation and construction Operations	Construction and Operations: • Treasury will have policies for hiring and purchasing locally.	During Site Preparation and Construction and Operations there will be an increase in government	Construction and Operations: Positive

Table 6.18.6-1: Economic Residual Effects (continued)

Predicted Effect	Project Phase	Enhancement and Mitigation Measures	Residual Effect	Direction
	Closure and post-closure	• Treasury will purchase a majority of its goods and services locally and within the Province of Ontario • Treasury will offer training including on the job training. • The above policies will maximize and enhance the Project's contribution to additional government revenues at the Federal, Provincial and Municipal level through both income and corporate tax. Closure and Post Closure: • During Project Closure and Post Closure, there will be a decrease in government revenues from the Project; but since this drop is expected after 12 of years of Project operations in the region and given market uncertainty it is hard to determine whether other projects will be proposed and or operational in the region to substitute that loss in government revenues. This is driven by the market and is outside Project control.	revenues through the payment of Project-related business and employment taxes At Closure and Post Closure, there will be a reduction in Project's contribution to government revenues due to reduced spending and employment	Closure and Post Closure: Negative

6.18.7 Information to Address Round 1 Information Requests

The following lists the Round 1 IRs related to the assessment of economic effects:

- CEA Agency
  - TMI_3-EA(1)-03: General VC and Assessment Criteria
  - TMI_227-PC(1) 42: Socio-economic Effects
  - TMI_230-HE(1)-37: General TML
- Métis Nation of Ontario
  - TMI_507-AC(1)-181: Socio-economic VC
- City of Dryden, Thunder Lake, and Village of Wabigoon residents
  - TMI_228-PC(1)-43: Socio-economic Effects
- Wabigoon Lake Ojibway Nation
  - TMI_348-AC(1)-22: Socio-economic Effects
  - TMI_728-PC(1)-43: Socio-economic Effects

6.19 Human Health

6.19.1 Potential Effects of the Project on the Environment

Treasury Metals are committed to ensuring the project is safe, and will not cause impact or harm to individuals working at the Project, or those who live in the vicinity of the Project. However, there will be activities throughout the life of the Project will alter the physical and biological environment in way that could have a potential effect on human health, especially those individuals who reside near to the Project, or consume country foods that may have been exposed to compounds released into the environment as a result of the Project activities. The following outlines the potential effects of the Project on human health by Project phase:

- **Site Preparation and Construction Phase**: During the site preparation and construction phase, activities equipment and activities at the Project will result in changes to noise levels and to air quality. A perimeter ditch and seepage collection system will be constructed around the operations area at the start of this phase will capture any runoff from the site. There will be no effects to surface water quality of groundwater quality during this phase of the Project.

- **Operations Phase**: Access to the site during operations would be restricted for safety and security reasons, so members of the public would not be directly affected by operations. During the operations phase, equipment and activities to support the mining will continue to affect noise levels and air quality. During operations, waste rock excavated from the open pit will be excavated and stored in the WRSA. As mining advances, waste rock will be stored in the mined out areas of the open pit to minimize the footprint of the WRSA. Waste from the ore processing will be treated to remove cyanide and will be discharged to the TSF sub-aqueously. The TSF will have a permanent cover of process throughout the operations phase. Both the WRSA and the TSF will be equipped with seepage collection systems. Any seepage that escapes the seepage collections systems would captures by the drawdown zone created by the dewatering of the open pit and underground mane and would be directed to the open pit. All runoff from the site will be collected and used in the processing of the ore. Any excess water not required in the process will be treated to meet the Provincial Water Quality Objectives (PWQO) prior to being discharged to Blackwater Creek. With the exception of nuisance animals, wildlife would be allowed to use the Project site during operations, where they would be able to access the TSF, and its cover of treated process water.

- **Closure Phase**: Following the end of mining activities, the process water covering the TSF will be withdrawn, treated and used to help fill the open pit. The tailings will be physically isolated with a granular cover and then chemically isolated using either a dry, low-permeability cover or a wet cover using non-process water. The WRSA will be covered with a dry, low-permeability cover to reduce the potential for acidification. The waste rock placed within the open pit will remain exposed until covered with water as the open pit is allowed to flood. Although the dewatering activities will be stopped at the end of mining, the drawdown zone created during operations will remain until through the closure phase, capturing any seepage from the WRSA and TSF and directing it to the open pit. Closure activities to return the site to a functioning ecosystem will affect noise levels and air quality throughout closure. There will be no discharges to surface water during closure as all runoff will be directing to the open pit to help with filling.

- **Post-closure Phase**: There will be no equipment operating during post-closure, so there will be no effects on noise levels or air quality. All site runoff will continue to be directed to the open pit, and the open pit will continue to experience an influx of groundwater. Once the pit is fully flooded, excess water will be released through a spillway into a tributary of Blackwater Creek, and the pit lake will start to function as a waterbody. Once the pit is flooded, groundwater levels will return to near pre-development conditions, allowing seepage from the TSF and WRSA to leave the site, and will ultimately report to various nearby waterbodies. For a period of time following closure, access to the site by people will continue to be restricted, but wildlife will be allowed unrestricted access to the site.

The potential effects of the Project on human health have been described using a simple linkage diagram on Figure 6.19.1-1. The figure illustrates the human health VCs (shown in blue on the figure) that are potentially affected during each phase of the Project.

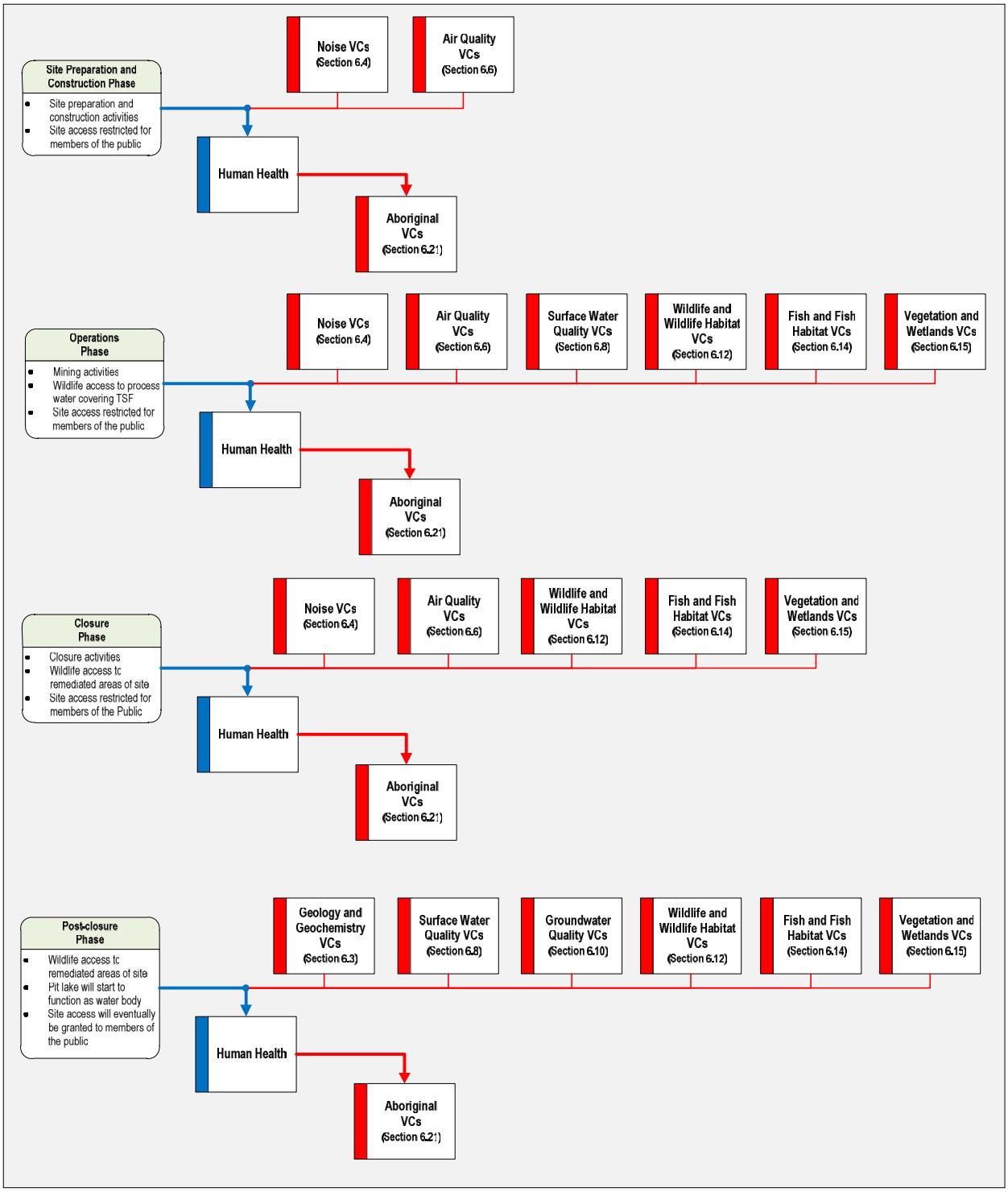


Figure 6.19.1-1: Human Health Linkage Diagram

The figure indicates those other components of the environment (shown in red in the figure) where the predicted effects of the Project on human health will be used as an input for determining the effects on other VCs. For example, human health will be used as an input for determining the effects of the Project on Aboriginal peoples. The human health VCs are affected by a range of other VCs throughout the life of the Project.

6.19.2 Effects Prediction Methods

The potential effects of the Project on human health were evaluated in the EIS by completing a screening level risk assessment, or SLRA. The results of the health risk assessment were provided as Appendix W to the EIS. An SLRA is intended to be an inherently conservative approach for calculating the potential effects of the Project, therefore the SLRA focussed on the operations and post-closure phases of the Project when the potential effects to human health are expected to be highest because of activity levels, expected releases, or potential higher exposures. The potential risks to human health during the site preparation and construction, and closure phases of the Project are expected to be similar to, but lower than the effects associated with the operations phase. To ensure the assessment was done appropriately, the consultants retained by Treasury Metals (TetraTech Inc.) approached Health Canada prior to completing the SLRA to obtain their recommendation on applicable guidance and spreadsheet models for evaluating risk to human health at a screening level. At that time, Health Canada provided the current “Spreadsheet Tool for Human Health Detailed Quantitative Risk Assessment” dated December 12, 2011, which has been used in this assessment.

The SLRA presented in Appendix W to the EIS focussed on the potential effects of the Project on human health as a result of the exposure to compounds generated, and released, as a result of the Project. The SLRA does not explicitly look at other determinants of health, such as social and economic, as these factors are addressed separately in Sections 6.17 and 6.18, respectively.

In the case of this SLRA completed as part of the EIS (Appendix W), the objective was to conduct a conservative, site-specific risk assessment to identify contaminants of concern (COCs) with the potential to cause adverse health effects to human and ecological receptors, based on understanding of the Project, the effects of the Project and the scenarios used to characterize the use of the land, and thus the likely levels of exposure. Risk assessments are a standardized process used to characterize potential adverse health effects of human and wildlife exposure to environmental hazards. The risk characterization is based on the estimated exposure and toxicity of COCs, and comparing the results a pre-determined the level of risk acceptability. The identification of risks above the level of acceptability does not mean that health effects will occur, but rather that predicted/modelled concentrations of parameters are sufficiently elevated to warrant further assessment.

Risk to human health can only occur if there are links between sources of exposure and human receptors, and if concentrations of the COCs are sufficiently high enough to cause risk. In other words, the following three elements are required:

- Sources of chemicals must be present;
- Receptors (e.g., humans, plants or animals) must be present; and
- Exposure pathways must exist between the source of the chemicals and the receptors.

In the absence of any one of the three elements (chemicals, exposure pathway or receptor), risks cannot occur. The initial step in the assessment is the problem formulation, which is used to review the COCs, and determine which are applicable to human health; to identify the ages and activities of the humans that would be present, and to identify the exposure pathways by which humans would come in contact with the COCs. The result of the problem formulation is a conceptual site model (CSM) of how humans might be exposed to COCs from the Project. Figure 6.19.1-2 provides a representation of the CSM for the operations phase, while Figure 6.19.1-3 illustrates the post-closure CSM.

6.19.2.1 Identify COCs

The following sources of potential COCs were identified as having the potential for the Project to affect human health:

- **Waste rock**: During the mining in the open pit, waste rock will be initially placed in the waste rock storage area (WRSA). Once practical, the waste rock will be placed in the mined out areas of the open pit. Following closures, the WRSA will be covered with a low permeability layer to isolate the waste rock and limit acidifications. This will then be covered with a layer of overburden and vegetated. The waste rock placed in the open pit will be covered with water when the open pit is allowed to flood.

- **Tailings**: During operations, tailings will be discharged with treated water from the process plant to the tailings storage facility (TSF), where they will be allowed to settle. During operations, a water cover will be maintained over the TSF to prevent acidification of the tailings. Following closure, the process water in the TSF will be withdrawn, treated and used to help fill the open pit. A granular layer will be placed over the TSF to physically isolate the tailings. The TSF will then be covered with either a low permeability synthetic cover, or a wet cover of non-process water.

- **Air and dust**: Activities at the Project during operations will generate particulate and gaseous emissions, which will affect the local air quality.

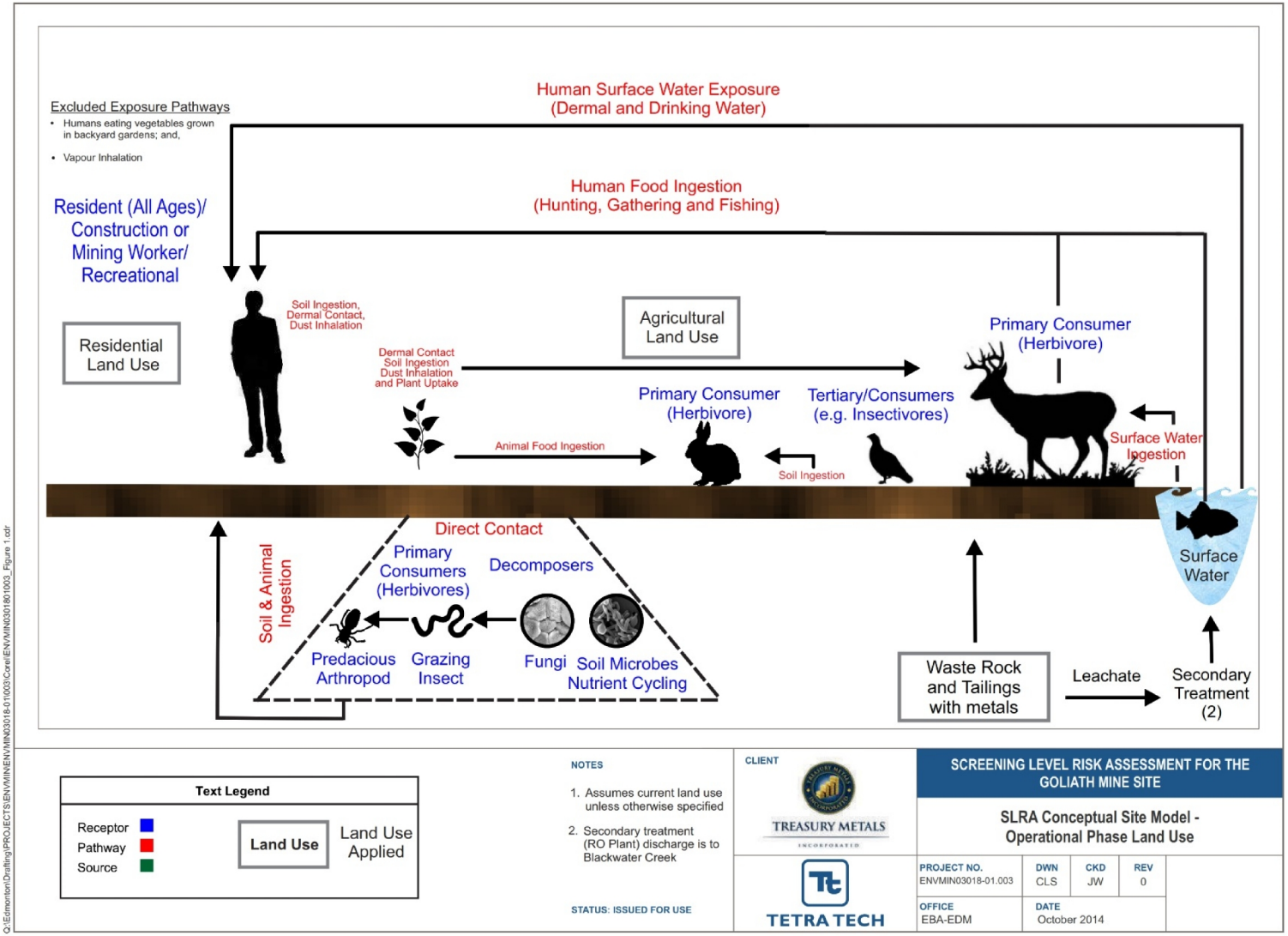


Figure 6.19.1-2: Conceptual Risk Model for Operations

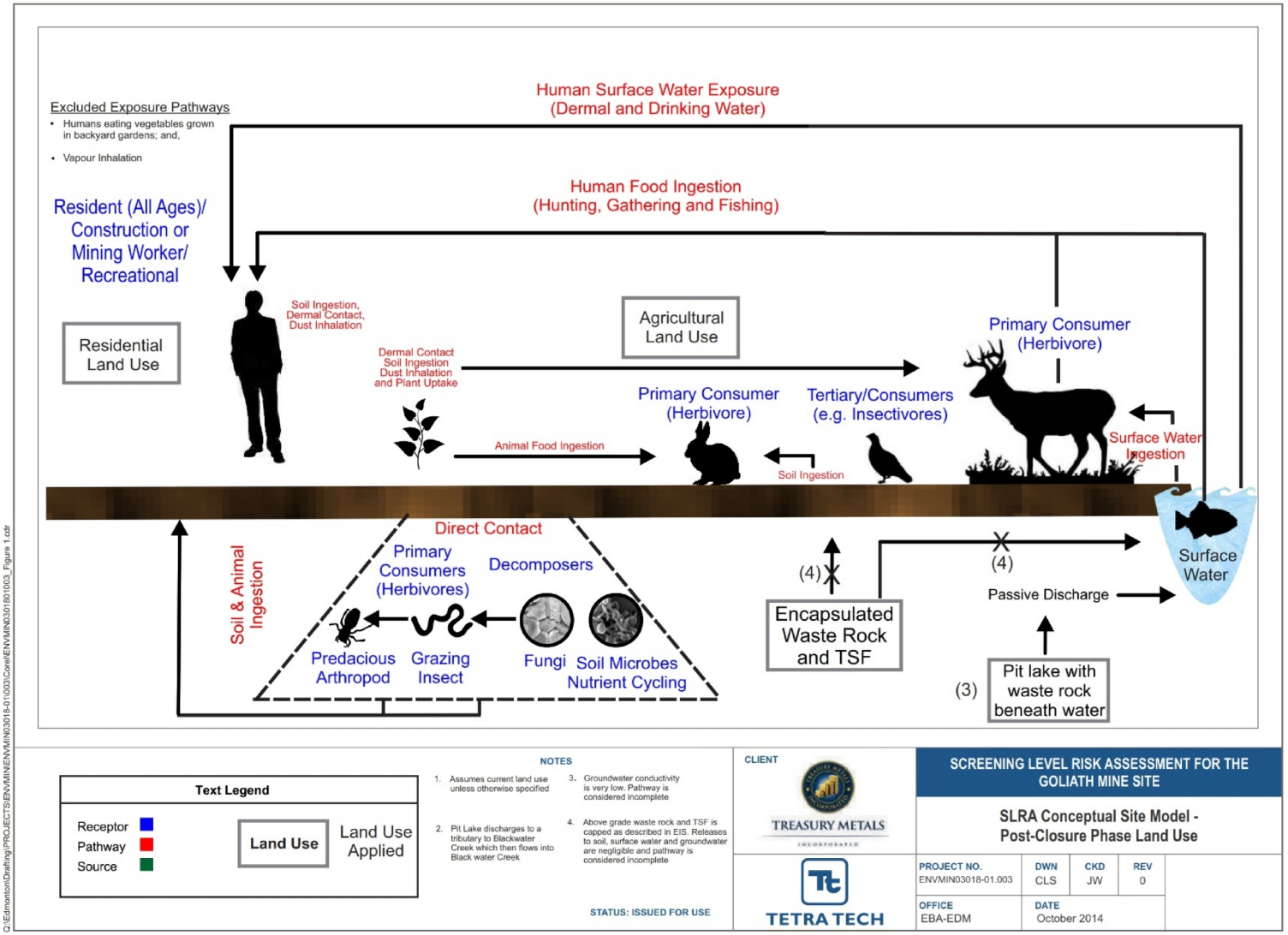


Figure 6.19.1-3: Conceptual Risk Model for Post-closure

- **Water**: During operations tailings and treater process water will be discharged to the TSF, where the tailings will settle and the process water will be partially recovered for re-use in the process. A cover of process water will be retained over the TSF throughout operations to prevent acidification. All minewater and runoff water within the operations area will be collected, and to the extent possible, used in the process. Excess water will be treated to meet Provincial Water Quality Objectives (PWQO), the Canadian Water Quality Guidelines (CWQG) when there are no PWQO, or background concentrations for the case of mercury. Dewatering of the open pit and underground mine will lower the groundwater elevations, creating a drawdown zone. Any seepage from the WRSA and TSF that escape the seepage collection systems will be captured in the drawdown zone and will be directed to the open pit. Then release of treated effluent into Blackwater Creek will affect the quality of water in Blackwater Creek, and further downstream in Wabigoon Lake.

  At closure, the dewatering of the open pit and underground mine will stop and the pit will be allowed to fill with water. The site will be graded to direct all runoff from the site towards the open pit. As the pit is filling, Treasury Metals will regularly test the quality of water and, if necessary, implement batch treatment to ensure that the quality of water in the pit lake will meet PWQO once filled. It is estimated to take between 5 and 8 years for the pit lake to fill, depending on weather conditions. Once the pit lake is filled, excess water will be allowed to passively discharge through a spillway into a former tributary of Blackwater Creek. Once the pit lake fills, and the groundwater elevations will recover to near pre-developments levels and seepage from the WRSA and TSF that escape the seepage collection systems will leave the site and discharge to surface watercourses around the Project. The passive discharges from the pit lake, and seepage from the TSF will affect the quality of water in Blackwater Creek, and further downstream in Wabigoon Lake. Seepage from the WRSA and TSF will affect the quality of water in Thunder Lake and its tributaries.

Waste Rock

The screening for potential COCs in the waste rock was provided in Table 1 of Appendix W, and the information is summarized in Table 6.19.2.1-1. The screening approach is as follows:

- If the concentrations of a compound in the waste rock is less than the mean concentrations in the mean baseline soils concentrations, the compound is not identified as a COC.

- If the concentration of a compound in the waste rock exceeds the mean baseline soils concentration, but is less than the screening guidelines, the compound is not identified as a COC.

- If the concentration of a compound in the waste rock exceeds the mean baseline soils concentration and one of the screening guidelines, the compound is identified as a COC.

Table 6.19.2.1-1: Screening for COCs in Waste Rock

Compound	Waste Rock				Baseline Soil Mean Concentration	Screening Guidelines (1)			
	Geometric Mean	Average	Minimum	Maximum		CCME SQG RL	CCME SQG AL	OMOE SCS (Table 2) RL	OMOE SCS (Table 2) AL
Aluminum	*12,047*	*14,713*	*3,175*	*38,665*	18,552	—	—	—	—
Antimony	—	—	—	—	<1	20	20	7.5	7.5
Arsenic	*7.06*	***13.85***	*0.55*	***92.25***	2.9	12	12	18	11
Barium	—	—	—	—	96	500	750	390	390
Beryllium	—	—	—	—	0.57	4	4	4	4
Bismuth	—	—	—	—	<1	—	—	—	—
Boron (total)	—	—	—	—	5.8	—	2	120	120
Cadmium	*0.14*	*0.74*	*0.02*	***22.60***	1.4	10	1.4	1.2	1
Calcium	—	—	—	—	12,780	-	-	-	-
Chromium (total)	*17.99*	*33.01*	*1.31*	***116.30***	48	64	64	160	160
Cobalt	***49.17***	***112.72***	*3.44*	***338.00***	9.9	50	40	22	22
Copper	*13.79*	*24.37*	*0.64*	***190.85***	20	63	63	140	140
Gallium	-	-	-	-	—	—	—	—	—
Iron	*15,408*	*17,453*	*5,055*	*45,270*	23,674	—	—	—	—
Lanthanum	-	-	-	-	—	—	—	—	—
Lead	*17.6*	***82.0***	*1.1*	***2,362.85***	8.1	140	70	120	45
Lithium	—	—	—	—	19	—	—	—	—
Magnesium	—	—	—	—	9435	—	—	—	—
Manganese	—	—	—	—	471	—	—	—	—
Mercury	-	*0.05*	*0.005*	***0.62***	0.11	6.6	6.6	0.27	0.25
Molybdenum	—	—	—	-	1.2	10	5	6.9	6.9
Nickel	*10.24*	*16.10*	*2.59*	***69.68***	27	50	50	100	100
Phosphorus	—	—	—	—	490	—	—	—	—
Potassium	—	—	—	—	2199	—	—	—	—
Scandium	—	—	—	—	—	—	—	—	—
Selenium	—	—	—	—	<1	1	1	2.4	2.4
Silver	*0.24*	*0.73*	*0.01*	*16.09*	0.26	20	20	20	20
Sodium	—	—	—	—	543	—	—	—	—
Strontium	—	—	—	—	36	—	—	—	—
Sulphur	—	—	—	—	—	—	—	—	—
Thallium	*0.24*	*0.28*	*0.05*	*0.65*	<0.5	1	1	1	1

Compound	Waste Rock				Baseline Soil Mean Concentration	Screening Guidelines (1)			
	Geometric Mean	Average	Minimum	Maximum		CCME SQG RL	CCME SQG AL	OMOE SCS (Table 2) RL	OMOE SCS (Table 2) AL
Thorium	—	—	—	—	—	—	—	—	—
Tin	—	—	—	—	<5	50	5	—	—
Titanium	—	—	—	—	1,354	—	—	—	—
Tungsten	—	—	—	—	—	—	—	—	—
Uranium	*0.52*	*0.75*	*0.13*	*2.96*	1	23	23	23	23
Vanadium	*12.2*	*16.5*	*1.2*	*52.5*	49	130	130	86	86
Zinc	*94.3*	***305.3***	*24.3*	***9,414.9***	56	200	200	340	340

Notes:

All values presented in mg/kg - milligrams per kilograms
'—' no guideline available or not analysed
COC - Contaminant of Concern
Waste Rock results from Table 3.1 from EcoMetrix Geochemistry draft report (Sept, 2013), except for Mercury. Calculated totals using 15% MSS, 70% BMS and 15% MSED as stated in EcoMetrix Geochemistry draft report (Sept, 2013). Mercury Waste Rock results from Table 7.10 from KCB draft report (2012). Calculated totals using 15% MSS, 70% BMS and 15% MSED.
Background soil results from Table 6.7 from KCB report Baseline Study Nov 2010 to Nov 2011, Dated September 2012 (25 samples used).
CCME SQG- Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (PEHH) by Canadian Council of Ministers of the Environment (CCME), 2007, revised 2010.
OMOE SCS (Generic) - Ontario Ministry of Environment, Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. Full Depth Generic Site Condition Standards in a Potable Ground Water Condition
(1) Values represent most stringent human health or ecological screening value available from given source.
Shade and Italics: Exceeds Background
Shade and Bold: Exceeds a Guideline

As described in Table D in Appendix W, aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, lead, mercury, nickel and zinc were identified as COCs in waste rock for the operations phase. Antimony was not specifically identified in the text, but did exceed one of the screening guidelines. However, this omission would not have altered the assessment completed or the results of the risk assessment (TMI_210-(HE)-17). There were no COCs identified during the post-closure because the waste rock in the WRSA will be covered by a low permeability cover and then a cover of overburden. The waste rock disposed of in the open pit will be isolated by a cover of water once the pit is flooded.

Tailings

The screening for potential COCs in the tailings was provided in Table 2 of Appendix W, and the information is summarized in Table 6.19.2.1-2. The screening approach is as follows:

- If the concentrations of a compound in the tailings is less than the mean concentrations in the mean baseline soils concentrations, the compound is not identified as a COC.
- If the concentration of a compound in the tailings exceeds the mean baseline soils concentration, but is less than the screening guidelines, the compound is not identified as a COC.
- If the concentration of a compound in the tailings exceeds the mean baseline soils concentration and one of the screening guidelines, the compound is identified as a COC.

Table 6.19.2.1-2: Screening for COCs in Tailings

Compound	Tailings Composite	Baseline Soil Mean Concentration	Screening Guidelines (1)			
			CCME SQG RL	CCME SQG AL	OMOE SCS (Table 2) RL	OMOE SCS (Table 2) AL
Aluminum	5,000	18,552	—	—	—	—
Antimony	11	<1	20	20	7.5	7.5
Arsenic	**46**	2.9	12	12	18	11
Barium	—	96	500	750	390	390
Beryllium	—	0.57	4	4	4	4
Bismuth	—	<1	—	—	—	—
Boron (total)	—	5.8	—	2	120	120
Cadmium	**5.3**	1.4	10	1.4	1.2	1
Calcium	—	12,780	-	-	-	-
Chromium (total)	9.6	48	64	64	160	160
Cobalt	11	9.9	50	40	22	22
Copper	**81**	20	63	63	140	140
Gallium	—	—	—	—	—	—
Iron	19,000	23,674	—	—	—	—
Lanthanum	—	—	—	—	—	—
Lead	**870**	8.1	140	70	120	45
Lithium	—	19	—	—	—	—

Table 6.19.2.1-2: Screening for COCs in Tailings (continued)

Compound	Tailings Composite	Baseline Soil Mean Concentration	Screening Guidelines (1)			
			CCME SQG RL	CCME SQG AL	OMOE SCS (Table 2) RL	OMOE SCS (Table 2) AL
Magnesium	—	9435	—	—	—	—
Manganese	—	471	—	—	—	—
Mercury	**0.62**	0.11	6.6	6.6	0.27	0.25
Molybdenum	—	1.2	10	5	6.9	6.9
Nickel	14	27	50	50	100	100
Phosphorus	—	490	—	—	—	—
Potassium	—	2199	—	—	—	—
Scandium	—	—	—	—	—	—
Selenium	—	<1	1	1	2.4	2.4
Silver	3.4	0.26	20	20	20	20
Sodium	—	543	—	—	—	—
Strontium	—	36	—	—	—	—
Sulphur	—	—	—	—	—	—
Thallium	0.17	<0.5	1	1	1	1
Thorium	—	—	—	—	—	—
Tin	—	<5	50	5	—	—
Titanium	—	1,354	—	—	—	—
Tungsten	—	—	—	—	—	—
Uranium	0.46	1	23	23	23	23
Vanadium	6.0	49	130	130	86	86
Zinc	**2,000**	56	200	200	340	340
Zirconium	—	—	—	—	—	—

Notes:
All values presented in mg/kg - milligrams per kilograms.
'-' no guideline available or not analysed
COC - Contaminant of Concern
Waste Rock results from Table 3.1 from EcoMetrix Geochemistry draft report (Sept, 2013), except for Mercury. Calculated totals using 15% MSS, 70% BMS and 15% MSED as stated in EcoMetrix Geochemistry draft report (Sept, 2013). Mercury Waste Rock results from Table 7.10 from KCB draft report (2012). Calculated totals using 15% MSS, 70% BMS and 15% MSED.
Background soil results from Table 6.7 from KCB report Baseline Study Nov 2010 to Nov 2011, Dated September 2012 (25 samples used).
CCME SQG- Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (PEHH) by Canadian Council of Ministers of the Environment (CCME), 2007, revised 2010.
OMOE SCS (Generic) - Ontario Ministry of Environment, Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act. Full Depth Generic Site Condition Standards in a Potable Ground Water Condition
(1) Values represent most stringent human health or ecological screening value available from given source.
Shade and Italics: Exceeds Background
Shade and Bold: Exceeds a Guideline

As described in Table D in Appendix W, arsenic, cadmium, cobalt, copper, lead, mercury and zinc were identified as COCs in tailings for the operations phase. Antimony was not specifically identified in the text, but did exceed one of the screening guidelines. However, this omission would not have altered the results of the risk assessment (TMI_210-(HE)-17). There were no COCs identified during the post-closure because the tailings would be covered during the post-closure phase. The following two options are being considered for the closure of the TSF:

- The dry cover option assumes that the process water in the TSF will be withdrawn at closure, treated and used to help fill the pit. The tailings will then be physically isolated

using a granular cover. Finally, the tailings will be covered with a low-permeability dry cover to limit the potential for acidification.

- The wet cover option assumes that the process water in the TSF will be withdrawn at closure, treated and used to help fill the pit. The tailings will then be physically isolated using a granular cover. Finally, the tailings will be isolated from oxygen using a cover of non-process water to prevent acidification.

Air and Dust

The screening for potential COCs in the dust, which also air concentrations associated with gaseous emissions was provided in Table 3 of Appendix W. A refined screening of the air compounds has been provided Table 6.19.2.1-3. The refined screening approach presents the maximum of the concentrations predicted at the identified sensitive receptors near the Project, which represents the maximum predicted effects at the closest "community-oriented receptors" as defined by the CCME (2000). Only the cumulative concentrations (including background, as per TMI_213-HE(1)-20), for 24-hour TSP and 24-hour PM_{10} exceed the screening criteria. Therefore both were identified as COCs for the operations phase. There will be no sources of air emissions during the post-closure phase.

Table 6.19.2.1-3: Screening for COCs in Air and Dust

Compound	Averaging Period	Maximum at Sensitive Receptors			Screening Criteria (5)
		Modelled Prediction	Background (1)(2)	Cumulative Prediction	
TSP	24-hour	258.2	33.0	**291.2**	120
	Annual	42.4	14.0	56.4	60
PM_{10}	24-hour	70.8	15.0	**85.8**	50
$PM_{2.5}$	24-hour	15.6	10.0	25.6	27
	Annual	2.7	4.3	7.0	8.8
Dustfall (3)	30 day	4.1	— (4)	4.1	7
	Annual	3.2	—	3.2	4.6
CO	1-hour	167.4	1,248.0	1415.4	36,200
	8-hour (4)	93.5	1,248.0	1341.5	15,700
NO_2	1-hour	187.7	33.0	220.7	400
	24-hour	108.7	33.0	141.7	200
SO_2	1-hour	1.5117	4.0	5.5117	690
	24-hour	0.2400	4.0	4.2400	275
	Annual	0.0278	1.0	1.0278	55
Arsenic	24-hour	0.0146	0.00	0.0156	0.3
Barium	24-hour	0.1705	—	0.1705	10
Beryllium	24-hour	0.0009	—	0.0009	0.1
Cadmium	24-hour	0.0016	—	0.0016	0.025
Chromium	24-hour	0.0527	0.005	0.0577	0.1
Cobalt	24-hour	0.0041	—	0.0041	0.5
Lead	24-hour	0.1079	0.005	0.1129	0.5
Manganese	24-hour	0.1955	0.019	0.2145	0.4
Nickel	24-hour	0.0139	—	0.0139	0.2

Table 6.19.2.1-3: Screening for COCs in Air and Dust (continued)

Compound	Averaging Period	Maximum at Sensitive Receptors			Screening Criteria (5)
		Modelled Prediction	Background (1)(2)	Cumulative Prediction	
	Annual	0.0019	—	0.0019	0.04
Phosphorous	24-hour	0.1796	—	0.1796	0.35 (2)
Platinum	24-hour	0.0069	—	0.0069	0.03
Rhodium	24-hour	0.0022	—	0.0022	2
Thallium	24-hour	0.0059	—	0.0059	0.4 (2)
Titanium	24-hour	0.6274	—	0.6274	0.2
Uranium	24-hour	0.0036	—	0.0036	0.3
	Annual	0.0005	—	0.0005	0.06
Vanadium	24-hour	0.0165	—	0.0165	0.24

Notes:

(1) The 1-hour, ½-hour, and 24-hour background values were based on 90th percentile of the monitoring data. The annual background values were based on the highest of the annual mean value over the latest 5 years of available monitoring data.
(2) Background metals per TMI_163-AE(1)-01.
(3) Predicted dustfall values are in units of g/m²/30 days.
(4) The "—" in the table indicates that background values were not available for the compound.
(5) The screening criteria are based on the relevant Ontario Ambient Air Quality Objectives, with the exception of $PM_{2.5}$. The Canadian Ambient Air Quality Standards for $PM_{2.5}$ will be reduced to 27 (24-hour) and 8.8 (annual) after 2020.

Shade and Bold: Exceeds screening criteria and identified as a COC

Water

The screening for potential COCs in the water associated with the Project was done in Tables 5 and 6 of Appendix W. This screening made use of the water quality information available in the EIS. Since the submission of the EIS, Treasury Metals have refined their engineering for the Project, which has resulted in changes in the site water balance and corresponding changes in the water quality predictions. The refined water quality predictions for the pit lake are provided in Section 6.2 of this Revised EIS, while the surface water predictions are provided in Section 6.7. These refined water quality numbers have been used to screen for COCs in surface water, using the following approach:

- If the modelled concentrations of a compound in the receiving water is less than or equal to the existing conditions, the compound is not identified as a COC.

- If the concentration of a compound in the receiving water exceeds the existing conditions, but is less than the screening guidelines, the compound is not identified as a COC. For surface water, the Provincial Water Quality Objectives (PWQO) for the protection of aquatic life are used. Where PWQO are not available, the Canadian Water Quality Guidelines (CWQG) are used as screening criteria.

- If the concentration of a compound in the receiving water exceed the existing conditions and exceed the screening criteria, the compound is identified as a COC.

The screening criteria used are established to be protective of sensitive aquatic receptors, and are more stringent that the requirements for drinking water or recreational uses. Therefore, only

one set of water quality screening is required for each phase of the Project. During the operations phase, the only releases from the Project to surface water will be the excess water from the site that will be treated to meet PWQO prior to discharge to Blackwater Creek through an engineered structure. Therefore, only water in Blackwater Creek downstream of the Project, as well as Wabigoon Lake into which Blackwater Creek discharges could be affected. The predicted operation phase surface water quality for the two modelling locations on Blackwater Creek downstream of the Project discharge (see Section 6.8), as well as Wabigoon Lake are provided in Table 6.19.2.1-4. There were no COCs identified for surface water during operations, as all of the predicted concentrations are either less than or equal to the existing conditions or meet the screening criteria, which are based on the PWQO and CWQG.

Table 6.19.2.1-4: Operations Phase Surface Water Predictions

Compound	Predicted Surface Water Concentrations (mg/L) (1)						Screening Criteria (2) (mg/L)
	BW1: Blackwater Creek (downstream of Project)		BW2: Blackwater Creek (discharge to Wabigoon Lake)		WL: Wabigoon Lake (mg/L)		
	Existing	Operations	Existing	Operations	Existing	Operations	
Aluminum	0.251	0.214	0.251	0.228	0.669	0.668	0.075
Antimony	0.00060	*0.0047*(3)	0.00060	*0.0032*	0.00060	0.00062	0.020
Arsenic	0.0010	*0.022*	0.0010	*0.014*	0.001	*0.001*	0.100
Beryllium	0.001	*0.003*	0.001	*0.002*	0.001	0.001	0.011
Boron	0.050	*0.081*	0.050	*0.070*	0.050	0.050	0.200
Cadmium	0.00002	*0.0001*	0.00002	*0.00004*	0.00002	0.00002	0.0002
Chloride	1	*26*	1	*17*	3.23	3.36	120
Chromium	0.0010	*0.003*	0.0010	*0.002*	0.0010	0.001	0.0089
Cobalt	0.0006	*0.0006*	0.0006	*0.0006*	0.0005	0.0005	0.0009
Copper	0.0012	*0.0020*	0.0012	*0.0017*	0.002	0.002	0.005
Cyanide	0.002	*0.003*	0.0020	*0.0024*	0.002	0.002	0.005
Iron	1.450	1.209	1.450	1.297	0.457	0.456	0.300
Lead	0.001	*0.002*	0.001	*0.002*	0.001	0.001	0.020
Mercury	0.00001	*0.00001*	0.00001	*0.00001*	0.00001	0.00001	0.0002
Molybdenum	0.0010	*0.0092*	0.0010	*0.0062*	0.001	0.001	0.040
Nickel	0.0020	*0.0068*	0.0020	*0.0051*	0.002	0.002	0.025
Nitrate	0.03	*3*	0.03	*2*	0.03	0.04	13
Phosphorus	0.027	0.027	0.027	0.027	0.023	0.023	0.030
Selenium	0.001	*0.022*	0.001	*0.014*	0.001	0.001	0.100
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.0012	*0.0022*	0.001	*0.002*	0.001	0.001	0.006
Zinc	0.004	*0.010*	0.004	*0.008*	0.003	0.003	0.030

Notes:
(1) Predictions in the above table represent predictions for the average hydrologic year.
(2) The Provincial Water Quality Objectives (PWQO) for protecting aquatic life are used as screening criteria, where available. The Canadian Water Quality Guidelines (CWQG) for protecting aquatic life are used for nitrate and chloride, for which there are no PWQO.
(3) The *italicized* values in the above table indicate those parameters where the predictions exceed existing levels.
The **Shaded and Bold** values in table indicates where the predicted levels exceed both existing conditions and the screening criteria.

The predicted post-closure phase water quality predications are provided in Table 6.19.2.1-5 (pit lake quality, Blackwater Creek and Wabigoon Lake) and Table 6.19.2.1-6 (Thunder Lake and its tributaries). There were no COCs identified for surface water during post-closure phase, as all of the predicted concentrations are either less than or equal to the existing conditions or meet the screening criteria, which are based on the PWQO and CWQG. The modelling of pit lake quality (Section 6.3) and surface water quality (Section 6.8) include the contributions of seepage from the WRSA and TSF.

As described in Section 4.2.2 of Appendix W to the EIS, only mercury and lead were identified as the only human health COCs requiring evaluation in the SLRA, for the following reasons:

- **Lead**: The maximum lead concentration in the waste rock exceeded all of the federal or provincial regulatory criteria derived for the protection of human health for waste rock, and the average waste rock concentration exceeded the Residential Land Use (RL) standards. Lead also exceeded all of the federal or provincial regulatory criteria for tailings.

- **Mercury**: The maximum mercury concentration exceeded the provincial regulatory criteria derived for the protection of human health for waste rock. Mercury concentrations in tailings were not available to include in the SLRA. Therefore mercury concentrations in waste rock were used to represent mercury concentrations in tailings. Because the air quality modelling did not predict mercury concentrations directly, exposure to mercury in dust was on the TSP and PM_{10} (Table 6.17.2-3) predictions and the concentrations in waste rock.

  Mercury was also selected as a COC due to its bio-accumulative properties. Mercury and lead are both neurotoxins so these COCs may be of particular interest to the community and as a public health concern.

6.19.2.2 Toxicity Assessment

The toxicity assessment involves identification of the potentially toxic effects of the COCs and the determination of the amount of the COCs that can be taken into the body without experiencing adverse health effects. This value is called a toxicity reference value (TRV). For chemicals that do not cause cancer (i.e., non-carcinogenic), there is a threshold exposure level below which no observable adverse health effects occur. Above the threshold, adverse health effects may occur, and can increase in severity with increasing exposure to the substance.

For chemicals that can cause cancer (carcinogens), a non-threshold TRV is considered applicable. Even at low doses, carcinogenic compounds pose some risk of genetic damage. In order to establish whether the identified COCs are carcinogenic or not, the authors of Appendix W to the EIS (Section 4.4) reviewed the available literature and determined that both lead and mercury would be assessed as a non-carcinogenic. The default TRV values for lead and mercury provided in the DQRA model (HC, 2011b) were used in the risk assessment. These TRV are listed in Table 6.19.2.2-1.

Table 6.19.2.1-5: Post-closure Phase Water Predictions for Blackwater Creek Catchment

Compound	Predicted Surface Water Concentrations (mg/L) [1]							Screening Criteria [2] (mg/L)
	Post-closure Pit Lake Quality	BW1: Blackwater Creek (downstream of Project)		BW2: Blackwater Creek (discharge to Wabigoon Lake)		WL: Wabigoon Lake (mg/L)		
		Existing	Post-closure	Existing	Post-closure	Existing	Post-closure	
Aluminum	*0.075*	0.251	0.198	0.251	0.217	0.669	0.668	0.075
Antimony	*0.0011*	0.00060	*0.00075*	0.00060	*0.00070*	0.00060	0.00060	0.020
Arsenic	*0.0015*	0.0010	*0.0012*	0.0010	*0.0011*	0.001	0.001	0.100
Beryllium	*0.0011*	0.001	0.001	0.001	0.001	0.001	0.001	0.011
Boron	*0.055*	0.050	0.052	0.050	0.051	0.050	0.050	0.200
Cadmium	*0.00009*	0.00002	*0.00004*	0.00002	*0.00003*	0.00002	0.00002	0.0002
Chloride	‡	1	*36*	1	*24*	3.23	—	120
Chromium	*0.0010*	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0089
Cobalt	*0.00090*	0.0006	*0.001*	0.0006	*0.001*	0.0005	0.0005	0.0009
Copper	*0.004*	0.0012	*0.002*	0.0012	*0.002*	0.002	0.002	0.005
Cyanide	‡	0.002	*0.003*	0.0020	*0.003*	0.002	0.002	0.005
Iron	*0.30*	1.450	1.105	1.450	1.226	0.457	0.456	0.300
Lead	*0.0029*	0.001	*0.002*	0.001	0.001	0.001	0.001	0.020
Mercury	*0.00002*	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0002
Molybdenum	*0.0011*	0.0010	0.001	0.0010	0.001	0.001	0.001	0.040
Nickel	*0.025*	0.0020	0.009	0.0020	0.006	0.002	0.002	0.025
Nitrate	‡	0.03	*3.84*	0.03	*2.50*	0.03	*0.05*	13
Phosphorus	‡	0.027	‡	0.027	‡	0.023	‡	0.030
Selenium	*0.0010*	0.001	0.001	0.001	0.001	0.001	0.001	0.100
Silver	*0.00010*	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	*0.00030*	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	*0.0050*	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	*0.0011*	0.0012	0.001	0.001	0.001	0.001	0.001	0.006
Zinc	*0.030*	0.004	0.01	0.004	*0.009*	0.003	0.003	0.030

Notes:
(1) Predictions in the above table represent predictions for the average hydrologic year
(2) PWQO, and CWQG for nitrate and chloride
(3) The *italicized* values the predictions exceed existing levels
The **Shaded and Bold** values exceed both existing conditions and the screening criteria

Table 6.19.2.1-7: Post-closure Phase Water Predictions for Thunder Lake Catchment

Compound	Predicted Surface Water Concentrations (mg/L) (1)								Screening Criteria (2) (mg/L)
	HB1: Hoffstrom's Bay Tributary (at Thunder Lake)		TL2: Thunder Lake Tributary 3 (downstream of Tree Nursery Ponds)		TL3: Thunder Lake Tributary 2 (at Thunder Lake)		TL: Thunder Lake		
	Existing	Post-closure	Existing	Post-closure	Existing	Post-closure	Existing	Post-closure	
Aluminum	0.078	0.078	0.077	0.077	0.077	0.077	0.026	0.029	0.075
Antimony	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.00060	0.020
Arsenic	0.0010	0.0010	0.0010	0.001	0.001	0.0010	0.0010	0.001	0.100
Beryllium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.011
Boron	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.200
Cadmium	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.0002
Chloride	0.4	*0.5*	0.3	*0.3*	0.3	*0.3*	4	‡	120
Chromium	0.0010	0.0010	0.0010	0.0010	0.001	0.0010	0.0010	0.0010	0.0089
Cobalt	0.0005	0.001	0.0005	0.0005	0.0005	0.001	0.0005	0.0005	0.0009
Copper	0.0010	0.001	0.0010	0.001	0.0010	0.001	0.001	0.001	0.005
Cyanide	0.0020	0.002	0.0020	0.002	0.0020	0.002	0.002	0.002	0.005
Iron	0.365	0.364	0.862	0.859	0.862	0.861	0.150	*0.158*	0.300
Lead	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.020
Mercury	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0002
Molybdenum	0.0010	0.001	0.0010	0.001	0.001	0.001	0.001	0.001	0.040
Nickel	0.0020	0.0020	0.0020	0.002	0.0020	0.002	0.002	0.002	0.025
Nitrate	0.1	0.1	0.1	0.1	0.1	0.1	0.04	0.04	13
Phosphorus	0.011	‡	0.011	‡	0.011	‡	0.008	‡	0.030
Selenium	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.100
Silver	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Thallium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Uranium	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Vanadium	0.0010	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.006
Zinc	0.0030	0.003	0.0030	0.003	0.0030	0.003	0.003	0.003	0.030

Notes:
(1) Predictions in the above table represent predictions for the average hydrologic year
(2) PWQO, and CWQG for nitrate and chloride
(3) The *italicized* values the predictions exceed existing levels
The **Shaded and Bold** values exceed both existing conditions and the screening criteria

Table 6.18.2.2-1: Toxicity Reference Values (TRVs) used in Health Assessment

Identified COC	TRV Toddler (µg/kg bw/d)	TRV Adult (µg/kg bw/d)	Identified Critical Effects	Reference
Mercury	0.0003	0.0003	The central nervous system is probably the most sensitive target for elemental mercury vapour exposure (ICPS Inchem 2003). Mercury is lipophilic and is therefore will bioaccumulate and biomagnify within a food chain.	HC, 2011b
Lead	0.0036	0.0036	Behavioural and learning disabilities in children (Health Canada 2012). Systolic blood pressure increases in adults (Health Canada 2012).	HC, 2011b

6.19.2.3 Exposure Scenarios

Appendix W to the EIS identified the following exposure scenarios:

- Resident or First Nation resident (operations);
- Recreational user (operations); and
- Country foods assessment (operations and post-closure).

For the resident and recreational user scenarios, the primary pathway of exposure would be via the COCs transported off-site with dust. As access to the site will be limited for safety and security reasons, other exposure pathways are not viable. For the country foods assessment, the wildlife are assumed to have free access to the site and consume a large portion of their food from areas of the site that contain COCs (i.e., TSF and WRSA). This is conservative assessment because both the WRSA and TSF will be capped at the end of mining operations. In the case of the WRSA, a low permeability layer will be placed over the waste to isolate it from oxygen and limit acidification. The low permeability cover will then be covered with a layer of overburden and vegetated. In the case of eh TSF, the process water will be withdrawn at eh end of operations, treated, and used to help fill the open pit. The tailings will then be covered by a granular layer to physically isolate the tailings. The tailings will then be isolated using either a dry cover with a low permeability layer covered with soil and vegetated, or a wet cove with non-process water.

The details of the inputs used in the DQRA model (HC, 2011b) are detailed in Appendix W to the EIS.

The DRQ is limited to dust for the operations phase, and one exposure scenario for the post-closure phase. The toxicity assessment involves identification of the potentially toxic effects of the COCs and the determination of the amount of the COCs that can be taken into the body without experiencing adverse health effects. This value is called a Toxicity Reference Value (TRV). For chemicals that do not cause cancer (i.e., non-carcinogenic), there is a threshold exposure level below which no observable adverse health effects occur. Above the threshold,

adverse health effects may occur, and can increase in severity with increasing exposure to the substance.

The Health Canada spreadsheet tool for Human Health Detailed Quantitative Risk Assessment (DQRA) (Version: December 2011) was used to calculate the exposures and associated hazard quotients. Typically, worked examples of the calculations incorporated in the models are not provided in report (as was the case in Appendix W to the EIS), but in response to a question during the Round 1 information requests (TMI_218-(HE)-25), a worked example is provided below:

1. **Concentration of lead in plant tissue:**

   $C_{plant} = C_{soil} \times TF \times DTW$

   Where:

   C_{plant} = Concentration in plant tissue (mg/kg)

   C_{soil} = Concentration in soil (mg/kg) – 870 mg/mg

   TF = Transfer factor - vegetative tissue 0.0049; root/berry 0.0015

   DTW = Dry-to-wet weight conversion – vegetative 0.126; root/berry 0.222

   $C_{root/berry} = 870 \times 0.0015 \times 0.222 = 0.289$

   $C_{veg} = 870 \times 0.0049 \times 0.126 = 0.537$

2. **Exposure adjusted plant tissue concentration**

   $C_{plant(adjst)} = C_{plant}$ x area of tailings & waste rock/total area available for harvesting

   Area of tailings & waste rock = 125 ha

   Total area available for harvesting = 6341 ha

   $C_{root/berry(adjst)} = 0.289 \times 125/6341 = 0.0057$ mg/kg wet weight

   $C_{veg(adst)} = 0.537 \times 125/6341 = 0.016$ mg/kg wet weight

3. **Human Exposure from Consumption of Plant Tissue (Toddler)**

   Intake = $C_{plant(adst)}$ x FIR / BW / 1000g/kg

   Where:

BW = Body Weight = 16.5 kg

FIR = Food Ingestion Rate – root veg = 105 g/d

FIR = Food Ingestion – other veg = 67 g/d

Intake = ((0.0057 mg/kg x 105 g/d) + (0.016 mg/kg x 67 g/d))/16.5 kg/1000 g/kg

Intake = 7.95E-05 mg/kg-d

4. **Hazard Quotient – consumption of vegetation**

HQ = intake/TRV

HQ = 7.95E-05/0.0036

HQ = 0.022 (oral - for consumption of plants; total oral HQ is the sum of all relevant exposure pathways).

6.19.3 Project Effects Avoidance Measures Used in Predictions

Most of the mitigation measures used to reduce the effects of the Project on the environment will have a benefit in reducing or avoiding the effects of the Project on human health. Some of the more notable avoidance measures are as follows:

- Prior to operations, a perimeter ditch and seepage collection system will be established to collect all of the runoff from the operations area.
- At closure, remediate and cover the WRSA in a manner that limits the potential for acidification while presenting a natural looking feature when viewed from Thunder Lake.
- The PAG waste rock would be placed in the mined out areas of the open pit, to the extent practical, to minimize the volume of PAG material in the waste rock storage area (WRSA).
- During operations, a water cover will be maintained over the tailings within the TSF to prevent the onset of acidification.
- As part of the closure activities, the WRSA will be covered with a low permeability cover to isolate the waste rock and reduce the potential for acidification.
- At closure, the open pit will be allowed to flood, isolating the exposed mine faces and the waste rock placed underneath a static cover of water to prevent acidification.

- At closure the process water will be withdrawn from the TSF, treated and used to help fill the open pit. The tailings within the TSF will be isolated using either a low permeability dry cover, or a wet cover of non-process water.

- The dry cover option where the tailings will be covered with a low-permeability dry cover to limit the potential for acidification.

- The wet cover option where the tailings will be isolated from oxygen using a cover of non-process water to prevent acidification.

- The pit lake will be monitored as it is filling to determine whether treatment will be required to meet PWQO prior the discharge of water from the pit lake to a tributary of Blackwater Creek.

- Perimeter runoff and seepage collection systems will be constructed around the WRSA, TSF, and overburden stockpiles.

- Ensure that all internal combustion engines are properly maintained and all emission control systems (e.g., diesel particulate filters) are in good working order.

- Water and chemical suppressants will be used for dust control on the haul roads is used at the mine site, when temperatures are above freezing. The watering program requires dedicated watering equipment, and enough water must be available and applied to off-set evaporation and maintain a wetted road surface. This program would also be supplemented with applications of an approved dust suppressant as required to minimize fugitive dust emissions.

- Best management practices plan for dust control will be implemented on the site during site preparation and construction, operations and closure.

- Seepage that escapes the seepage collection systems will be captured by the drawdown zone caused by the dewatering of the open pit and underground mine, and will report to the open pit. The drawdown zone will last until groundwater levels recover to near pre-development conditions in the post-closure phase.

- All surface water runoff collected from within the Project operations area will be treated to concentrations that meet Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, prior to discharging to Blackwater Creek. In the case of mercury, effluent will be treated to meet the background concentrations in Blackwater Creek (operations phase).

- Industry standard erosion and sediment controls will be implemented during the site preparations and construction phase.

- There will be no discharges to surface water during the site preparation and construction and closure phases

- The floor of the tailings storage facility (TSF) will be low-permeability. Where native soils do not provide a sufficiently thick low-permeability horizon beneath the TSF, it will be augmented with suitable clay from open pit stripping. If the volume of clay is insufficient, a synthetic liner will be used to ensure a low-permeability floor for the TSF.

- Revegetation of the reclaimed areas of the TSF to be carried out in accordance with O.Reg. 240/00, including proper sloping, scarification.

6.19.4 Predicted Effects

As described in Section 6.1.3.18, the effects of the Project on human health was evacuated using a single VC (human health) and two indicators, namely; Aboriginal health, and non-Aboriginal health. The following two measures were used for each of the indicators for human health:

- Carcinogenic effects; and

- Non-carcinogenic effects.

As described in Section 6.19.2.2, and detailed in Section 4.4 of Appendix W to the EIS, the COCs identified for the Project (i.e., lead and mercury) are not considered to be carcinogens and were evaluated ass non-carcinogens. Therefore, only the non-carcinogenic effects are presented here.

The following specific scenarios modelled in the SLRA presented in Appendix W to the EIS:

- Resident or First Nation resident (operations);

- Recreational user (operations); and

- Country foods assessment (operations and post-closure).

The results of the numerical model was a calculation of the hazard quotients for each of the COCs and for each exposure pathway. The results of the risk modelling are presented in Table 6.16.4-1. To facilitate the reader in understanding the relative importance of each of the COCs and exposure pathways to the overall HQs. As both lead and mercury have neurotoxic effects, the HQs can be summed as per Health Canada guidance. As shown in Table 6.19.4-1, the calculated HQs are considerably lower than the acceptable risk target HQ of 0.2 recommended in the Health Canada PQRA Guidance (HC, 2012).). As none of the scenarios approach the acceptable risk target threshold, there are no predicted adverse effects of the Project on human health. This conclusion remains valid even if the risk from two of the scenarios (e.g., “resident or First nation resident” and “country foods”) during the operations phase were summed, the results would still be well below the acceptable risk target HQ of 02.

Table 6.16.4-1: Predicted Effects of the Project on Human Health

Scenario	Exposure Pathway	Highest Calculated HQ for Each Scenario		
		Lead	Mercury	Combined
Operations Phase				
Resident or First Nation resident	Soil – inhalation	0.00145	0.0000000494	0.0014500494
	Country foods	—	—	
Recreational User	Soil – inhalation	0.000372	0.0000000127	0.0003720127
	Country foods	—	—	
Country foods assessment	Soil – inhalation	—	—	0.0670
	Country foods	0.0166	0.0504	
Post-closure Phase				
Country foods assessment	Soil – inhalation	—	—	0.04915
	Country foods	0.0419	0.00725	

Based on the very low levels of risk calculated to human health, no adverse effects to human health were identified.

6.19.5 Identified Mitigation

As there were no predicted adverse effects, no additional mitigation measures beyond the avoidance measures outlined in Section 6.19.3 have been identified.

6.19.6 Residual Adverse Effects

As described in Section 6.19.6, the results of the risk assessment determined there would be no adverse effects for the human health VC. Therefore, there would be no residual adverse effects for human health.

6.19.7 Information to Address Round 1 Information Requests

The following provides a listing of the questions raised as part of the Round 1 information requests that were, in whole or in part, relating to the methods used for predicting the effects of the Project on human health, or the predicted effects:

- TMI_195-HE(1)-02: screening process for COCs;
- TMI_196-HE(1)-03: consideration of direct soils contact;
- TMI_199-HE(1)-06: exposure frequencies;
- TMI_200-HE(1)-07: dose averaging of exposures;
- TMI_201-HE(1)-08: age groups and food ingestionn rates;

- TMI_202-HE(1)-09: current fish guidance on fish ingestion rates;
- TMI_203-HE(1)-10: forms of mercury considered;
- TMI_204-HE(1)-11: more recent lead TRVs;
- TMI_205-HE(1)-12: rationale for spatially adjusting concentrations and uptake rates;
- TMI_206-HE(1)-13: depth of soil cap on WRSA and TSF;
- TMI_209-HE(1)-16: use of site-specific data;
- TMI_210-HE(1)-17: antimony as a potential COC;
- TMI_211-HE(1)-18: mercury exposure point concentrations;
- TMI_212-HE(1)-19: screening using MOE POI limits;
- TMI_213-HE(1)-20: screening total air concentrations;
- TMI_214-HE(1)-21: justification for excluding COCs;
- TMI_215-HE(1)-22: screen using total water concentrations;
- TMI_216-HE(1)-23: baseline concentrations for whole fish consumption;
- TMI_217-HE(1)-24: use of total mercury exposures;
- TMI_218-HE(1)-25: worked examples for non-carcinogen and carcinogen;
- TMI_220-HE(1)-27: dry weight concentrations of lead in vegetation;
- TMI_221-HE(1)-28: clarify MOE POI for carbon monoxide;
- TMI_222-HE(1)-29: use current guidance for risk calculations;
- TMI_223-HE(1)-30: summing concentrations across species;
- TMI_224-HE(1)-31: apparent inconsistency for post-closure total hazard quotient (HQ);
- TMI_225-HE(1)-32: rationale for lead HQs used;
- TMI_325-SD(1)-20: modify PM_{10} and $PM_{2.5}$ air screening criteria;

- TMI_326-SD(1)-21: rational for substances without guidelines;
- TMI_327-SD(1)-22: adjust units for lead and mercury TRVs;
- TMI_328-SD(1)-23: update selenium CDWQG;
- TMI_329-SD(1)-24: update to reflect country food risk assessment;
- TMI_338-AC(1)-12: potential human health effects from air quality;
- TMI_347-AC(1)-21: potential contamination of food sources;
- TMI_374-AC(1)-48: contaminants in sport fish (e.g., walleye) already high ;
- TMI_556-AC(1)-230: effects of air compounds on Aboriginal peoples;
- TMI_557-AC(1)-231: assumptions related to uptake by grouse;
- TMI_710-PC(1)-25: effects of air quality on health;
- TMI_714-PC(1)-29: carcinogenic dust;
- TMI_719-PC(1)-34: water quality and health;
- TMI_731-PC(1)-46: perceived safety of chanterelle mushroom; and
- TMI_732-PC(1)-47” perceived safety of wild rice.

6.20 Heritage Resources

6.20.1 Potential Effects of the Project on the Environment

As described in Section 6.1.3.19, the assessment of heritage resources focusses on those aspects of the Project regulated under the *Ontario Heritage Act*, namely archaeological sites historic heritage sites. Potential effects of the Project on cultural activities and practices are addressed as part of the Aboriginal peoples assessment presented in Section 6.21. The following lists potential effects of the Project during the various phases identified for heritage resources:

- **Site Preparation and Construction Phase**: Most of the physical disturbance of soils, overburden and layers likely to hold heritage resources, should they be present, will occur during the site preparation and construction phase. These activities include the following:
    - Construction of perimeter ditches;

- Clearing and grubbing of vegetation;
- Clearing of overburden from the open pit;
- Initial construction of the overburden stockpiles;
- Construction of the initial tailings storage facility (TSF) footprint;
- Clearing and initial construction of the waste rock storage area (WRSA); and
- Construction of site facilities, roads and structures.

- **Operations Phase**: Once mining starts, most of the activities at the site will be occurring within the limits of the areas disturbed during the site preparation and construction phase. Those activities that could affect heritage resources during operations are as follows:
  - Placement of waste rock in the WRSA until waste rock can be placed in the mined out portions of the open pit;
  - Continued placement of overburden in the overburden stockpiles; and
  - Expansion of the footprint of the TSF.
- **Closure Phase**: Following the end of mining activities, the Project facilities will be decommissioned and removed and the site will be regraded to ensure all runoff drains towards the open pit. Suitable materials will be used to help re-vegetate the site and return it to a condition suitable to support a functioning ecosystem. Those activities that could affect heritage resources during operations are as follows:
  - The regrading of the site, especially areas not previously disturbed during the site preparation and construction phase, or during the operations.
- **Post-closure Phase**: Once the closure activities are complete there will be no further disturbance of the soils that could affect heritage resources.

The potential effects of the Project on noise have been described using a simple linkage diagram on Figure 6.20.1-1. The figure illustrates the heritage resources VCs (shown in blue on the figure) that are potentially affected during each phase of the Project. Additionally, the figure indicates those other components of the environment (shown in red in the figure) where the predicted effects of the Project on heritage resources will be used as an input for determining the effects on other VCs. For example, effects on heritage resources will be considered in the effects of the Projects on Aboriginal peoples. There are no other components or VCs that provide input the heritage resources effects.

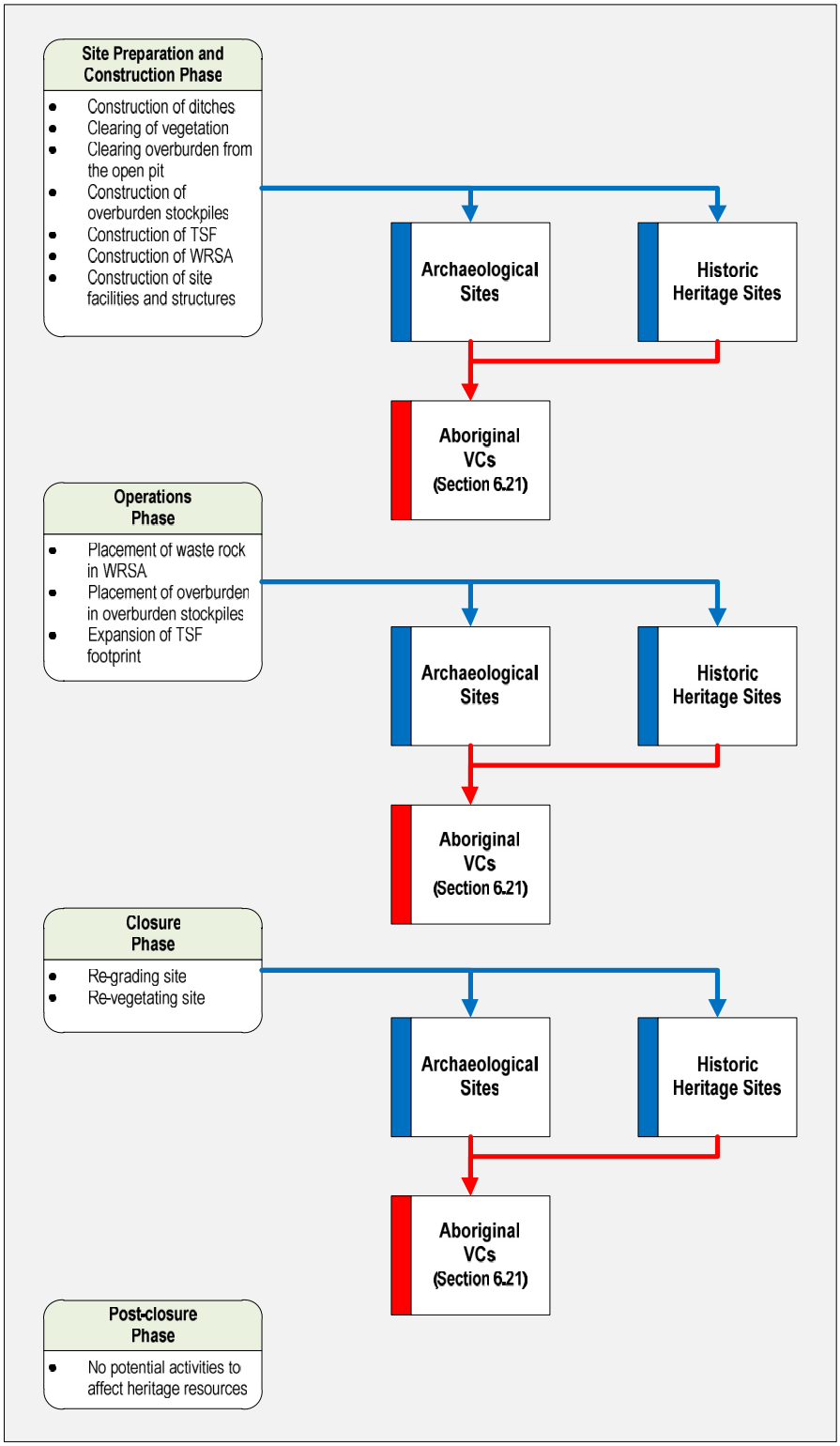


Figure 6.20.1-1: Heritage Resources Linkage Diagram

6.20.2 Effects Prediction Methods

The prediction of potential effects on heritage resources was done by identifying the presence, or potential for the presence within the areas to be disturbed by the Project. The determination of the likelihood for archaeological resources to be present within the Project footprint was done in accordance with the requirements of the Ontario Heritage Act, and included the completion of a Stage 1 and Stage 2 archaeological assessment in accordance with the methodologies developed by the Ministry of Tourism, Culture and Sport (MTCS). The findings of the assessments were assessment were documented (provided as Appendix U to the EIS), and reviewed by MTCS have, who expressed satisfaction at the recommendations made. The MTCS describes a Stage 1 assessment in the following manner (MTCS, 2017: website):

> "*The consultant archaeologist determines whether there is potential for archaeological sites on the property. He or she reviews geographic, land use and historical information for the property and the relevant surrounding area, visits the property to inspect its current condition and contacts this ministry to find out whether or not there are any known archaeological sites on or near the property. A Stage 2 assessment is required when the consultant archaeologist identifies areas of archaeological potential."*

The steps involved in completing the Stage 1 assessment included the following:

- A review of the historic context for the site, based on literature:
- A review of the archaeological context for the site, based on literature;
- A review of the geographic and land use context, based on literature;
- Contact MTCS to determine the presence of known, proximate archaeological sites; and
- Conduct a site visit to inspect the current conditions (this occurred on May 10, 2012).

A Stage 2 assessment in described is described by MTCS as follows (MTCS, 2017: website):

> *"The consultant archaeologist surveys the land to identify any archaeological resources on the property being developed. For a ploughed field, he or she will walk back and forth over it looking for artifacts on the surface. In forests, overgrown pasture areas or any other places that cannot be ploughed, he or she will dig parallel rows of small holes, called test pits, down to sterile subsoil at regular intervals and sift the soil to look for artifacts. He or she may use other strategies if properties are paved, covered in fill or have deeply buried former topsoils (such as floodplains or former sand dunes). The consultant archaeologist will help determine whether any archaeological resources found are of sufficient cultural heritage value or interest to require Stage 3 assessment."*

The Stage 2 work was completed undertaken during a site visit on May 10, 2012, and the work was reviewed on September 12, 2012 when the site was re-visited.

The archaeological assessment focused on the development area, the parts of the property that will be directly affected by the construction of the open pit mine and associated infrastructure. However, all evaluations of archaeological potential also consider areas adjacent to the subject property to confirm the accuracy of evaluations made.

6.20.3 Project Effects Avoidance Measures Used in Predictions

The following measures have been incorporated into the Project that help avoid, or minimize, the potential effects to heritage resources:

- Minimize the overall footprint of the Project.
- Leave a 50 m buffer zone around remaining watercourses within the Project area.

6.20.4 Predicted Effects

As described in Appendix U to the EIS, the archaeological assessment for the Project identified the following:

- The location of the Project is 500 m from major watercourses of waterbodies.
- The property is comprised of low lying areas, interspersed with higher areas of clay capped bedrock.
- Much of the site has been disturbed by previous past and present mining explorations activities, as well as by forestry practices in the area.
- The former Ministry of Natural Resources tree nursery, which was located on the property, does not represent a historic feature.
- There were no historic settlements or historic transportation routes within the site.
- A request for information from the site registration database regarding the presence of other identified archaeologic sites near the Project was made to MTCS, specifically information was requested for the DgJc Borden block. According to MTCS, there are no sites have been reported within two kilometres of the Project.
- The Stage I study indicated a low potential for archaeological resources at the Project based the identification from 1:50,000 topographic maps of the presence of terrain features and several small, intermittent watercourses on the property.
- A Stage 2 was required to be able to assess these locations.

- The Stage 2 property survey indicated a low potential for archaeological resources as the several intermittent watercourses are seasonal, and flow through dense scrub brush.
- A raised knoll on the property was examined and found to be disturbed.
- No other features of archaeological potential were identified.
- It was determined that there was no potential for archaeological resources within the Project footprint.

The archaeological assessment was focused on the development area, the parts of the property that will be directly impacted by the construction of the open pit mine and associated infrastructure. Evaluation of archaeological potential for any property considers areas adjacent to the property under consideration to confirm the evaluations made. The low archaeological potential evaluated for the Project is also supported the proximity to Thunder Lake and Wabigoon Lake. These areas would have been the preferred locations for settlement, and this settlement would have been related to available food resources (fish, rice), and access (canoe routes) among other variables.

As part of the Round 1 information requests, information was shared regarding a traditional canoe route between Wabigoon Lake, through Thunder Lake and Ghost Lake to access Rice Lake. The importance of this route from a cultural perspective is recognized by Treasury Metals. However, the canoe route identified lies beyond the area of anticipated to be directly affected by the development of the Project, and this route and should not be compromised. The information shared that Elders camped on sandy beaches along the route is valuable, and confirms the general approach taken in evaluating archaeological potential. Areas in close proximity to navigable waters represent areas of higher potential, while areas that are distant from navigable waterways, like the Project site, will have a lower archaeological potential.

Based on the findings of the archeological studies completed for the Project (Appendix U to the EIS), it was concluded that the area of the Project "…does not exhibit archaeological potential, therefore it is recommended that the location does not require further archaeological assessment." The archaeological report was submitted to MTCS for review, who expressed satisfaction at the recommendations made.

Therefore, the absence of archaeological potential at the Project means there would be no predicted adverse effects of the Project on heritage resources.

6.20.5 Identified Mitigation

The following measures incorporated into the Project design and implementation will help avoid adverse effects, or mitigate any effects that arise:

- Minimize the overall footprint of the Project; and

- Leave a 50 m buffer zone around remaining watercourses within the Project area.

In addition to the above avoidance measures, mitigation measures will be put in place, as part of the Archaeological and Cultural Heritage Resource Management Plan to respond to archaeological resources that may be encountered in the execution of the Project. These would include the following:

- If previously undocumented archaeological resources be discovered, the person discovering the resources must stop alteration of the site immediately of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (I) of the Ontario Heritage Act.

- If human remains are discovered, alteration of the site must stop and the person making the discovering must immediately notify the police, or coroner, and the Registrar of cemeteries, at the Ministry of Consumer Services, as required under the *Cemeteries Act*, R.S.O. 1990 c.C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 (when proclaimed in force).

- Restrict activities and development within 300 m of major water sources and within 300 m of historical travel routes, to only those areas where an archeological assessment has been completed.

- Do not allow new ground altering activities to occur in areas where an archaeological assessment has not been completed.

- Complete archaeological assessments for any new areas not previously assessed prior to allowing ground altering activities.

6.20.6 Residual Adverse Effects

As there were no predicted adverse effects of the Project on heritage resources (Section 6.20.4) there will be no residual adverse effects heritage resources.

6.20.7 Information to Address Round 1 Information Requests

The following lists the questions received as part of the Round 1 information requests that relate to the predicted effects, and prediction methods, for heritage resources:

- TMI_354-AC(1)-28: assess traditional canoe route to Rice Lake;
- +TMI_354-AC(1)-28: spiritual and ceremonial sites should be assessed separately;
- TMI_355-AC(1)-29: presence of underwater sites in Thunder Lake and Wabigoon Lake;

- TMI_681-AC(1)-353: concerned about potential for archeological resources on site;
- TMI_739-PC(1)-54: concerned about potential for archeological resources on site; and
- TMI_743-PC(1)-58: concerned about potential for archeological resources on site
- TMI_241-HE(1)-48: mitigation for heritage resources; and
- TMI_242-HE(1)-49: Archaeological and Cultural Heritage Resource Management Plan.

6.21 Aboriginal Peoples

6.21.1 Potential Effects of the Project on the Environment

The potential effects of the Project on Aboriginal peoples VCs described in Section 6.1.3.20 will vary by phase through the Project life, as noted below:

- **Site preparation and construction phase:**
  - Physical alteration of the Project area landscape;
  - Removal of traditional land use resources; and
  - Change in access to Project area.
- **Operations phase:**
  - Physical alteration of the Project area landscape;
  - Removal of traditional land use resources; and
  - Change in access to Project area.
- **Closure phase:**
  - Physical alteration of the Project area landscape; and
  - Change in access to Project area.
- **Post-closure phase:**
  - Physical alteration of the Project area landscape; and
  - Change in access to Project area.

The potential effects on Aboriginal Peoples has been described by a linkage diagram in Figure 6.21.1-1. The Aboriginal Peoples VCs, shown in blue, are impacted by other valued components, shown in red. Aboriginal Peoples do not impact other assessment components.

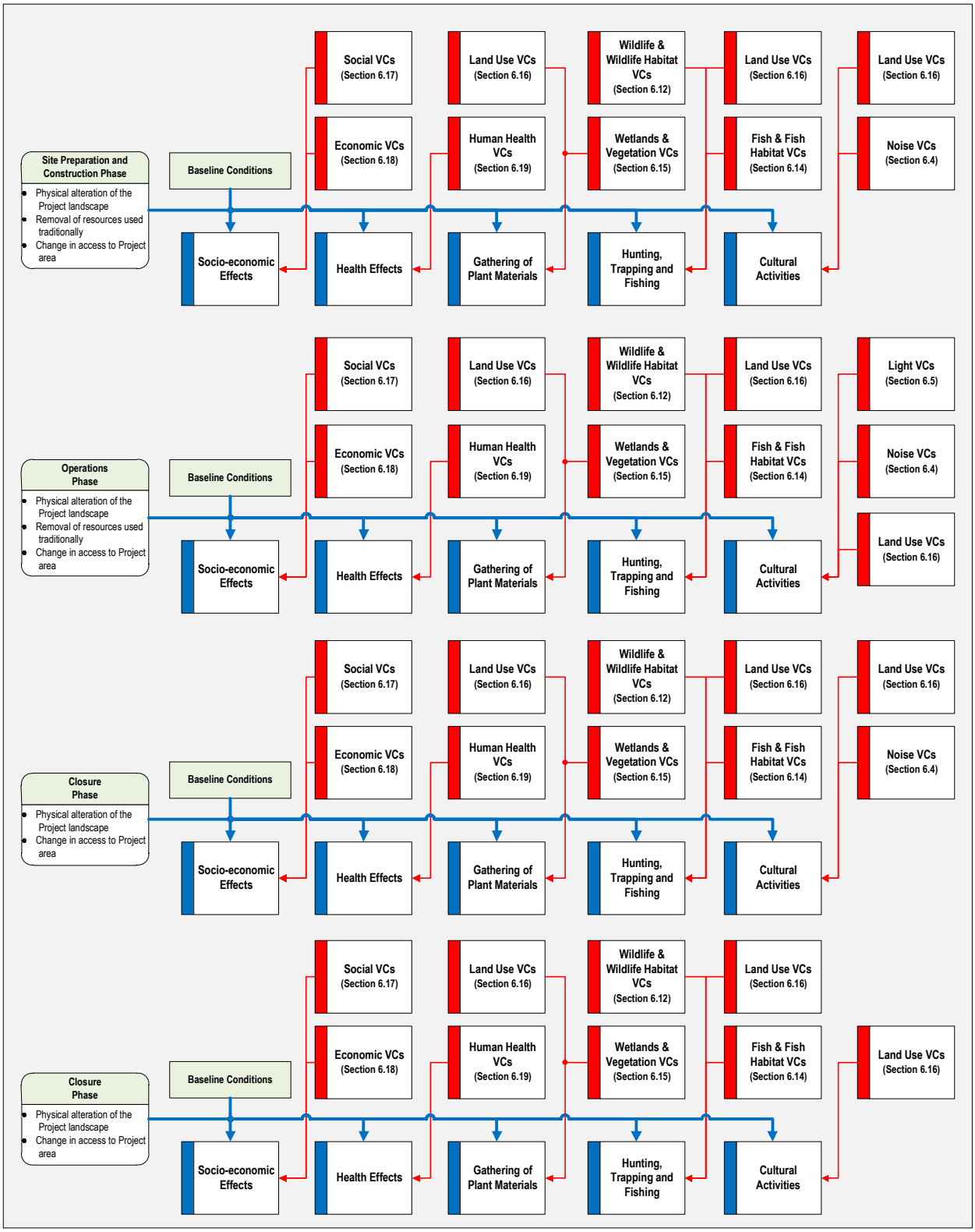


Figure 6.21.1-1: Aboriginal Peoples Linkage Diagram

6.21.2 Effects Prediction Methods

The qualitative prediction of Project effects on Aboriginal people is based on:

- EIS guidelines for the Project;
- Concerns raised by Aboriginal people and communities;
- Potential interactions between the Project and Aboriginal people valued components; and
- Industry knowledge and experience gained in other environmental impact assessments that impacted Aboriginal people, communities, and their traditional practices.

The prediction of effects is constrained as the Aboriginal communities did not provide traditional knowledge or traditional land use reports for the Project. Treasury Metals learned during engagement the importance of traditional land use and the associated resources and that traditional activities occurred in the general Project area, however, no specific land use activities were identified as taking place in the Project area.

6.21.3 Project Effects Avoidance Measures Used in Predictions

Aspects of the Project design have the effect of reducing potential effects through avoidance. The avoidance measures within the Project design affecting the Aboriginal People valued components are listed in Table 6.21.3-1.

Table 6.21.3-1: Aboriginal Peoples Effects Avoidance Measure Considered

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
Health Effects	Release of tailings storage facility effluent could result in exceedances of MMER, CCME and/or PWQO criteria.	Operations Closure Post-closure	Secondary treatment (reverse osmosis) to achieve water quality criteria for chemicals of concern in the effluent.
	Release of chemicals and petroleum products due to spills during handling and/or equipment malfunctions.	Site preparation and construction Operations Closure	Construction of refueling station over a spill collection system. Construction of a dedicated, contained chemical transfer area.
	Physical alteration of the Project area landscape could result in increased erosion and an increase in the total suspended sediments in surface water.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint. Stabilization of disturbed soils.
	Adverse health effects due to increased noise and vibration.	Site preparation and construction Operations Closure	Mobile equipment will be equipped with appropriate sound suppression devices. Process plant will be enclosed and insulated to ensure that operational noise levels are kept to a minimum. Blasting undertaken at the mine site will be conducted in a manner that will not

Table 6.21.3-1: Aboriginal Peoples Effects Avoidance Measure Considered (continued)

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
			result in impacts to private properties. Blasting will be conducted on a regular schedule and at a time that will not be disruptive. Waste rock storage area and overburden piles will be situated to act as noise berms.
Gathering of Plant Materials	Removal of plant materials traditionally gathered.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint.
	Loss of access to areas of traditional plant gathering.	Site preparation and construction Operations Closure	Minimize Project footprint. Minimize Crown land used in Project footprint.
	Contamination of traditionally gathered plant materials.	Site preparation and construction Operations Closure	Secondary treatment (reverse osmosis) to achieve water quality criteria for chemicals of concern in the effluent.
	Increased noise, vibration, and light and a change in the viewscape could diminish the experience of being on the land and conducting traditional activities.	Site preparation and construction Operations Closure Post-closure	None.
Hunting; Trapping Fishing	Reduction in numbers of species hunted or trapped.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint. Reforestation of former tree nursery site. Minimize activities on eastern portion of property.
	Loss of suitable habitat for species hunted or trapped.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint. Reforestation of former tree nursery site. Minimize activities on eastern portion of property.
	Loss of access to areas of traditional hunting, trapping, and fishing.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint. Minimize Crown land used in Project footprint. Reforestation of former tree nursery site. Minimize activities on eastern portion of property.
	Contamination of fish making them unsuitable for harvesting.	Site preparation and construction Operations Closure	Water treatment facilities to be installed to ensure discharge waters meet provincial water quality guidelines.
	Increased noise, vibration, and light and a change in the viewscape could diminish the experience of being on the land and conducting traditional activities.	Site preparation and construction Operations Closure	Limiting the height of the WRSA to between 25 and 30 m. Using 3:1 (horizontal to vertical) slopes on WRSA.

Table 6.21.3-1: Aboriginal Peoples Effects Avoidance Measure Considered (continued)

Valued Component	Potential Effect	Project Phase	Avoidance Measure Considered
		Post-closure	Revegetate the western face of the WRSA to make the feature less noticeable.
Cultural Activities	Loss of culturally significant sites	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint.
	Loss of access to culturally significant sites.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint. Minimize Crown land used in Project footprint.
	Loss of access to traditional use sites where cultural practices occur and can be taught.	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint. Minimize Crown land used in Project footprint.
	Increased noise, vibration, and light could diminish the experience of being on the land and conducting traditional activities.	Site preparation and construction Operations Closure Post-closure	None.
Socio-economic Effects	Increased employment and business opportunities.	Site preparation and construction Operations Closure Post-closure	None.
	Increased training opportunities.	Site preparation and construction Operations	None.
	Increased demand on existing community housing, infrastructure and services due to in-migration of Project workers.	Site preparation and construction Operations	None.

6.21.4 Predicted Effects

The predicted effects of the Project on Aboriginal peoples are listed in Table 6.21.4-1.

Table 6.21.4-1: Predicted Aboriginal Peoples Effects by Project Phase

Valued Component	Predicted Effect	Project Phase	Description of Effect
Health Effects	Release of tailings storage facility effluent could result in exceedances of MMER, CCME and/or PWQO criteria.	Operations Closure Post-closure	Released water that exceeds water quality guidelines could negatively impact the quality of the plants, fish, and animals that are harvested and consumed by Aboriginal

Table 6.21.4-1: Predicted Aboriginal Peoples Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
			people with a negative impact on their health.
	Release of chemicals and petroleum products due to spills during handling and/or equipment malfunctions.	Site preparation and construction Operations Closure	Released chemicals and petroleum products could negatively impact the quality of the plants, fish, and animals that are harvested and consumed by Aboriginal people with a negative impact on their health.
	Physical alteration of the Project area landscape could result in increased erosion and an increase in the total suspended sediments in surface water.	Site preparation and construction Operations Closure Post-closure	Increased total suspended sediments in surface water could negatively impact the quality of the plants, fish, and animals that are harvested and consumed by Aboriginal people with a negative impact on their health.
	Adverse health effects due to increased noise and vibration.	Site preparation and construction Operations Closure	Project-related noise could be disruptive to the sleep and mental health of Aboriginal people living near the Project.
Gathering of Plant Materials	Removal of plant materials traditionally gathered.	Site preparation and construction Operations Closure Post-closure	The loss of plants traditionally gathered could eliminate a source of those plants for Aboriginal people.
	Loss of access to areas of traditional plant gathering.	Site preparation and construction Operations Closure Post-closure	A restriction in accessing an area of traditionally harvested plants could eliminate a source of those plants to Aboriginal people.
	Contamination of traditionally gathered plant materials.	Site preparation and construction Operations Closure	Contamination of traditionally harvested and consumed plants could reduce the amount of those plants consumed.
	Increased noise, vibration, and light and a change in the viewscape could diminish the experience of being on the land and conducting traditional activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience for Aboriginal people and reduce the amount of traditional land use activities.
Hunting; Trapping Fishing	Reduction in abundance of animals hunted or trapped.	Site preparation and construction Operations Closure Post-closure	A reduction in the abundance of animals hunted or trapped could reduce the success of hunting and trapping by Aboriginal people and reduce that food or income source.
	Loss of suitable habitat for animals hunted or trapped.	Site preparation and construction Operations Closure	A loss of suitable habitat for animals hunted or trapped could reduce the success of hunting and trapping by Aboriginal people and reduce that food or income source.

Table 6.21.4-1: Predicted Aboriginal Peoples Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
		Post-closure	
	Loss of access to areas of traditional hunting, trapping, and fishing.	Site preparation and construction Operations Closure Post-closure	The loss of access to areas of traditional hunting, trapping, and fishing could reduce the success of hunting and trapping by Aboriginal people and reduce that food or income source.
	Contamination of fish making them unsuitable for harvesting.	Site preparation and construction Operations Closure	Contamination of fish could reduce the amount of fish consumed.
	Increased noise, vibration, and light could diminish the experience of being on the land and conducting traditional activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience for Aboriginal people and reduce the amount of traditional land use activities.
Cultural Activities	Loss of culturally significant sites.	Site preparation and construction Operations Closure Post-closure	The loss of cultural significant cultural sites would adversely affect the ability of Aboriginal people to conduct cultural activities and the preservation of their culture.
	Loss of access to culturally significant sites.	Site preparation and construction Operations Closure Post-closure	The loss of access to cultural significant cultural sites would adversely affect the ability of Aboriginal people to conduct cultural activities and the preservation of their culture.
	Loss of access to traditional use sites where cultural practices occur and can be taught.	Site preparation and construction Operations Closure Post-closure	The loss of access to traditional use areas would adversely affect the ability of Aboriginal people to conduct and teach cultural activities and the preservation of their culture.
	Increased noise, vibration, and light could diminish the experience of being on the land and conducting traditional activities.	Site preparation and construction Operations Closure Post-closure	Increased noise, vibration, and light and a change to the viewscape could diminish the on-the-land experience for Aboriginal people and reduce the amount of cultural activities.
Socio-economic Effects	Increased employment and business opportunities.	Site preparation and construction Operations Closure Post-closure	The demand for employees and goods and services will increase in the study area during the construction and operations phases. During closure the demand will decline and during post-closure will be eliminated.
	Increased training opportunities.	Site preparation and construction Operations	During construction and operations, there will be a Project-related demand for trained workers and training opportunities will be available.

Table 6.21.4-1: Predicted Aboriginal Peoples Effects by Project Phase (continued)

Valued Component	Predicted Effect	Project Phase	Description of Effect
	Increased demand on existing community housing, infrastructure and services due to in-migration of Project workers.	Site preparation and construction Operations	The potential of in-migration of workers and families into the local area to take Project-related employment will offset out-migration from the local communities and will place additional demands on community housing, services, and infrastructure.

6.21.5 Identified Mitigation

The Project measures identified to mitigate the potential adverse effects or enhance positive effects on Aboriginal peoples are listed in Table 6.21.5.1-1. Some mitigation measures are applicable to more than one predicted effect.

Table 6.21.5.1-1 Mitigation and Enhancement Measures for Aboriginal Peoples Effects

Mitigation Measure Title	Mitigation Measure Description
Communications	Ongoing communications with stakeholders and Aboriginal peoples regarding Project activities, concerns, and traditional land use.
Environmental Management Plan	Environmental aspects and potential impacts of the project will be managed within an environmental management plan (EMP) which integrates environmental performance with overall project management. The EMP will have measures to minimize the potential for the release of deleterious substances and will include a Spill Response Plan and a Waste Management Plan.
Water quality	For specific measures, see Section 6.8.5 Surface Water Quality and Section 6.10.5.
Air quality	For specific measures, see Section 6.6.5.
Noise	For specific measures, see Section 6.4.5.
Light	For specific measures. See Section 6.5.5.
Visual effects – contouring of waste storage areas	The waste rock storage area (WRSA) and the tailings storage facility (TSF) will be contoured during operations and closure to blend in with other terrain features. The WRSA will be progressively reclaimed during Project operations and covered with soil and vegetation to assist in blending in with the surrounding landscape.
Wildlife habitat	For specific measures, see Section 6.12.5
Wildlife harvesting access	The removal of Crown land from hunting and trapping will be limited to 43.4 hectares or 1.11% of the Project area; the rest of the Project footprint will be on private land where hunting and trapping had been previously restricted. Crown land east of the Project area will remain open to hunting and trapping.
Plant habitat	For other specific measures, see Section 6.15.5.
Traditional land use information collection	Collect traditional land use information for the Project area through meetings and traditional land use studies to identify areas of plant gathering, hunting, trapping, fishing, and cultural activities.
Socio-economic Management Plan	Plan to ensure socio-economic commitments are implemented, adverse socio-economic effects are minimized, results are monitored, and effects are adaptively managed.

Table 6.21.5.1-1 Mitigation Measures for Aboriginal Peoples Effects (continued)

Mitigation Measure Title	Mitigation Measure Description
Socio-economic baseline	Treasury Metals will undertake an update of the socio-economic baseline (GCK Consulting 2014) to establish a pre-construction baseline of the affected communities prior to commencing Project construction. This will serve as the basis for future monitoring and management of socio-economic effects throughout the life of the Project.
Local hiring	Develop and implement employment practices that give preference to local and regional labour where possible, including First Nation communities. The application of this policy is dependent upon the skills and workforce being available locally.
Local purchasing	Treasury will maintain, where applicable, a local purchasing policy to purchase goods and services from local suppliers. This policy has the expectation that goods and services will be purchased locally assuming price, delivery and service is competitive with outside suppliers.
Workforce development	Develop training programs for unemployed and under employed resident and non-resident workers. Training would be done through in-house programs and in conjunction with local and regional educational institutes. Make educational attainment or the equivalent competencies a hiring requirement for the mine workers. At closure, ensure ongoing training opportunities are available to help residents to increase their competitiveness and chances to get employment elsewhere.
Housing	For specific measures, see Section 6.4.5 Noise, Section 6.5.5 Light, and Section 6.1.05 Ground Water Quality.
Education enrollments	Continuously communicate the appropriate information (e.g., the timing and the communities in which new residents may locate) to the school district(s) to assist with their resource planning process.
Regional infrastructure and services	Closely and frequently communicate with government agencies and service providers to ensure that the appropriate information (e.g., proposed transportation volumes, potential variation to the local population) are considered in the planning of future services and response capabilities. Work with local and regional governments to minimize the in-migration workforce where possible.
Protective services	Work with public safety services to develop safety and work policy guidelines for mine workers. Work with local agencies to assist in monitoring community wellbeing and take corrective actions where appropriate.
Employment at closure	Closure mitigation measures will focus on working with the affected communities and government agencies to develop a mine closure plan that includes a strategy for buffering the effects of eventually losing direct mine-related jobs and assist in the placement of potentially affected employees.

6.21.6 Residual Effects

The residual effects on Aboriginal peoples are presented in Table 6.22.3-1 together with the applicable avoidance and mitigation measures.

Table 6.22.3-1 Aboriginal Peoples Residual Effects

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
Health Effects				
Release of tailings storage facility effluent could result in exceedances of MMER, CCME and/or PWQO criteria.	Operations Closure	Environmental management plan Water quality measures	Potential release of tailings storage facility effluent causing water quality to exceed regulatory criteria with adverse effects on resources used by Aboriginal people. This could occur during operations and closure but is expected to be low in probability and infrequent through facility design.	Adverse
Release of chemicals and petroleum products due to spills during handling and/or equipment malfunctions.	Site preparation and construction Operations Closure	Environmental management plan Water quality measures	Potential release of chemicals and petroleum products with adverse effects on resources used by Aboriginal people. This could occur during site preparations and construction, operations, and closure but is expected to be low in probability and infrequent through environmental management.	Adverse
Physical alteration of the Project area landscape could result in increased erosion and an increase in the total suspended sediments in surface water.	Site preparation and construction Operations Closure Post-closure	Environmental management plan Water quality measures	Potential erosion of disturbed soils and an increased in water total suspended sediments with adverse effects on resources used by Aboriginal people. This could occur during site preparations and construction, operations, and closure and managed through water collection and treatment.	Adverse
Adverse health effects due to increased noise and vibration	Site preparation and construction Operations Closure	Noise and vibration measures	Potential adverse health effects due to increased noise and vibration to Aboriginal people living near the Project. Noise and vibration effects will be limited to the Project site during site preparations and construction, operations, and closure.	Adverse
Gathering of Plant Materials				
Removal of plant materials traditionally gathered	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Wildlife habitat and plant habitat measures Traditional land use information collection	Removal of traditionally harvested plant materials could reduce the amount of plants harvested by Aboriginal people. Effects during all Project phases are limited to the Project site on which there is little or no known traditional plant gathering as most of the site is private land; the site represents a small proportion of the available habitat for traditionally harvested plants.	Adverse

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
Loss of access to areas of traditional plant gathering	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Traditional land use information collection	Potential loss of access to areas of traditional plant gathering could reduce the amount of plants harvested by Aboriginal people. Effects during all Project phases are limited to the Project site on which there is little or no known traditional plant gathering as most of the site is private land; the site represents a small proportion of the available habitat for traditionally harvested plants.	Adverse
Contamination of traditionally gathered plant materials	Site preparation and construction Operations Closure	Environmental management plan Water quality measures Air quality measures	Potential contamination of traditionally harvested plant material could reduce the amount of plants harvested by Aboriginal people. Effects during all Project phases are limited to the Project site on which there is little or no known traditional plant gathering as most of the site is private land.	Adverse
Increased noise, vibration, and light and a change in the viewscape could diminish the experience of being on the land and conducting traditional activities	Site preparation and construction Operations Closure Post-Closure	Communications Noise and vibration measures Light measures Visual effects – contouring of waste storage areas Traditional land use information collection	Potential diminished traditional land use experience and a decline in traditional land use activities. Noise and vibration effects will be restricted to the Project site. Noise, vibration, and light will effects will begin at site preparation and construction and cease at post-closure. Waste piles will be contoured and vegetated to blend into the surroundings.	Adverse
Hunting; Trapping Fishing				
Reduction in abundance of animals hunted or trapped	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize activities on eastern portion of property Wildlife habitat measures Traditional land use information collection	Potential reduction in the abundance of traditionally hunted or trapped animals and a reduction in food or income sources. Effects during all Project phases are limited to the local Project area on which there is little or no known traditional hunting, fishing, or trapping; most of the Project site is private land. Assessment of effects on wildlife predicts no impact on wildlife abundance.	Adverse
Loss of suitable habitat for animals hunted or trapped	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize activities on eastern portion of property Wildlife habitat measures Traditional land use information collection	Potential reduction in suitable habitat for species traditionally hunted or trapped and a reduction in food or income sources. Effects during all Project phases are limited to the Project site on which there is little or no known traditional hunting, fishing, or trapping; most of the Project site is private land	Adverse

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
Loss of access to areas of traditional hunting, trapping, and fishing	Site preparation and construction Operations Closure Post-closure	Minimize Project footprint Minimize Crown land used in Project footprint Minimize activities on eastern portion of property Wildlife habitat measures Traditional land use information collection	Potential loss of access to areas of traditional hunting, trapping, and fishing and a reduction in food or income sources. Effects during all Project phases are limited to the local Project area on which there is little or no known traditional hunting, fishing, or trapping; most of the Project site is private land.	Adverse
Contamination of fish making them unsuitable for harvesting	Site preparation and construction Operations Closure	Environmental management plan Water quality measures	Potential contamination of fish making them unsuitable for harvesting and a loss of a food source. There is little or no fish harvesting on the Project site. If water from the Project site were to be contaminated and affect downstream fish, it could occur during operations and closure but is expected to be low in probability and infrequent through facility design.	Adverse
Increased noise, vibration, and light and a change in the viewscape could diminish the experience of being on the land and conducting traditional activities	Site preparation and construction Operations Closure Post-closure	Communications Noise and vibration measures Light measures Visual effects – contouring of waste storage areas Traditional land use information collection	Potential diminished traditional land use experience and a decline in traditional land use activities. Noise and vibration effects will be restricted to the Project site. Noise, vibration, and light will effects will begin at site preparation and construction and cease at post-closure. Waste piles will be contoured and vegetated to blend into the surroundings.	Adverse
Cultural Activities				
Loss of culturally significant sites	Site preparation and construction Operations Closure Post-closure	Communication Traditional land use information collection	Potential loss of culturally significant sites and loss of ability to practice cultural activities. Effects during all Project phases are limited to the Project site on which there is no known culturally significant sites.	Adverse
Loss of access to culturally significant sites	Site preparation and construction Operations Closure Post-closure	Communication Traditional land use information collection	Potential loss of access to culturally significant sites and loss of ability to practice cultural activities. Effects during all Project phases are limited to the Project site on which there is no known culturally significant sites.	Adverse

Predicted Effect	Project Phase	Avoidance and Mitigation Measures	Residual Effect	Direction
Loss of access to traditional use sites where cultural practices occur and can be taught	Site preparation and construction Operations Closure Post-closure	Communication Traditional land use information collection	Potential loss of access to traditional use sites where cultural practices occur and can be taught. Effects during all Project phases are limited to the Project site on which there are no known culturally significant sites.	Adverse
Increased noise, vibration, and light and a change in the viewscape could diminish the experience of being on the land and conducting traditional activities	Site preparation and construction Operations Closure Post-closure	Communications Traditional land use information collection Noise and vibration measures Light measures Visual effects – contouring of waste storage areas	Potential diminished traditional land use experience and a decline in traditional land use activities. Noise and vibration effects will be restricted to the Project site. Noise, vibration, and light will effects will begin at site preparation and construction and cease at post-closure. Waste piles will be contoured and vegetated to blend into the surroundings.	Adverse
Socio-economic Effects				
Increased employment and business opportunities	Site preparation and construction Operations Closure Post-Closure	Local hiring Local purchasing Employment at closure	There will be increased employment and business opportunities during site preparation and construction and operations directly by Project spending and indirectly from local businesses working for the Project. The employment and business opportunities will decline during closure and post-closure.	Positive during construction, operations, and closure Adverse post-closure
Increased training opportunities	Site preparation and construction Operations	Workforce development	Increased training and educational opportunities during site preparation and construction and operations. The training and educational opportunities will decline during closure and post-closure.	Positive during construction, operations. Adverse during closure and post-closure
Increased demand on existing community housing, infrastructure and services due to in-migration of Project workers	Site preparation and construction Operations Closure	Socio-economic Management Plan Socio-economic baseline Education enrollment Regional infrastructure and services Protective services Housing measures	The in-migration of construction and operations workers could place increased demand on existing community housing, infrastructure and services during site preparation and construction and operations. Demand on community housing, infrastructure, and services will decline during closure and post-closure if Project workers leave the area.	Adverse during construction and operations. Positive during closure and post-closure

Several of the residual effects for Aboriginal peoples are regional in nature, and could occur anywhere within the terrestrial and aquatic study areas presented on Figures 6.1.4.16-1 and 6.1.4.16-2, respectively. There are some effects that will be spatially tied to the effects of the Project on the biophysical environment. This is the case for VC such as “hunting, trapping and fishing” and “gathering of plant material”. For these VC, the spatial effects of the Project can be characterized by identifying the areas where harvesting or traditional uses of the land may be affected. Figure 6.21.6-1 provides a compilation of the areas identified as being affected for one, or more, of the biophysical disciplines. The areas shaded in gold represent those areas where one or more of the biophysical disciplines are affected to the point where harvesting or traditional uses may be affected. The areas shaded in green represent areas where harvesting and traditional practices can continue unaffected, but the users may notice a change in the experience on the land (e.g., noise levels are noticeable).

6.21.7 Information to Address Round 1 Information Requests

The following lists the questions received as part of the Round 1 information requests that relate to the predicted effects, and prediction methods, for Aboriginal peoples:

6.21.7.1 Aboriginal Health:

- Government Agencies
    - TMI_169-AE(1)-07 Aboriginal health
    - TMI_194.2-HE(1)-01 Aboriginal health
    - TMI_199-HE(1)-06 Aboriginal health
    - TMI_200-HE(1)-07 Aboriginal health
    - TMI_216-HE(1)-23 Aboriginal health
    - TMI_246.1-AM(1)-04 Aboriginal health
- Eagle Lake First Nation; Wabigoon Lake Ojibway Nation
    - TMI_347-AC(1)-21 Aboriginal health
- Wabigoon Lake Ojibway Nation
    - TMI_361-AC(1)-35 Aboriginal health
- Métis Nation of Ontario

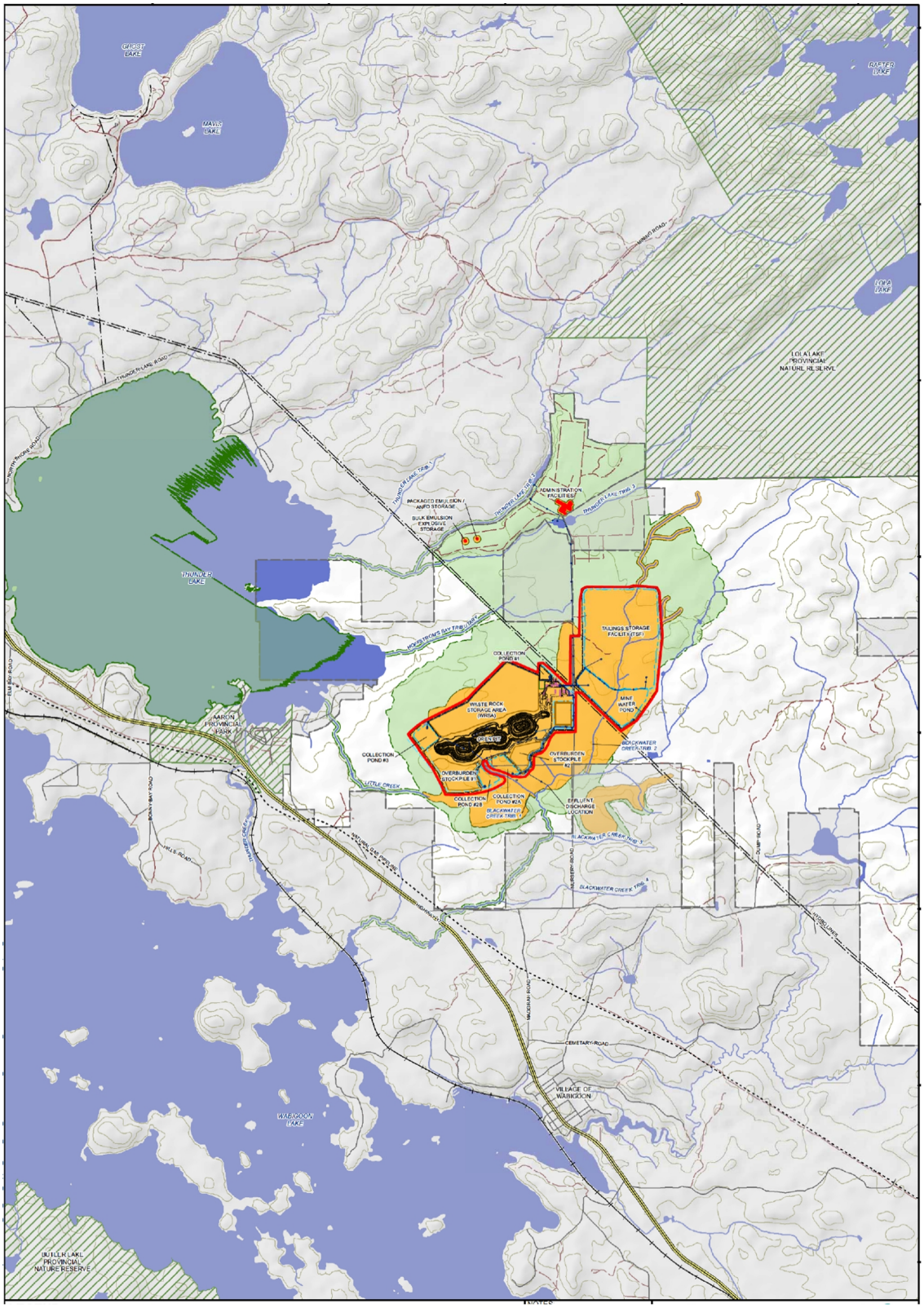


Figure 6.21.6-1: Spatial Extent for Residual Effects on Traditional Land Use

6.21.7.2 Gathering Plant Materials; Hunting, Trapping, Fishing; and Cultural Activities

Aboriginal and treaty rights

- Government Agencies
    - TMI_11-AC(1)-02 Impacts on Aboriginal and treaty rights
    - TMI_21-AA(1)-02 Impacts on Aboriginal and treaty rights
    - TMI_22-AA(1)-03 Impacts on Aboriginal and treaty rights
    - TMI_231.1-HE(1)-38 Impacts on Aboriginal and treaty rights
- Wabauskang First Nation; Aboriginal People of Wabigoon
    - TMI_364-AC(1)-38 Impacts on Aboriginal and treaty rights
- Wabauskang First Nation
    - TMI_396-AC(1)-71 Impacts on Aboriginal and treaty rights
- Eagle Lake First Nation
    - TMI_607.1-AC(1)-280 Impacts on Aboriginal and treaty rights
- Naotkamegwanning (Whitefish Bay) First Nation
    - TMI_642-AC(1)-315 Impacts on Aboriginal and treaty rights
    - TMI_643-AC(1)-316 Impacts on Aboriginal and treaty rights
    - TMI_679-AC(1)-351 Impacts on Aboriginal and treaty rights
    - TMI_680-AC(1)-352 Impacts on Aboriginal and treaty rights
    - TMI_684-AC(1)-356 Impacts on Aboriginal and treaty rights
- Métis Nation of Ontario
    - TMI_448-AC(1)-122 Impacts on Aboriginal and treaty rights
    - TMI_511-AC(1)-185 Impacts on Aboriginal and treaty rights

- TMI_537-AC(1)-211 Impacts on Aboriginal and treaty rights
- TMI_581-AC(1)-255 Impacts on Aboriginal and treaty rights
- TMI_584-AC(1)-258 Impacts on Aboriginal and treaty rights
- TMI_598-AC(1)-263 Impacts on Aboriginal and treaty rights
- TMI_599-AC(1)-272 Impacts on Aboriginal and treaty rights

Traditional land use

- Government Agencies
  - TMI_17-PD(1)-04 Access
  - TMI_229-HE(1)-36 Traditional land use
- Eagle Lake First Nation
  - TMI_362-AC(1)-36 Traditional land use
  - TMI_618-AC(1)-291 Traditional land use study
- Wabauskang First Nation
  - TMI_363-AC(1)-37 Traditional land use
- Naotkamegwanning First Nation
  - TMI_659-AC(1)-332 Traditional land use study
  - TMI_673-AC(1)-345 Traditional land use
  - TMI_675-AC(1)-347 Traditional land use study
  - TMI_678-AC(1)-350 Traditional land use
- Multiple Aboriginal peoples
  - TMI_390-AC(1)-65 Traditional land use study
- Métis Nation of Ontario

- TMI_415-AC(1)-90 Traditional lands
- TMI_422-AC(1)-97 Traditional land use study
- TMI_426-AC(1)-101 Traditional land use study
- TMI_428-AC(1)-103 Traditional land use study
- TMI_433-AC(1)-108 Traditional land use study
- TMI_449-AC(1)-123 Traditional land use
- TMI_457-AC(1)-131 Traditional land use
- TMI_479-AC(1)-153 Traditional land use
- TMI_485-AC(1)-159 Traditional land use
- TMI_494-AC(1)-168 Traditional land use
- TMI_563-AC(1)-237 Traditional land use
- TMI_582-AC(1)-256 Traditional land use
- TMI_585-AC(1)-259 Traditional land use study
- TMI_600-AC(1)-273 Traditional land use

Traditional harvesting

- Government Agencies
  - TMI_151-WL(1)-08 Traditional harvesting
  - TMI_181-AE(1)-19 Traditional harvesting
  - TMI_238.1-HE(1)-45 Traditional harvesting
  - TMI_264-EE(1)-07 Traditional harvesting
- Naotkamegwanning First Nation
  - TMI_651-AC(1)-324 Traditional harvesting

- TMI_654-AC(1)-327 Traditional harvesting
- TMI_665-AC(1)-338 Traditional harvesting
- TMI_667-AC(1)-340 Traditional harvesting

- Métis Nation of Ontario
  - TMI_438-AC(1)-113 Traditional harvesting
  - TMI_500-AC(1)-174 Traditional harvesting

- City of Dryden resident
  - TMI_732-PC(1)-47 Traditional harvesting
  - TMI_733-PC(1)-48 Traditional harvesting
  - TMI_742-PC(1)-57 Traditional harvesting
  - TMI_747-PC(1)-62 Traditional harvesting

Cultural resources

- Government agencies
  - TMI_240.1-HE(1)-47 Cultural resources
- Wabigoon Lake Ojibway Nation
  - TMI_354-AC(1)-28 Cultural resources
- Naotkamegwanning First Nation
  - TMI_664-AC(1)-337 Cultural resources
  - TMI_683-AC(1)-355 Cultural resources

6.21.7.3 Socio-economic Effects on Aboriginal people

- Government Agencies
  - TMI_226-HE(1)-33 Aboriginal socio-economic study area

- TMI_228-HE(1)-35 Aboriginal socio-economic effects
- TMI_265-PB(1)-1 Aboriginal socio-economic effects

- Métis Nation of Ontario
  - TMI_407-AC(1)-82 Aboriginal socio-economic conditions
  - TMI_446-AC(1)-120 Aboriginal socio-economic effects
  - TMI_496-AC(1)-170 Aboriginal socio-economic conditions
  - TMI_560-AC(1)-234 Aboriginal socio-economic effects
  - TMI_575-AC(1)-249 Aboriginal socio-economic conditions
  - TMI_578-AC(1)-252 Aboriginal socio-economic conditions

6.22 Summary of Mitigation

A number of mitigation measures will be implemented at the Project to mitigate the potential adverse effects. A list of all these mitigation measures is provided in Table 6.22-1.

Table 6.22-1: Summary of Mitigation Measures

Mitigation Identifier	Mitigation Description
Mit_001	Reduce the overall height of the constructed features to the extent possible.
Mit_002	Construct WRSA and overburden stockpiles with a 3:1 (horizontal to vertical) side slope.
Mit_003	Initiate construction of the WRSA from the western edge
Mit_004	Vegetate the western facing side of the WRSA as soon as possible
Mit_005	Vegetate of the overburden stockpile as soon as possible
Mit_006	Decommission the low-grade ore (LGO) stockpile at the end of operations
Mit_007	Overburden materials (clay, sand or organic material) stripped during the site preparation and construction phase will be placed in the overburden stockpiles located directly to the south of the proposed open pits.
Mit_008	Construct a perimeter ditch and seepage collection system around the operations area to capture and direct all runoff from the site to the water management system.
Mit_009	Equipment will be maintained in good working order and inspected regularly
Mit_010	Re-fueling of equipment will be done in a manner to limit the potential for spills
Mit_011	Fuel will be stored in a lined, contained area.
Mit_012	Fueling vehicles will be parked in a concrete lined area when not in use.
Mit_013	Emulsion will be stored and dispensed in a lined, contained area
Mit_014	Trucks used for the delivery of emulsion will be parked in a concrete lined area when not in use.
Mit_015	Processing plant area will be lined and equipped with runoff and seepage collection
Mit_016	LGO stockpile will be lined and equipped with runoff and seepage collection
Mit_017	Activities on the overburden stockpiles will be minimized and the stockpiles left undisturbed until closure activities are underway.

Table 6.22-1: Summary of Mitigation Measures (continued)

Mitigation Identifier	Mitigation Description
Mit_018	The WRSA will be covered with a low permeability cover during closure
Mit_019	Waste rock will be evaluated and segregated between PAG and NAG rock, if feasible
Mit_020	The PAG waste rock would be placed in the mined out areas of the open pit, to the extent practical.
Mit_021	A water cover will be maintained over the tailings in the TSF during operations
Mit_022	The open pit will be allowed to flood at closure
Mit_023	Tailings within the TSF will be isolated using either a low permeability dry cover, or a wet cover of non-process water. The preferred option for limiting environmental effects is a wet cover.
Mit_024	Batch treatment of the pit lake during filling, as required, to meet PWQO prior to release.
Mit_025	Heavy equipment activity will be conducted between the hours of 07:00 and 22:00, if feasible
Mit_026	Endeavor to schedule noise causing events, such as blasting, to reduce disruption to residents.
Mit_027	Advise nearby residents of significant noise-causing activities, such as blasting.
Mit_028	All internal combustion engines will be fitted with appropriate muffler systems
Mit_029	Implement a modern blasting program that minimizes the blast area, the overall amount of explosives required, and through detonating procedures, minimize the amount of explosives per delay.
Mit_030	Adjust blasting practices if effects of vibration to spawning shoals is identified
Mit_031	Material will be loaded into haul trucks in a manner that minimizes the drop height from the loader or excavator bucket to the bed of the truck
Mit_032	The WRSA and overburden stockpile will be situated to act as noise berms
Mit_033	In the event that complaints lead to the identification of specific sources of concern, source-specific abatement such as noise walls, berms, or operational restrictions will be employed, as appropriate.
Mit_034	Activities during the site preparation and construction phase will generally occur during the daytime. If there are times when lighting is required to ensure the safety of the workers, portable lighting will be used in required areas only.
Mit_035	Portable lighting will be directed downward
Mit_036	The higher Lux illumination levels (>80) will be placed within the process plant and mine infrastructure buildings, which contains the process and electrical equipment.
Mit_037	All externally mounted luminaires and their associated lamps will be designed to meet the requirements and recommendations of the Canadian Electrical Code (CEC), and the Building Code of Ontario.
Mit_038	External light fixtures will be installed at a tilt angle of 45º
Mit_039	Cut off angles for external lightings will be designed to minimize the off-site light trespass
Mit_040	Nighttime illumination will not be provided at the tailings storage facility (TSF).
Mit_041	Nighttime illumination will only be provided in the open pit when required. Portable lighting will be used in these situations.
Mit_042	Activities during the closure phase will generally occur during the daytime. If there are times when lighting is required to ensure the safety of the workers, portable lighting will be used in required areas only.
Mit_043	Blasting will likely be restricted to once per day, and only a few days per week.
Mit_044	All internal combustion engines will be properly maintained and all emission control systems (e.g., diesel particulate filters) will be kept in good working order.
Mit_045	Water and chemical suppressants will be used for dust control on the haul roads at the mine site when temperatures are above freezing
Mit_046	Best management practices plan for dust control will be implemented on the site during site preparation and construction, operations and closure.
Mit_047	The Project will utilize the 115 kV transmission line adjacent to the Project
Mit_048	The WRSA will be located immediately to the north of the open pit
Mit_049	Placing the overburden storage area immediately to the south of the open pit to reduce the haul distances.
Mit_050	Project design incorporates a compact footprint.
Mit_051	Perimeter runoff and seepage collection systems will be constructed around the TSF.

Table 6.22-1: Summary of Mitigation Measures (continued)

Mitigation Identifier	Mitigation Description
Mit_052	The drawdown zone of the dewatering process will capture all seepage that bypasses the seepage collection systems and will report to the open pit.
Mit_053	During operations, excess water not required in the process will be treated to concentrations that meet Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, prior to discharging to Blackwater Creek. In the case of mercury, effluent will be treated to meet the background concentrations in Blackwater Creek.
Mit_054	Industry standard erosion and sediment controls, such as sediment traps within ditches, will be implemented during the site preparations and construction phase.
Mit_055	There will be no discharges to surface water during the closure phase.
Mit_056	During closure, the site will be graded such that runoff for the operations area will be directed to the open pit during closure and post-closure phases.
Mit_057	Effectively manage water collected on-site using constructed storage facilities, reducing the need for fresh water withdrawals and discharges of treated water.
Mit_058	An engineered structure, designed to dissipate flows and avoid erosion, will be constructed to discharge effluent during operations into Blackwater Creek.
Mit_059	Fresh water takings from tree nursery irrigation ponds on Thunder Lake Tributaries 2 and 3 will not exceed 5% of the flow entering the ponds
Mit_060	Once the open pit has been filled, excess water from the open pit will be passively released through an engineered spillway into the existing channel of Blackwater Creek Tributary 1.
Mit_061	Effluent from the processing plant will be treated prior to being discharged to the TSF. Effluent directed to the TSF would meet MMER requirements.
Mit_062	The floor of the TSF will be low-permeability using both native soils and suitable clay from open pit stripping. In the event the volume of clay is insufficient, a synthetic liner will be used.
Mit_063	Deepen those wells where the drawdown affects the wells ability to provide the required supply.
Mit_064	Financial assurance will be provided to MNDM to deepen neighbouring residential wells, if required, as part of Project start-up approvals.
Mit_065	Minimized the amount of habitat clearing required for the Project by siting Project infrastructure in previously disturbed areas and optimizing the use of existing roadways.
Mit_066	Develop slope dependent vegetated buffers along rivers creeks and wetlands in conjunction with the MNRF. Buffers should be 120 m, wherever feasible.
Mit_067	Timber clearing will be conducted outside the breeding bird window (May 1 to August 15).
Mit_068	Closure activities should include revegetation with species suitable for the development of habitats capable of supporting a diversity of wildlife species.
Mit_069	Enforcement of speed limits within the Project area
Mit_070	Avoid disturbing areas with suitable bird breeding habitat, where possible.
Mit_071	Wildlife awareness training for all staff will be provided including SAR identification/legislation and education regarding seasonal changes in animal behaviour and their presence.
Mit_072	Disposal of food waste generated on site will be done in an appropriate manner
Mit_073	Clearing of potential terrestrial reptile and amphibian breeding habitats will be restricted to periods outside the breeding season as directed by MNRF
Mit_074	Develop a wetland clearing strategy with the local MNRF to reduce the effects to overwintering frogs (i.e. draining wetlands to discourage hibernation).
Mit_075	If habitat cannot be avoided, alternate nesting habitat will be provided as a provision of compensatory habitat for species protected under the ESA
Mit_076	Acceptable buffers will be provided around all raptor nests identified throughout all Project phases
Mit_077	Prior to overburden removal, any beaver dams within the Project footprint will be removed and the impoundments will be allowed to draw down.

Table 6.22-1: Summary of Mitigation Measures (continued)

Mitigation Identifier	Mitigation Description
Mit_078	Activities and the construction of Project components that will impact or overprint watercourses will occur during the fisheries timing window when in-stream work is permitted.
Mit_079	To the extent possible, fish in the sections of Blackwater Creek Tributary 1 that will be isolated by the construction of the perimeter ditch and overprinted by the removal of overburden from the open pit will be captured and relocated to the same tributary downstream from the operations area, or to the main branch of Blackwater Creek.
Mit_080	To the extent possible, fish in the sections of Blackwater Creek Tributary 2 that will be isolated by the construction of the perimeter ditch and overprinted by the construction of the TSF and minewater pond will be captured and relocated to the same tributaries downstream from the operations area, or to the main branch of Blackwater Creek.
Mit_081	Pump intakes in the irrigation ponds at the former MNRF tree nursery will be fitted with fish screens to prevent entrainment.
Mit_082	As the Project advances, detailed engineering will be completed to ensure that all downstream culverts can support any predicted increases in flows and maintain current levels of fish passage.
Mit_083	Provide offsetting of fisheries habitat losses as part of the authorization required under the Fisheries Act.
Mit_084	Retention of forested areas wherever feasible.
Mit_085	Identify and protect the locations of any known SAR or provincially significant plant.
Mit_086	Broadcast spraying of herbicides will be avoided
Mit_087	Revegetation of all slopes around the open pit to encourage the development of riparian habitats.
Mit_088	Reclamation of mining footprints to be carried out in accordance with O.Reg. 240/00.
Mit_089	Seeding or hydro-seeding of the reclaimed areas with native seed mix.
Mit_090	Minimize crown land in the Project footprint
Mit_091	Minimize activities on the eastern portion of the Project property.
Mit_092	During the operating life of the Project, the operations area will be fenced and no access will be permitted for security and safety reasons. Access to the former MNRF tree nursery will be controlled. Aboriginal peoples will be able to arrange for accompanied access to these areas with Treasury Metals. Appropriate signage will be placed around areas where access is limited.
Mit_093	Implement a Communications Management Plan to address ongoing engagement with potentially affected stakeholders and Aboriginal groups throughout the life of the Project. The plan should include a framework for a transparent grievance process.
Mit_094	Treasury Metals will undertake a land and resources use baseline to establish a pre-construction baseline of the land and resource users.
Mit_095	Develop a Socio-Economic Management Plan to help ensure commitments are implemented, adverse socio-economic effects are minimized, results are monitored, and effects are adaptively managed.
Mit_096	Collect traditional land use information for the Project area through meetings and traditional land use studies to identify areas of plant gathering, hunting, trapping, fishing, and cultural activities.
Mit_097	Contract security services to help promote a secure and safe worksite environment
Mit_098	Incorporate strategies and actions to aid residents following closure in the Socio-Economic Management Plan.
Mit_099	Treasury Metals will establish and enforce traffic safety protocols, regulatory and cautionary signage, road maintenance and emergency response plans on all Project roads to prevent collisions and accidents.
Mit_100	Ongoing engagement with potentially affected Aboriginal peoples throughout the life of the Project.
Mit_101	Ongoing engagement with potentially affected stakeholders throughout the life of the Project.
Mit_102	Treasury Metals will undertake an update of the socio-economic baseline to establish a pre-construction baseline of the affected communities prior to commencing the Project site preparation and construction
Mit_103	Employment preference will be given to local and regional labour where possible, including Aboriginal and non-Aboriginal communities. This will be dependent upon the skills and workforce being available locally.
Mit_104	Develop training and job transfer policies to support workforce development in the socio-economic study area
Mit_105	Develop training programs for unemployed and under employed residents and non-workers

Table 6.22-1: Summary of Mitigation Measures (continued)

Mitigation Identifier	Mitigation Description
Mit_106	Treasury Metals will communicate appropriate information (e.g., the timing and communities in which new residents may locate) to the school district(s) to assist with their resource planning process.
Mit_107	Treasury Metals will communicate education requirements needed for employment on the site.
Mit_108	Treasury Metals will work with specific affected homeowners to ensure that their concerns about potential Project-related effects are addressed.
Mit_109	Treasury Metals will work with local and regional governments to minimize the effects of in-migration and out-migration where possible.
Mit_110	Treasury will work with public safety services to develop safety and work policy guidelines for mine workers, including a policy of no alcohol or drugs onsite and policies and guidelines to support a respectful work environment.
Mit_111	Incorporate strategies and actions to help local agencies monitor community wellbeing and take corrective actions where appropriate.
Mit_112	Treasury Metals will engage the Local Services Board in Wabigoon to acquire Tree Nursery Road in its entirety from north of Normans Road.
Mit_113	Treasury Metals will approach MTO to discuss recommendations presented within the transportation study (Appendix E to the Revised EIS) regarding the snow plow turn-around for Anderson Rd. and Highway 17.
Mit_114	Treasury Metals will approach MTO to discuss recommendations presented within the transportation study (Appendix E to the Revised EIS) regarding the need for lighting at the Anderson Rd. and Highway 17 intersection.
Mit_115	Treasury Metals will approach MTO to discuss recommendations presented within the transportation study (Appendix E to the Revised EIS) regarding clearing of shrubbery, trees, soil mounds, etc. that could cause a visual obstruction for vehicles using the Anderson Rd. and Highway 17 intersection.
Mit_116	Treasury will maintain, where applicable, a local purchasing policy to purchase goods and services from local suppliers. This policy has the expectation that goods and services will be purchased locally assuming price, delivery and service is competitive with outside suppliers.
Mit_117	Revegetation of the WRSA and TSF will be done using species that are not traditionally used for medicinal purposes, or for consumption, and would deter these types of plants from growing.
Mit_118	Leave a 50 m buffer zone around remaining watercourses within the Project area.
Mit_119	If previously undocumented archaeological resources are discovered, the person discovering the resources will stop alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (l) of the Ontario Heritage Act.
Mit_120	If human remains are discovered, alteration of the site will stop and the person making the discovering will immediately notify the police, or coroner, and the Registrar of cemeteries, at the Ministry of Consumer Services, as required under the Cemeteries Act, R.S.O. 1990 c.C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 (when proclaimed in force).
Mit_121	Restrict activities and development within 300 m of major water sources and within 300 m of historical travel routes, to only those areas where an archeological assessment has been completed.
Mit_122	Do not allow new ground altering activities to occur in areas where an archaeological assessment has not been completed. Once an archaeological assessments has been completed ground altering activities.
Mit_123	At closure, continue training opportunities to help residents to increase their competitiveness and chances to get employment elsewhere

6.23 Federal Consideration

The description of the potential effects of the Project on the physical, biological and human components of the environments are presented in Sections 6.2 to 6.21. This section identifies

where the information that is directly linked or necessary or incidental federal decisions that would be required in order to permit the Project to be carried out.

6.23.1 Changes in Environmental Components within Federal Jurisdiction

As described in Section 6.13, the Project has the potential to affect migratory birds. More specifically, the following Project activities may potentially affect species that are covered under the *Migratory Birds Convention Act*:

- Clearing of the Project site may displace potential habitat areas;
- General site activities during the various Project phases may deter bird species from using the area; and
- Vehicle collisions may result in accidental bird fatalities.

As described in Sections 6.12 (Wildlife), 6.14 (Fish), and 6.15 (Wetlands and Vegetation), the Project has the potential to affect species at risk. More specifically, the following Project activities may potentially affect species that are covered under the *Species at Risk Act*:

- Clearing of the Project site may displace species at risk for potential habitat areas;
- Clearing of the Project site may result in the loss of plant species at risk;
- Overprinting of watercourses may cause mortality to fish species at risk, or remove habitat for fish species at risk;
- Releases form the Project could affect the health of species at risk, or the habitat they rely on;
- Changes in surface water flows as a result of the Project could affect habitat fish species at risk; and
- General site activities during the various Project phases may deter species at risk from using the area.

As described in Section 6.14, the Project has the potential to affect fish and fish habitat. More specifically, the following Project activities may potentially affect species that are covered under the *Fisheries Act*.

- Overprinting creeks and tributaries could have a direct loss of habitat and reduction of flows;

- Blasting could cause mortality of fish; and
- Project activities affect flow conditions in adjacent watercourses.

6.23.2 Changes to Environment on Federal or Transboundary Lands

The Project is not anticipated to cause any changes to the environment on federal lands. The Project is located about 120 km from the border between Canada and the United States, which is beyond the 100 km range where notification may be required under the 1991 Canada-United States Air Quality Agreement. There are no other transboundary effects of eh Project.

6.23.3 Changes to the Environment Linked or Incidental to Federal Decisions

The activities described in Section 3 that could potentially affect fish and fish habitat and/or aquatic species may require authorizations under the *Fisheries Act*.

The Project activities including overprinting watercourses and altering flows in watercourses, which may interfere with navigation in non-scheduled waters under the *Navigation Protection Act* may be subject to the common law right of navigation. Treasury Metals has received a letter from the Navigation Protection Program of Transport Canada (2017) indicating that the Project would not require an exemption under the *Navigation Protection Act,*

6.23.4 Effects of Changes to the Environment on Aboriginal People

An important responsibility for the Agency is to ensure that the proposed Project does not adversely impact Aboriginal peoples. It is recognized that such effects could be direct effects on Aboriginal peoples and their rights, or the effects could be as a result of changes to the environment caused by the Project. To capture these potential effects, Treasury Metals has provided an integrated assessment that identifies, and assesses how potential changes to the environment could potentially affect Aboriginal peoples. The linkages that were considered between changes in the environment and potential effects on Aboriginal peoples are described in Section 6.21.1 and illustrated in Figure 6.21.1-1. For example, the predicted effects of the Project on Aboriginal peoples considers how changes in the environment could affect traditional practices such as hunting, fishing, trapping, and gathering traditional plants. Additionally, the potential for changes in the environment to affect the health of people in the area, including Aboriginal peoples has been assessed.

6.23.5 Effects of Changes to the Environment Linked or Incidental to Federal Decisions

The changes described above in Section 6.21 are not expected to have any effects on social conditions (Section 6.17), economic factors (Section 6.18), human health (Section 6.19) or heritage resources (Section 6.20).