APPENDIX D

TAILINGS STORAGE FACILITY

D-1 TSF Alternatives Assessment WSP
D-2 Multiple Accounts Analysis

NOTE TO READER
APPENDIX D

In April 2015, Treasury Metals submitted an Environmental Impact Statement (EIS) for the proposed Goliath Gold Project (the Project) to the Canadian Environmental Assessment Agency (the Agency) for consideration under the Canadian Environmental Assessment Act (CEAA), 2012. The Agency reviewed the submission and informed Treasury Metals that the requirements of the EIS Guidelines for the Project were met and that the Agency would begin its technical review of the submission. In June 2015, the Agency issued a series of information requests to Treasury Metals regarding the EIS and supporting appendices (referred to herein as the Round 1 information requests). The Round 1 information requests included questions from the Agency, other federal and provincial reviewers, First Nations and other Aboriginal peoples, as well as interested stakeholders. As part of the Round 1 information request process, the Agency requested that Treasury Metals consolidate the responses to the information requests into a revised EIS for the Project.

Appendix D to the revised EIS (Tailings Storage Facility assessment and multiple accounts analysis) presents the information related to the alternatives assessment of various locations and methodologies for the storage of mine tailings and location of the minewater pond. The appendix includes the following two components:

- D-1: Tailings Storage Facility Alternatives assessment written by WSP Canada Inc., dated July 21, 2014. This provides a full assessment of tailings storage methodologies and locations for the Project and was submitted as part of the original EIS. The report includes Site Characteristics, Alternatives Assessment Parameters, Alternatives Assessment and technical information pertaining to the preferred alternative. As part of the Round 1 information requests, Treasury Metals has made significant changes to the alternatives assessment for tailings storage. As such, Sections 1, 2, 4 and 6 have been superseded by the information provided in Appendix D-2. No changes have been made to Sections 3.0 and 5.0 of Appendix D-1, which continue to be relied on in Appendix D-2 and the revised EIS.

- D-2: Multiple Accounts Analysis - Assessment of Alternatives for Storage of Mine Waste, dated August 31, 2017. This draft report provides a full multiple accounts analysis of various methodologies and locations for the storage of tailings material as per the Metal Mines and Effluent Regulations and pursuant to the Guidelines for the Assessment of Alternatives for Mine waste Disposal. The report is currently in a draft form as discussions with appropriate regulators are still pending. The draft report includes a summary of the environmental conditions, study methodology, candidate alternatives, pre-screening assessment of alternatives, characterization of remaining alternatives and a value based decision process using a multiple accounts ledger and sensitivity analysis. Finalization of the multiple accounts analysis is pending consultation with relevant agencies and incorporating their feedback.

The information in this appendix was used in preparing Section 2.4.2 and Section 3.7 of the revised EIS.

As part of the process to revise the EIS, Treasury Metals has undertaken a review of the status for the various appendices. The status of each appendix to the revised EIS has been classified as one of the following:

- **Unchanged**: The appendix remains unchanged from the original EIS, and has been re-issued as part revised EIS.
- **Minor Changes:** The appendix remains relatively unchanged from the original EIS, and has been re-issued with relevant clarification.
- **Major Revisions**: The appendix has been substantially changed from the original EIS. A re-written appendix has been issued as part of the revised EIS.
- **Superseded:** The appendix is no longer required to support the EIS. The information in the original appendix has been replaced by information provided in a new appendix prepared to support the revised EIS.
- **New**: This is a new appendix prepared to support the revised EIS.

The following table provides a listing of the appendices to the revised EIS, along with a listing of the status of each appendix and their description.

List of Appendices to the Revised EIS		
Appendix	Status	Description
Appendix A	Major Revisions	Table of Concordance
Appendix B	Unchanged	Optimization Study
Appendix C	Unchanged	Mining Study
Appendix D	Major Revisions	Tailings Storage Facility
Appendix E	Minor Changes	Traffic Study
Appendix F	Major Revisions	Water Management Plan
Appendix G	Superseded	Environmental Baseline
Appendix H	Minor Changes	Acoustic Environment Study
Appendix I	Unchanged	Light Environment Study
Appendix J	Minor Changes	Air Quality Study
Appendix K	Minor Changes	Geochemistry
Appendix L	Superseded	Geochemical Modelling
Appendix M	Minor Changes	Hydrogeology
Appendix N	Unchanged	Surface Hydrology
Appendix O	Superseded	Hydrologic Modeling
Appendix P	Unchanged	Aquatics DST
Appendix Q	Major Revisions	Fisheries and Habitat
Appendix R	Major Revisions	Terrestrial
Appendix S	Major Revisions	Wetlands
Appendix T	Unchanged	Socio-Economic

List of Appendices to the Revised EIS		
Appendix	Status	Description
Appendix U	Minor Changes	Heritage Resources
Appendix V	Major Revisions	Public Engagement
Appendix W	Unchanged	Screening Level Risk Assessment
Appendix X	Major Revisions	Alternatives Assessment Matrix
Appendix Y	Unchanged	EIS Guidelines
Appendix Z	Unchanged	TML Corporate Policies
Appendix AA	Major Revisions	List of Mineral Claims
Appendix BB	Unchanged	Preliminary Economic Assessment
Appendix CC	Unchanged	Mining, Dynamic And Dependable For Ontario's Future
Appendix DD	Major Revisions	Indigenous Engagement Report
Appendix EE	Unchanged	Country Foods Assessment
Appendix FF	Unchanged	Photo Record Of The Goliath Gold Project
Appendix GG	Minor Changes	TSF Failure Modelling
Appendix HH	Unchanged	Failure Modes And Effects Analysis
Appendix II	Major Revisions	Draft Fisheries Compensation Strategy and Plans
Appendix JJ	New	Water Report
Appendix KK	New	Conceptual Closure Plan
Appendix LL	New	Impact Footprints and Effects

PROJECT N^{O}: 141-12598-00

Tailings Storage Facility Alternatives Assessment

GOLIATH PROJECT

Treasury Metals Incorporated

141-12598-00

Report 1, Rev. 0

July 21, 2014

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1 INTRODUCTION

1.1 GENERAL

Treasury Metals Incorporated (TM) owns mining rights to the Goliath Project (Project) and is in the process of completing preliminary engineering assessments for the site. The Goliath Project site is located adjacent to the village of Wabigoon, Ontario, approximately 20 km east of Dryden, Ontario and is approximately 330 km west of the city of Thunder Bay, Ontario. The geodetic coordinates of the proposed Project are approximately centered on 49°45'25" N by 92°36'30" W and the Project Site Location and Key Plan is shown on Figure 1.1. The Goliath site contains gold and silver deposits and consists of 137 unpatented mining claims and 20 patented mining claims within an area of 4,064 hectares. The site is located partially within both the Hartman and Zealand townships and includes a total area of approximately 4,976 hectares. The general elevation is approximately 400 metres above sea level (masl), has an average annual temperature of 2.1°C and experiences 0.7 metres of precipitation annually with approximately 24% of the annual total falling as snow.

The site is currently accessible year round from Highway 17 and multiple public secondary roads that extend north from Hwy 17 consisting of Anderson Road, Maggrah Road and Tree Nursery Road. Power supplies are close to the site and there is a natural gas pipeline proximal to the site.

The November 2011 National Instrument 43-101 (NI 43-101) Mineral Resource report by A.C.A. Howe indicates an approximate resource of 1.6 million ounces of gold including an additional 5 million ounce silver by-product resource. Future drilling is planned for the site that could identify additional resources that would be available to be mined.

1.2 BACKGROUND INFORMATION

The Goliath site will be a new development as the area has no historic mining activities completed to date. The site was previously used by the Ministry of Natural Resources (MNR) as a tree nursery and the existing infrastructure at the site consists primarily of buildings that were used for the tree nursery.

Limited documentation is available prior to 1989 for site exploration activities. Work done by Teck Exploration (now Teck Resources) after 1989 identified a poorly exposed, broad area of weak mineralisation and anomalous gold extending through parts of lots 3 through 8 of

Concession IV of Zealand Township. Site exploration commenced in 1990 and concluded in 1998 that consisted of approximately 78,000 metres of diamond drilling, after which the project was suspended. A bulk sample of 2,375 tonnes was collected in 1998 from an underground drift at a depth of approximately 250 m accessed from an underground ramp that runs north into the main zone of the ore body and splits off in the east-west direction (on strike) for approximately 100-150 metres in either direction. The portal to the underground ramp was closed as per a closure plan by Teck in 1998.

The current Project site primarily consists of two historic properties consisting of the Thunder Lake Property, previously owned by Teck-Corona, and the Laramide Property. TM obtained the mining rights to the site in 2008 and since that time has been active at the site completing site exploration activities. Site exploration is currently on-going, at the time of this report, which includes in-fill and condemnation drilling activities.

Operations for the Project will consist of an onsite crusher, mill and processing plant, ore stockpile, warehouse and other office buildings. Mining activities will consist of an open pit followed by an underground operation. The open pit can be used for storage of mine waste rock once underground mining activities commence. Mine waste, consisting of waste rock and tailings will be stored on-site. The processing is anticipated to consist of 2,700 dry tonnes per day (dtpd) throughput over the mine life which is currently estimated at 12 years.

TM completed a Project Description Report (PD Report) entitled "Project Description – Goliath Gold Project, Treasury Metals Incorporated" dated November 26, 2012. The PD Report was submitted to the Canadian Environmental Assessment Agency (EAA) and the Ministry of Northern Development and Mines (MNDM) for consideration.

1.3 PROJECT SCOPE OF WORK

TM is in the process of completing the Environmental Impact Statement (EIS) for the Goliath Project Site. An Alternatives Assessment for the tailings storage location and deposition technology has been identified for completion to support the EIS. The scope of work identified for this project consists of completion of the Alternatives Assessment and identification of the preferred location for tailings storage and the deposition technology. This report presents a comprehensive summary of the work undertaken to complete the Alternatives Assessment and the identification of the preferred alternative. The information presented in this report will be included with the EIS for the project.

2 SITE CHARACTERISTICS

2.1 SITE LOCATION

The Goliath property is located approximately 20 km east of the city Dryden, Ontario, adjacent to the village of Wabigoon, which is approximately 330 km west of the city of Thunder Bay, Ontario. The property is located within the Arctic Watershed for general global site runoff and specifically within the Wabigoon River Watershed. The area has moderate to flat topography with elevations ranging from approximately 360 masl to 500 masl. The area has been generally identified as having hardwood boreal forests consisting of black spruce, white spruce, balsam fir, jack pine and tamarack and incudes an abundance of wetlands including bogs, fens and marshes. A plan showing the existing conditions of Project Site is provided as Figure 2.1.

Access to the site is from Highway 17 and multiple public secondary roads that extend north from Hwy 17 consisting of Anderson Road, Maggrah Road and Tree Nursery Road. Road travel is accessible year round with snow clearing completed on the municipal roads by the City of Dryden and the mining roads maintenance including snow clearing being the responsibility of TM.

Dryden is a community of more than 7,000 people and has services such as an airstrip, a hospital, schools, restaurants, grocery stores and hotels. Dryden is primarily accessible from the west and east via Highway 17, from the North via Hwy 72 and from the South via 594.

2.2 HABITAT AND LAND USE

Previous studies and a field programs completed during the 2010-2011 field season were used by TM to identify the local habitat. A total of 20 mammal species were previously identified that included moose, white-tailed deer, black bear, grey wolf, and small furbearers. A total of 120 bird species were previously observed with 101 of those known to nest, or suspected to nest in the area. A total of seven species of amphibians were observed, and five were previously recorded during the 2011 field season that was limited to one toad, three tree frogs, two true frogs and one mole salamander. The tetraploid gray tree frog and eastern American toad were observed in most of the suitable habitats. Two (2) reptile species, the western painted turtle and the eastern garter snake, were observed during the 2011 field program. Four (4) species of butterflies and eighteen species of dragonflies and damselflies (Odonates) have been observed in the study area. Two of the species, the Pronghorn Clubtail and Horned Clubtail are provincially rare.

The surrounding area of the Goliath Project site has a varied land use. The project site is located in close proximity to the village of Wabigoon and the city of Dryden. Snowmobiling, hunting, fishing and camping are popular recreational activities in the area, and both forestry and the pulp industries have played a large part in the local economy.

2.3 GEOLOGICAL SETTING

The Goliath Project site is situated within the volcano-plutonic Eagle-Wabigoon-Manitou Greenstone belt in the Wabigoon Subprovince, just north of the large-scale regional Wabigoon fault. This Subprovince is part of the Archean Superior Province and located in northwestern, Ontario. The greenstone belt is 150 kilometres wide, with an exposed strike length of 700 kilometres. The Wabigoon fault is a large-scale regional structure that is separated into a northern and southern domain. The northern domain generally consists of southward-facing panels of alternating metavolcanic and metasedimentary rocks. North of the Wabigoon fault the geology primarily consists of metasedimentary rocks that are assumed to be predominant. The southern domain is generally composed of northward-facing, volcanic rocks. The Wabigoon fault is observed at surface just north of the village of Wabigoon.

The majority of the project area is underlain by the Thunder Lake Assemblage, an upper greenschist to lower amphibolite metamorphic grade volcanogenic-sedimentary complex of felsic metavolcanic rocks and clastic metasedimentary rocks. The assemblage comprises quartz-porphyritic felsic to intermediate metavolcanic rocks represented by biotite gneiss, mica schist, quartz-porphyritic mica schist, a variety of metasedimentary rocks and minor amphibolites. Compositional layering is present in metasedimentary rocks strikes ~70° to 90° and dips from 70° to 80° south to southeast. The Thunder River Mafic Metavolcanic rocks underlie the south part of the Property. The mafic rocks are generally massive flows but are pillowed locally and include amphibolite and mafic dykes, which are characterised as chlorite schists. Some rocks have been described as ultramafic in character. The regional geology and lithology is included as a Figure 2.2.

2.4 SURFICIAL MATERIALS

The surficial geotechnical materials at the Goliath site generally consist of outwash plain, valley terrain, Glaciolacustrine plain, organic terrain, Kame, kame field, kame terrace, kame moraine and bedrock knobs. They occur in varying thickness depending on the topography in which they are deposited and the process by which they settled. The soils deposits are described as being clay or clayey, silt to silty, sands and also gravels and organic peat. A Ground Moraine located to the north of the project site is described as being predominantly till material. Relief at the site is low to moderate of undulating to rolling variety. Drainage is described as being predominantly dry with wet conditions in areas consisting of organic terrain.

A site investigation (SI) was completed in late March to early April, 2013 for the purpose of investigating the in situ soil conditions at the proposed plant site and potential TSF areas, consisting of Location 1 and Location 6. The information collected during the SI will be used to support the engineering design phase as the project is advanced. The factual soils information from the SI is provided as Appendix A.

2.5 CLIMATE CONDITIONS

The climate in the Dryden and Goliath project site area is characterized by moderately long, cold winters and shorter, warm summers typical of continental conditions. The area experiences a wide variation in temperature throughout the year. In winter months, the temperature can drop below -20°C for extended periods. In the summer, the maximum daily temperature may reach over 30°C for extended periods. The daily mean temperatures typically fall below freezing from November through March.

Two meteorological stations are close to the project site and are identified as “Dryden” and “Dryden A”. Review of Climate Normals for 1970 – 2000 for the Dryden A station indicates that precipitation in the region is characterized as moderate and is generally distributed throughout the year with some seasonal trends. However, the wettest months generally occur in the summer, from June to September. The average annual total precipitation at the Dryden A station based on Climate Normals (1971-2000) is 701 mm, with 536 mm falling as rain and 165 mm falling as water equivalent to snow. The Report “Goliath Gold Project Baseline Study – November 2010 to November 2011” by Klohn Crippen Berger, Ref. No. M09706A01, dated September 21, 2012 (Environmental Baseline Study) for the site assessed longer ranges of data for the Dryden A, Dryden Station as well as the Sioux Lookout A station. The results of the assessment for Dryden A station indicated values of 536 mm rainfall, 170 mm was water equivalent snow with a total precipitation of 706 mm. These values compare with the 1970-2000 Climate Normals and have therefore been adopted for this project. The Environmental Baseline report also identified daily average temperature ranges from -18.2 C in January to +18.5 C in July.

TM has installed a meteorological station at the site. The station became operational on July 18, 2012 and collects wind, precipitation, barometric and humidity data. Data from the meteorological station is anticipated to be utilized throughput the operations at the site.

Evaporation data is not collected at the local meteorological stations. The Environmental Baseline Report indicated that mean annual lake evaporation ranges from 500 mm to 600 mm. This result compares to the PD Report that indicted annual lake and pond evaporation estimated at the site for the year 2011 was in the range to 500 mm to 600 mm. Environment Canada recommended that (TML) use the EC lake evaporation data observed at Rawson Lake station (ID: 6036904, 49.65°N, 93.72°W), which is located approximately 80 km southwest of the project site. The total yearly evaporation identified at the Rawson Lake station is approximately 537 mm, which corresponds to the values presented in the Environmental Baseline Report. The monthly evaporation data from the Rawson Lake station is provided below.

Month	Evaporation, (mm)
May	115
June	123
July	127
Aug	109
Sept	63
Total	**537**

Extreme rainfall depths for the project were investigated to determine 24-hr storm depths for various return periods. The amount of rainfall for the various extreme rainfall return periods was calculated using the following equation (Hogg and Carr, 1985):

- $X(T) = X_m + K(m_{24}) \times S$, where:
- X = Total Rainfall for Event (mm)
- X_m = Mean Precipitation (mm)
- S = Standard Deviation (mm)
- T = Return Period (years)
- $K(m_{24})$ = Return Period Constant

Based on Figures D1 and D2 in the "Rainfall Frequency Atlas For Canada" (Hogg and Carr, 1985), the mean precipitation (X_m) and the standard deviation (S) for the Dryden Area have been taken to be 46 mm and 16 mm, respectively. The resultant storm depths are provided below:

Return Period (Years)	Storm Depth (mm)
2	43
10	67

25	79
50	87
100	96
200	105
1,000	125
PMP	320

The Environmental Baseline Study that was previously completed for the Goliath Project included an assessment of potential storm depth for various return periods as well as storm durations (i.e. 5-min, 1-hr, 12-hr, etc.), that also included the rainfall depth (storm depth) for the 24-hr storm. Selected resultant storm depths as presented in the Environmental Baseline Report are as per the following table:

Return Period (Years)	Storm Depth (mm)
2	44
10	62
25	90
50	101
100	113
200	-
1,000	-
PMP	-

Comparison of the Environmental Baseline study values shows a slight increase when compared to the storm depths resulting from the Hog and Carr method. Therefore the storm depths from the Environmental Baseline Study have been adopted for this project. However, storm depth for the 1:200, 1:1,000 and PMP were not provided in the Environmental Baseline Study and therefore storm depths from the Hogg and Car method have been adopted for these 24-hr return periods.

2.6 TOPOGRAPHY

Topography in the general area of the Goliath Property is described as having low slopes, rolling hills and is marked by a low occurrence of streams, ponds, and marsh lands. The approximate elevation of the proposed plant site is El. 395 masl and elevation differences within 20 km of the Goliath Site range from El. 360 to 500 masl. The highest elevations are found 9 km to the north and the lowest elevations at 17 km north-west of the Goliath Site. In the immediate area where infrastructure is planned topography is generally noted as increasing to the north and north-east and moderately to the south-east of the Goliath Site. Topography decreases to the west and south-west towards bodies of water identified as Thunder Lake to the west and Wabigoon Lake to the south-west.

2.7 SURFACE DRAINAGE

Surface water drainage in the area of the Goliath Site will generally occur in a West to South-west direction within two (2) main catchments and smaller sub-catchments. The main catchments route surface water runoff to the south-west towards Wabigoon Lake and to the west towards Thunder Lake. Several seasonal and permanent streams are present within sub-catchments that route surface water runoff to Wabigoon and Thunder Lake. The area of the proposed open pit mine and potential tailings storage locations are anticipated to be within areas of surface water runoff to Wabigoon Lake. The existing facilities at the Goliath Site, located to the north of the proposed open pit mine, are within surface water runoff areas that will be directed to Thunder Lake.

2.8 SEISMICITY

The project site is located within the Interior Platform Seismic Zone. This zone spans from the Cordilleran Deformation Front to the Eastern Northern Ontario region that begins east of Thunder Bay at 88°W longitude.

Seismicity within the interior platform is defined as a “Low” relative hazard region by Natural Resources Canada and is shown on Figure 2.3.

Seismic activity in this zone is very low, with the exception of an area in Southern Saskatchewan. The largest earthquake ever recorded in this area was a magnitude 5.5 event in 1909 near the Canadian-American border. Other than this small area, the entire Interior

Platform at the centre of the North American plate is a stable craton area, is the lowest Seismic Hazard Zone of Canada and is considered a seismically inactive zone.

The Geological Survey of Canada (GSC) publishes the seismic hazard model for Canada, most recently as the GSC Open File 5913 (2008) that forms the basis for Seismic Hazard Calculation. This 4th generation seismic hazard model is the basis for seismic design provisions in the 2005 National Building Code of Canada (NBCC). The 4th generation model included updated seismic source zones, magnitude-recurrence relations and ground motion attenuation relations. The 2005 code uses median ground motion on firm soils sites for a probability of exceedance of 2% in 50 years, with the ground motion being described by seismic hazard values for five parameters; spectral acceleration at 0.2, 0.5, 1.0 and 2.0 second period and peak acceleration (PA). The values of the five parameters are tabulated for more than 200,000 grid points over Canadian territory and surrounding areas. The four spectral parameters allow the construction of approximate uniform hazard spectra for all locations in Canada to provide improved earthquake resistant design.

For the central "stable" craton region of Canada, the 'F' model is used, as the source zone model. As this area has had too few earthquakes recorded to define reliable source zone and rates, the 'F' model is based on earthquake activity rates for three separate regions: central Canada, the portion of North America that is geologically similar to central Canada, and global regions that are geologically similar to central Canada. These regions have an overall activity rate that is a combined weighting of 0.2, 0.4 and 0.4 respectively. The 'F' model is the lowest level of ground motion for seismic design of buildings in Canada. However, although the seismic hazard and related seismicity levels are too low to allow for reliable estimation based on historical seismicity, international examples suggest that large (greater than Magnitude 6 Richter) can occur anywhere, however, the probability is extremely low (Johnston et al., 1994).

Consistent with current design philosophy for structures such as embankment dams, the Maximum Design Earthquake (MDE) will be selected to represent extreme earthquake loading conditions (ICOLD, 1995). Values of maximum ground acceleration and design earthquake magnitude will be determined for the MDE.

The appropriate design earthquake for the Goliath Site tailings dam can be selected on the basis of the Hazard Potential Classification (HPC) criteria taken from the CDA Guidelines (2007) and is discussed later in this report. The MDE for design purposes will be determined in accordance with the HPC as the design is advanced. Probabilistic seismic risk parameters were calculated for the site by the Canadian Geological Survey based on the NBCC and analyses of the earthquake data for the region are presented in Table 2.1.

2.9 EXISTING FACILITIES

The Goliath Project site was not been previously developed as a mining operation. There are existing buildings at the site that consist of the Tree Nursery Buildings. The existing facilities will be used as project management and mine administration offices as the project is advanced. New infrastructure is anticipated to consist of the mill, shop and administration offices to support the mining activities. There are existing roads that are currently used to access the site for the current operations, consisting of exploration drilling and environmental monitoring to support baseline data. An existing overhead utility power line is present at the site that diagonally crosses the site in a north-west direction. An existing gravel pit is present, outside of the TM property boundary, to the south near Anderson Road. A Figure showing the existing conditions site, including current property boundaries, is provided on Figure 2.1.

3 ALTERNATIVES ASSESSMENT - DESIGN PARAMETERS AND ASSUMPTIONS

3.1 GENERAL

Previous work and studies at the Goliath Project site have primarily been related to mining exploration and environmental baseline studies. As a result, design work related to tailings storage and management as well as ore processing, mine design and site water handling have been limited. Design work related to ore processing and mine designs are understood to be progressing in parallel to the tailings storage Alternatives Assessment and therefore limited information is available for inclusion with the assessment. Design parameters and assumptions have been developed to advance the Alternatives Assessment that are based on the information that is currently available, as well as previous experience with similar projects. The Alternatives Assessment includes different types of tailings disposal technologies that have required assumptions to advance their assessment. The design parameters are therefore preliminary and will need to be refined and/or confirmed, as well as the assumptions, as the project is advanced to subsequent levels of design. The subsequent levels of the design are understood to include the Feasibility and Detailed Design levels. The following is a summary of the design parameters and assumptions that have been adopted for the completion of the Alternatives Assessment.

3.2 PROCESSING

The following processing information has been provided for use in the Alternative Assessment. It has been used to determine total tailings volume that will require on land storage. The ore/tailings processing has also been used to identify water management requirements related to water flows directed to the tailings storage facility as well as water reclaim requirements for use in processing.

- Processing of 2,700 dry tonnes per day;
- Operations of 365 days per year for 12 years; and
- 11,826,000 total tonnes of dry tailings solids produced over the expected 12 year life of mine.

3.2.1 TAILINGS PARAMETERS AND VOLUMES

Laboratory testing to determine the potential in situ density of tailings solids has not been completed for the project at this stage and therefore assumptions have been made to estimate the total tailings volume to be stored within the on land tailings facility to complete the Alternatives Assessment. The assumptions of in situ density are based on current known parameters, published historic information as well as previous experience with similar projects. The following tailings parameters have been used to complete the Alternatives Assessment.

- Total tailings solids of 11,826,000 dry tonnes

- Tailings specific gravity of 2.7 (provided by process design)

- Conventional Tailings:
  - 43% solids content in tailings stream (provided by process design)
  - Estimated In situ dry density of 1.1 t/m^3
  - Tailings solids volume 10,750,909 m^3

- Thickened Tailings:
  - Estimated 65% solids content in Tailings Stream
  - Estimated In situ dry density of 1.4 t/m^3
  - Tailings solids volume 8,447,143 m^3

- Dry Stack Tailings:
  - Assumed Moisture Content 15%
  - Estimated dry density 1.6 t/m^3
  - Tailings solids volume 7,391,250 m^3

Co-Disposal of Tailings into the Mine Workings will consist of initial disposal in the tailings facility during the initial years of operations followed by removal of percentage of the tailings solids from the stream. The portion of the tailings removed will be used as paste backfill in the underground mine workings. This concept assumes that disposal of tailings solids into underground mine workings can occur after Year 5 of operations and that an assumed 40% can be removed from the tailings stream (directed to the on land tailings facility after Year 5) and directed to the underground mine workings. Tailings solids directed to the underground mine are assumed to be thickened to a paste prior to being routed back to the underground mine workings. Total tailings requiring storage on-land with 40% removal after Year 5 is 8,243,000 m^3.

The tailings solids have been assumed to be Potential Acid Generating (PAG), based on the Draft Report "Geochemical Evaluation of the Goliath Gold Project" by EcoMatrix Inc., Ref. No. 12-1938 dated September, 2013. The results of the Draft Report indicated that tailings materials should be treated as PAG. Water in the tailings stream is anticipated to be generally inert (based on preliminary indications from processing design)

3.3 DAM CROSS-SECTION AND MATERIALS

Several potential tailings storage locations and tailings technologies will be assessed as part of the Alternatives Assessment and therefore preliminary assumptions have been established to develop preliminary construction material volume estimates related to embankment construction. The assumptions are preliminary at this stage of the project and can be optimized as the project is advanced to subsequent levels of design when additional information is available related to the sub-surface soil conditions at the site as well as material parameters of potential fill materials and volumes. The preliminary estimate of materials and volumes has been developed in order to estimate costs as inputs to the Alternatives Assessment. Similar assumptions have been applied to the impoundments at all locations for the purpose of maintaining consistency in completing of the Alternatives Assessment. It is anticipated that the assumptions adopted for the completion of the Alternatives Assessment will be confirmed and optimised as the project is advanced during subsequent levels of design. The following assumptions have been adopted for the dam cross sections and potential fill materials to complete the Alternatives Assessment.

- Dams required for tailings containment (based on tailings technology) will be initially established with a starter dam for 4 years of operations utilizing local borrow materials and/or from materials from local pits.

- Raising of the dams post Year 4 can be completed with NAG mine waste rock and has been conservatively assigned as a downstream raise. This assumption will be dependent on the results of the mine design and planning, sufficient availability of mine waste rock and also TM ability to effectively sort NAG and PAG rock at the source.

- The style of dam raise will be dependent on the foundation conditions that will be determined as the project is advanced.

- Basin areas in locations anticipated to consist of low permeable materials (i.e. clay) can be constructed with low permeable soil embankments (clay) with graded internal geotechnical filters and that the basin area can use the in situ low permeable geotechnical materials to achieve containment.

- Basin areas in locations anticipated to consist of higher permeable sands and gravels will utilize engineered liner products for the basin and upstream embankments for containment.

- Embankment slopes:

  - Fine grained fill:
    - Upstream 2.5H:1V
    - Downstream 2.25H:1V
  - Downstream Mine Waste Rock – 1.5H:1V
  - Upstream Slopes with Liner – 3H:1V

- Foundation Parameters – Based on available Site Investigation data

- Construction fill materials consisting of low permeable clay have been assumed to be provided from borrow sources at the mine site. The proposed open pit mine area has clay overburden that will require stripping in preparation for mining activities that may be used in the construction of the impoundment dams.

- Fill materials for internal graded filters can be supplied from potential borrow sources at the mine site or alternatively from local gravel pits in the Dryden area.

- Fill materials to construct the proposed starter dam, for the initial years of operations, can be supplied form borrow sources at the site or alternatively form local gravel pits.

- Topsoil from basin and foundation preparation activities will be stockpiled on site for use in closure activities.

3.4 OPERATIONAL AND STORMWATER MANAGEMENT

Limited information related to the site water handling was available as input for the Alternatives Assessment and will become available as the project is advanced. The following inputs and assumptions have been adopted to complete the Alternatives Assessment.

- Water reclaim to plant for conventional tailings – 140 m^3/hr (provided by processing design);

- Mine dewatering that will be routed to the on land tailings storage facility can range from 540 m^3/day to 1,600 m^3/day. The larger mine dewatering rate has been utilized for the Alternatives Assessment to identify potential surplus water, for this stage of the project, that would be accumulated in the tailings area. A methodology to address the surplus water collected at the tailings area is ongoing and being developed by TM.

- Average precipitation that will be reporting to the on-land tailings facility is 706 mm per year with approximately 550 mm per year of evaporation.

Additional water inputs to the on land tailings facility may become apparent as the project is advanced and the water management design will incorporate these additional inputs, as required.

The following assumptions related to water management have been adopted to complete the Alternatives Assessment:

- Impoundments established for conventional tailings and thickened storage can be used for temporary storage of surplus water, if necessary. Yearly surplus water, after process reclaim, will be directed to a water treatment plant prior to release.

- Dry stack storage will require a secondary water collection pond for temporary storage of surplus water prior to being directed to treatment. The potential for utilizing a future secondary containment structure for water collection for thickened tailings disposal may be required and would be dependent on the use of a central tailings discharge. This would be determined as the project is advanced to subsequent levels of design. The Alternatives Assessment has been completed assuming a single impoundment for tailings and water storage with scoring reflecting the potential of utilizing a future secondary containment facility for water collection.

- All dam impoundments will be required to contain an Environmental Design Storm (EDS) resulting from the 1:1,000 yr, 24-hr storm event.

- All dam impoundments will include sufficient embankment heights to provide adequate normal and minimum freeboards.

- A water cover will be used for conventional tailings storage to minimise the potential for acid generation of the tailings solids.

- Dry stack tailings will require a foundation collection system to collect potential seepage water from the tailings to prevent ARD. Perimeter runoff collection ditching would also be used to collect surface water runoff form the storage area. Seepage and runoff water would be routed to a collection pond for containment and potential treatment.

- A perimeter seepage collection ditch with pump back system will be used to intercept seepage from the impoundment area and return it to the facility.

- All dam impoundments will include a spillway designed to accommodate the required Inflow Design Flood (IDF) based on the Hazard Classification Potential (HPC). The HPC has been estimated for each dam impoundment as part of the Alternatives Assessment. The HPC will be adopted for the water collection pond for the Dry Stack Option.

3.5 OPERATIONAL AND CAPITAL COSTS

Preliminary cost ranking has been completed, at a high level, to provide inputs for the purpose of completing the Alternatives Assessment based on the available design input parameters and assumptions outlined above. Cost estimating will be developed and optimized for the project once the design commences for the preferred alternative. Cost ranking for this stage of the project has been estimated to provide a direct comparison of economic account inputs for the Alternatives Assessment. Relative cost rankings were developed for construction, operation and closure, for each alternative advanced past the pre-screening step of the Alternatives Assessment. The cost rankings have been compared (at this stage of the project) on a relative scale and have been factored based on the lowest cost alternative (lowest anticipated cost assigned as 1 and other alternatives assigned a relative rank based cost increase). This allows for cost comparisons by ranking as economic inputs to be scored as part of the Alternatives Assessment process. The lowest anticipated cost was assigned the highest score (as being favourable) with the higher cost Alternatives assigned an incremental lower score to provide the required comparison for the assessment. The following assumptions have been adopted to estimate cost ranking for the Alternatives Assessment.

- Cost rankings for construction represent the anticipated final embankment stage and include allowances for contractor mobilization and demobilization, as a percentage of the construction costs, as well as inclusion of a construction contingency.

- Processing of conventional tailings was taken as the base case. Operational cost increases associated with the processing of thickened and dry stack tailings have been included with the operational costs for the individual tailings technology.

- Operational cost rankings associated with hauling dry stack tailings have been considered to include site and foundation preparation activities as well as the costs associated with establishing a secondary water collection pond.

- Closure cost rankings have been included associated with closure of the facilities. The closure concept consists of capping the tailings with clay and providing a soil water shedding cover.

The cost ranking for each Alternative is provided in the Alternatives Assessment, as discussed below in Section 4.0.

4 ALTERNATIVES ASSESSMENT

4.1 GENERAL

Assessment of potential alternatives for tailings storage and tailings disposal technology is required under Environment Canada's Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2013) when potential alternative locations are within bodies of water or streams. This requires an assessment of mine waste disposal alternatives, and specifically an assessment of tailings deposition technology and tailings management facility locations.

All projects require an assessment of mine waste disposal alternatives if the Tailings Management Facility (TMF) or the Waste Rock Management Facility (WRMF) is placed in natural water bodies frequented by fish. If this is the case, the facilities are then designated as Tailings Impoundment Areas (TIA's), as specified by Schedule 2 of the Metal Mining Effluents Regulations (MMER).

The alternatives assessment for the tailings management facility and the tailings disposal technology builds on previously issued documentation for the Project including:

- Goliath Gold Project Description (Treasury Metals Incorporated, December 2012);
- Metallurgy Test Work Technical Report (September, 2012);
- National Instrument 43-101 Preliminary Economic Analysis of the Goliath Gold Project (A.C.A. Howe International Limited, August 2012);
- Geochemical Evaluation of the Goliath Gold Project (EcoMetrix Incorporated, June 2013); and
- Technical Report and National Instrument 43-101 Preliminary Economic Assessment on the Goliath Gold Project (A.C.A. Howe International Limited, August 2010).

4.2 ASSESSMENT APPROACH

Environment Canada's Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Guidelines), has identified a seven step process, which is as follows:

- Step 1: Identify Candidate Alternatives
- Step 2: Pre-screening Assessment
- Step 3: Alternative Characterization
- Step 4: Multiple Accounts Ledger
- Step 5: Value-Based Decision Process
- Step 6: Sensitivity Analysis
- Step 7: Document Results

This process has been followed as several streams are present at the site so as to ensure that the location selected for the on-land tailings storage facility will have the least impact. The most suitable or preferred tailings alternative is selected from an environmental, technical and socio-economic perspective.

4.3 IDENTIFICATION OF CANDIDATE ALTERNATIVES

A total of seven (7) candidate locations for potential on-land tailings storage were selected for consideration in the Alternatives Assessment. The assessment also included potential tailings disposal technologies at each of the candidate locations. A potential dry location was included as Location 7, as recommended by the guidelines. The Goliath project area does have natural streams that are present at the site and care has been taken to avoid or minimise contact with streams for the placement of candidate alternative locations. On-land waste management facilities for mining operations can be relatively large to meet storage requirements. This area also has existing streams that would make it difficult if not impossible to identify consistent dry land candidate alternatives that would provide sufficient storage capacity while maintaining a stable and aesthetic impoundment area. The degree of impact is evaluated in the assessment for each candidate alternative. A list of the candidate locations, tailings technologies and potential alternatives that were assessed are provided on Table 4.1.

Tailings deposition technology and locations are assessed together in order to determine mutual interactions and effects. A figure showing the locations of the alternatives is provided on Figure 4.1.

A set of threshold criteria has been established in order to determine the regional boundaries for selecting candidate alternatives. The threshold criteria were determined to include:

- Exclusion based on distance;
- Exclusion based on the presence of protected areas;
- Exclusion based on legal boundaries; and
- Exclusion based on corporate policy.

4.3.1 POTENTIAL TAILINGS MANAGEMENT FACILITY LOCATIONS

Seven (7) unique sites were identified within the site boundaries. The topography of all options is of a similar flat nature, and hence will require similar containment designs using perimeter embankments.

LOCATION 1 – NORTHEAST OF MINE SITE

This location has minimal fish habitat within the footprint and very little water flow. The water flow for the Blackwater Creek Tributary #2 has been determined to be seasonal, and only present during the spring. Topography is gently sloping towards the west. The process plant is less than 500 metres away and minimal access roads will be required for development and operation. This option for the tailings storage will ensure constant monitoring due to its close proximity to the plant, and the project access road (Tree Nursery Road). Fish habitat is present directly downstream of the proposed tailing storage area and any environmental spillage incident may be more complex to mitigate than other options.

LOCATION 2 – EAST OF MINE SITE

This location is located to the north and east of Location 1. Within the footprint of this location option, are the headwaters of tributaries of the Blackwater Creek and Hughes Creek. Both of these creeks drain into Wabigoon Lake. The topography is very rolling, with elevation changes of up to 40 metres. The process plant is located over 3 kilometers to the west, and significantly farther when travelling by on site road access. The only access to Location 2 is via a logging road, of unknown condition that runs north of the community of Wabigoon landfill site (closed) towards the southeast corner of Location 2. The east side of Location 2 has recently been harvested for logging purposes. This location has the largest footprint of all the options.

LOCATION 3 – FAR EAST OF MINE SITE

Location 3 is located on the far southeast of the TM property boundary and northeast of extents of Anderson Road. There are no known creeks, rivers or water bodies within the boundaries of the Location 3 Option. Topography is generally fairly flat, with the exception on the east side of the property, which is elevated in excess of 10 metres. Road access exists within 100 metres on the west side off Anderson Road. This option is slightly smaller than Location 2 with respect to area.

LOCATION 4 – SOUTHEAST CORNER OF NORMANS ROAD AND NURSERY ROAD

This alternative is similar to Location 1, in that the footprint has minimal fish habitat, little water flow, is also close to the process plant (about 500 metres), requires few roads to be built and has similar topography. Two headwaters for tributaries flowing into Blackwater Creek, and eventually to Wabigoon Lake, commence within the footprint of Location 4. This location has significant elevation changes and topography (in excess of 30 metres) and has rolling terrain. The site is within 200 meters of the frequently travelled Normans Road. Location 4 is not within the TM land position holdings.

LOCATION 5 – SOUTHEAST OF SITE AND NORTH OF POWER LINE

Location 5 has ideal topography for the site as it is a large flood plain with easy access from both Normans Road and Anderson Road. However, this option involves the destruction of fish habitat within the Hughes Creek System. This option widens the affected area and watershed impacts of the tailing storage, and substantially spreads out the project footprint. Location 5 requires a tailings pipeline in excess of 3,000 metres with associated road construction for monitoring purposes and corresponding increase in risk from other options due to monitoring and footprint. The topography is mostly flat, with sections around the exterior having hilly terrain. Portions of location 5 are not within the Goliath Project Property boundaries.

LOCATION 6 – SOUTH OF SITE

The sixth alternative is located adjacent to the site operations (<250 metres), and directly south of the open pit and Normans Road. This location has the smallest footprint area of the seven options. This location is bisected by a tributary of Blackwater Creek, with headwaters in the vicinity of the open pit. The terrain within this option is hilly with a ridge dissecting the footprint. Location 6 is directly south of Normans Road and adjacent to planned on site infrastructure.

LOCATION 7 – SOUTH OF ANDERSON ROAD

Location 7 is located south of Anderson Road. This location is in between two tributaries of Hughes Creek. The footprint of Location 7 is coincident with the surface projection of the Wabigoon Fault, of unknown geological and geotechnical characteristics. The mill and plant facilities are approximately 3 kilometers from the confines of this location. The topography is very hilly, with elevations changes in excess of 40 metres over the proposed site location. Location 7 is not on property currently owned by Treasury Metals.

4.3.2 POTENTIAL TAILINGS DISPOSAL TECHNOLOGIES

Four (4) different mine tailings waste disposal technologies were considered for use at the Goliath Gold Mine Project site. The four options consist of conventional slurry tailings, thickened tailings, filtered/dry stack tailings and co-disposal.

The various types of tailings waste disposal technologies are defined in the following sections.

CONVENTIONAL SLURRY TAILINGS

Conventional Slurry or hydraulic fill tailings are an un-thickened product of wet ore mineral processing and are transported via pipeline and deposited. Typical slurry solids content range from 5% to 50%, with the normal range between 20 to 40%. Slurry depositional systems can be via a single point discharge or at multiple locations (spigots) and can be discharged in the open air or sub-aqueous. The later method is utilized when the tailings have the potential to produce 'Acid Rock Drainage or Metal Leachates" (ARD/ML). Water will continue to decant from the tailings over time and consolidation within the tailings will occur.

THICKENED TAILINGS

Thickened tailings are similar to conventional slurry tailings, except that they contain less water with a typical solids content of 60 to 80%. Thickened tailings involve the mechanical process of dewatering low solids concentrated slurry by using compression thickeners or a combination of thickeners and filter presses. The tailings are typically dewatered to form a homogenous non-segregated mass when depositing from the end of a pipe. Little solid/liquid separation results in less oxygen ingress which will reduce oxidations and subsequent acid generation from sulphur bearing tailings. In addition, water requirements for thickened tailings are smaller compared to conventional slurry tailings.

Paste tailings are thicker and denser than thickened tailings and have a chemical additive resulting in the elimination of bleed water and separation from the tailings. Paste tailings have an increased strength and subsequent slope within a tailings management facility resulting in a smaller footprint compared to conventional slurry methods. Potential slope angles of 1 to 3.5 degrees can be achieved to form a self-draining reclaimable shape.

Thickened tailings and paste tailings are transported via high pressure pipelines and positive displacement pumping systems.

FILTERED/DRY STACK TAILINGS

Filtered or dry stack tailings vary from the above-mentioned technologies as it does not require a pumped system to transport the tailings for deposition. Tailings are mechanically filtered using vacuum or high pressure filtration systems with chemical additives to dewater the tailings. Filtered tailings have a typical solids content of 50 to 70% and cannot be pumped. The water requirements for filtered tailings are the lowest of all methods. Tailings are deposited via conveyor or truck followed by spreading and compaction of the tailings to produce a dense stable arrangement. These systems are often cost prohibitive due to the increased capital costs of the filter systems and associated operating costs (electrical consumption, filters and transport costs). Containment structures are not required for tailings storage. These systems have a smaller associated footprint, but do require surface water and seepage management systems to ensure that contamination does not occur.

CONVENTIONAL SLURRY TAILINGS WITH FUTURE CO-DISPOSAL OF A PORTION OF TAILINGS INTO UNDERGROUND MINE WORKINGS

Co-disposal occurs when waste rock and tailings are disposed of within a single facility. Co-disposal methods vary widely and depending upon quantities and qualities of waste, physical arrangement, and degree of mixing. Co-disposal can occur in surface tailings impoundment areas, in underground voids or within a mined-out area of an open pit.

For the purposes of this analysis, conventional slurry tailings surface disposal following by future partial stream co-disposal of tailings and waste rock into the underground mine openings was considered as an alternative for this assessment.

4.4 DESCRIPTION OF ALTERNATIVES

For each of the alternative locations, some or all the disposal technologies were applied for this assessment. The co-disposal option was only assessed for Location 1 as this was determined to be the optimum location due to proximity to the open pit and underground operations while minimizing travel distance and environmental harm. This stage of the assessment is very high level and determination of specific depositional regimes and operating conditions were not detailed. Each of the locations, combined with the disposal technologies will be subjected to the next stage, the pre-screening assessment.

4.5 PRE-SCREENING ASSESSMENT

The purpose of the pre-screening assessment, as defined by the Guidelines, is to exclude alternatives that are "non-compliant", in that they do not meet the minimum specifications which have been developed for the project. The pre-screening process filters out alternatives that exhibit a fatal flaw, are non-compliance with regulatory requirements, or unable to achieve economic or environmental targets.

Pre-screening criteria were formulated such that only a simple "Yes" or "No" response to whether the alternative complies with the set criteria is required. The criteria that each alternative were subjected to are detailed below:

- **Criterion 1:** Would the tailings impoundment area sterilize a potential resource?
- **Criterion 2:** Is any part of the tailings disposal technology unproven at the proposed throughput?
- **Criterion 3:** Is any part of the tailings disposal technology unproven for the climate at the site?
- **Criterion 4:** Does the life-of-mine tailings production exceed the available storage of the alternative?
- **Criterion 5:** Does the disposal site exceed a practical distance from the mill?
- **Criterion 6:** Is the location topography favourable for the potential tailings deposition technology?
- **Criterion 7:** Does the increased cost of the alternative exceed a reasonable threshold for the viability of the project?
- **Criterion 8:** Does the alternative present an unacceptable environmental liability?

- **Criterion 9:** Does the alternative exceed the risk threshold for failure of engineering containment?

- **Criterion 10:** Does the footprint of the Alternative exceed the land holding currently held by Treasury Metals Incorporated?

- **Criterion 11:** Does the footprint of the Alternative occur above a geo-hazard, or a structural geological feature(s)?

Each candidate was screened based on each of the criteria detailed above. The criteria were structured such that a Yes response indicates that the alternative fails to pass one of the screening criteria and indicates a fatal flaw in the alternative, thus eliminating the alternative.

4.5.1 PRE-SCREENING ASSESSMENT RESULTS

The Pre-screening resulted in the elimination of 14 alternatives, resulting in a reduction of the possible alternatives from 22 to 8 as described below.

- Alternative 2C failed to pass screening Criterion 7 due to the excessive distance from the proposed mine site for transportation of dry stack tailings material.
- Alternatives 3A, 3B and 3C failed to pass screening Criterion 5 due to exceeding a practical distance from the mill for operational and cost purposes. In addition, option 3C does not meet Criterion 7 (economic viability) due to the excessive distance from the operational facilities.
- Alternatives 4A, 4B and 4C failed to pass screening Criterion 10 as the footprint of the proposed tailings impoundment area exceeds the land position currently held by Treasury Metals Inc.
- Alternatives 5A, 5B and 5C failed to pass screening Criteria 8 and 10. It was determined that location 5 presented an unacceptable environmental liability (wetlands, ponds and existing water courses within footprint). In addition, the footprint of option 5 extends beyond the property boundary of Treasury Metals. Option 5C also does not pass Criterion 5 and 7 (practical distance and economic viability) due to distance from the operating facility.
- Alternative 6B failed to pass screening Criterion 6 due to the extreme rolling topography of the area and the technical and operational difficulties resulting from paste deposition.
- Alternative 7 failed to pass screening Criterion 8 and 10. The footprint of location 7 is completely outside of the property boundary.
- Alternative 1A, 1B, 1C, 2A, 2B and 6A and 6C passed all screens and will be carried forward into the detailed multiple accounts analysis (MAA).

The following alternatives have been put forward for further MAA:

- Location 1 – Conventional Slurry Tailings
- Location 1 – Thickened Tailings (1A)
- Location 1 – Filtered/Dry Stack Tailings (1B)
- Location 1 – Co-disposal (1C)
- Location 2 – Conventional Slurry Tailings (2A)
- Location 2 – Thickened Tailings (2B)
- Location 6 – Conventional Slurry Tailings (6A)
- Location 6 – Co-disposal (6C)

A summary table of the Pre Screening Assessment has been provided as Table 4.2.

4.6 ALTERNATIVE CHARACTERIZATION

Additional detailed characterization and assessment is completed upon completion of the pre-screening assessment to further define the preferred alternative. A description of each of the alternatives is provided below as well as a description of accounts, sub accounts and indicators to which each alterative is assessed and is based on available information for the site.

4.6.1 DESCRIPTIONS OF SELECTED OPTIONS

Each of the selected tailings management options are further described below detailing construction considerations, operational considerations, water management features and other physical features.

LOCATION 1 – CONVENTIONAL SLURRY TAILINGS

Location 1 is located 400 metres to the northwest of the proposed operational facilities. Minimal road construction will be required as existing roads can be used for access and pipeline alignments. The approximate footprint area is 88 hectares. In terms of possible fish habitat, 3.7 ha of the Blackwater Creek may be impacted. No additional bodies of open water are directly impacted. Some diversion of excess water from seasonal runoff will be required.

This tailing storage facility will be a clay lined zoned earthfill dam and will be contained by an assumed natural clay basin with an internal drain system with a secondary downstream seepage and pump-back system. The remediation requirements for this option will be the most complex, requiring stabilization of slopes and surface water management.

LOCATION 1 – THICKENED TAILINGS

Location 1 is located directly to the northwest of the operational facilities within 400 metres. Minimal road construction will be required and existing roads can be primarily used for access and pipeline alignments. The approximate footprint area is 88 hectares. In terms of possible fish habitat, 3.7 ha of the Blackwater Creek may be impacted. No additional bodies of open water are directly impacted. Some diversion of excess water from seasonal runoff will be required.

The topography in this area is favourable for paste tailings. Local topography can be utilized to minimize dam embankments. A zoned earthfill dam with a low permeability clay liner or liner material has been conceptualized with the foundation material favourable for key-in. The dam can be raised during operations. A lower dam embankment height is required than for conventional slurry due to the greater density of the tailings. The tailings and water will be stored within a single containment facility.

LOCATION 1 – FILTERED/DRY STACK TAILINGS

Location 1 is located directly to the northwest of the operational facilities within 400 metres. Existing road infrastructure will be used to haul the dry tailings waste. The approximate footprint area is 100 hectares including the tailings storage facility and the water collection pond. In terms of possible fish habitat, 3.7 ha of the Blackwater Creek may be impacted. No additional bodies of open water are directly impacted. Some diversion of excess water from seasonal runoff will be required.

Tailings waste will be stockpiled on surface. Runoff will be collected by perimeter collection ditches and routed to a separate facility for containment and reclaim. Dust entrainment and emissions are very likely, especially during the summer months. With respect to remediation requirements, this alternative has the lowest complexity, as it only requires capping of the facility and provision of stable final surfaces to achieve closure.

LOCATION 1 – CO-DISPOSAL

Location 1 is located directly to the northwest of the operational facilities within 400 metres. Existing road infrastructure will be used to haul waste rock for co-disposal purposes and can also be used for pipeline alignment, although additional road infrastructure will be required for depositional and monitoring purposes. The approximate footprint area is estimated to be 88 hectares including the tailings storage facility and the water collection pond. In terms of possible fish habitat, 3.7 ha of the Blackwater Creek may be impacted. No additional bodies of open water are directly impacted. Some diversion of excess water from seasonal runoff will be required.

Tailings waste will be contained by the assumed natural clay basin and a clay lined dam with an internal drain system with secondary downstream seepage collection and a pump-back system. It is anticipated that local topography will be used to reduce embankment heights. It is anticipated that underground co-disposal will occur during the underground operational phase that will result in a decrease of tailings to be impounded on surface and subsequent lower height for the tailings impoundment structures. The water reclaim system has a low level of complexity, consisting of containment within facility and reclaim for processing with surplus water being directed to treatment. Closure will be highly complex, requiring facility closure, long term stability of embankments, potential grading of slopes, addressing remaining contained water within the facility and capping of the final tailings surface. This location is favourable to expansion for additional tailings storage through embankment raising.

LOCATION 2 – CONVENTIONAL SLURRY TAILINGS

Alternative 2A (Location 2 and conventional slurry tailings) is approximately 2,200 metres from the plant and will require development of access roads and pipeline alignments that will disturb existing land and vegetation. The footprint area of this option is 246 ha. New access routes also require crossing of existing streams and water features. Both Hughes Creek and Blackwater Creek may be permanently affected due to hydrological changes associated with dam and infrastructure development. It is estimated that 5.8 ha of stream habitat will be impacted by this option.

The tailings containment foundation conditions consist of sands and gravels, which are generally not suitable for basin containment. Local topography can be used to establish embankment layouts and sloping topography will assist with seepage collection. The dam has been conceptualized as a zoned earthfill with a low permeable clay layer or liner material. The location is not proximal to local borrow sources, mine waste rock and other supplied materials that will be required for construction. All tailings solids and water management will be contained within the perimeter embankments. Water will be reclaimed from the facility and will be supplied to the operations for use as process water while surplus will be treated and released. Closure is anticipated to consist of grading and capping tailings with a low permeable liner or clay material and vegetation to prevent water infiltration.

LOCATION 2 – THICKENED TAILINGS

Alternative 2B (Location 2 and thickened tailings) is approximately 2,200 metres from the plant and will require extensive development of access roads and pipeline alignments that will disturb existing land and vegetation. The footprint area of this option is 246 ha. Access routes will also require crossing of existing streams and water features. Both Hughes Creek and Blackwater Creek may be permanently affected due to hydrological changes associated with dam and infrastructure development. It is estimated that 5.8 ha of stream habitat will be impacted by this option.

The tailings will be stored in a zoned earthfill dam with a clay layer or liner system in the basin and dam structure with an internal drain system and secondary downstream seepage collection and pump-back system. Local topography can be used to establish embankment layouts. The dam can be raised during operations if required. The location is not adjacent to local borrow sources, mine waste rock and other supplied materials that will be required for construction. Tailings and water storage will be contained within a single containment facility with potential requirements for further containment for water management. Closure is anticipated to consist of grading and capping tailings with low permeable liner or clay material and vegetation to prevent water infiltration.

LOCATION 6 – CONVENTIONAL SLURRY TAILINGS

Alternative 6A (Location 6 and conventional slurry tailings) is located approximately 1.4 km from the process site and will require additional access roads and pipeline alignments to be constructed. The proposed storage facility is close to the open pit and may be visible from cottages around Thunder Lake. The footprint area of this option is 54 ha. A portion of the existing Tree Nursery Road can be used as part of the access road and pipeline alignment. It is likely that Blackwater Creek and approximately 3.3 ha of land position will be permanently affected due to hydrological changes associated with dam and infrastructure development. The area is thought to consist of clay and bedrock knobs. While this undulating topography can be used to establish perimeter embankments, bedrock may hinder establishment of perimeter ditches.

The dam would be designed as a zoned earthfill with a low permeable clay layer or liner. The rock foundation will require a complex and detailed design for the key-in or anchor for the basin liner. A higher dam hazard classification is anticipated due to proximity to Highway 17 and Wabigoon Lake. This location has a closer proximity to local borrow material, mine waste rock and externally supplied materials than Locations 1 and 2. The tailings solids and water management will be contained within perimeter embankments with water reclaim from the facility. Closure will require regrading of tailings and slopes, and capping the final tailings surface with a low permeable liner or clay and revegetation.

LOCATION 6 – DRY STACK TAILINGS

Alternative 6C (Location 6 and dry stack tailings) is located approximately 1.4 km from the process site and will require additional access roads, and subsequent truck traffic and tailings haulage. The footprint of this alternative is 60 ha including the tailings storage and water collection pond. The proposed storage facility is close to the open pit and may be visual from Thunder Lake communities. The dry stack technology is expected to result in increased dust generation. A portion of the existing Tree Nursery Road can be used as an access road. It is likely that Blackwater Creek and approximately 3.3 ha of land position will be permanently affected due to hydrological changes associated with tailings storage area infrastructure. The area is thought to consist of clay and bedrock knobs. While this undulating topography can be used to establish perimeter embankments, bedrock may hinder establishment of perimeter ditches.

The tailings will not be required to be contained within perimeter embankments. Tailings will be dewatered at the plant site, but will require collection and treatment of water runoff. A water collection pond would be included with the Dry Stack option to collect seepage and surface water runoff from the storage area as well as other surplus water from the operations. The undulating topography will require operational planning for tailings placement. Closure will require regrading to stabilize the tailings pile slopes for placement of cover material and subsequent revegetation. This location is less favorable to expansion due to local topography, property boundaries, local infrastructure and its proximity to the open pit.

4.7 ALTERNATIVE CHARACTERIZATION ASSESSMENT

The alternative characterization provides a detailed description of the alternatives to ensure that every aspect of an alternative is properly considered and to allow for direct comparison within the remaining alternative set.

The following site specific characterization criteria were developed for the Goliath Gold Project and are categorized into four categories, or "accounts" as defined by Environment Canada, that reflects the entire project life cycle. The four "accounts" are as follows:

- Environmental Account;
- Technical Account;
- Project Economic Account; and
- Socio-Economic Account.

The summaries for each of the accounts (from Environment Canada, Guidelines for the Assessment of Alternatives for Mine Waste, September, 2013) are as follows:

- **Environmental Account -** Characterizing the local and regional environment surrounding the proposed TIA. These include elements such as climate, geology, hydrology, hydrogeology, water quality and potential impacts on aquatic, terrestrial and bird life.

- **Technical Account -** Characterization of the engineered elements of each alternatives such as storage capacity, dam size and volume, diversion channel size and capacity, dumping techniques (if applicable), haul distances (if applicable), sedimentation and pollution control, dam requirements, tailings discharge methods, pipeline grades and routes, closure design, discharge and/or water treatment infrastructure and supporting infrastructure such as access roads.

- **Economic Account -** Characterizes the project life economics. All aspects of the Tailings Management Plan needs to be considered including investigation, design, construction (inclusive of borrow development and royalties where applicable), operation, closure, post closure care and maintenance, water management, associated infrastructure (including transport and deposition systems), compensation payments and land use or lease fees.

- **Socio-Economic Account** – Identifies how a proposed TIA may influence local and regional land users. Elements that are considered here include characterization and valuation of land use, cultural significance, presence of archaeological sites and employment and/or training opportunities.

Each of these subaccounts and indicators were assigned an indicator parameter by which the subaccount could be measured. The Alternative Characterization table is included as Table 4.3.

4.7.1 ENVIRONMENTAL ACCOUNT

The environmental account details a range of issues relating to direct and indirect impacts as a result of the development, construction, operation and closure of a given location and tailings disposal technology.

The environmental account has been subdivided into the following subaccounts with indicators detailed in brackets:

- **Land Use** (*distance from the mine site, pipeline and access road requirements and storage facility and associated infrastructure footprint*)
- **Water Impacts** (*number of watersheds affected, potential impact to surface water availability and potential impacts to water quality*)
- **Aquatic Habitat** (*permanent streams impacted, indirect impacts such as downstream reductions, direct impact to open water, and number of fish bearing lakes impacted*)
- **Terrestrial Habitat** (*area of feeding or shelter loss due to tailings storage facilities or associated structures and existing vegetation, and/or ecosystems that will be lost or impacted by operations)*; and
- **Air Quality** (*potential for dust emission contributed by haulage, potential for dust emission contributed by tailings, potential for greenhouse gas emissions and noise emissions)*.

4.7.2 TECHNICAL ACCOUNT

The technical account details the technical advantages and disadvantages during the mine life including development, construction, operation, closure and post closure phases of a given location and tailings disposal technology.

The technical account has been subdivided into the following subaccounts with indicators detailed in brackets:

- **Design** (*foundation conditions, distance from plant, topographic complexity, topography, dam complexity, dam hazard potential classification, construction material availability, slope stability including height and slope angle, and number of watersheds);*
- **Operations** (*distance between storage facility and mill site, operational risks and other uncertainties, water treatment requirements)*;
- **Closure** (*remediation requirements, post closure water treatment requirements, post closure landform stability, post closure chemical stability);*
- **Capacity** (*tailings storage efficiency and tailings storage expansion capacity and probability*); and

- **Water management** (*sensitivity to climate variability, surface water control measures and seepage control measures).*

4.7.3 ECONOMIC ACCOUNT

The economic account and factors consider direct and indirect costs associated with the development of each of the alternatives.

The economic account has been subdivided into the following subaccounts with indicators detailed in brackets:

- **Life of Mine Costs** (*capital, operational, fish habitat compensation, closure and reclamation costs).*

4.7.4 SOCIO-ECONOMIC ACCOUNT

The socio-economic account serves to detail the social, cultural significance, land use and economic indicators of each of the alternatives assessed.

The socio-economic account has been subdivided into the following subaccounts with indicators detailed in brackets:

- **Archaeology** (*archaeological potential);*
- **Health and Safety** (*risk to human health, public safety and worker safety*);
- **Socio-Economic Indicators** (*economic benefits to regional communities, regional job creation and diversity, and indirect employment);*
- **First Nation Impacts** (*potential impacts to identified areas of Aboriginal Rights, extent of Traditional Land use detailed by number of persons and by activity type); and*
- **Recreational and Commercial Land Use** *(visual impact of storage facility, impact to navigable waters, extent of recreational land use and extent of commercial land use).*

4.8 MULTIPLE ACCOUNTS LEDGER FOR CANDIDATE ALTERNATIVES

A multiple accounts ledger was established to evaluate the eight alternatives to provide a basis for scoring and weighting. The multiple accounts ledger consists of the following two elements in accordance with the guidelines:

- Sub-accounts (evaluation criteria), and;
- Indicators (measurement criteria).

The summary table for the each of the sub-accounts within the multiple accounts ledger is provided on Table 4.4.

4.9 VALUE-BASED DECISION PROCESS

A value based decision process is applied for each of the site alternatives upon conclusion of providing the scoring matrix for each of the indicators and accounts. This process entails taking the list of accounts, sub-accounts and indicators and assessing the combined impacts for each of the alternatives under review. This entails scoring of all indicators and also weighting of all indicators, sub-account and accounts and quantitatively determining merit ratings for each alternative. There are three steps to this process (Scoring, Weighting and Quantitative Analysis), which are detailed in the following sections.

4.9.1 SCORING

The indicators determined in the previous step, are a qualitative or quantitative measurement of the impact (that is, a benefit or loss) associated with each alternative or sub-account and are required to be measureable. The multiple accounts ledger and the indicator quantity or quality was assessed.

Upon determination and definition of all of the indicators for the multiple accounts leger, quantitative scoring for each of the indicators has been developed, and as per the Guidelines, a six point scale has been used to address the range for all quantitative scoring. This provides sufficient capacity to differentiate between options.

Scoring is completed by developing a quantitative value scales for every indicator, including those that are easily measureable and assigning an indicator value (S) to each subaccount. The scoring criteria are summarized in Table 4.5.

4.9.2 WEIGHTING

The Value based decision process requires the ability to introduce a value bias between the individual indicators. This was completed by applying a weighting factor to each indicator. As recommended by the Guidelines, the weighting factors range from 1 through 6. An indicator with a weighting factor of 2 is twice as important as an indicator with a weighting factor of 1.

Weighting factors are constant for any given indicator, sub-account or account across all alternatives.

As recommended by the Guidelines, the alternatives assessment was completed using the following weightings factors (W) for accounts:

- Environment Accounts – 6
- Technical Accounts – 3
- Project Economics – 1.5
- Socio-Economic – 3

The weighting factors are summarized in Table 4.6.

4.9.3 QUANTITATIVE ANALYSIS

The Quantitative Analysis serves to determine an indicator merit score for each of the indicators. This is completed by determining the product of Indicator Value (S) developed in the scoring section and multiplying it by the Weighting Factor (W) determined in the weighting section. The formula for this is:

Indicator Value (**S**) x Weighting Factor (**W**) = **Indicator Merit Score**

Indicator Merit Scores were directly compared across alternatives, as were sub-account merit scores (Σ{S x W}) for the Environmental, Socio-Economic, Technical and Project Economics Accounts. In order to compare values of all sub-accounts, the scores were normalized to a six point scale. This was achieved by dividing the sub-account merit score by the sum of the weightings (ΣW) to yield a sub-account merit rating (R_s = (Σ{SxW}/{ΣW)ΣW). This normalization is required to balance out different numbers of indicators and sub-accounts for each account. The results of the Quantitative Analysis and summary table are detailed on Table 4.7.

The same procedure of weighting and normalization is followed to determine account merit scores (Σ{R_sxW}) and account merit ratings (R_a = Σ(R_s x W)/ΣW).

To complete the value-based decision process, an alternative merit score (Σ{R_a x W}), and an alternative merit rating (A = Σ(R_axW)/ΣW) was determined for each of the alternatives and the results are provided on Table 4.8.

The result of the Alternatives Assessment value-based decision process has selected Option 1D consisting of Candidate Location 1 with Co-disposal of tailings as the preferred option for tailings management at the Goliath site. The selection of Option 1D is based on the highest Alternative Merit score that considers all of the input Indicators for the Environmental, Technical, Economic and Socio-Economic Accounts for the project.

4.10 SENSITIVITY ANALYSIS

A sensitivity analysis is recommended for completion as part of the Alternatives Assessment. The sensitivity analysis is completed by adjusting the weightings that are assigned to sub-account and accounts to determine the range of variances within the alternatives and the sensitivity to the Indicator parameters. This part of the analysis is completed to eliminate bias and subjectivity. The sensitivity analysis utilizes the results of the Alternatives Assessment, presented above, with Option 1D as the Base Case with comparison to the scenarios developed to assess sensitivity. The following scenarios were analyzed as part of the sensitivity analysis:

- Scenario 1 – Adjust Weights of Environmental Account from 6 to 9
- Scenario 2 – Increase the Weighting factor for Technical input Indicators from 3 to 6
- Scenario 3 – Adjust all Weighs to 1 for all Accounts
- Scenario 4 – Reduce the Socio-Economic Weighting factors from 3 to 1.5

The results of the sensitivity analysis for the Scenarios presented above as well as the result of the Base Case are provided on Table 4.9. The results of the sensitivity analysis completed for each of the Scenarios presented above maintained the results of the Alternatives Assessment with Option 1D remaining the preferred alternative for tailings management at the Goliath site.

5 PREFERRED ALTERNATIVE

5.1 GENERAL

The results of the Alternatives Assessment and sensitivity analysis completed for the location and tailings disposal technology for the Goliath Site identified that Option 1D, consisting of conventional tailings disposal within Location 1 with future co-disposal of the tailings back into the underground mine workings as the preferred alternative.

Mining activities at the site will involve extraction of ore initially from an open pit mining operation followed by an underground mining operation. The open pit operation is anticipated to be in operation for four (4) years followed by the underground mining operations until the end of planned operations after 12 years. Ore processing will be carried out at the site with recommended disposal of tailings on-land and co-disposed on-land and into the underground mine workings after Year 5 of operations. It was estimated that 40% of the waste tailings solids were removed from the tailings stream and directed to the TSF will be thickened to a paste consistency and directed to the underground mine workings for disposal.

The objective of the Tailings Storage Facility (TSF) for the Goliath Project is to ensure protection of the environment during operations and in the long-term (after closure) and to achieve effective reclamation at mine closure. The design of the TSF will take into account the following requirements:

- Permanent, secure and total confinement of all solid waste materials within an engineered facility
- Maintain a water cover over the tailings beach to minimize potential acid generation of the tailings solids as initial studies have indicated that mine waste can be considered as Potentially Acid Generating (PAG). Excess water directed to the facility will be retained and directed to the plant site as reclaim for use in the operations and any surplus to treatment at a water treatment plant
- The inclusion of monitoring features for all aspects of the facility to ensure performance goals are achieved, and the design criteria and assumptions are met.

The TSF will be initially constructed with a Stage 1 dam embankment height at the pre-production stage to accommodate mine start-up and initial operations. The dam will be raised in stages during the operations to the full height required to accommodate the total required tailings solids scheduled to be deposited into the facility as well as allowances for operational, storm water and additional allowances for freeboard. This approach to the construction and operation of the TSF offers a number of advantages as follows:

- Reduces the initial capital costs and defers a portion of the capital expenditures until the mine is operating fully and Non Acid Generating (NAG) mine waste rock can be utilized for construction and raising the embankments.
- Reduces construction requirements at pre-production
- Provides ability to refine design and construction methodologies as experience is gained with local conditions and constraints, and also allows for monitoring and collection of field data on the deposited tailings to optimize tailings parameters for use in design.
- Provides ability to adjust plans at a future date to remain current with “state-of-the-art” engineering and environmental practices, and
- Allows the observational approach to be utilized in the ongoing design, construction and operation of the facility.

The observational approach is a powerful technique that can deliver substantial cost savings while maintaining a high level of safety. It also enhances knowledge and understanding of site-specific conditions. For this method to be applicable, the character of the project must be such that it can be altered during construction (Peck, 1969).

The construction and staging of the TSF will be scheduled to ensure that sufficient storage capacity is provided in the facility to avoid overtopping and prevent water from exiting through the spillways during operations by providing sufficient freeboard to safely accommodate the supernatant pond and design storm event, combined with wave run-up.

5.2 EMBANKMENT HEIGHT AND CONSTRUCTION STAGING

The required storage capacity of the TSF will be established to accommodate the total anticipated tonnage of tailings solids scheduled to be deposited over the life of the mine with consideration of the portion being directed to the underground mine workings. The available storage capacity of the TSF is based on the site selection of the facility determined from the Alternatives Assessment and the natural ground topography has been used to align the dam embankments to maximise storage capacity while minimizing embankment fill volumes. A figure showing the storage capacity of the TSF alignment is provided in Figure 5.1.

Tailings solids generation for the project has been identified at 2,700 dry tonnes per day (dtpd) for a total of 11,826,000 dry tonnes over the life of the mine. An estimated 4,925,500 dry tonnes will be routed to the TSF up until the end of Year 5 of operations followed, after which approximately 40% will be routed to the underground mine workings from Year 6 to end of the operations in Year 12. An estimated 4,139,600 dry tonnes will be routed to the TSF from Year 6 to end of Year 12 of the operations for a total of approximately 9,066,600 dry tonnes requiring storage within the TSF. The actual fraction of tailings solids that can be directed to the underground mine workings as well as the schedule will be confirmed as the mine design is advanced.

Laboratory testing of the tailings solids or small-scale pilot projects can be used to quantify the tailings in situ density when deposited. At this stage of the project laboratory testing or pilot projects have not been completed and therefore an estimate of the tailings solids in situ density has been used develop to estimate the volume of tailings solids that will require storage within the TSF. An in situ density of 1.1 t/m^3 has been estimated for the project that is based on literature and experience with similar projects. The in situ density of the tailings can be optimized with laboratory testing as the project is advanced as well as monitoring during the operations. Applying the in situ dry density of 1.1 t/m^3 adopted for the design results in a total tailings volume of approximately 8,242,364 m^3 that will be directed to the TSF.

A preliminary stage storage for the TSF has been developed that is based on the embankment layout and has been used to preliminarily identify potential embankment staging and requirements for operational and stormwater management. The embankment heights have been assigned to provide containment of the required volume of tailings as well as an allowance for operational water, the EDS and normal freeboard. A figure showing the potential embankment staging is provided as Figure 5.2. Embankment staging at this time is preliminary and will be revised/optimized as the project is advanced.

Water management and freeboard allowances have been applied to each embankment Stage to ensure that full containment of tailings and water is provided during operations and to protect the dam from overtopping during the occurrence of significant storm events. A Maximum Operating Level has been established to contain runoff as well as water inputs to maintain a water cover over the tailings beach. Water transfer will be required for reclaim to process as well as transfer to treatment of yearly excess volumes.

An allowance for the containment of storm water has also been provided that corresponds to the volume of water resulting from the EDS. The EDS that has been adopted for the TSF is the 1:1,000 yr, 24 hr. storm event that has a storm depth of approximately 125 mm. The catchment area for the TSF is approximately 70.6 ha and the corresponding volume of water resulting from the occurrence of the EDS is approximately 88,250 m^3. A spillway invert for each embankment stage will be assigned to ensure that containment of the volume of water resulting from the EDS is maintained without being released though the spillway.

A freeboard allowance will be included to ensure that water overtopping the dam does not occur in the event that the spillway becomes active. The freeboard will be based on peak water levels occurring within the spillway during the occurrence of the IDF. The IDF will be based on the HPC as identified by the CDA Guidelines and also the MNR Best Management Practices. The freeboard for each embankment stage has been preliminary assigned at 1.5 m above the spillway invert.

5.3 TSF EMBANKMENT

The preliminary embankment cross section for the TSF has been developed with the Alternatives Assessment and will form the basis for advancing to subsequent levels of design. The embankments will be constructed in a staged approach, as discussed above, with the initial stage constructed at pre-production with subsequent embankment raises during the life of mine to accommodate tailings solids storage, operational and stormwater management. The upstream slope of the embankment has been assigned at 2.5H:1V and the downstream slope at 2.25H:1V for the initial embankment. Subsequent raising of the embankments will utilize NAG mine waste rock with downstream slopes of 1.5H:1V while maintaining the upstream slope at 2.5H:1V. The downstream waste rock slopes for embankment raising can be stepped with benches to accommodate covering the Stage 1 downstream embankment. The internal drain and transition zones will be constructed at a slope of 2.5H:1V for Stage 1 and the type of embankment raising will dictate the drain and transition slopes for subsequent raises. The style of embankment raising is envisaged to consist of a centreline style that would utilize vertical drainage and transition zones for subsequent embankment raising. The type or style of embankment raising will be confirmed and optimized as the project is advanced to the subsequent level of design and will be based on stability analysis with inputs from site investigation programs. A figure showing the plan layout of the Stage 1 embankment (pre-production) is provided on Figure 5.3 and for the potential final embankment stage on Figure 5.4. A preliminary embankment cross-section showing the potential embankment staging is provided as Figure 5.5.

The TSF will provide primary and secondary containment of the tailings solids and impounded water as it consists of a zoned earthfill with an upstream low permeable clay zone. The upstream clay zone will be placed on the upstream slope of the embankment and also be keyed into the basin foundation within the key trench. The zoned earthfill section of the dam will provide the secondary containment and also seepage control to maintain dam stability and integrity of the anticipated low seepage flows through the dam.

5.3.1 FOUNDATION PREPARATION

Foundation areas will require clearing of all standing trees and low level shrubs, grubbing and stripping of topsoil and potentially unsuitable materials prior to fill placement for the embankment. Topsoil that is stripped from the embankment footprint area would be hauled and stockpiled for later use in reclamation activities. Zones of soft or highly saturated and unsuitable foundation material would require removal and replacement with compacted fill material.

The main section of the dam will be constructed on a prepared foundation of native materials, anticipated to consist of clay material. The area immediately underlying the upstream clay zone of the embankment would be excavated to form a key trench. The excavation would extend down as far as necessary to provide a suitable cut off against seepage. Clay zone fill would then be placed in horizontal lifts and compacted into the trench. Foundation preparation and key trench excavation, depending on the required depths, may involve measures for dewatering during excavation activities that will require development of a sediment control plan.

A drain network (blanket drain) would be constructed into the base of the embankments, downstream of the clay zone, to drain groundwater from the foundation and also control seepage flows through the dam. Where necessary some trenching may be required for the drains to ensure gravity flow to the downstream toe of the embankment. Seepage flows would be collected in a perimeter collection ditch and routed back (pumped) into the TSF.

Foundation preparation within the basin area would consist of clearing all trees and shrubs and stockpiling at the site. Cleared trees consisting of merchantable timber can be hauled to forestry operations. Non-merchantable timber can be chipped and spread on-site.

5.3.2 EMBANKMENT ZONES

The embankment zones for the TSF have been preliminary established based on available site investigation information and indications of fill materials in potential local borrow sources and also material availability from gravel pits in the Dryden area. The internal drain system will be designed as graded filters so that the individual zones function to control the movement of seepage while maintaining stability of the zone by preventing the migration of finer material into the adjacent zone. A non-woven geotextile can be included with the embankment cross-section, between the upstream clay zone and adjacent drain that can aid in the prevention of migration of fine material into the drain zone. This will be determined with the filter design when material parameters for the fill materials are determined. Local fill will form the main body of the dam for Stage 1 and also the upstream clay zone for Stage 1 and subsequent embankment raises, and can be provided from local borrow sources. Subsequent embankment staging will utilize NAG mine waste rock from the mining operations in the downstream shell of the dam. An additional transition zone may be required after Stage 1, between the transition zone and the mine waste rock, which will be determined once mine waste rock gradations have been established.

Fill zone widths and the final dam width will be confirmed as the project is advanced based on stability, seepage and also graded filter designs based on geotechnical parameters obtained from site investigation activities. The following provides a preliminary summary of the embankment zones for the TSF embankment.

- Low Permeable Upstream Clay Zone (Zone A) – Constructed with native material from the local borrow sources (i.e. stripping form the open pit mine area) will provide primary containment of tailings solids and stored water. The upstream and internal slopes at Stage 1 will be 2.5H:1V and can be raised vertically with embankment raises. At the final embankment height the clay zone width can be between 2 m to 3 m and will be determined from stability and seepage modeling. A geotextiles can be included with the design and placed on the downstream side of the clay zone to prevent migration of fines into the adjacent zone that will be determined with filter grading design as the project is advanced.

- Internal Filter (Zone B) – Will be constructed on the downstream face of the clay zone using screened sand from local borrow sources or local gravel pits in the Dryden area. The filter width will be determined with seepage analysis (typically 0.5 m to 1.0 m width) over the entire downstream face of the clay zone and will have the same upstream and internal slopes as the clay zone. The drain material can be raised vertically utilizing a centreline style of embankment raise. The filter will also serve to heal cracks that may develop in the core zone by retaining fines at the core/filter interface. The filter design will ensure sufficient permeability to drain the downstream face of the clay zone. The internal filter will also be connected to a blanket drain that is located on the downstream shell zone of the embankment.
- Transition (Zone C) – Will be constructed on the downstream side of the Filter (Zone B) and will function to pass seepage and prevent the migration of fines from the adjacent. The transition zone width will be determined similar to the filter zone and can be constructed from screened local material or from a gravel source in the Dryden Area. The width of the zone is anticipated to be about 1 m to 1.5 m. The transition zone will be placed at the same slope as the filter for Stage 1 and subsequent embankment raises.
- General Fill (Zone D) – Will be used to construct the main body, or downstream shell zone, for the Stage 1 embankment. The general fill material will be placed on the downstream side of the transition zone with an upstream slope of 2.5H:1V and downstream slope of 2.25H:1V. The downstream slope will be confirmed with stability assessments as the project is advanced. Materials for the general fill zone can be provided from local borrow sources at the site or alternatively as pit run material from gravel pits in the Dryden area.
- Waste Rock Shell (Zone E) – Will consist of NAG rock and will be provided from the mining operations. The mine waste rock will be used as downstream shell zone material for embankment raises after Stage 1. The material gradation will be determined from the mine design as the project is advanced and be used in the graded filter design. The mine waste rock will require sorting of NAG and PAG to ensure that only NAG material is used in the construction of the TSF. NAG waste rock volumes available for construction will be determined as the project is advanced with the mine design.
- Riprap (Zone F) – Will be placed on the upstream embankment slope and will function to provide protection from potential erosion, wave action and ice damage. Riprap can initially be provided from a local gravel pit for Stage 1 and the construction of future raises can utilize select mine waste rock for subsequent embankment raises. The zone will have the same slope as the upstream embankment at 2.5H:1V.

Other embankment zones will be included with the dam cross section, as required, as the design is advanced and input parameters become available.

<u>Internal Drain System</u>

The presence of the upstream clay zone will contain the tailings and control the movement of water through the dam embankment. The phreatic surface within the embankment and foundation would be controlled with the engineered filters and drains. Two systems are in place to control seepage as secondary containment and control; one behind the core zone (as described above) and one over the prepared foundation of the downstream shell. These systems would collect and control seepage flows that pass through the core and prevent the finer particles from the core or foundation soils from migrating with the seepage flows. All potential seepage water would continue to be contained and would not be discharged from the site as the flows from the filter and drains would be conveyed beneath the shell zone of the embankment to the collection ditch, located along the downstream toe of the embankment, and would then be collected and routed(pumped) back into the TSF.

5.4 SEEPAGE CONTROL

A seepage collection ditch will be located along the downstream toe of the TSF for collection and containment of potential seepage flows through the dam. The ditch will also collect runoff from the downstream embankment of the TSF consisting of Zone E material or NAG waste rock. All water that is collected in the seepage collection ditch will be contained, collected and transferred back into the TSF utilizing a sump, pump and pipeline system. The design of the TSF ditch will include consideration of all potential water inputs as well as seepage estimates, and location, determined from the embankment seepage analysis.

5.5 WATER MANAGEMENT

Water management for the TSF will require management of both operational and storm water. The tailings solids have been classified as PAG and therefore the concept of utilizing a water cover over the tailings beach has been adopted for the project. The water cover will keep the tailings solids submerged to restrict contact with the atmosphere to minimize acid generation.

Water collected in the TSF will consist of runoff from the catchment created by the perimeter embankments as well as operational water delivered to the TSF in the tailings stream that is not locked in the settled tailings. The water inputs into the TSF in addition to tailings have been identified at this stage of the project as consisting of mine dewatering. Other potential inputs may become apparent as the project is advanced and these will be included with the water management design. Surplus water collected in the TSF can be stored and directed to a treatment facility prior to being released. The TSF while in operation will therefore contain all operational water and also provide containment of the Environmental Design Storm (EDS) for stormwater management. An emergency overflow spillway will be included to maintain embankment stability during the occurrence of significant stormwater events.

Water pond levels will be confirmed for each embankment stage for operational and stormwater management as presented below.

- Maximum Operating Level – required to contain runoff from average and wet precipitation conditions considering the volume of water being removed from the facility (evaporation and water transferred to treatment and process) while maintaining a water cover

- Spillway Invert Level – Pond level providing storage capacity between the invert of the spillway and Maximum Operating Water Level to contain an Environmental Design Storm (EDS), currently assigned as the volume of water resulting from the 1:1,000 yr, 24-hr. event
- Embankment Height – Freeboard above the invert of the spillway for each embankment stage to prevent water from overtopping the dam during the occurrence of the prescribed Inflow Design Flood (IDF) that will be determined once the dam's Hazard Potential Classification has been established.

5.5.1 WATER TRANSFER SYSTEM

A water transfer system will be used to transfer water from the TSF to the plant site as reclaim for use in the processing operations as well as potential surplus water for treatment. The transfer to treatment rates, as well as timelines during the year will be determined with the water balance that will be prepared during detailed design as the project is advanced. The water transfer system can consist of a floating pump barge with a HDPE pipeline or alternatively a stationary reclaim system and will be dependent on the detailed water/solids balance modeling as the project is advanced.

5.5.2 WATER/SOLIDS BALANCE

A monthly water/solids balance will be completed as the design is advanced to determine the effect of various precipitation conditions on the overall water management requirements for the TSF and to confirm that the operational and stormwater pond levels will be maintained over the life of the facility. The analyses were completed for the planned 12 years of operations based on the tailings solids volume that is planned for deposition into the TSF with co-disposal occurring into the mine workings.

The water/solids balance will be used to determine the quantity of water that must be transferred to the water treatment plant based on net inputs from precipitation on catchments, process water and other water inputs that includes underground mine dewatering. The analysis will also be used to confirm that the proposed water cover can be maintained during periods of low precipitation conditions. The water/solids balance analyses will utilize a computer add on program called @RISK to statistically determine pond elevations. Water/solids balance modeling utilizing the program @RISK permits cell inputs to be modelled as distributions rather than as single values. The @RISK software has the capability to perform Monte Carlo type simulations and track the various outputs that result from variations in the input. The model can run several iterations (i.e. 1,000 or more) such that 1,000 or more different sequences of monthly precipitation over the year are considered and the resultant pond levels tracked. This analysis will produce the average as well as the high and low pond levels during the planned 12 years of operations. This analysis will be used to establish the required pond operational limits and identify the maximum operating water level.

Tailings Rate of Rise

Tailings deposition into the facility will result in development of a tailings beach that will rise over the operational life and dictate the required embankment heights at each stage to provide containment. A deposition plan will be required for the planned 12 years of operation based on the total volume of tailings that will be deposited into the TSF. Deposition will consist of depositing approximately 8,242,364 m^3 of tailings from the embankment crest by spigotting.

The yearly rate of tailings flow is not consistent over the life of the operations as tailings will be deposited initially into the TSF followed by a portion of the tailings solids being directed to the underground mine workings for disposal. The following yearly tailings flow rates have been used to identify the tailings rate of rise within the TSF basin:

Year of Operation	Dry Tonnes per Year	Total Tailings Volume
1	985,500	895,909
2	985,500	1,791,818
3	985,500	2,687,727
4	985,500	3,583,636
5	985,500	4,479,545
6	591,300	5,017,091
7	591,300	5,554,636
8	591,300	6,092,182
9	591,300	6,629,727
10	591,300	7,167,273
11	591,300	7,704,818
12	591,300	8,242,364

The yearly volumes presented above are based on the design solids content of 43% and a corresponding in situ dry density of 1.1 t/m^3. A figure showing the tailings rate of rise over the 12 years of operation is provided on Figure 5.2 and represents the tailings beach surface over time. The rate of rise in Year 1 will be approximately 10 m as the lower areas of the basin are filled in. The average rate of rise from Years 2 to 5 is approximately 1.4 m per year. A reduction in the tailings rate of rise will occur after Year 5 to approximately 0.7 m per year based on a percentage of tailings being routed to co-disposal. The tailings surface, over time, will be used to confirm and optimize the required embankment heights, pond levels for operations and storm containment and also identify the required embankment freeboard.

Model Inputs and Outputs

Water inputs and outputs for the TSF will be confirmed as the project is advanced with the completion of design work for other aspects of the project, consisting of the mine design, waste rock stockpile design, plant site design, etc. The following identifies the water inputs and outputs that have been identified at this stage of the project for the TSF. The values shown represent the Year 1 to Year 5 operations prior to the start of co-disposal of tailings solids into the underground mine.

TSF Inputs:

- Paste tailings solids (2,700 dtpd)
- TSF Catchment runoff (determined with the analysis)
- Direct pond precipitation (dependant on the area of the pond as it varies during the year)
- Water in Tailings Stream (3,579 m^3/day)
- Mine dewatering (1,600 m^3/day)
- Seepage Reclaim (determined with analysis)

TSF Outputs:

- Water retained in tailings voids (1,455 m^3/day)
- Evaporation from pond (dependant on the area of the pond as it varies during the year)
- Water reclaim to the plant site for processing (3,360 m^3/day)
- Water transfer to treatment (determined with analysis)
- Embankment Seepage (determined with analysis)

A water/solids balance schematic showing the current water inputs and outputs for the TSF is provided as Figure 5.6. The results of the water/solids balance will identify the transfer rates from the TSF to water treatment. The following is a discussion of the water input and output constraints that have been applied to the water/solids balance to identify the required pond levels and also the required water transfer rates.

Methodology

The monthly water/solids balance will be completed by applying various precipitation conditions over the planned 12 years of operations. The water/solids balance will be completed as a spreadsheet analysis and applied the design constraints, as listed above, with the @RISK simulation. The analysis will be used to ensure that operational pond levels are maintained to provide the water cover over the tailings beach and do not infringe above the prescribed maximum operational pond level established for each embankment stage.

Runoff into the pond will be from the contributing drainage basin areas and estimates of the runoff coefficients for each. Snowmelt parameters will be included within the model to account for the effects of snowpack and spring melt. Accumulated snow up to the months of March, April and May can be assigned to melt at a rate of 10 percent in March, 20 percent in April and 70 percent in May, meaning that 100 percent of the accumulated snow has melted by the end of May. A percentage of monthly snowfall will also be converting to runoff during the winter months. Consideration for the freezing conditions at the site during the winter months will also be included with the model by applying pond ice thickness. Pond levels in the TSF may need to be maintained to provide some unfrozen water to ensure that the pond does not become completely frozen to depth and to ensure that makeup water to the mill is provided on a yearly basis. Allowing the pond to freeze through its depth can result in “growing ice” as additional water is discharged onto the frozen surface which can also cause damage to intakes and reclaim pumps.

5.5.3 STORMWATER MANAGEMENT

The Maximum Operating Pond Level and allowances for containment of the EDS will be used for water pond management for each embankment stage during the project. The stormwater modelling for design of the emergency overflow spillway for each embankment Stage will involve assessing the IDF event for the facility based on the HPC. The HPC is the classification system established by the CDA as a selection criteria used to determine the overall hazard potential based on the effects of a dam failure. Each dam is generally classified in accordance with the severity of the hazard resulting from the failure of the dam or its associated structures and the perceived risk of occurrence. This hazard potential classification forms the basis for the design requirements and ongoing surveillance activities. Classification of each dam is carried out based on consideration of the potential consequences of failure, which includes Population at Risk, Potential Loss of Life, Environmental and Cultural Values and Infrastructure and Economics. The criteria that is used to determine the HPC for dams in accordance with the CDA Guidelines and MNR Best Management Practices is provided on Tables 5.1 and 5.2, inclusively. The required IDF based on the HPC is provided on Tables 5.3 and 5.4 for the CDA Guidelines and MNR Best Management Practices, inclusively. These criteria will be used to identify the HPC and corresponding IDF for the TSF as the project is advanced.

The prescribed IDF will be routed thought the facility and will be used to design the emergency overflow spillway. The spillway design will be completed with HydroCAD®, which is a computer program that utilizes accepted methods of hydrologic analysis to estimate the runoff flows resulting from a particular storm routed through a watershed(s) with specified characteristics.

The IDF event will be assessed by distributing the precipitation over time using the SCS (Soil Conservation Service) Type II distribution. Typically this method of analysis determines the time of concentration (tc) for each sub catchment based on the soil cover, average land slope and hydraulic length for each area. The time of concentration is the time required for runoff to arrive at the outlet of the sub-catchment from its most remote point. The soil cover is categorized using CN numbers based on SCS runoff curve numbers ranging from 1 to 99. The analysis will set the starting pond elevation at the invert of the spillway to model the potential worst case condition assuming that all potential allowances for water storage have been used. Due to the anticipated pond area corresponding to the starting elevation (spillway inverts) at the start of the model, a large portion of the catchment will be modelled as pond (open water) with a CN of 99. Additional inputs into the models included pond storage characteristics and spillway geometry.

To determine the required spillway configuration for the selected embankment crest elevations, HydroCAD® uses the IDF, catchment and storage information to develop a discharge rate and water level over time for a given spillway configuration. The spillway configuration is required to meet two principle design objectives, which include passing the peak flow within the designated freeboard allowance (minimum freeboard) and ultimately discharging the total IDF volume and returning the pond to normal levels within a reasonable period of time. The designated minimum freeboard allowance above the peak flood level is included to account for wave run-up. Freeboards for the facility will be determined utilizing the Lakes and Rivers Improvement Act and the CDA Guidelines.

5.6 EMBANKMENT STABILITY AND SEEPAGE

Stability and seepage assessments of the TSF embankments will be completed for each embankment stage of the project. The assessments will be used to determine the required dam cross section, consisting of upstream and downstream slopes, required zone thicknesses and crest width, to maintain the required Factor of Safety (FoS) against instability during operation and closure conditions. Stability assessment will utilize results from site investigations for foundation conditions and also fill material parameters from laboratory index testing. Design criteria for the embankment stability will utilize the CDA Guidelines to ensure the embankments are stable under various conditions and loadings. The minimum design criteria as prescribed by the CDA Guidelines are provided below:

Loading Conditions	Minimum Factor of Safety	Slope
End of Construction (before reservoir filling)	1.3	Downstream and Upstream
Long-term (steady state seepage, normal reservoir level)	1.5	Downstream and Upstream
Full or partial rapid drawdown	1.2 to 1.3	Upstream
Pseudo-static	1.0	Downstream and Upstream
Post –Earthquake	1.2 to 1.3	Downstream and Upstream

Stability assessment will be completed using the program SLOPE/W©, which is a limited equilibrium computer software program developed by Geo-Slope International Ltd. Bishops Simplified Method of Slices will be used to analyze potential failure surfaces through the embankment slopes and underlying foundations. The circular failure mode and the composite (block) failure modes for assessing potential sliding of the overburden on the underlying bedrock, were assessed as part of the stability modeling. Analysis will include static as well as pseudo-static conditions. The required seismic input is based on the HPC of the dam and the design criteria according to the CDA Guidelines and the MNR Best Management Practices is provided on Tables 5.5 and 5.6, inclusively.

A seepage assessment will be completed to estimate potential seepage flows from the perimeter embankments. The seepage that does leave the facility will be collected in the downstream seepage collection ditch and pumped back into the facility. The modelling will be completed using the computer program SEEP/W®. Seepage models will be developed from site investigation information as well as laboratory index testing of fill materials. The results of the water/solids balance modeling will be used to identify pond elevations as input parameters. Seepage assessment results will be utilized in the design of the seepage return system as well as to identify the location of the downstream seepage collection ditch.

5.7 TAILINGS MANAGEMENT

The Stage 1 TSF embankment will be stabilised at the pre-production stage and will be raised over the operational life of the facility to provide containment of tailings solid, operational and stormwater management. Spigotting from the embankment crest will be utilized to fill in the low areas of the basin and will allow the tailings to build a beach against the upstream embankment face that will provide stability to the upstream slope and aid in containment. Monitoring of the tailings placed in Year 1 can also be used to better identify the in situ tailings beach slopes and in-situ densities that can then be used to update the deposition model for the remainder of the life of the facility. Deposition into the TSF is anticipated to consist of sub-aqueous conditions resulting from the ponded water utilized to provide the cover over the tailings solids to prevent acid generation. Deposition will be from the embankment crest by opening a series of spigots and allow the tailings to flow into the basin area. The deposition location(s) will be moved progressively along the deposition line on the embankment crest on a daily basis or as required. This is generally carried out by closing one (1) spigot and opening (1) spigot at the other end of the series. This is repeated on a daily or on an as required basis in order to maximise the tailings densities and to ensure a uniform tailings elevation across the storage.

The tailings deposition system will consist of an HDPE delivery pipeline and an HDPE deposition pipeline for routing tailings to the TSF. The deliver pipeline will be aligned from the plant to the crest of the TSF embankment. The tailings deposition line will be aligned along the upstream crest of the embankment. The delivery and deposition pipelines will be connected to a flow control assembly located on the crest of the embankment that should be placed within a heated control building to prevent freezing. The flow control assembly will consist of a concrete pad to support a pipe header and a series of control valves to direct the tailings flow around the perimeter embankment.

The design of the tailings deposition system line will utilize the maximum anticipated tailings flow rate over the life of the facility. The design of the tailings deposition pipelines will consider the design criteria for the tailings consisting of solids content, specific gravity and anticipated flow rates. The deposition pipeline will also be equipped with a series of single point off takes spaced at approximately 25 m to 50 m centres along the pipeline. The spigot off takes will be comprised of tees, flexible hose and Spigot clamps.

The tailing delivery pipeline will be routed on the surface between the plant and TSF embankment. A sand berm is to be placed (on top of the pipe) at internals to act as a thrust support along the pipe route. Pipe routing under roadway access shall be installed in a corrugated galvanized culvert to allow minimal roadway disturbance, ease of inspection and maintenance requirements. Applicable slurry isolation valves shall be provided at each end of the pipes to allow for minimal downtime in the event of pipe switchover and drains at low point locations with containment as required along the pipe route.

The deposition pipeline can be relocated to the top of each embankment stage for each raise. Due to the potential erosion of the tailings flow and the potential sanding of the pipeline that can reduce the pipelines integrity, the pipeline should be monitored and routinely inspected for signs of deterioration. Monitoring can consist of installation of pressure gauges along the alignment to monitor changes in pressure resulting from a decrease in cross section. Deteriorated sections can be replaced in the field by cutting the pipeline, removing the deteriorated section and replacing it with a new section butt fused in the field.

All pumps and pipelines will need to be supplied as acid resistant due to the potentially acidic nature of the materials being handled. Pipelines should also be insulated and heat traced to ensure that the lines do not become frozen during winter operations.

5.8 MONITORING

Monitoring of the TSF will be required during the construction phase as well as during operations. Full time construction monitoring is recommended to ensure that the facilities are constructed according to the design intent as presented on the drawings and in accordance with the technical specifications. The monitoring program would include a quality assurance and quality control program, consisting of filed inspections and geotechnical laboratory testing, to ensure construction fill materials meet the specifications for the required zones.

Monitoring of the TSF embankments is also required during the operations. The monitoring will include survey pins to check for potential embankment movements, piezometers in the embankment to check for pore water pressures and monitoring wells downstream of the embankment to monitor groundwater quality. Any problems identified should result in an increase in monitoring frequency and the designer should be notified immediately to assess the situation. Regular inspections will help identify any areas of concern that may require maintenance or more detailed evaluation. The following general inspection program should be followed:

- Daily visual inspection of all embankments and berms, pipelines, pumps, culverts, spillways etc. to look for obvious problems such as pipeline damage, blockage, embankment seepage, slope instabilities, etc. During high precipitation period or spring freshet, more frequent inspections will be warranted.
- On a monthly basis, a more detailed inspection of all facilities should be conducted to look for any less obvious signs of potential problems
- During and following any extreme events, including snowmelt and precipitation, a more detailed inspection should be conducted to assess if any damages due to erosion, etc. require attention
- The facility should be inspected by a qualified Geotechnical Engineer on annual basis to verify that the embankments are performing as designed and that the operations are being continued as intended. The inspections would likely be carried out during or shortly after the spring melt under snow free conditions.

Seepage monitoring is also recommended during the operations. Groundwater monitoring wells are recommended downstream of the TSF to monitor/ identify if the facilities are not performing as required. This will help to ensure that the local environment is protected from seepage in the event that the containment systems are not performing and there is seepage occurring though the foundation and under/into the seepage collection ditches. Each monitoring installation should consist of one shallow hole, extending through into the overburden soils and the near surface horizon and one deep hole terminating at the underlying foundations. Each borehole will be cased and screened over an interval set in the field during installation, and sealed back to surface with low permeability grout. It is recommended that the boreholes be constructed before commissioning the tailings storage facility to accumulate baseline data specific to the storage location.

Porewater pressures should be monitored at various key locations within the TSF embankment to ensure that stability is not compromised. The monitoring will consist of standpipe piezometers installed at critical areas in the embankment. The base of the piezometer will be contained within the embankment to ensure that the phreatic surface within the embankment is measured. The standpipe piezometers would be installed at Stage 1 and raised with embankment staging. Survey pins will be installed along the embankment crest and downstream face to monitor any movement and the resulting effects on the embankment. Periodic survey checks of the embankment crests would be carried out to verify that no localized settlement has occurred resulting in the loss of freeboard.

Tailings performance monitoring will be used in the initial years of operation to identify the tailings behaviour related to beach slopes and its in situ density. The information collected during the initial years of operation can be applied to improve the calibration of the waster/solids balance and also as design parameters for subsequent stages of design. Monitoring of the following variables on a continuous basis is recommended thought out the life of the facility:

- Solids tonnage to the TSF.
- Water volume to the TSF from process or other streams.
- Rainfall and evaporation at the facility.
- Water transfer to the plant and treatment.

Monitoring of tailings moisture contents and densities, and surveying of the tailings beach and supernatant pond elevations should be conducted each year. Monitoring of pond levels and water transfer (volume & rates) from the TSF will be required to identify issues with increasing pond levels resulting from issues with the water transfer systems. The following monitoring is recommended:

- Daily recording of the pond water levels
- All pumps transferring water in or out of the TSF should be equipped with flow meters to allow pumping volumes to be estimated and compared to the water balance predictions
- Site specific meteorological data should be gathered and used in conjunction with the flows and levels to refine the hydrology modelling and improve future prediction
- Confirmation of ice thicknesses by drilling and measuring.

- Monthly monitoring of water levels in standpipes installed in the embankments and underlying foundations.

6 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been generated for the Goliath Project TSF based on the completion of the Alternatives Assessment.

6.1 CONCLUSIONS

- An Alternatives Assessment was completed to enable the selection of the Tailings Storage Facility location and deposition technology. Seven (7) locations and four (4) deposition technologies were assessed with a total of 22 potential alternatives. The assessment followed the Environment Canada's Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2013). Several input Indicators were assessed for the Environmental, Technical, Economic and Socio-Economic Accounts.
- A pre-screening assessment was used in accordance with the guidelines to identify options that were advanced thought the Alternatives Assessment process.
- The results of the Alternatives Assessment showed that Location 1 with conventional tailings deposition and future co-disposal of tailings into the underground mine workings (Option 1D) had the highest alternative merit score.
- The results of the sensitivity analysis were consistent with the Alternatives Assessment with Option 1D returning the highest alternative merit score.
- Option 1D is recommended as the preferred alternative for tailings management at the Goliath project site.
- Design parameters and assumptions developed to complete the Alternatives Assessment will form the basis for the design of the Tailings Storage Facility as the project is advanced to subsequent levels of design. Parameters and assumptions will be confirmed/refined/optimized with the subsequent levels of design as site specific information is obtained and design of other areas (mine design, waste rock stockpiles, plant site runoff and collection, etc.) are completed.

6.2 RECOMMENDATIONS

- A detailed Site Investigation (SI) program is recommended for completion as part future designs of the Tailings Storage Facility. The site investigation will be completed along the proposed alignments of the embankments. The detailed site investigation will provide in situ parameters, overburden details and depth to bedrock. This information will then be used to develop detailed foundation parameters for use in detailed stability and seepage modeling and also required foundation treatments. The SI should include sampling of potential borrow sources for construction fill materials.
- The site investigation will also be used to confirm the required basin containment and embankment containment measures that are based on the natural ground conditions and presence of low-permeable material in the basin area.
- Testing of the tailings is recommended to identify the materials in situ density and potential beach slopes for use in the detailed design. This can be completed by laboratory testing or with a small scale pilot project to determine tailings in situ density as well as potential tailings beach slopes.
- Detailed tailings deposition modeling should be completed as part of subsequent levels of design using updated parameters from available tailings test work.
- A site water management plan should be developed to identify water flows and volumes that will be reporting to the Tailings Storage Facility. The site water management plan will be used to complete a detailed water/solids balance analysis for the Tailings Storage Facility to identify yearly surplus water that requires direction to treatment.
- Confirmation of the acid potential of the mine waste materials should be determined prior to proceeding with the design.
- Complete mine design to confirm available volumes of NAG waste rock that can be used for construction fill materials for staged raising of the tailings storage facility. The mine design should also confirm available volume for co-disposal of tailings into the underground mine workings and also the type of tailings backfill to determine the type plant required to generate the backfill.
- The mine dewatering rate that reports to the Tailings Storage Facility can be refined to identify yearly flows for use in the water/solids balance analysis and identify yearly surplus water volumes.
- The HPC of the dam will be confirmed with the subsequent level of design once final embankment heights have been established based on detailed water/solids balance analysis and confirmation of the volume of tailings that can be directed to the underground mine workings. This will identify the IDF and stability seismic return period design requirements.

- Completion of detailed stability assessments for each proposed embankment stage utilizing geotechnical parameters collected from site investigations and required seismic return period.
- Completion of detailed seepage assessments to support the need to design seepage collection and pump-back systems.
- Design for closure will be required as the project is advanced.

7 OPPORTUNITIES

The following opportunities have been developed for the Tailings Storage Facility that are based on available information for the site.

- The style of embankment raising for the Tailings Storage Facility can be reviewed and optimized with subsequent levels of design. The style of embankment raising will be based on fill material availability, foundation conditions and stability assessments and local topography. Optimizing the embankment raising can reduce the fill material requirements and project costs over the life of the facility.

- Opportunities to utilize the mined out open pit should be considered for storage of tailings solids as the project is advanced. Utilizing the open pit will reduce the volume of tailings that require storage within the on-land Tailings Storage Facility, which will reduce the required embankment height (improve aesthetics and improve stability) and also reduce costs associated with dam construction.

8 REFERENCES

- "Guidelines for the Assessment of Alternatives for Mine Waste Disposal", by Environment Canada Mining and Processing Division DATE 2013
- "Project Description – Goliath Gold Project, Treasury Metals Incorporated", by Treasury Metals, November 26, 2012.
- "Feasibility Metallurgical Testing Goliath Gold Project", by ALS Metallurgy, Ref. No.: KM3406, September 4, 2012.
- "Goliath Gold Project Baseline Study November 2010 to November 2011" by Klohn Crippen Berger, Ref. No.: M09706A01.732, September 21, 2012.
- "Goliath Gold Project Environmental Baseline Studies Soil Baseline", in Draft, by Klohn Crippen Berger, Ref. No.: M09706A01.730, February 16, 2012.
- May 2013 Borehole Logs from TBTE.
- Metal Mining Effluent Regulations, Published by the Minister of Justice, SOR/2002-222, Current to January 14, 2014
- Memo: "Geochemical Evaluation of the Goliath Gold Project", in Draft by EcoMetrix, Ref. No.: Ref:
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- 20010 National Building Code Seismic Hazard Calculation
- Canadian Dam Association – Dam Safety Guidelines 2007
- Ontario Ministry of Natural Resources – Classification and Inflow Design Flood Criteria, Technical Bulletin, August 2011.
- Ontario Ministry of Natural Resources – Seismic Hazard Criteria, Assessment and Considerations, Technical Bulletin, August 2011
- Hogg, W. D. and Carr, D. A., 1985. Rainfall Frequency Atlas for Canada. Environment Canada.
- Lakes & Rivers Improvement Act Technical Guidelines – Criteria and Standards for Approval, Ministry of Natural Resources, June 2004.
- Environment Canada - Rawson Lake station (ID: 6036904, 49.65^{o}N, 93.72^{o}W)

9 SIGNATURE

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*This review report has been prepared for the exclusive use of Treesury Metals Incorporated and its representetives for this specific application described within this report. Any use that a third party makes of this report, or eny relience or decisions besed on this report are sole responsibility of those perties.

TABLES

TABLE 2.1

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

PROBABILISTIC SEISMIC RISK PARAMETERS

P:\Mining\Treasury Metals\141-12598-00 - Alternatives Assessment\Report\Report 1, Rev. 0\Tables\[Table 2.1 - Seismic.xlsx]Table 2.1

	Probability of Exceedance per Year			
	0.01	0.0021	0.001	0.000404
Return Period in Years	100	476	1,000	2,475
Peak Horizontal Ground Acceleration (PGA)	0.003	0.011	0.019	0.036
Spectral Acceleration, Sa(0.2)	0.011	0.035	0.055	0.095
Spectral Acceleration, Sa(0.5)	0.007	0.022	0.034	0.057
Spectral Acceleration, Sa(1.0)	0.003	0.01	0.016	0.026
Spectral Acceleration, Sa(2.0)	0.001	0.003	0.005	0.008

Notes:
1. Source: National Building Code of Canada Interpolated Seismic Hazard Values.
2. Data calculated for location at Latitude 49.77°N and Longitude 92.59°W.
3. Values are in units of g.
4. Values are for "Firm Ground" as per the NBCC 2010 Soil Class C - average shear wave velocity 360-750 m/s.
5. Sa(T) is spectral acceleration where T is the period in seconds.
6. Median (5th percentile) values are given in unites of g.

TABLE 4.1

TREASURY METALS INC.
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 1 - IDENTIFICATION OF CANDIDATE ALTERNATIVES

Project Aspect	Candidate Locations	General Location
Tailings Management Facility Location	Location 1	Northeast of the proposed plant site
	Location 2	Northeast of Location 1
	Location 3	Far east of the plant site
	Location 4	South of Location 1, east side of Tree Nursery Road
	Location 5	Between Location 4 and Location 3
	Location 6	South of proposed mine site and south of existing Normans Road
	Location 7	South of Location 4, potential dry option

Project Aspect	Candidate Tailings Technology
Tailings Disposal Technology	Conventional Slurry Tailings
	Thickened Tailings
	Filtered/Dry Stack Tailings
	Conventional Slurry Tailings with Future Co-Disposal Portion of Tailings into mine workings

Number of Candidate Alternatives	Alternative Identification	Description
1	1A	Location 1- Conventional Slurry Tailings
2	1B	Location 1 - Thickened Tailings
3	1C	Location 1 - Filtered/Dry Stack Tailings
4	1D	Location 1 - Conventional with Future Co-Disposal
5	2A	Location 2- Conventional Slurry Tailings
6	2B	Location 2- Thickened Tailings
7	2C	Location 2 - Filtered/Dry Stack Tailings
8	3A	Location 3 - Conventional Slurry Tailings
9	3B	Location 3 - Thickened Tailings
10	3C	Location 3- Filtered/Dry Stack Tailings
11	4A	Location 4 - Conventional Slurry Tailings
12	4B	Location 4 - Thickened Tailings
13	4C	Location 4 - Filtered/Dry Stack Tailings
14	5A	Location 5- Conventional Slurry Tailings
15	5B	Location 5 - Thickened Tailings
16	5C	Location 5 - Filtered/Dry Stack Tailings
17	6A	Location 6 - Conventional Slurry Tailings
18	6B	Location 6 - Thickened Tailings
19	6C	Location 6 - Filtered/Dry Stack Tailings
20	7A	Location 7 - Conventional Slurry Tailings
21	7B	Location 7 - Thickened Tailings
22	7C	Location 7 - Filtered/Dry Stack Tailings

Notes:
1. Alternatives selected for pre-screening.

<u>**TABLE 4.2**</u>

<u>**TREASURY METALS INC.**</u>
<u>**GOLIATH PROJECT**</u>

<u>**TAILINGS STORAGE FACILITY**</u>
<u>**ALTERNATIVES ASSESSMENT**</u>

<u>**STEP 2 -PRE-SCREENING ASSESSMENT OF CANDIDATE ALTERNATIVES**</u>

Criteria #	Pre-Screening Criteria	Rationale
1	Would the TIA sterilize a potential Resource?	If a TIA that is located over an area where there are proven indicators of mineralization, or a reasonable indication of possible mineralization based on regional trends, may be excluded from further consideration.
2	Is any part of the Tailings Disposal Unproven Technology at the proposed throughput?	If a specific depositional method relies on unproven technology at the project site, then it could justifiability be argued that the alternative should be excluded from further consideration.
3	Is any part of the Tailings Disposal Unproven Technology at the given climate?	If a specific depositional technology could be adversely affected by the local climate conditions, then it could justifiability be argued that the alternative should be excluded from further consideration.
4	Does the life-of-mine tailings production exceed the available storage of the alternative?	If the selected alternative does not have the required capacity to hold the produced tailings, it should be eliminated.
5	Does the disposal site exceed a practical distance from the mill?	If an alternatives location is too far from the production facilities, it may become economically unviable and should be eliminated.
6	Is the location topography favourable for the tailings deposition technology	Steep topography can be unfavourable for some types of tailings deposition (such as paste) and should be eliminated as an alternative.
7	Does the increased cost of an alternative exceed a reasonable threshold for the viability of the project?	The feasibility of any mining project is sensitive to cost. Higher costs may be warranted to eliminate significant adverse effects; however, there is no reason to investigate alternatives requiring significant additional costs unless there is reasonable assumption of environmental gains, and as such, it should be eliminated.
8	Does the Alternative present an Unacceptable Environmental Liability?	Treasury Metals Inc., follows the PDAC Framework for Responsible Mining. Treasury Metals policy states that they are committed to responsible stewardship of the environment. Their key focus is on meeting the company's goals of minimizing environmental impact, efficient use of the resources consumed and conserving natural resources for future generations. If an alternative is perceived to present an unacceptable environmental liability, it should be eliminated.
9	Does the Alternative exceed the risk threshold for failure of engineering containment?	If the tailings management facility exceeds the risk threshold for failure (CDA guidelines), then the Alternative should be eliminated.
10	Does the footprint of the Alternative exceed the land position currently held by Treasury Metals Incorporated?	If the tailing management facility extends beyond the current land boundaries established by Treasury Metals Incorporated, then the Alternative should be eliminated.
11	Does the footprint of the Alternative occur above a geohazard, or a structural geological feature?	If the tailings management facility occurs above a geohazard or a structural geological feature that adversely affects the stability of said facility, than the Alternative should be eliminated.
Should the Alternative be Excluded from Further Consideration		

Criteria #	Candidate Alternative Idnetifier[1]																					
	1A	**1B**	**1C**	**1D**	**2A**	**2B**	**2C**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**6C**	**7A**	**7B**	**7C**
1	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
2	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
3	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
4	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
5	No	No	No	No	No	No	No	Yes	Yes	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No
6	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No
7	No	No	No	No	No	No	Yes	No	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No
8	No	No	No	No	No	No	No	No	No	Yes	No	No	No	Yes	Yes	Yes	No	No	No	No	No	No
9	No	No	No	No	No	No	No	No	No	No	No	No	No	N o	No	No	No	No	No	No	No	No
10	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
11	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
Should the Alternative be Excluded from Further Consideration	**No**	**No**	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Yes**	**Yes**

Alternative Identification	Description
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
2C	Location 2 - Filtered/Dry Stack Tailings
3A	Location 3 - Conventional Slurry Tailings
3B	Location 3 - Thickened Tailings
3C	Location 3- Filtered/Dry Stack Tailings
4A	Location 4 - Conventional Slurry Tailings
4B	Location 4 - Thickened Tailings
4C	Location 4 - Filtered/Dry Stack Tailings
5A	Location 5- Conventional Slurry Tailings
5B	Location 5 - Thickened Tailings
5C	Location 5 - Filtered/Dry Stack Tailings
6A	Location 6 - Conventional Slurry Tailings
6B	Location 6 - Thickened Tailings
6C	Location 6 - Filtered/Dry Stack Tailings
7A	Location 7 - Conventional Slurry Tailings
7B	Location 7 - Thickened Tailings
7C	Location 7 - Filtered/Dry Stack Tailings

<u>Notes:</u>
1. Options that do not pass pre-screening are not advanced though the Alternatives Assessment.

TABLE 4.3

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 3 - ALTERNATIVE CHARACTERIZATION

Environmental Account					**Alternatives Location and Deposition Technology Identifier**							
Sub-Account	**Description**	**Rationale**	**Indicator Parameter**	**Unit**	**1A**	**1B**	**1C**	**1D**	**2A**	**2B**	**6A**	**6C**
Land Use	Distance from the Mine	Distance to monitoring, pipeline distance and/or haul distance (for filtered/dry stack tailings only) results in more construction and higher consumables (fuel) and emissions (noise, exhaust, dust)	Direct Distance from Plant Site to Structure	m	Shortest distance to the plant site at ~400 m	Shortest distance to the plant site at ~400 m	Shortest distance to the plant site at ~400 m	Shortest distance to the plant site at ~400 m	Longest distance to the plant site at ~2,200 m	Longest distance to the plant site at ~2,200 m	Medium distance to plant site at ~1,400 m	Medium distance to plant site at ~1,400 m
	Pipeline/Access Road Requirements	Additional requirements for pipeline or access road requirements beyond that existing that will be required for Option	Length of Additional Infrastructure Required	m	Minimal access road required as existing roads can be primarily used for access and pipeline alignments.	Minimal access road required as existing roads can be primarily used for access and pipeline alignments.	Existing road infrastructure can be used to haul tailings waste. Increased road maintenance requirements.	Minimal access road required as existing roads can be primarily used for access and pipeline alignments. Future planned road infrastructure can be used alignments to pump tailings to the mine workings.	Required development of access roads and pipeline alignments that will disturb existing land and vegetation. Will also require crossing several existing streams.	Required development of access roads and pipeline alignments that will disturb existing land and vegetation. Will also require crossing several existing streams.	More access roads and pipeline alignments required to be constructed than Location 1. Existing Tree Nursery Road can be used for part of the alignment.	Can use Tree Nursery Road for hauling, however will generate increased truck traffic on road used for mine access. Increased in dust generation around the mine area.
	Storage Facility and Associated Infrastructure Footprint	A larger footprint resulting in a greater disturbance to vegetation and species	Estimate of Storage Facility(s) Area	ha	Footprint Area ~ 88 ha	Footprint Area ~ 88 ha	Footprint Area 100 ha that includes tailings storage and water collection pond.	Footprint Area ~ 88 ha	Footprint Area ~ 246 ha	Footprint Area ~ 246 ha	Footprint Area ~ 54 ha	Footprint Area ~60 ha that includes tailings storage and water collection pond.
Water Impacts	Number of Main Watersheds Affected	Various locations may impact one or more watersheds	Number of Main Watersheds directly impacted	No	1	1	1	1	1	1	1	1
	Potential Impact to surface water availability	Various locations may have an impact to surface water availability	Qualitative Estimate of Potential Surface Water Impact	Rank	Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	Farthest from Wabigoon Lake and Thunder Lake	Farthest from Wabigoon Lake and Thunder Lake	Closest proximity to Wabigoon Lake	Closest proximity to Wabigoon Lake
	Potential Impacts to Water Quality (ARD, Metal Leaching, etc)	Locations as well as construction materials may have impacts on water quality	Likelihood of Mining Impacts and mitigative measures required	Rank	Anticipated to be contained by natural clay basin and clay lined dam with internal drain system with secondary downstream seepage collection and pump back system.	Anticipated to be contained by natural clay basin and clay lined dam with internal drain system with secondary downstream seepage collection and pump back system.	Tailings waste stockpiled on surface. Runoff collected by perimeter collection ditches and routed to separate facility for containment and reclaim.	Anticipated to be contained by natural clay basin and clay lined dam with internal drain system with secondary downstream seepage collection and pump back system.	Anticipated to be contained by engineered liner in basin and upstream slopes of embankment with internal drain system and secondary downstream seepage collection and pump back system.	Anticipated to be contained by engineered liner in basin and upstream slopes of embankment with internal drain system and secondary downstream seepage collection and pump back system.	Anticipated to be contained by natural clay basin and clay lined dam with internal drain system with secondary downstream seepage collection and pump back system.	Tailings waste stockpiled on surface. Runoff collected by perimeter collection ditches and routed to separate facility for containment and reclaim.
Aquatic Habitat	Permanent Streams Impacted	Locations may impact one or more permanent streams	No. of Streams Directly Impacted	No	1 - Blackwater Creek may be permanently affected.	1 - Blackwater Creek may be permanently affected.	1 - Blackwater Creek may be permanently affected.	1 - Blackwater Creek may be permanently affected.	2 - Hughes Creek and Blackwater Creek may be permanently affected.	2 - Hughes Creek and Blackwater Creek may be permanently affected.	1 - Blackwater Creek may be permanently affected.	1 - Blackwater Creek may be permanently affected.
	Indirect impacts (downstream flow reductions)	Locations may have indirect impacts to downstream flows	No of Streams Potentially Indirectly Impacted	No	3 - Blackwater Creek, Hoffstroms Bay Creek may be permanently affect due to hydrological changes associated with dam and infrastructure development. Spring freshet level may be directly changed and total discharge volume for each creek may be adversely affected (Blackwater due to loss of tributary, and Hoffstroms Bay due to topographical change due to construction and flow variation).	3 - Blackwater Creek, Hoffstroms Bay Creek may be permanently affect due to hydrological changes associated with dam and infrastructure development. Spring freshet level may be directly changed and total discharge volume for each creek may be adversely affected (Blackwater due to loss of tributary, and Hoffstroms Bay due to topographical change due to construction and flow variation).	3 - Blackwater Creek, Hoffstroms Bay Creek may be permanently affect due to hydrological changes associated with dam and infrastructure development. Spring freshet level may be directly changed and total discharge volume for each creek may be adversely affected (Blackwater due to loss of tributary, and Hoffstroms Bay due to topographical change due to construction and flow variation).	3 - Blackwater Creek, Hoffstroms Bay Creek may be permanently affect due to hydrological changes associated with dam and infrastructure development. Spring freshet level may be directly changed and total discharge volume for each creek may be adversely affected (Blackwater due to loss of tributary, and Hoffstroms Bay due to topographical change due to construction and flow variation).	6 - Hughes Creek and Blackwater Creek may be permanently affected due to hydrological changes associated with damn and infrastructure development. Spring freshet levels may be directly changed and total discharge volume may be adversely affected (Blackwater Creek as the headwaters are in the TSF location and Hughes Creek due to tributary loss).	6 - Hughes Creek and Blackwater Creek may be permanently affected due to hydrological changes associated with damn and infrastructure development. Spring freshet levels may be directly changed and total discharge volume may be adversely affected (Blackwater Creek as the headwaters are in the TSF location and Hughes Creek due to tributary loss).	3 - Blackwater Creek may be permanently affected due to hydrological changes associated with dam and infrastructure development. Spring freshet level may be directly changed and total discharge volume for Blackwater Creek may be adversely affected (Blackwater due to loss of tributary).	3 - Blackwater Creek may be permanently affected due to hydrological changes associated with dam and infrastructure development. Spring freshet level may be directly changed and total discharge volume for Blackwater Creek may be adversely affected (Blackwater due to loss of tributary).
	Direct impact to open water	Various locations may impact open water	No of Water Bodies Directly Impacted	No	1 - Only impact associated with open water created by way of beaver dams on Blackwater Creek. Hydrological change to Blackwater Creek may cause flow concerns and abandonment of open water areas by local beaver population.	1 - Only impact associated with open water created by way of beaver dams on Blackwater Creek. Hydrological change to Blackwater Creek may cause flow concerns and abandonment of open water areas by local beaver population.	1 - Only impact associated with open water created by way of beaver dams on Blackwater Creek. Hydrological change to Blackwater Creek may cause flow concerns and abandonment of open water areas by local beaver population.	1 - Only impact associated with open water created by way of beaver dams on Blackwater Creek. Hydrological change to Blackwater Creek may cause flow concerns and abandonment of open water areas by local beaver population.	2 - Impact associated with open water created by beaver damns on Blackwater Creek and beaver damns within the Hughes Creek marshland, and Anderson road culvert dam. Loss of flow may lower water levels and in turn affect the local population at either of these locations.	2 - Impact associated with open water created by beaver damns on Blackwater Creek and beaver damns within the Hughes Creek marshland, and Anderson road culvert dam. Loss of flow may lower water levels and in turn affect the local population at either of these locations.	1 - Only impact associated with open water created by way of beaver dams on Blackwater Creek. Hydrological change to Blackwater Creek may cause flow concerns and abandonment of open water areas by local beaver population.	1 - Only impact associated with open water created by way of beaver dams on Blackwater Creek. Hydrological change to Blackwater Creek may cause flow concerns and abandonment of open water areas by local beaver population.
	Number of fish bearing lakes impacted	Various locations may impact fish bearing lakes	No of Fish Bearing Lakes Directly Affected	No	1 - Probable impact associated with Wabigoon Lake. Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	1 - Probable impact associated with Wabigoon Lake. Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	1 - Probable impact associated with Wabigoon Lake. Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	1 - Probable impact associated with Wabigoon Lake. Closest proximity to Thunder Lake, medium proximity to Wabigoon Lake.	1 - Discharge would flow by way of Hughes or Blackwater Creek to Wabigoon Lake. Farthest from Wabigoon Lake and Thunder Lake	1 - Discharge would flow by way of Hughes or Blackwater Creek to Wabigoon Lake. Farthest from Wabigoon Lake and Thunder Lake	1 - Probable impact associated with Wabigoon Lake. Close proximity to Wabigoon Lake	1 - Probable impact associated with Wabigoon Lake. Close proximity to Wabigoon Lake
Terrestrial Habitat	Area of feeding or shelter loss due to TSF or associated structures.	Various locations may impact habitat of animals (moose, deer, bear etc)	No of Terrestrial Areas Directly Impacted	No.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.	1 - Impact area would be associated with footprint area associated with construction of TSF and associated infrastructure.
	Existing vegetation, ecosystems will be lost	Various locations may impact wetlands, rare ecosystems, grasslands, forests and associated species.	Loss of Flora and Fauna	ha	FRI indicates that there are 6 varieties of forest type within the area (Ecosites include: Pine / Spruce / Feathermoss: Fresh Silty Soil, Spruce / Pine / Feathermoss: Fresh, Fine, Loamy-Clayey Soil, Hardwood-Fir-Spruce Mixedwood: Fresh, Fine, Loamy-Clayey Soil, Intermediate Swamp: Black Spruce (Tamarack), Organic Soil, Rich Swamp: Black Ash (Hardwoods), Organic Mineral Soil, Thicket Swamp: Mineral Soil). Birds and small mammals will be affected by development.	FRI indicates that there are 6 varieties of forest type within the area (Ecosites include: Pine / Spruce / Feathermoss: Fresh Silty Soil, Spruce / Pine / Feathermoss: Fresh, Fine, Loamy-Clayey Soil, Hardwood-Fir-Spruce Mixedwood: Fresh, Fine, Loamy-Clayey Soil, Intermediate Swamp: Black Spruce (Tamarack), Organic Soil, Rich Swamp: Black Ash (Hardwoods), Organic Mineral Soil, Thicket Swamp: Mineral Soil). Birds and small mammals will be affected by development.	FRI indicates that there are 6 varieties of forest type within the area (Ecosites include: Pine / Spruce / Feathermoss: Fresh Silty Soil, Spruce / Pine / Feathermoss: Fresh, Fine, Loamy-Clayey Soil, Hardwood-Fir-Spruce Mixedwood: Fresh, Fine, Loamy-Clayey Soil, Intermediate Swamp: Black Spruce (Tamarack), Organic Soil, Rich Swamp: Black Ash (Hardwoods), Organic Mineral Soil, Thicket Swamp: Mineral Soil). Birds and small mammals will be affected by development.	FRI indicates that there are 6 varieties of forest type within the area (Ecosites include: Pine / Spruce / Feathermoss: Fresh Silty Soil, Spruce / Pine / Feathermoss: Fresh, Fine, Loamy-Clayey Soil, Hardwood-Fir-Spruce Mixedwood: Fresh, Fine, Loamy-Clayey Soil, Intermediate Swamp: Black Spruce (Tamarack), Organic Soil, Rich Swamp: Black Ash (Hardwoods), Organic Mineral Soil, Thicket Swamp: Mineral Soil). Birds and small mammals will be affected by development.	FRI indicates that there are different varieties of forest type within the area (Ecosites include: (Poor Swamp: Black Spruce, Organic Soil, Intermediate Swamp: Black Spruce (Tamarack), Organic Soil, Treed Bog: Black Spruce, Organic Soil, Treed Fen: Tamarack-Black Spruce / Sphagnum, Organic Soil, Spruce - Pine / Feathermoss: Fresh, Sandy-Coarse Loamy Soil). Birds and small mammals will be affected by development.	FRI indicates that there are different varieties of forest type within the area (Ecosites include: (Poor Swamp: Black Spruce, Organic Soil, Intermediate Swamp: Black Spruce (Tamarack), Organic Soil, Treed Bog: Black Spruce, Organic Soil, Treed Fen: Tamarack-Black Spruce / Sphagnum, Organic Soil, Spruce - Pine / Feathermoss: Fresh, Sandy-Coarse Loamy Soil). Birds and small mammals will be affected by development.	FRI indicates that there are 7 varieties of forest type within the area (Ecosites include: Thicket Swamp: Mineral Soil, Shore Fen: Organic Soil, Fir - Spruce Mixedwood: Fresh, Coarse, Loamy Soil, Rock Barren, Hardwood-Fir-Spruce Mixedwood: Fresh, Fine, Loamy-Clayey Soil, Fir - Spruce Mixedwood: Moist, Silty-Clayey Soil). Birds and small mammals will be affected by development.	FRI indicates that there are 7 varieties of forest type within the area (Ecosites include: Thicket Swamp: Mineral Soil, Shore Fen: Organic Soil, Fir - Spruce Mixedwood: Fresh, Coarse, Loamy Soil, Rock Barren, Hardwood-Fir-Spruce Mixedwood: Fresh, Fine, Loamy-Clayey Soil, Fir - Spruce Mixedwood: Moist, Silty-Clayey Soil). Birds and small mammals will be affected by development.
Air Quality	Potential for Dust Emission (contributed by trucks)	Longer haul distances will increase potential dust contribution.	Length of Access Roads	km	No hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	No hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Shortest haul distance related to tailings placement. Daily traffic required for tailings placement. Also traffic related to operations, maintenance and surveillance.	No hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	No hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	No hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	No hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Longest haul distance related to tailings placement. Daily traffic required for tailings placement. Also traffic related to operations, maintenance and surveillance.
	Potential for Dust Emission (Contributed by tailings)	Potential for Deposited Tailings to produce Dust	Type of tailings technology used and potential dust generation	Rank	Lowest potential for dusting based on water storage within facility maintaining tailings beach in wet conditions.	Increased potential from conventional tailings based on potential less water being stored in facility.	Highest potential for dusting.	Lowest potential for dusting based on water storage within facility maintaining tailings beach in wet conditions.	Lowest potential for dusting based on water storage within facility maintaining tailings beach in wet conditions.	Increased potential from conventional tailings based on potential less water being stored in facility.	Lowest potential for dusting based on water storage within facility maintaining tailings beach in wet conditions.	Highest potential for dusting.
	Potential for Greenhouse Gas Emission (number of truck hours)	Increased truck traffic will increase potential for Greenhouse Gas Emissions.	Qualitative Rank of Potential Greenhouse Gas Emissions	Rank	Lowest potential, no hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Lowest potential, no hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Highest potential based on truck hauling used for tailings deposition.	Lowest potential, no hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Lowest potential, no hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Lowest potential, no hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Lowest potential, no hauling of tailings required for tailings disposal. Traffic related to operations, maintenance and surveillance.	Highest potential based on truck hauling used for tailings deposition.
	Noise	Increased truck traffic will increase noise pollution	Qualitative rank - estimate of noise generation from truck traffic based on tailings disposal technology	Rank	Low noise generation	Low noise generation	High noise generation from truck traffic	Low noise generation	Low noise generation	Low noise generation	Low noise generation	High noise generation from truck traffic

Technical Account												
Sub-Account	**Description**	**Rationale**	**Indicator Parameter**	**Unit**	**1A**	**1B**	**1C**	**1D**	**2A**	**2B**	**6A**	**6C**
Design	Foundation Conditions	Conditions of the foundation may be undesirable and may require additional stability measures	Qualitative Rank of Foundation Conditions	Rank	Natural ground in the area generally consisting of clay materials. Potential containment in basin area.	Natural ground in the area generally consisting of clay materials. Potential containment in basin area.	Natural ground in the area generally consisting of clay materials. Potential containment in basin area.	Natural ground in the area generally consisting of clay materials. Potential containment in basin area.	Natural ground in the area generally consisting of sands and gravels. Not suitable for basin containment.	Natural ground in the area generally consisting of sands and gravels. Not suitable for basin containment.	Potentially consisting of clay to bedrock knobs.	Potentially consisting of clay to bedrock knobs.
	Distance from Plant	Longer distance results in more access roads (or haul roads for dry stack) and pipeline construction, more pumping energy and potential booster stations (for conventional slurry or paste)	Distance From Plant Site to Far End of Facility for pipeline or haul road.	m	Closest proximity to plant site.	Closest proximity to plant site.	Closest proximity to plant site.	Closest proximity to plant site.	farthest proximity to plant site	farthest proximity to plant site	Medium proximity to plant site	Medium proximity to plant site.
	Topographic Complexity	More complex topography may constrain approaches to type of seepage ditch construction (based on expected flow velocity)	Qualitative Rank of Topographic Complexity	Rank	Local topography can be used to reduce embankment heights.	Favourable topography for paste tailings. Local topography can be used to minimize dam embankments.	Local topography favourable for tailings placement.	Local topography can be used to reduce embankment heights. Directing tailings underground in future years operations will also reduce required embankment heights. Minimal topographic change from the plant site.	local topography can be used to establish embankment layouts. Topography can be used for seepage collection.	Local topography can be used to establish embankment layouts. Largest topographic difference to the plant site at ~50 m elevation difference.	Undulating topography present, can be used to establish perimeter embankments. Potential bedrock can hinder establishing perimeter ditches.	Undulating topography will require operational planning for tailings placement.
	Topography	Elevation difference between processing plant and tailings storage facility affects pumping requirements	Elevation Difference From Plant Site at final Embankment Arrangement. For tailings pumping.	m	Medium topographic change from the plant site	Medium topographic change from the plant site	No tailings pumping	Medium topographic change from the plant site	Largest topographic difference to the plant site	Largest topographic difference to the plant site	Location is at equal or lower elevation difference from the plant site. Some topographic undulation between plant site and location.	No tailings pumping
	Dam Complexity	More complex dam design will result in more difficult construction requirements and associated monitoring conditions	Qualitative Rank of Dam Complexity	Rank	Zoned earthfill with low permeable clay layer or liner material. Foundation favourable for foundation key-in. Dam can be raised during operations.	Zoned earthfill with low permeable clay layer or liner material. Foundation favourable for foundation key-in. Dam can be raised during operations. Lower embankment heights resulting from higher in situ density conditions.	Containment dam for water collection and reclaim, separate facility from dry stack pile.	Zoned earthfill with low permeable clay layer or liner material. Foundation favourable for foundation key-in. Dam can be raised during operations. Anticipated lower dam heights with portion of tailings waste directed to the mine workings for storage.	Zoned earthfill with low permeable clay layer or liner material. Foundation anticipated to consist of sand or gravel that will require basin lining. Dam can be raised during operations.	Zoned earthfill with low permeable clay layer or liner material. Foundation anticipated to consist of sand or gravel that will require basin lining. Dam can be raised during operations. Lower embankment heights resulting from higher in situ density conditions.	Zoned earthfill with low permeable clay layer or liner material. Foundation may consist of rock that will be more complex for embankment key-in or liner anchorage. Foundation consisting of rock will provide good embankment stability. Dam can be raised during operations.	Containment dam for water collection and reclaim, separate facility from dry stack pile.
	Dam Hazard Classification	Based on classification systems, various designs can be assessed a hazard classification	CDA Dam Classification Estimate	Classification	HPC will be dependant on Environmental considerations and proximity to the plant site.	HPC will be dependant on Environmental considerations and proximity to the plant site.	HPC based on WCP	HPC will be dependant on Environmental considerations and proximity to the plant site.	HPC will be dependant on Environmental considerations.	HPC will be dependant on Environmental considerations.	Anticipated to require a higher HPC due to proximity to Hwy 17 and Wabigoon Lake.	HPC based on WCP
	Construction Material Availability	Areas closer to confirmed borrow pit sources and amount of material required to construct dams	Qualitative Rank of Construction Material Availability	Rank	Close to local clay borrow source and mine waste rock that will be provided from the open pit mining area. Adjacent to established roads for materials hauled from external sources.	Close to local clay borrow source and mine waste rock that will be provided from the open pit mining area. Adjacent to established roads for materials hauled from external sources.	Close to local clay borrow source and mine waste rock that will be provided from the open pit mining area. Adjacent to established roads for materials hauled from external sources.	Close to local clay borrow source and mine waste rock that will be provided from the open pit mining area. Adjacent to established roads for materials hauled from external sources.	Farther distance that Location 1 and 6 for local borrow sources, mine waste rock and external supplied materials. Will also require establishing construction roads for access.	Farther distance that Location 1 and 6 for local borrow sources, mine waste rock and external supplied materials. Will also require establishing construction roads for access.	Closest proximity for local borrow material, mine waste rock and also external supplied materials than Location 1 and 2.	Closest proximity for local borrow material, mine waste rock and also external supplied materials than Location 1 and 2.
	Slope Stability	Taller slopes required to achieve the required volume while minimizing footprint increases risk of instability	Preliminary Estimate of Total Embankment Height	m	24	22	18 (estimate of final height of tailings pile)	22	30	29	34	27 (estimate of final height of tailings pile)
	Slope Stability	Steeper slopes required to achieve the required volume while minimizing footprint increases risk of instability	Estimate of Slope Angle during operations	H:V	1.5H:1V	1.5H:1V	2.1H:1V	1.5H:1V	1.5H:1V	1.5H:1V	1.5H:1V	2.1H:1V
	Number of Watersheds	Larger footprints may impact more than one watershed and require additional drainage measures for settling ponds or water collection ditching.	No. of Primary Watersheds	No.	See Environmental Account Above.							

TABLE 4.3

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 3 - ALTERNATIVE CHARACTERIZATION

Operations	Distance between storage facility and Mill Site	Longer access road requirements, longer transport distance for tailings materials required increased surveillance and potential for spills outside of containment areas.	Distance from Plant Site to Far End of Facility	m	2,200	2,200	2,200	2,200	5,200	5,200	2,400	2,400
	Operational Risks and Other Uncertainties	Various depositional technologies and locations may have additional operational risks	Qualitative Rank of operations assessment based on tailings and water management .	Rank	Tailings solids and water management contained within perimeter embankments. Water reclaim from the facility.	Tailings and water storage within single containment facility, potential requirements for further containment for water management. Capacity dependant on achieving consistent beach slopes and in situ densities in summer and winter conditions.	Tailings solids not contained within perimeter embankments. Potential dusting issue in summer. Potential to trap ice lenses in lifts. Will require snow removal during winter operations. Requires collection and containment of surface water runoff.	Tailings solids and water management contained within perimeter embankments. Water reclaim from the facility. Portion of tailings requires thickening and direction to the underground that reduces volume of tailings operations within the facility.	Tailings solids and water management contained within perimeter embankments. Water reclaim from the facility.	Tailings and water storage within single containment facility, potential requirements for further containment for water management. Capacity dependant on achieving consistent beach slopes and in situ densities in summer and winter conditions.	Tailings solids and water management contained within perimeter embankments. Water reclaim from the facility.	Tailings solids not contained within perimeter embankments. Potential dusting issue in summer. Potential to trap ice lenses in lifts. Will require snow removal during winter operations. Requires collection and containment of surface water runoff.
	Water Treatment Requirements	The depositional technologies have various water treatment requirements	Estimate of Water Treatment Volume	m^3	Highest anticipated volume of water released to supernatant pond. Facility required to provide storage of surplus water for direction to treatment.	Medium volume of water released to supernatant pond. May require inclusion of secondary water management facility during the operations.	Tailings dewatered at the plant site prior to being stored at the facility. Water treatment from runoff collection from stored tailings and other water collection at the site.	Highest volume of water released to supernatant pond. Facility required to provide storage of surplus water for direction to treatment.	Highest volume of water released to supernatant pond. Facility required to provide storage of surplus water for direction to treatment.	Medium volume of water released to supernatant pond. May require inclusion of secondary water management facility	Highest volume of water released to supernatant pond. Facility required to provide storage of surplus water for direction to treatment.	Tailings dewatered at the plant site prior to being stored at the facility. Water treatment from runoff collection from stored tailings and other water collection at the site.
Closure	Remediation Requirements	Complexity of Remediation requirements for Closure	Quantitative Rank of Remediation Requirements	Rank	Highest complexity, requiring facility closure (stabilize slopes) and surface water management design.	Medium to High complexity, requiring closure of facility.	Lowest complexity, requiring closure and capping of facility and providing stable final surfaces.	Highest complexity, requiring facility closure and water management design.	Highest complexity, requiring facility closure and water management design.	Medium to High complexity, requiring closure of facility.	Highest complexity, requiring facility closure and water management design.	Lowest complexity, requiring closure and capping of facility and providing stable final surfaces.
	Post Closure Water Treatment Requirements	Post Closure water treatment requirements may be more involved for various options.	Quantities Rank of Potential Post Closure Water Treatment Requirements	Rank	Potential short-term water treatment until facility is closed.	Potential short-term water treatment until facility is closed.	Potential long-term water treatment requirements - to be determined with monitoring of seepage and runoff after closure activities are completed.	Potential short-term water treatment until facility is closed.	Potential short-term water treatment until facility is closed.	Potential short-term water treatment until facility is closed.	Potential short-term water treatment until facility is closed.	Potential long-term water treatment requirements - to be determined with monitoring of seepage and runoff after closure activities are completed.
	Post Closure Landform Stability	Various landform designs may be more stable than others	Qualitative Rank - Estimate of Post Closure Landform Stability	Rank	Closure requires long-term stability of embankments, potential grading of slopes, medium embankment height	Closure requires long-term stability of embankments, potential grading of slopes, medium embankment height	Closure requires long-term stability of tailings pile slopes, may require regrading at closure for placement of cover material, lower final height.	Closure requires long-term stability of embankments, potential grading of slopes, medium embankment height	Closure requires long-term stability of embankments, potential grading of slopes, higher final embankment height	Closure requires long-term stability of embankments, potential grading of slopes, higher final embankment height	Closure requires long-term stability of embankments, potential grading of slopes, higher final embankment height	Closure requires long-term stability of tailings pile slopes, may require regrading at closure for placement of cover material, lower to medium final height.
	Post Closure Chemical Stability	Various closure plans may allow for more chemical stability	Qualitative Rank - Estimate of Post Closure Chemical Stability	Rank	Closure anticipated to consist of capping final tailings surface with low permeable liner or clay material and inclusion of a shedding cover with revegetation to prevent water infiltration into deposited tailings.	Closure anticipated to consist of capping final tailings surface with low permeable liner or clay material and inclusion of a shedding cover with revegetation to prevent water infiltration into deposited tailings.	Closure anticipated to consist of capping final tailings surface with low permeable clay material and revegetation.	Closure anticipated to consist of capping final tailings surface with low permeable liner or clay material and inclusion of a shedding cover with revegetation to prevent water infiltration into deposited tailings.	Closure anticipated to consist of capping final tailings surface with low permeable liner or clay material and inclusion of a shedding cover with revegetation to prevent water infiltration into deposited tailings.	Closure anticipated to consist of capping final tailings surface with low permeable liner or clay material and inclusion of a shedding cover with revegetation to prevent water infiltration into deposited tailings.	Closure anticipated to consist of capping final tailings surface with low permeable liner or clay material and inclusion of a shedding cover with revegetation to prevent water infiltration into deposited tailings.	Closure anticipated to consist of capping final tailings surface with low permeable clay material and revegetation.
Capacity	Tailings Storage Expansion Capacity	Some geographical locations and designs may allow for additional expansion requirements more easily than others	Qualitative Rank of Potential Expansion	Rank	Area is favourable to expansion for additional tailings storage through embankment raising.	Area is favourable to expansion for additional tailings storage through embankment raising.	Area is favourable to expansion for additional tailings storage with increases to footprint area or increased pile heights.	Area is favourable to expansion for additional tailings storage through embankment raising.	Area is favourable to expansion for additional tailings storage through embankment raising.	Area is favourable to expansion for additional tailings storage through embankment raising.	Area is less favourable to expansion due to local topography and adjacent property boundaries.	Area is less favourable to expansion due to local topography and adjacent property boundaries.
	Storage Efficiency	Designs may be more efficient than others at storing tailings	Storage Capacity Volume per Construction Material Volume	m^3/m^3	5	5.3	>7	5.2	4.6	4.1	2.4	>7
Water Management	Sensitivity to Climate Variability	Some locations and other influences can produce options that are more sensitive to climate variability	Qualitative Rank of climate sensitivity	Rank	moderate sensitivity to climate variability, requires reclaim from pond during winter with ice buildup in pond.	moderate to high sensitivity, requires reclaim from pond during winter with ice buildup in pond.	low to moderate sensitivity, requires reclaim from pond during winter with ice buildup in pond.	moderate sensitivity to climate variability, requires reclaim from pond during winter with ice buildup in pond.	moderate sensitivity to climate variability, requires reclaim from pond during winter with ice buildup in pond.	moderate to high sensitivity, requires reclaim from pond during winter with ice buildup in pond.	moderate sensitivity to climate variability, requires reclaim from pond during winter with ice buildup in pond.	low to moderate sensitivity, requires reclaim from pond during winter with ice buildup in pond.
	Surface Water Control Measures	Various options may require more complex surface water control measures	Qualitative Rank of Surface Water Control	Rank	Low complexity, consisting of containment within facility and reclaim from the facility. To be completed with surface water operational plan.	Moderate complexity. Bleed water anticipated, management within Cell 2 during initial phase of operations. Additional water management facility required in second phase of operations and required to store water from mine dewatering.	Moderate to High complexity. Surface water management required consisting of runoff from tailings pile and surrounding catchment runoff management. Separate facility required to store water from mine dewatering.	Low complexity, consisting of containment within facility and reclaim from the facility. To be completed with surface water operational plan. Less process water with portion of the tailings being directed to the underground.	Low complexity, consisting of containment within facility and reclaim from the facility. To be completed with surface water operational plan.	Moderate complexity. Bleed water anticipated, water management will include separate facility to manage surface water and mine dewatering.	Low complexity, consisting of containment within facility and reclaim from the facility. To be completed with surface water operational plan.	Moderate to High complexity. Surface water management required consisting of runoff from tailings pile and surrounding catchment runoff management. Separate facility required to store water from mine dewatering.
	Seepage Control Measures	Ability to restrict the migration of mine water	Qualitative Rank of Seepage Control	Rank	Seepage control with low permeable clay or liner materials. Collection of seepage with downstream ditching and pump back system.	Seepage control with low permeable clay or liner materials. Collection of seepage with downstream ditching and pump back system.	Seepage control with foundation liners (natural or product) and perimeter containment ditching.	Seepage control with low permeable clay or liner materials. Collection of seepage with downstream ditching and pump back system.	Seepage control with low permeable clay or liner materials. Collection of seepage with downstream ditching and pump back system.	Seepage control with low permeable clay or liner materials. Collection of seepage with downstream ditching and pump back system.	Seepage control with low permeable clay or liner materials. Collection of seepage with downstream ditching and pump back system.	Seepage control with foundation liners (natural or product) and perimeter containment ditching.

Economic Account

Sub-Account	Description	Rationale	Indicator Parameter	Unit	1A	1B	1C	1D	2A	2B	6A	6C
Life of Mine Costs	Capital	Larger Capital Costs will result in a decreased project return.	Factored Cost Ranking	Rank	34.5	28.8	9.9	29.1	119.3	113.4	54.1	6.3
	Operational	Larger Operational costs will result in a decreased project return	Factored Cost Ranking	Rank	2.9	10.9	31.3	10.9	3.7	11.7	3.1	31.3
	Fish Habitat Compensation	Increased fish habitat impacts increases compensation costs (including bonding, capital and monitoring)	Factored Cost Ranking	Rank	Not Assessed - Each Alternative Assigned a Neutral Rating							
	Closure and Reclamation Costs	More complex dam design will result in more difficult construction requirements and associated monitoring conditions	Factored Cost Ranking	Rank	18.4	18.4	10.8	18.4	51.5	51.5	11.5	7.4

Socio-Economic Account

Sub-Account	Description	Rationale	Indicator Parameter	Unit	1A	1B	1C	1D	2A	2B	6A	6C
Archaeology	Archaeological Potential	Tailings Storage Facility that impacts archaeological resources will potentially require additional investigation, permitting and may attract adverse public concern	Area of direct impact and archaeological potential	ha/potential	No archeological potential.	No archeological potential.	No archeological potential.	No archeological potential.	No archeological potential.	No archeological potential.	No archeological potential.	No archeological potential.
Health and Safety	Risk to Human Health	Tailings facilities that can generate tailings dust or potential discharge of untreated water can cause adverse affects to human health.	Qualitative Rank of Human Health Risk	Rank	Medium to High risk based on water management	Medium to High risk based on water management	High risk based on potential surface dusting	Medium to High risk based on water management	Medium risk based on lower embankments and water management.	Medium risk based on lower embankments and water management.	High Risk based on high dams and water management	High risk based on potential surface dusting
	Risk to Public Safety	Facilities with significant embankment heights can be less stable. Facilities without perimeter containment can be higher risk. Facilities dependant on water management can be higher risk if unwanted water is released from the facility.	Qualitative Rank of Public Safety Risk	Rank	Medium risk based on dam heights and water management	Medium risk based on dam heights and water management	Low to Medium risk based on reduced water management and tailings storage arrangement	Medium risk based on dam heights and water management	Low risk based on location and water management	Low risk based on location and water management	Medium risk based on dam heights and water management	Low to Medium risk based on reduced water management and tailings storage arrangement
	Risk to Worker Safety	Facilities that are upstream of other operating facilities or require increased manpower for operations can be higher risk to worker safety.	Qualitative Rank of Worker Safety Risk	Rank	Medium to High risk based on location and required operations.	Medium to High risk based on location and required operations.	High risk based on required daily operations.	Medium to High risk based on location and required operations.	Medium risk based on location and required operations.	Medium risk based on location and required operations.	High risk based on location and operations	High risk based on location and operations
Socio-Economic Indicators	Economic Benefits to Regional Communities	Facilities requiring start-up and future construction activities as well as on-going operations can beneficial to the regional community.	Qualitative Rank of Economic Benefits to Community	Rank	Medium Impact with initial construction costs, on-going construction costs, low operation costs.	Medium Impact with initial construction costs, on-going construction costs, low operation costs.	Low - Medium based on low initial construction costs and higher operational costs.	Medium Impact with initial construction costs, on-going construction costs, low operation costs.	Medium - High Impact with initial construction costs, on-going construction costs, low operation costs.	Medium - High Impact with initial construction costs, on-going construction costs, low operation costs.	Medium Impact with initial construction costs, on-going construction costs, low operation costs.	Low - Medium based on low initial construction costs and higher operational costs.
	Regional Job Creation and Diversity	Potential job creation for start-up construction, potential future construction or on-going operations.	Qualitative Rank of Job Creation - Employment Numbers	Rank	Medium indirect employment with initial construction costs, future construction costs and with low impact as TSF becomes operational to closure.	Medium indirect employment with initial construction costs, future construction costs and with low impact as TSF becomes operational to closure.	Low - Medium - Low initial costs to construct with higher employment as operational staff is greater in nature then traditional tailings facility.	Medium indirect employment with initial construction costs, future construction costs and with low impact as TSF becomes operational to closure.	Medium - High indirect employment with initial construction costs, future construction costs and with low impact as TSF becomes operational to closure.	Medium - High indirect employment with initial construction costs, future construction costs and with low impact as TSF becomes operational to closure.	Medium - High indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low - Medium - Low initial costs to construct with higher employment as operational staff is greater in nature then traditional tailings facility.
	Indirect Employment	Direct relation of Regional Job Creation.	Qualitative Rank of Potential Indirect Employment	Rank	Low to Medium indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low to Medium indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low - initial costs to construct with medium indirect employment as operational staff is greater in nature then traditional tailings facility.	Low to Medium indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low to Medium indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low to Medium indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low to Medium indirect employment with initial construction costs, with low impact as TSF becomes operational to closure.	Low - initial costs to construct with medium indirect employment as operational staff is greater in nature then traditional tailings facility.
First Nation Impacts	Aboriginal Rights	Potential impacts to identified areas of Aboriginal Rights	Qualitative Rank of Local Aboriginal Rights	Rank	Medium	Medium	Medium	Medium	Low	Low	Low	Low
	Extent of Traditional Land Use	Potential impacts to Traditional Land Use by Person	Qualitative Rank of Traditional Land Use	Rank	Medium	Medium	Medium	Medium	Low	Low	Low	Low
	Extent of Traditional Land Use	Potential impacts to Traditional Land Use by Activity	Qualitative Rank of Traditional Land Use	Rank	3 - Traditional uses of the area include that of berry picking, hunting, trapping, and mushroom picking.	3 - Traditional uses of the area include that of berry picking, hunting, trapping, and mushroom picking.	3 - Traditional uses of the area include that of berry picking, hunting, trapping, and mushroom picking.	3 - Traditional uses of the area include that of berry picking, hunting, trapping, and mushroom picking.	2 - Traditional uses of the area due to access issues are assumed to be hunting and trapping needs.	2 - Traditional uses of the area due to access issues are assumed to be hunting and trapping needs.	1 - Due to access concerns and the presence of private and Company own land this area has been only used for hunting.	1 - Due to access concerns and the presence of private and Company own land this area has been only used for hunting.
Recreational and Commercial Land Use	Visual Impact	Potential impact of facility above potential sight lines	Extent of structure above topography and sight lines	m	Low - Medium - TSF and Embankment system is in close proximity to the road network and the open pit. However due to tree height and associated topography dam will be visible in a limited fashion.	Low - Medium - TSF and Embankment system is in close proximity to the road network and the open pit. However due to tree height and associated topography dam will be visible in a limited fashion.	Low - Due to tree height and associated topography, dam and infrastructure will be visible in a limited fashion.	Low - Medium - TSF and Embankment system is in close proximity to the road network and the open pit. However due to tree height and associated topography dam will be visible in a limited fashion.	Low - TSF area is located at the furthest location from local community and road network.	Low - TSF area is located at the furthest location from local community and road network.	Low - Medium - TSF and Embankment system is in close proximity to the road network and the open pit. In initial stages of development dam may be visible from Thunder Lake as WRSA may not provide a visual buffer.	Low - Due to tree height and associated topography, dam and infrastructure will be visible in a limited fashion.
	Impact to Navigable Waters	Facility impact to established waterways used for travel	Area of Direct Impact	ha	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.	0 - No impact to navigable waters throughout course of project.
	Extent of Recreational Land Use	Facility negatively impacting Recreational Land Use.	Qualitative Rank of Recreational Use	Rank	Low - Medium, concern for recreational activity as traditional use for area include berry picking, hunting, trapping, and mushroom picking. However area is under private property therefore activities have been limited .	Low - Medium, concern for recreational activity as traditional use for area include berry picking, hunting, trapping, and mushroom picking. However area is under private property therefore activities have been limited .	Low - Medium, concern for recreational activity as traditional use for area include berry picking, hunting, trapping, and mushroom picking. However area is under private property therefore activities have been limited .	Low - Medium, concern for recreational activity as traditional use for area include berry picking, hunting, trapping, and mushroom picking. However area is under private property therefore activities have been limited .	Low, limited recreational activities due to access issues. Limited to hunting and trapping.	Low, limited recreational activities due to access issues. Limited to hunting and trapping.	Low, limited recreational activities due to access and private	Low, limited recreational activities due to access and private
	Extent of Commercial Land Use	Facility negatively impacting Commercial Land Use.	Qualitative Rank of Commercial Use	Rank	0 - No impact to commercial land use.	0 - No impact to commercial land use.	0 - No impact to commercial land use.	0 - No impact to commercial land use.	0 - No impact to commercial land use.	0 - No impact to commercial land use.	0 - No impact to commercial land use.	0 - No impact to commercial land use.

Alternative Identification	Description
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
6A	Location 6 - Conventional Slurry Tailings
6C	Location 6 - Filtered/Dry Stack Tailings

Notes:
1. Indicators that can not be quantified have been assigned a rank to enable comparison for assessment.

WSP

TABLE 4.4

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 4 - MULTIPLE ACCOUNTS LEDGER FOR CANDIDATE ALTERNATIVES

Environmental Account				Indicator Quantity							
Sub-Account	**Description**	**Indicator**	**Indicator Parameter**	**1A**	**1B**	**1C**	**1D**	**2A**	**2B**	**6A**	**6C**
Land Use	Distance from the Mine	Direct Distance from Plant Site to Structure	m	400	400	400	400	2,200	2,200	1,400	1,400
	Pipeline/Access Road Requirements	Length of Additional Infrastructure Required	m	700	700	700	700	2,400	2,400	1,500	1,500
	Storage Facility and Associated Infrastructure Footprint	Estimate of Storage Facility(s) Area	ha	88	88	100	88	246	246	54	61
Water Impacts	Number of Main Watersheds directly impacted	Number of Watersheds directly impacted	No	1	1	1	1	1	1	1	1
	Impact to surface water availability	Qualitative Estimate of Potential Surface Water	Rank	Medium - High	Medium - High	Medium - High	Medium - High	High	High	Medium	Medium
	Potential Impacts to Water Quality (ARD, Metal Leaching, etc)	Likelihood of Mining Impacts and mitigative measures required	Rank	Low - Medium	Medium	High	Low - Medium	Low - Medium	Medium	Low - Medium	High
Aquatic Habitat	Permanent Streams Impacted	No. of Streams Directly Impacted	No	1	1	1	1	2	2	1	1
	Indirect impacts (downstream flow reductions)	No of Streams Potentially Indirectly Impacted	No	3	3	3	3	6	6	3	3
	Direct impact to open water	No of Water Bodies Directly Impacted	No	1	1	1	1	1	1	1	1
	Fish Bearing Lakes	No of Fish Bearing Lakes Directly Affected	No	1	1	1	1	1	1	1	1
Terrestrial Habitat	Area of feeding or shelter loss due to TSF or associated structures.	No of Terrestrial Areas Directly Impacted	No	1	1	1	1	1	1	1	1
	Existing vegetation, ecosystems will be lose	Potential Loss to flura and Fana with construction and operations	ha	88	88	100	88	246	246	54	61
Air Quality	Potential for Dust Emission (contributed by trucks)	Length of Access Roads	km	0	0	700	0	0	0	0	1,500
	Potential for Dust Emission (Contributed by tailings)	Type of tailings technology used and potential dust generation	Rank	Low	Low to Medium	Medium to High	Low	Low	Low to Medium	Low	Medium to High
	Potential for Greenhouse Gas Emission (number of truck hours)	Qualitative Rank of Potential Greenhouse Gas Emissions	Rank	Low	Low	High	Low	Low	Low	Low	High
	Noise	Qualitative rank - estimate of noise generation from truck traffic based on tailings disposal technology	dB	Low	Low	High	Low	Low	Low	Low	High

Technical Account				Indicator Quantity							
Sub-Account	**Description**	**Indicator**	**Indicator Parameter**	**1A**	**1B**	**1C**	**1D**	**2A**	**2B**	**6A**	**6C**
Design	Foundation Conditions	Qualitative Rank of Foundation Conditions	Rank	Anticipated to consist of clay over bedrock to sands and gravels.	Anticipated to consist of clay over bedrock to sands and gravels.	Anticipated to consist of clay over bedrock to sands and gravels.	Anticipated to consist of clay over bedrock to sands and gravels.	Anticipated to consist of sands and gravels	Anticipated to consist of sands and gravels	Anticipated to consist of clay to bedrock knob to swamp and organic material.	Anticipated to consist of clay to bedrock knob to swamp and organic material.
	Distance From Plant Site	Distance From Plant Site to Far End of Facility for pipeline or haul road.	m	2,200	2,200	2,200	2,200	5,200	5,200	2,400	2,400
	Topographic Complexity	Qualitative Rank of Topographic Complexity	Rank	Topography provides good use of undulating elevations for embankment construction and future raising. Suitable for tailings and water management	Topography provides good use of undulating elevations for embankment construction and future raising. Suitable for tailings and water management	Topography is suitable for storage of tailings solids. Area can also be used for water management.	Topography provides good use of undulating elevations for embankment construction and future raising. Suitable for tailings and water management	Topography provides good use of undulating elevations for embankment construction and future raising. Suitable for tailings and water management	Topography provides good use of undulating elevations for embankment construction and future raising. Suitable for tailings and water management	Topography could provide some challenges to embankment construction and raising due to potential bedrock outcropping. Some potential challenges to tailings management in initial years of operations.	Potential challenges to construction and tailings management due to undulating topography. Potential challenges to collection of surface water runoff.
	Topography	Elevation Difference From Plant Site at final Embankment Arrangement. For tailings pumping.	m	27	25	No Pumping	25	35	34	24	No Pumping
	Dam Complexity	Qualitative Rank of Dam Complexity	Rank	Zoned Earthfill with foundation key-in	Zoned Earthfill with foundation key-in	Berm and Ditch Containment	Zoned Earthfill with foundation key-in	Zoned Earthfill, foundation key-in with liner product	Zoned Earthfill, foundation key-in with liner product	Zoned earthfill, potential bedrock key-in.	Zoned earthfill, potential bedrock key-in.
	Dam Hazard Classification	CDA Dam Classification, MNR Dam Classification	CDA Dam Classification Estimate	High	High	High	High	High	High	Very High	Very High
	Construction Material Availability	Qualitative Rank of Construction Material Availability	Qualitative Rank of Construction Material Availability	Medium distance to potential clay borrow source at Open Pit Mine and material hauled in from off-site.	Medium distance to potential clay borrow source at Open Pit Mine and material hauled in from off-site.	Medium distance to potential clay borrow source at Open Pit Mine and material hauled in from off-site.	Medium distance to potential clay borrow source at Open Pit Mine and material hauled in from off-site.	Farthest distance from potential clay source at Open Pit Mine and material hauled in from off-site.	Farthest distance from potential clay source at Open Pit Mine and material hauled in from off-site.	Closest distance to potential clay borrow source at Open Pit Mine and material hauled in from off-site.	Closest distance to potential clay borrow source at Open Pit Mine and material hauled in from off-site.
	Slope Stability	Preliminary Estimate of Total Embankment Height	m	24	22	18	22	30	29	34	27
	Slope Stability	Estimate of Slope Angle during operations	H:V	1.5H:1V	1.5H:1V	2.1H:1V	1.5H:1V	1.5H:1V	1.5H:1V	1.5H:1V	2.1H:1V
	Number of Watersheds	No. of Primary Watersheds	No	1	1	1	1	1	1	1	1
Operations	Operation Distance	Distance From Plant Site to Far End of Facility	m	2,200	2,200	2,200	2,200	5,200	5,200	2,400	2,400
	Operational Risks and Other Uncertainties	Qualitative Rank of operations assessment based on tailings and water management .	Rank	Requires tailings deposition planning and operational management with consideration of seasonal influences for water management. Water management requires several reclaim lines and monitoring.	Requires tailings deposition planning and operational management. Potential seasonal influence on tailings deposition. Water management may require two facilities and several reclaim lines and monitoring.	Requires truck placement of tailings. Seasonal influences will require snow clearing of tailings area and potential ice lensing in placed tailings. Water management in separate facility with reclaim line.	Requires tailings deposition planning and operational management with consideration of seasonal influences for water management. Water management requires several reclaim lines and monitoring.	Requires tailings deposition planning and operational management with consideration of seasonal influences for water management. Water management requires several reclaim lines and monitoring.	Requires tailings deposition planning and operational management. Potential seasonal influence on tailings deposition. Water management may potential require two facilities and several reclaim lines and monitoring.	Requires tailings deposition planning and operational management with consideration of seasonal influences for water management. Water management requires several reclaim lines and monitoring.	Requires truck placement of tailings. Seasonal influences will require snow clearing of tailings area and potential ice lensing in placed tailings. Water management in separate facility with reclaim line.
	Water Treatment Requirements	Estimate of Water Treatment Volume	m^3/yr	340,000	250,000	720000	340,000	702,000	620,000	260,000	690,000
Closure	Remediation Requirements	Quantitative Rank of Remediation Requirements	Rank	Closure of embankment slopes and containment area.	Closure of embankment slopes and containment area. Potential reclamation of water collection pond if used.	Closure of slopes and final surfaces. Potential for progressive reclamation. Reclamation of water management facility.	Closure of embankment slopes and containment area.	Closure of embankment slopes and containment area.	Closure of embankment slopes and containment area. Potential reclamation of water management facility, if used.	Closure of embankment slopes and containment area.	Closure of slopes and final surfaces. Potential for progressive reclamation. Reclamation of water management facility.
	Post Closure Water Treatment Requirements	Quantities Rank of Potential Post Closure Water Treatment Requirements	Rank	Potential short-term water treatment requirements until closure activities completed.	Potential short-term water treatment requirements until closure activities completed.	Potential short to long-term water treatment requirements after closure.	Potential short-term water treatment requirements until closure activities completed.	Potential short-term water treatment requirements until closure activities completed.	Potential short-term water treatment requirements until closure activities completed.	Potential short-term water treatment requirements until closure activities completed.	Potential short to long-term water treatment requirements after closure.
	Post Closure Landform Stability	Qualitative Rank - Estimate of Post Closure Landform Stability	Rank	Medium to High - Single dam structure stabilized at closure	Medium - Potential two dam structures stabilized at closure	Low to Medium - Stockpile of tailings covered at closure, slopes regraded, includes closure of dam structure for water management.	Medium to High - Single dam structure stabilized at closure, lower dam heights than 1A	Medium to High - Single dam structure stabilized at closure	Medium - Potential two dam structures stabilized at closure	Medium to High - Single dam structure stabilized at closure	Low to Medium - Stockpile of tailings covered at closure, slopes regraded, includes closure of dam structure for water management.
	Post Closure Chemical Stability	Qualitative Rank - Estimate of Post Closure Chemical Stability	Rank	Medium to High - Facility uses low-permeable embankment and basin, capped with engineered liner and shedding cover.	Medium to High - Facility uses low-permeable embankment and basin, capped with engineered liner and shedding cover.	Low to Medium - Facility uses foundation seepage collection and final surface covered with shedding cover.	Medium to High - Facility uses low-permeable embankment and basin, capped with engineered liner and shedding cover.	High - Facility uses engineered liner for embankments and basin, capped with engineered liner and shedding cover.	High - Facility uses engineered liner for embankments and basin, capped with engineered liner and shedding cover.	Medium to High - Facility uses low-permeable embankment and basin, capped with engineered liner and shedding cover.	Low to Medium - Facility uses foundation seepage collection and final surface covered with shedding cover.

TABLE 4.4

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 4 - MULTIPLE ACCOUNTS LEDGER FOR CANDIDATE ALTERNATIVES

Capacity	Tailings Storage Expansion Capacity	Qualitative Rank of Potential Expansion	Rank	High - Area and Topography favourable for tailings expansion	High - Area and Topography favourable for tailings expansion	High - Area and Topography favourable for tailings expansion	High - Area and Topography favourable for tailings expansion	High - Area and Topography favourable for tailings expansion	High - Area and Topography favourable for tailings expansion	Low - Area unfavorable to expansion due to adjacent land, topography and adjacent infrastructure.	Low - Area unfavorable to expansion due to adjacent land, topography and adjacent infrastructure.
	Storage Efficiency	Storage Capacity Volume per Construction Material Volume	m^3/m^3	5.0	5.3	>7	5.2	4.6	4.1	2.4	>7
Water Management	Sensitivity to Climate Variability	Qualitative Rank of climate sensitivity	Rank	Medium	moderate to high sensitivity	moderate to high sensitivity	lowest sensitivity to climate variability	lowest sensitivity to climate variability	moderate to high sensitivity	lowest sensitivity to climate variability	moderate to high sensitivity
	Surface Water Control Measures	Qualitative Rank of Surface Water Control	Rank	Medium - Fully contained within a single impoundment with water transfer to plant site for reclaim and treatment.	Low to Medium - Collection in single facility, potential requirement for secondary facility with water transfer to plant site for reclaim and treatment.	Medium to High - Surface runoff collected in single facility, water management within single faculty with transfer to plant site for reclaim and treatment.	Medium - Fully contained within a single impoundment with water transfer to plant site for reclaim and treatment.	Medium - Fully contained within a single impoundment with water transfer to plant site for reclaim and treatment.	Low to Medium - Collection in single facility, Potential use of secondary facility with water transfer to plant site for reclaim and treatment.	Medium - Fully contained within a single impoundment with water transfer to plant site for reclaim and treatment.	Medium to High - Surface runoff collected in single facility, water management within single faculty with transfer to plant site for reclaim and treatment.
	Seepage Control Measures	Qualitative Rank of Seepage Control	Rank	High - Seepage collection by perimeter ditch and berm with pump back system.	Medium to High - Seepage collection by perimeter ditch and berm with pump back system from two potential containment areas.	Low to Medium - Seepage collection from foundation, collection by ditch and berm with transfer to secondary containment facility. Secondary containment facility to have berm and ditch with pump back system.	High - Seepage collection by perimeter ditch and berm with pump back system.	High - Seepage collection by perimeter ditch and berm with pump back system.	Medium to High - Seepage collection by perimeter ditch and berm with pump back system from two potential containment areas.	High - Seepage collection by perimeter ditch and berm with pump back system.	Low to Medium - Seepage collection from foundation, collection by ditch and berm with transfer to secondary containment facility. Secondary containment facility to have berm and ditch with pump back system.

Economic Account				**Indicator Quantity**							
Sub-Account	**Description**	**Indicator**	**Indicator Parameter**	**1A**	**1B**	**1C**	**1D**	**2A**	**2B**	**6A**	**6C**
Life of Mine Costs	Capital	Factored Cost Ranking	Rank	5.5	4.6	1.6	4.6	18.9	18	8.6	1.0
	Operational	Factored Cost Ranking	Rank	1.0	3.8	10.8	3.8	1.3	3.9	1.1	10.8
	Fish Habitat Compensation	Factored Cost Ranking	Rank	Not Assessed - Each Alternative Assigned a Neutral Rating							
	Closure and Reclamation Costs	Factored Cost Ranking	Rank	2.5	2.5	1.5	2.5	7.0	7.0	1.6	1.0

Socio-Economic Account				**Indicator Quantity**							
Sub-Account	**Description**	**Indicator**	**Indicator Parameter**	**1A**	**1B**	**1C**	**1D**	**2A**	**2B**	**6A**	**6C**
Archaeology	Archaeological Potential	Area of direct impact and archaeological potential	ha/potential	0, Low	0, Low	0, Low	0, Low	0, Low	0, Low	0, Low	0, Low
Health and Safety	Risk to Human Health	Qualitative Rank of Human Health Risk	Rank	Medium - High	Medium - High	High	Medium - High	Medium	Medium	High	High
	Risk to Public Safety	Qualitative Rank of Public Safety Risk	Rank	Medium	Medium	Low - Medium	Medium	Low	Low	Medium	Low to Medium
	Risk to Worker Safety	Qualitative Rank of Worker Safety Risk	Rank	Medium - High	Medium - High	High	Medium - High	High	High	High	High
Socio-Economic Indicators	Economic Benefits to Regional Communities	Qualitative Rank of Economic Benefits to Community	Rank	Medium	Medium	Low	Medium	Medium - High	Medium - High	Low - Medium	Low
	Regional Job Creation and Diversity	Qualitative Rank of Job Creation - Employment Numbers	Rank	Medium	Medium	Low	Medium	Medium - High	Medium - High	Medium	Low
	Indirect Employment	Qualitative Rank of Potential Indirect Employment	Rank	Low - Medium	Low - Medium	Low	Low-Medium	Low - Medium	Low - Medium	Low - Medium	Low
First Nation Impacts	Aboriginal Rights	Qualitative Rank of Local Aboriginal Rights	Rank	Medium	Medium	Medium	Medium	Low	Low	Low	Low
	Extent of Traditional Land Use (# of individual users)	Qualitative Rank of Traditional Land Use	Rank	Medium	Medium	Medium	Medium	Low	Low	Low	Low
	Extent of Traditional Land Use (# of Activities)	Qualitative Rank of Traditional Land Use	Rank	3	3	3	3	2	2	1	1
Recreational and Commercial Land Use	Visual Impact	Extent of structure above topography and sight lines	m	24	22	18	22	30	29	34	27
	Impact to Navigable Waters	Area of Direct Impact	ha	0	0	0	0	0	0	0	0
	Extent of Recreational Land Use	Qualitative Rank of Recreational Use	Rank	88, Medium	100, Medium	Medium	88, Medium	246, Low	Low	54, Low	47, Low
	Extent of Commercial Land Use	Qualitative Rank of Commercial Use	Rank	0	0	0	0	0	0	0	0

Alternative Identification	**Description**
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
6A	Location 6 - Conventional Slurry Tailings
6C	Location 6 - Filtered/Dry Stack Tailings

Notes:
1. Inputs for Indicators based on available information and work completed to date.

TABLE 4.5

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 5 - VALUE-BASED DECISION PROCESS
QUANTITATIVE SCORING FOR CANDIDATE ALTERNATIVES INDICATORS

Environmental Account

Indicator	Descriptor					
	1 (Worst)	**2**	**3**	**4**	**5**	**6 (Best)**
Direct Distance from Plant Site to Structure	>2,000	2,000 - 1,600	1,600 - 1,200	1,200 - 900	900 - 500	>500
Length of Additional Infrastructure Required	>2,000	2,000 - 1,600	1,600 - 1,200	1,200 - 900	900 - 500	>500
Estimate of Storage Facility(s) Area	>100	100 - 90	90 - 80	80 - 70	70 - 60	>60
Number of Main Watersheds directly impacted	6	5	4	3	2	1
Qualitative Estimate of Potential Surface Water Impact	High	High to Medium	Medium	Medium to Low	Low	>Low
Likelihood of Mining Impacts and mitigative measures required	High Potential	High to Medium Potential	Medium Potential	Medium to Low Potential	Low Potential	>Low Potential
No. of Streams Directly Impacted	>4	4	3	2	1	>1
No of Streams Potentially Indirectly Impacted	>4	4	3	2	1	>1
No of Water Bodies Directly Impacted	5	4	3	2	1	>1
No of Fish Bearing Lakes Directly Affected	5	4	3	2	1	>1
No of Terrestrial Areas Directly Impacted	5	4	3	2	1	>1
Potential Loss to flura and Fana with construction and operations	Permanent loss of flora and fauna of footprint area >100 ha	Permanent loss of flora and fauna of footprint area of 90 to 100 ha.	Permanent loss of flora and fauna of footprint area of 80 to 90 ha.	Permanent loss of flora and fauna of footprint area of 50 to 80 ha.	Short-term loss of flora/fauna during construction.	No Impact
Length of Access Roads	>2,000	2,000 - 1,600	1,600 - 1,200	1,200 - 900	900 - 500	>500
Type of tailings technology used and potential dust generation	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Potential Greenhouse Gas Emissions	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative rank - estimate of noise generation from truck traffic based on tailings disposal technology	High	High to Medium	Medium	Medium to Low	Low	>Low

Technical Account

Indicator	Descriptor					
	1 (Worst)	**2**	**3**	**4**	**5**	**6 (Best)**
Qualitative Rank of Foundation Conditions	Conditions providing poor foundation strength and poor containment, consisting primarily of swamp or organic materials.	Conditions providing poor foundation strength and poor containment, having areas of potential swamp or organic materials.	Conditions providing fair foundation strength and fair containment, having areas of potential swamp or organic material.	Conditions providing good foundation strength and poor containment, minimal areas of swamp or organic material.	Conditions providing fair foundation strength and poor containment, minimal areas of swamp or organic material	Conditions providing good foundation conditions and low permeable material for containment, no presence of swamp or organic material.
Distance From Plant Site to Far End of Facility for pipeline or haul road.	>5000	5,000 to 4,000	4,000 - 3,000	3,000 - 2,000	2,000 - 1,000	<1000
Qualitative Rank of Topographic Complexity	Topography provides difficulties to dam construction, embankment raising, tailings and water management.	Topography provides difficulties to dam construction, embankment raising, and tailings management but is suitable for water management.	Topography provides difficulties to dam construction, embankment raising, but is suitable for tailings and water management.	Topography is suitable for dam construction and embankment raising but is not suitable for tailings and water management.	Topography is suitable for dam construction, embankment raising and tailings management but is not suitable for water management.	Topography is suitable for dam construction and embankment raising, tailings and water management.
Elevation Difference From Plant Site at Final Embankment Elevation, for tailings pumping.	60 - 50	50 - 40	40 - 30	30 - 20	20 - 10	<10
Qualitative Rank of Tailings Dam Complexity	Embankment Constructed on sloping ground, difficult foundation key-in, significant internal drain system with engineering products required for containment.	Embankment Constructed on sloping ground, favourable foundation key-in, significant internal drain system and engineering products required for containment.	Embankment Constructed mostly perpendicular to sloping ground, favourable foundation key-in, significant internal drain system and engineering products required for containment.	Embankment Constructed primarily perpendicular to ground, favourable foundation key-in, moderate internal drain system and engineering products required for containment.	Embankments constructed primarily perpendicular to sloping ground, favourable foundation key-in conditions, moderate internal drain system and low permeable fill material.	Low height berm and ditch system for surface runoff containment.
CDA Dam Classification Estimate	Extreme	Very High	High	Significant	Low	No Rating
Qualitative Rank of Construction Material Availability	Farthest Distance from Sources, Dependant on Mine Waste	Farthest distance, not dependant on mine waste	Medium Distance, Dependant on Mine Waste	Medium Distance, not dependant on mine waste	Close to Source, dependant on mine waste	Close to Sources, not dependant on Mine Waste
Preliminary Estimate of Total Embankment Height	>50	50-40	40-30	30-20	20-10	<10
Estimate of Slope Angle during operations	1.0H:1V	1.5H:1V	2.0H:1V	2.5H1V	3.0H:1V	3.5H:1V
No. of Primary Watersheds	6	5	4	3	2	1
Distance From Plant Site to Far End of Facility	3,000 - 2,500	2,500 - 2,000	2,000 - 1,500	1,500 - 1,000	1,000 - 500	<500
Qualitative Rank of operations assessment based on tailings and water management .	Potential difficulty with tailings and water management.	Potential difficulty with tailings management, moderate difficulty with water management.	Moderate Difficulty with tailings and water management.	Favourable water management, moderate difficulty with tailings management.	Favourable tailings management, moderate difficulty with water management.	Favourable tailings and water management.
Estimate of Water Treatment Volume per Year	>900,000	900,000 - 700,000	700,000 - 500,000	500,000 - 300,000	300,000 - 100,000	<100,000
Quantitative Rank of Remediation Requirements	Reclamation of more than one facility with potential long term water management requirements.	Reclamation of more than one facility with water management requirements.	Reclamation of more than one facility with no water management requirements	Reclamation of single facility with potential water management requirements.	Reclamation of single facility with no potential water management.	Reclamation of single facility with no potential water management and potential progressive reclamation.
Quantities Rank of Potential Post Closure Water Treatment Requirements	Water treatment in perpetuity	Long-Term Water treatment to Perpetuity	Long-Term Water Treatment.	Long-Term to Short-Term Water Treatment	Short-Term Water Treatment.	No water treatment requirements
Qualitative Rank - Estimate of Post Closure Landform Stability	Low	Low to Medium	Medium	Medium to High	High	>High
Qualitative Rank - Estimate of Post Closure Chemical Stability	Low	Low to Medium	Medium	Medium to High	High	>High
Qualitative Rank of Potential Expansion	Low	Low to Medium	Medium	Medium to High	High	>High

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TABLE 4.5

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 5 - VALUE-BASED DECISION PROCESS
QUANTITATIVE SCORING FOR CANDIDATE ALTERNATIVES INDICATORS

Storage Capacity Volume per Construction Material Volume	<3	3-4	4-5	5-6	6-7	<7
Qualitative Rank of climate sensitivity	<High	High	High to Medium	Medium	Medium to Low	Low
Qualitative Rank of Surface Water Control	Low	Low to Medium	Medium	Medium to High	High	>High
Qualitative Rank of Seepage Control	Low	Low to Medium	Medium	Medium to High	High	>High

Economic Account						
Indicator	Descriptor					
	1 (Worst)	2	3	4	5	6 (Best)
Capitol Costs, $M, Life of Mine (differentiating)	>9	9-7	7-6	6-5	5-2	<2
Operational Cost Estimate, $M, Life of Mine	>6	6-5	5-4	4-3	3-2	<2
Potential Fish Habitat Compensation, $M, Life of Mine	5	4	3	2	1	0
Closure Cost Estimate, $M, Life of Mine (differentiating)	>6	6-5	5-3	4-3	3-1	1

Socio-Economic Account						
Indicator	Descriptor					
	1 (Worst)	2	3	4	5	6 (Best)
Area of direct impact and archaeological potential	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Human Health Risk	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Public Safety Risk	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Worker Safety Risk	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Economic Benefits to Community	Low	Low to Medium	Medium	Medium to High	High	>High
Qualitative Rank of Job Creation - Employment Numbers	Low	Low to Medium	Medium	Medium to High	High	>High
Qualitative Rank of Potential Indirect Employment	Low	Low to Medium	Medium	Medium to High	High	>High
Qualitative Rank of Local Aboriginal Rights	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Traditional Land Use	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Traditional Land Use	5	4	3	2	1	<1
Extent of structure above topography and sight lines	>30	30-25	25-20	20-15	15-10	<10
Area of Direct Impact	>50	50-40	40-30	30-20	20-10	<10
Qualitative Rank of Recreational Use	High	High to Medium	Medium	Medium to Low	Low	>Low
Qualitative Rank of Commercial Use	High	High to Medium	Medium	Medium to Low	Low	>Low

Notes:
1. Scoring based on inputs for assessment Indicators.

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TABLE 4.6

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 5 - VALUE-BASED DECISION PROCESS
QUANTITATIVE WEIGHTING FOR CANDIDATE ALTERNATIVES INDICATORS

Environmental Account

Sub-Account	Indicator	Indicator Weight	Alternatives Location and Deposition Technology Identifier															
			1A		1B		1C		1D		2A		2B		6A		6C	
			Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score
		W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Land Use	Direct Distance from Plant Site to Structure	6	6	36	6	36	6	36	6	36	1	6	1	6	3	18	3	18
	Length of Additional Infrastructure Required	6	5	30	5	30	5	30	5	30	1	6	1	6	3	18	3	18
	Estimate of Storage Facility(s) Area	6	3	18	3	18	2	12	3	18	1	6	1	6	6	36	5	30
Water Impacts	Number of Main Watersheds directly impacted	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6	1	6
	Qualitative Estimate of Potential Surface Water Impact	6	2	12	2	12	2	12	2	12	1	6	1	6	3	18	3	18
	Likelihood of Mining Impacts and mitigative measures required	6	4	24	3	18	1	6	4	24	4	24	3	18	4	24	1	6
Aquatic Habitat	No. of Streams Directly Impacted	6	5	30	5	30	5	30	5	30	4	24	4	24	5	30	5	30
	No of Streams Potentially Indirectly Impacted	6	3	18	3	18	3	18	3	18	1	6	1	6	3	18	3	18
	No of Water Bodies Directly Impacted	6	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30
	No of Fish Bearing Lakes Directly Affected	6	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30
Terrestrial Habitat	No of Terrestrial Areas Directly Impacted	6	5	30	5	30	5	30	5	30	5	30	5	30	5	30	5	30
	Potential Loss to flura and Fana with construction and operations	6	3	18	3	18	2	12	3	18	1	6	1	6	4	24	4	24
Air Quality	Length of Access Roads	6	6	36	6	36	5	30	6	36	6	36	6	36	6	36	3	18
	Type of tailings technology used and potential dust generation	6	5	30	4	24	2	12	5	30	5	30	4	24	5	30	2	12
	Qualitative Rank of Potential Greenhouse Gas Emissions	6	5	30	5	30	1	6	5	30	5	30	5	30	5	30	1	6
	Qualitative rank - estimate of noise generation from truck traffic based on tailings disposal technology	6	5	30	5	30	1	6	5	30	5	30	5	30	5	30	1	6

Technical Account

Sub-Account	Indicator	Indicator Weight	Alternatives Location and Deposition Technology Identifier															
			1A		1B		1C		1D		2A		2B		6A		6C	
			Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score
		W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Design	Qualitative Rank of Foundation Conditions	3	5	15	5	15	5	15	5	15	4	12	4	12	3	9	3	9
	Distance From Plant Site to Far End of Facility for pipeline or haul road.	3	4	12	4	12	4	12	4	12	1	3	1	3	4	12	4	12
	Qualitative Rank of Topographic Complexity	3	6	18	6	18	6	18	6	18	6	18	6	18	2	6	1	3
	Elevation Difference From Plant Site at final embankment height, for tailings pumping	3	4	12	4	12	6	18	4	12	3	9	3	9	4	12	6	18
	Qualitative Rank of Dam Complexity	3	5	15	5	15	6	18	5	15	3	9	4	12	2	6	6	18
	CDA Dam Classification Estimate	3	3	9	3	9	3	9	3	9	3	9	3	9	2	6	2	6
	Qualitative Rank of Construction Material Availability	3	5	15	5	15	6	18	5	15	1	3	1	3	3	9	4	12
	Preliminary Estimate of Total Embankment Height	3	4	12	4	12	5	15	4	12	3	9	4	12	3	9	3	9
	Estimate of Slope Angle during operations	3	2	6	2	6	3	9	2	6	2	6	2	6	2	6	3	9
	No. of Primary Watersheds	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3	1	3
Operations	Distance From Plant Site to Far End of Facility	3	2	6	2	6	2	6	2	6	1	3	1	3	2	6	2	6
	Qualitative Rank of operations assessment based on tailings and water management .	3	5	15	4	12	3	9	5	15	5	15	4	12	3	9	4	12
	Estimate of Water Treatment Volume	3	4	12	5	15	2	6	4	12	2	6	3	9	5	15	3	9
Closure	Quantitative Rank of Remediation Requirements	3	4	12	4	12	3	9	4	12	4	12	3	9	4	12	3	9
	Quantities Rank of Potential Post Closure Water Treatment Requirements	3	5	15	5	15	4	12	5	15	5	15	5	15	5	15	4	12
	Qualitative Rank - Estimate of Post Closure Landform Stability	3	4	12	3	9	2	6	4	12	4	12	3	9	4	12	2	6
	Qualitative Rank - Estimate of Post Closure Chemical Stability	3	4	12	4	12	2	6	4	12	5	15	5	15	4	12	2	6
Capacity	Qualitative Rank of Potential Expansion	3	5	15	5	15	5	15	5	15	5	15	5	15	1	3	1	3
	Storage Capacity Volume per Construction Material Volume	3	3	9	4	12	6	18	4	12	3	9	3	9	1	3	6	18
Water Management	Qualitative Rank of climate sensitivity	3	4	12	3	9	5	15	4	12	4	12	3	9	4	12	5	15
	Qualitative Rank of Surface Water Control	3	3	9	2	6	4	12	3	9	3	9	2	6	3	9	4	12
	Qualitative Rank of Seepage Control	3	5	15	4	12	2	6	5	15	5	15	4	12	5	15	2	6

Economic Account

Sub-Account	Indicator	Indicator Weight	Alternatives Location and Deposition Technology Identifier															
			1A		1B		1C		1D		2A		2B		6A		6C	
			Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score
		W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Life of Mine Costs	Factored Cost Ranking	1.5	4	6	5	7.5	6	9	5	7.5	1	1.5	1	1.5	2	3	6	9
	Factored Cost Ranking	1.5	6	9	5	7.5	1	1.5	5	7.5	6	9	4	6	6	9	1	1.5
	Factored Cost Ranking	1.5	3	4.5	3	4.5	3	4.5	3	4.5	3	4.5	3	4.5	3	4.5	3	4.5
	Factored Cost Ranking	1.5	5	7.5	5	7.5	5	7.5	5	7.5	1	1.5	1	1.5	5	7.5	6	9

TABLE 4.6

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 5 - VALUE-BASED DECISION PROCESS
QUANTITATIVE WEIGHTING FOR CANDIDATE ALTERNATIVES INDICATORS

Socio-Economic Account																		
Sub-Account	Indicator	Indicator Weight	Alternatives Location and Deposition Technology Identifier															
			1A		1B		1C		1D		2A		2B		6A		6C	
			Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score	Indicator Value	Indicator Merit Score
		W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Archaeology	Area of direct impact and archaeological potential	3	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5	15
Health and Safety	Qualitative Rank of Human Health Risk	3	2	6	2	6	1	3	2	6	3	9	3	9	1	3	1	3
	Qualitative Rank of Public Safety Risk	3	3	9	3	9	4	12	3	9	5	15	5	15	3	9	4	12
	Qualitative Rank of Worker Safety Risk	3	2	6	2	6	1	3	2	6	3	9	3	9	1	3	3	9
Socio-Economic Indicators	Qualitative Rank of Economic Benefits to Community	3	3	9	3	9	1	3	3	9	4	12	4	12	2	6	1	3
	Qualitative Rank of Job Creation - Employment Numbers	3	3	9	3	9	1	3	3	9	4	12	4	12	3	9	1	3
	Qualitative Rank of Potential Indirect Employment	3	2	6	2	6	1	3	2	6	2	6	2	6	2	6	1	3
First Nation Impacts	Qualitative Rank of Local Aboriginal Rights	3	3	9	3	9	3	9	3	9	5	15	5	15	5	15	5	15
	Qualitative Rank of Traditional Land Use	3	3	9	3	9	3	9	3	9	5	15	5	15	5	15	5	15
	Qualitative Rank of Traditional Land Use	3	3	9	3	9	3	9	3	9	4	12	4	12	5	15	5	15
Recreational and Commercial Land Use	Extent of structure above topography and sight lines	3	3	9	3	9	4	12	3	9	2	6	2	6	1	3	2	6
	Area of Direct Impact	3	6	18	6	18	6	18	6	18	6	18	6	18	6	18	6	18
	Qualitative Rank of Recreational Use	3	3	9	3	9	3	9	3	9	5	15	5	15	5	15	5	15
	Qualitative Rank of Commercial Use	3	6	18	6	18	6	18	6	18	6	18	6	18	6	18	6	18
Sub-Account Merit Score				**837**		**816**		**709.5**		**840**		**718.5**		**694.5**		**783**		**687**
Sub-Account Merit Rating				**3.99**		**3.89**		**3.38**		**4.00**		**3.42**		**3.31**		**3.73**		**3.27**

Alternative Identification	Description
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
6A	Location 6 - Conventional Slurry Tailings
6C	Location 6 - Filtered/Dry Stack Tailings

TABLE 4.7

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 5 - VALUE-BASED DECISION PROCESS
QUANTITATIVE WEIGHTING AND ANALYSIS FOR CANDIDATE ALTERNATIVES SUB-ACCOUNTS

Sub-Account	Sub-Account Weight	1A Sub-Account Merit Rating	1A Sub-Account Merit Score	1B Sub-Account Merit Rating	1B Sub-Account Merit Score	1C Sub-Account Merit Rating	1C Sub-Account Merit Score	1D Sub-Account Merit Rating	1D Sub-Account Merit Score	2A Sub-Account Merit Rating	2A Sub-Account Merit Score	2B Sub-Account Merit Rating	2B Sub-Account Merit Score	6A Sub-Account Merit Rating	6A Sub-Account Merit Score	6C Sub-Account Merit Rating	6C Sub-Account Merit Score
Environmental Account																	
	W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Land Use	6	4.7	28.0	4.7	28.0	4.3	26.0	4.7	28.0	1.0	6.0	1.0	6.0	4.0	24.0	3.7	22.0
Water Impacts	6	2.3	14.0	2.0	12.0	1.3	8.0	2.3	14.0	2.0	12.0	1.7	10.0	2.7	16.0	1.7	10.0
Aquatic Habitat	6	4.5	27.0	4.5	27.0	4.5	27.0	4.5	27.0	3.8	22.5	3.8	22.5	4.5	27.0	4.5	27.0
Terrestrial Habitat	6	4.0	24.0	4.0	24.0	3.5	21.0	4.0	24.0	3.0	18.0	3.0	18.0	4.5	27.0	4.5	27.0
Air Quality	6	5.3	31.5	5.0	30.0	2.3	13.5	5.3	31.5	5.3	31.5	5.0	30.0	5.3	31.5	1.8	10.5
Technical Account																	
	W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Design	3	3.9	11.7	3.9	11.7	4.5	13.5	3.9	11.7	2.7	8.1	2.9	8.7	2.6	7.8	3.3	9.9
Operations	3	3.7	11.0	3.7	11.0	2.3	7.0	3.7	11.0	2.7	8.0	2.7	8.0	3.3	10.0	3.0	9.0
Closure	3	4.3	12.8	4.0	12.0	2.8	8.3	4.3	12.8	4.5	13.5	4.0	12.0	4.3	12.8	2.8	8.3
Capacity	3	4.0	12.0	4.5	13.5	5.5	16.5	4.5	13.5	4.0	12.0	4.0	12.0	1.0	3.0	3.5	10.5
Water Management	3	4.0	12.0	3.0	9.0	3.7	11.0	4.0	12.0	4.0	12.0	3.0	9.0	4.0	12.0	3.7	11.0
Economic Account																	
	W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Life of Mine Costs	1.5	4.5	6.8	4.5	6.8	3.8	5.6	4.5	6.8	2.8	4.1	2.3	3.4	4.0	6.0	4.0	6.0
Socio-Economic Account																	
	W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Archaeology	3	5.0	15.0	5.0	15.0	5.0	15.0	5.0	15.0	5.0	15.0	5.0	15.0	5.0	15.0	5.0	15.0
Health and Safety	3	2.3	7.0	2.3	7.0	2.0	6.0	2.3	7.0	3.7	11.0	3.7	11.0	1.7	5.0	2.7	8.0
Socio-Economic Indicators	3	2.7	8.0	2.7	8.0	1.0	3.0	2.7	8.0	3.3	10.0	3.3	10.0	2.3	7.0	1.0	3.0
First Nation Impacts	3	3.0	9.0	3.0	9.0	3.0	9.0	3.0	9.0	4.7	14.0	4.7	14.0	5.0	15.0	5.0	15.0
Recreational and Commercial Land Use	3	4.5	13.5	4.5	13.5	4.8	14.3	4.5	13.5	4.8	14.3	4.8	14.3	4.5	13.5	4.8	14.3
Account Merit Score			**243.2**		**237.5**		**204.6**		**244.7**		**212.0**		**203.8**		**232.6**		**206.4**
Account Merit Rating			**4.0**		**3.9**		**3.3**		**4.0**		**3.4**		**3.3**		**3.8**		**3.4**

Alternative Identification	Description
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
6A	Location 6 - Conventional Slurry Tailings
6C	Location 6 - Filtered/Dry Stack Tailings

TABLE 4.8

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 5 - VALUE-BASED DECISION PROCESS
QUANTITATIVE WEIGHTING AND ANALYSIS FOR CANDIDATE ALTERNATIVES ACCOUNTS

Account	Account Weight	Alternatives Location and Deposition Technology Identifier															
		1A		1B		1C		1D		2A		2B		6A		6C	
		Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score	Account Merit Rating	Account Merit Score
	W	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)	S	(SxW)
Environment	6	4.2	24.9	4.0	24.2	3.2	19.1	4.2	24.9	3.0	18.0	2.9	17.3	4.2	25.1	3.2	19.3
Technical	3	4.0	11.9	3.8	11.4	3.8	11.3	4.1	12.2	3.6	10.7	3.3	9.9	3.0	9.1	3.2	9.7
Project Economics	1.5	4.5	6.8	4.5	6.8	3.8	5.6	4.5	6.8	2.8	4.1	2.3	3.4	4.0	6.0	4.0	6.0
Socio-Economic	3	3.5	10.5	3.5	10.5	3.2	9.5	3.5	10.5	4.3	12.9	4.3	12.9	3.7	11.1	3.7	11.1
Alternative Merit Score			**54.0**		**52.9**		**45.4**		**54.3**		**45.7**		**43.5**		**51.3**		**46.1**
Alternative Merit Rating			**4.00**		**3.92**		**3.36**		**4.03**		**3.38**		**3.22**		**3.80**		**3.41**

Alternative Identification	Description
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
6A	Location 6 - Conventional Slurry Tailings
6C	Location 6 - Filtered/Dry Stack Tailings

141-12598-00
Rev. 0
July 21, 2014

TABLE 4.9

TREASURY METALS
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

STEP 6 - SENSITIVITY ANALYSIS

Analysis ID	Scenario Description	Alternative Merit Rating							
		1A	1B	1C	1D	2A	2B	6A	6C
Base Case	Results of Alternatives Assessment	4.00	3.92	3.36	4.03	3.38	3.22	3.80	3.41
No. 1	Change All Environmental Weights to 9	4.03	3.94	3.33	4.05	3.31	3.16	3.87	3.38
No. 2	Change All Technical Weights to 6	4.00	3.90	3.43	4.03	3.42	3.24	3.66	3.38
No. 3	Change All Weights to 1	4.03	3.96	3.46	4.05	3.40	3.18	3.73	3.54
No. 4	Change all Socio-Economic Weights to 1.5	4.07	3.97	3.39	4.09	3.27	3.09	3.81	3.38

Alternative Identification	Description
1A	Location 1- Conventional Slurry Tailings
1B	Location 1 - Thickened Tailings
1C	Location 1 - Filtered/Dry Stack Tailings
1D	Location 1 - Conventional with Future Co-Disposal
2A	Location 2- Conventional Slurry Tailings
2B	Location 2- Thickened Tailings
6A	Location 6 - Conventional Slurry Tailings
6C	Location 6 - Filtered/Dry Stack Tailings

TABLE 5.1

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

CANADIAN DAM ASSOCIATION - DAM SAFETY GUIDELINES 2007
DAM CLASSIFICATION

Dam Class	Population at Risk [note 1]	Incremental Losses		
		Loss of Life [note 2]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short-term loss No long-term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary Only	Unspecified	No Significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or Fewer	Significant loss or deterioration of *important* fish or wildlife habitat Restoration or compensation in kind highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very High	Permanent	100 or Fewer	Significant loss or deterioration of *critical* fish or wildlife habitat Restoration or compensation in kind possible but not impractical	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances)
Extreme	Permanent	More Than 100	Major loss of *critical* fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services (e.g., hospital, major industrial complex, major storage facilities for dangerous substances)

Notes:

Note 1. Definition for population at risk:

None - There is no identifiable population at risk, so there is no possibility of loss of life other than through unforeseen misadventure.

Temporary - People are only temporary temporarily in the dam-breach inundation zone (e.g., seasonal cottage use, passing thorough on transportation routes, participating in recreational activities).

Permanent - The population at risk is ordinarily located in the dam-breach inundation zone (e.g., as permanent residents); three consequence classes (high, very high, extreme) are proposed to allow for more detailed estimates of potential loss of life (to assist in decision-making if the appropriate analysis is caused out).

Note 2. Implications for loss of life:

Unspecified - The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, the exposure time, the nature of their activity, and other conditions. A higher class could be appropriate, depending on the requirements. However, the design flood requirements, for example, might not be higher if the temporary population is not likely to be present during the flood season.

TABLE 5.2

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

MINISTRY OF NATURAL RESOURCES
CLASSIFICATION AND INFLOW DESIGN FLOOD CRITERIA - TECHNICAL BULLETIN
HAZARD POTENTIAL CLASSIFICATION

Hazard Potential	Hazard Categories - Incremental Losses[1]			
	Life Safety[2]	Property Losses[3]	Environmental Losses	Cultural - Built Heritage Losses
Low	No potential loss of life	Minimal damage to property with estimates losses not to exceed $300,000.	Minimal loss of fish and/or wildlife habitat with high capability of natural restoration resulting in a very low likelihood of negatively affecting the status of the population.	Reversible damage to municipally designated cultural heritage sites under the Ontario Heritage Act.
Moderate	No potential loss of life	Moderate damage with estimated losses not to exceed $3 million, to agricultural, forestry, mineral aggregate and mining, and petroleum resource operations, other dams or structures not for human habitation, infrastructure and services including local roads and railway lines. The inundation zone is typically undeveloped or predominantly rural or agricultural, or it is managed so that the land usage is for transient activities such as with day-use facilities. Minimal damage to residential, commercial, and industrial areas, or land identified as designated growth areas as shown in official plans.	Moderate loss or deterioration of fish and/or wildlife habitat with moderate capability of natural restoration resulting in a low likelihood of negatively affecting the status of the population.	Irreversible damage to municipally designated cultural heritage sites under the Ontario Heritage Act. Reversible damage to provincially designated cultural heritage site under the Ontario Heritage Act or nationally recognized heritage sites.
High	Potential Loss of life of 1 - 10 persons	Appreciable damage with estimated losses not to exceed #30 million, to agricultural, forestry, mineral aggregate and mining, and petroleum resource operations, other dams or residential, commercial, industrial areas, infrastructure and services, or land identified as designated growth areas as shown in official plans. Infrastructure and services includes regional roads, railway lines, or municipal water and wastewater treatment facilities and publicly-owned utilities	Appreciable loss of fish and/or wildlife habitat or significant deterioration of critical fish and/or wildlife habitat with reasonable likelihood of being able to apply natural or assisted recovery activities to promote species recovery to viable population levels. Loss of portion of the population of a species classified under the Ontario Endangered Species Act as Extirpated, Threatened or Endangered, or reversible damage to the habitat of that species.	Irreversible damage to provincially designated cultural heritage site under the Ontario Heritage Act or damage to nationally recognized heritage sites.
Very High	Potential loss of life of 11 or more persons	Extensive damage, estimated losses in excess of $30 million, to buildings, agricultural, forestry, mineral aggregate and mining, and petroleum resources operations, infrastructure and services. Typically includes destruction of, or extensive damage to, large residential, institutional, concentrated commercial and industrial areas and major infrastructure and services, or land identified as designated growth areas as shown in official plans. infrastructure and services includes highways, railway lines or municipal water and wastewater treatment facilities and publicly-owned utilities.	Extensive loss of fish and/or wildlife habitat with very little or no feasibility of being able to apply natural or assisted recovery activities to promote species recovery to viable popu8lation levels. Loss of a viable portion of the population of a species classified under the Ontario Endangered Species Act as Extirpated, Threatened or Endangered or irreversible damage to the habitat of that species.	

Notes:

1. Incremental losses are those losses resulting from dam failure above those which would occur under the same conditions (flood, earthquake or other event) with the dam in place but without failure of the dam.

2. Life safety. Refer to Technical Guide – River and Streams Systems: Flooding Hazard Limits, Ontario Ministry of Natural Resources, 2002, for definition of 2 x 2 rule. The 2 x 2 rule defines that people would be at risk if the product of the velocity and the depth exceeded 0.37 square metres per second or if velocity exceeds 1.7 metres per second or if depth of water exceeds 0.8 metres. For dam failures under flood conditions the potential for loss of life is assessed based on permanent dwellings (including habitable buildings and trailer parks) only. For dam failures under normal (sunny day) conditions the potential for loss of life is assessed based on both permanent dwellings (including habitable dwellings, trailer parks and seasonal campgrounds) and transient persons.

3. Property losses refer to all direct losses to third parties; they do not include losses to the owner, such as loss of the dam, or revenue. The dollar losses, where identified, are indexed to Statistics Canada values Year 2000.

4. An HPC must be developed under both flood and normal (sunny day) conditions.

5. Evaluation of the hazard potential is based on both present land use and on anticipated development as outlined in the pertinent official planning documents (e.g. Official Plan). In the absence of an approved Official Plan the HPC should be based on expected development within the foreseeable future. Under the Provincial Policy Statement, 'designated growth areas' means lands within settlement areas designated in an official plan for growth over the long-term planning horizon (specifies normal time horizon of up to 20 years), but which have not yet been fully developed. Designated growth areas include lands which are designated and available for residential growth in accordance with the policy, as well as lands required for employment and other uses (Italicized terms as defined in the PPS, 2005).

6. Where several dams are situated along the same watercourse, consideration must be given to the cascade effect of failures when classifying the structures, such that if failure of an upstream dam could contribute to failure of a downstream dam, then the HPC of the upstream dam must be the same as or greater than that of the downstream structure.

7. The HPC is determined by the highest potential consequences, whether life safety, property losses, environmental losses, or cultural-built heritage losses.

TABLE 5.3

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

CANADIAN DAM ASSOCIATION - DAM SAFETY GUIDELINES 2007
INFLOW DESIGN FLOOD (IDF) AND CONSEQUENCE CLASSES

Consequence Class	IDF
Low	1/100-year
Significant	Between 1/100 and 1/1,000 year (Note 1)
High	1/3 between 1/1,000-year and PMP (Note 2)
Very High	2/3 between 1/1,000-year and PMF (Note 2)
Extreme	PMF

Notes:

Note 1. Selected based on incremental flood analysis, exposure and consequence of failure

Note 2. Extrapolation of flood statistics beyond 1/1,000 year flood (10-3 AEP) is generally discouraged. The PMF has no associated AEP. The flood defined as "1/3 between 1/1,000-year and PMF" or "2/3 between 1/1,000-year and PMF" has no defined AEP.

TABLE 5.4

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

MINISTRY OF NATURAL RESOURCES
CLASSIFICATION AND INFLOW DESIGN FLOOD CRITERIA - TECHNICAL BULLETIN
RANGE OF MINIMUM INFLOW DESIGN FLOODS[2]

Hazard Potential Classification	Range of Minimum Inflow Design Floods[1]			
	Life Safety[3]		Property and Environment	Cultural - Built Heritage
Low	25 Year Flood to 100 Year Flood			
Moderate	100 Year Flood to 1,000 year flood or Regulatory Flood whichever is greater			
High	1 - 10	1/3 between the 1,000 year flood and PMF	1,000 Year Flood or Regulatory Flood whichever is greater to 1/3 between the 1,000 year flood and PMF	1,000 Year Flood or Regulatory Flood whichever is greater
Very High	11 - 100	2/3 between the 1,000 year Flood and PMF	1/3 between the 1,000 Year Flood and PMF to PMF	
	Greater than 100	PMF		

Notes:

1. The selection of the IDF within the range of flows provided should be commensurate with the hazard potential losses within the HPC Table. The degree of study required to define the hazard potential losses of dam failure will vary with the extent of existing and potential downstream development and the type of dam (size and shape of breach and breach time formation).

2. As an alternative to using the table the IDF can also be determined by an incremental analysis. Incremental analysis is a series of scenarios for various increasing flows, both with and without dam failure that is used to determine where there is no longer any significant additional threat to loss of life, property, environment and cultural – built heritage to select the appropriate IDF.

3. Where there is a potential for loss of life the IDF may be reduced provided that a minimum of 12 hours advanced warning time is available from the time of dam failure until the arrival of the inundation wave, provided that property, environment, or cultural – built heritage losses do not prescribe a higher IDF.

TABLE 5.5

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

CANADIAN DAM ASSOCIATION - DAM SAFETY GUIDELINES 2007
SUGGESTED DESIGN EARTHQUAKE LEVELS

Dam Class	AEP EDGM [note 1]
Low	1/500
Significant	1/1,000
High	1/2,500
Very High	1/5,000 [note 2]
Extreme	1/10,000 [note 2]

Notes:

Acronyms: AEP, annual exceedance probability; EDGM, earthquake design ground motion

Note 1. AEP levels for EDGM are to be used for mean rather than median estimates for the hazard.

Note 2. The EDGM value must be justified to demonstrate conformation to societal norms of acceptable risk. Justification can be provided with the help of failure modes analysis focused on the particular modes that can contribute to failure initiated by a seismic event. If justification cannot be provided the EDGM should be 1/10,000.

TABLE 5.6

TREASURY METALS INCORPORATED
GOLIATH PROJECT

TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

MINISTRY OF NATURAL RESOURCES
SEISMIC HAZARD CRITERIA, ASSESSMENT AND CONSIDERATIONS - TECHNICAL BULLETIN
DESIGN EARTHQUAKE CRITERIA

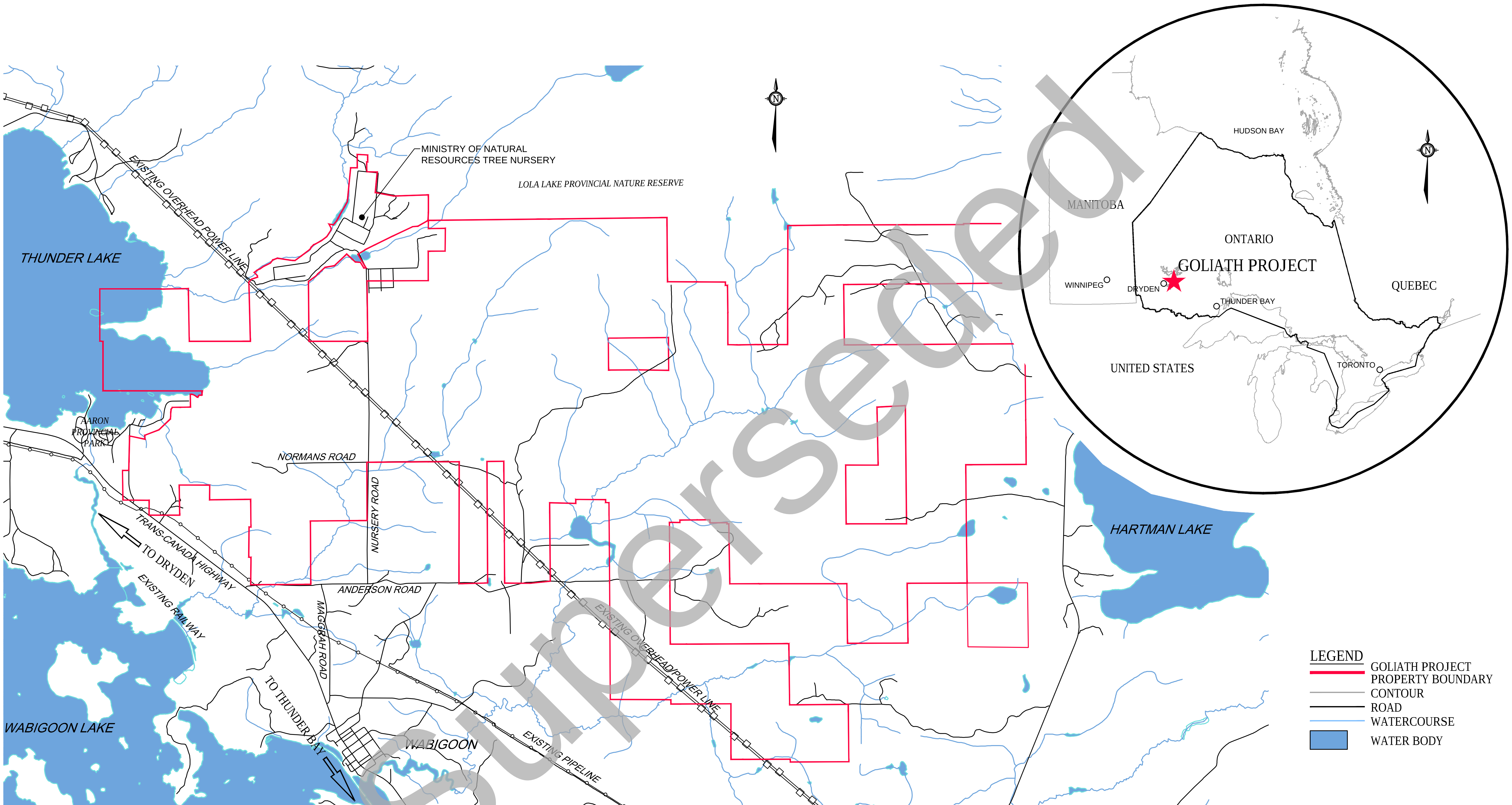
<table>
<tr><th rowspan="2">Hazard Potential Classification</th><th colspan="4">Earthquake Design Ground Motion (annual exceedance probability)</th></tr>
<tr><th colspan="2">Life Safety[3]</th><th>Property and Environment</th><th>Cultural - Built Heritage</th></tr>
<tr><td>Low</td><td colspan="4">500 year</td></tr>
<tr><td>Moderate</td><td colspan="4">500 to 1,000 year</td></tr>
<tr><td>High</td><td>10 or fewer</td><td>2,500 year</td><td>1,000 to 2,500 year</td><td>1,000 year</td></tr>
<tr><td rowspan="2">Very High</td><td>11 - 100</td><td>5,000 year</td><td rowspan="2">2,500 to 10,000 year</td><td rowspan="2"></td></tr>
<tr><td>More than 100</td><td>10,000 year</td></tr>
</table>

Notes:

1. The AEP levels are to be used for the “mean” rather than the “median” estimates. The mean is the expected value given the epistemic uncertainties and, for typical seismic hazard computations in Canada, the mean hazard value typically lies between the 65th and 75th percentiles of the hazard distribution. The median is at the 50th percentile.

2. Generally, a seismic hazard evaluation will not be required for Low or Moderate HPC dams unless specifically requested by the Minister with supporting rationale.

FIGURES



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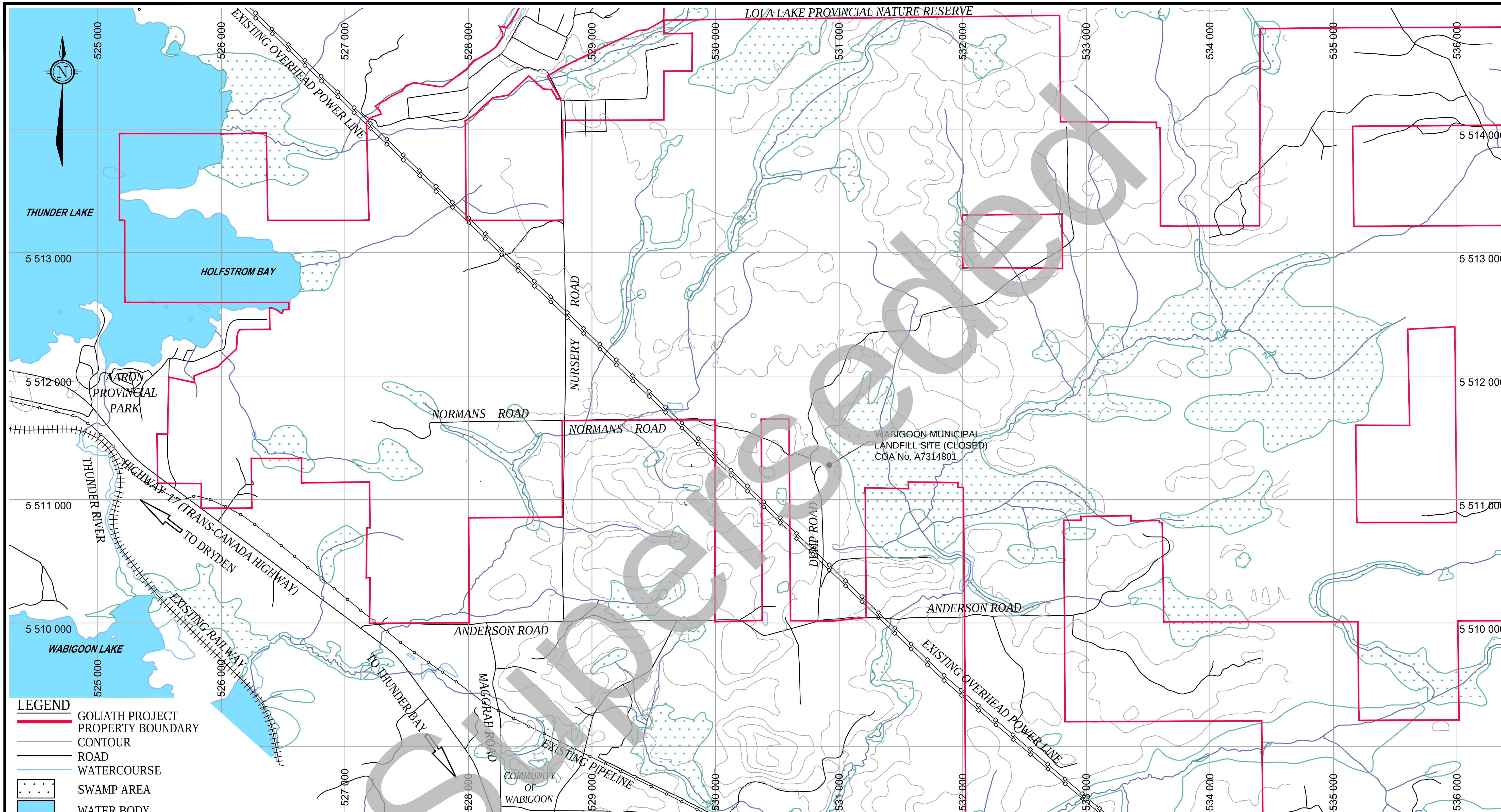
PROJECT:	TREASURY METALS - GOLIATH PROJECT TAILINGS STORAGE FACILITY ALTERNATIVES ASSESSMENT
TITLE:	PROJECT SITE LOCATION PLAN AND KEY PLAN
PROJECT NO:	141-12598-00
SCALE:	1:50000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 1.1



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0 500 1000 metres

NOTES:
- COORDINATES SHOWN REFER TO NAD83 UTM ZONE 15.
- CONTOURS SHOWN ARE 10m INTERVAL FROM ONTARIO BASE MAPPING.

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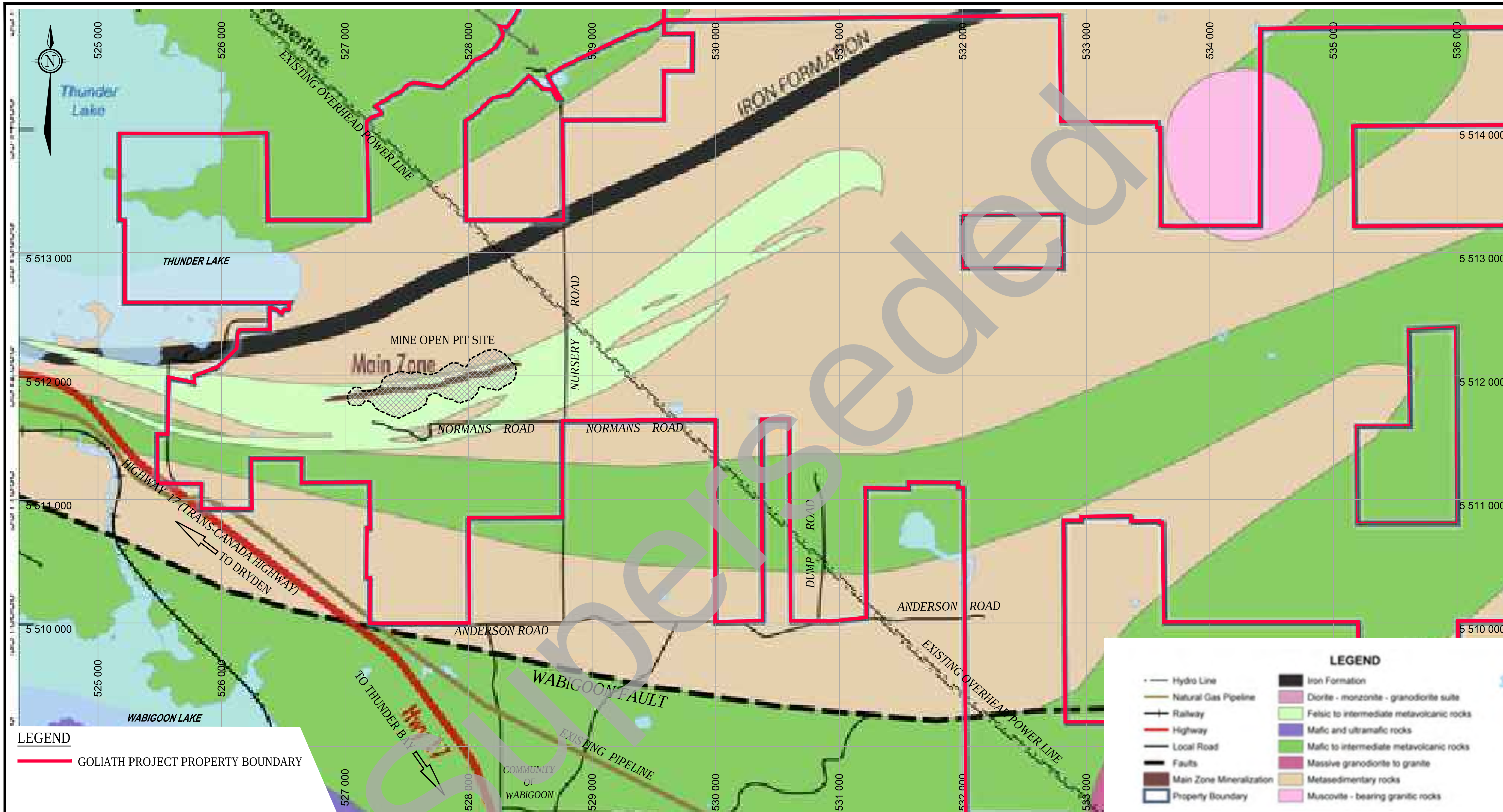
PROJECT:	TREASURY METALS - GOLIATH PROJECT TAILINGS STORAGE FACILITY ALTERNATIVES ASSESSMENT
TITLE:	EXISTING SITE CONDITIONS
PROJECT NO:	141-12598-00
SCALE:	1:30000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 2.1



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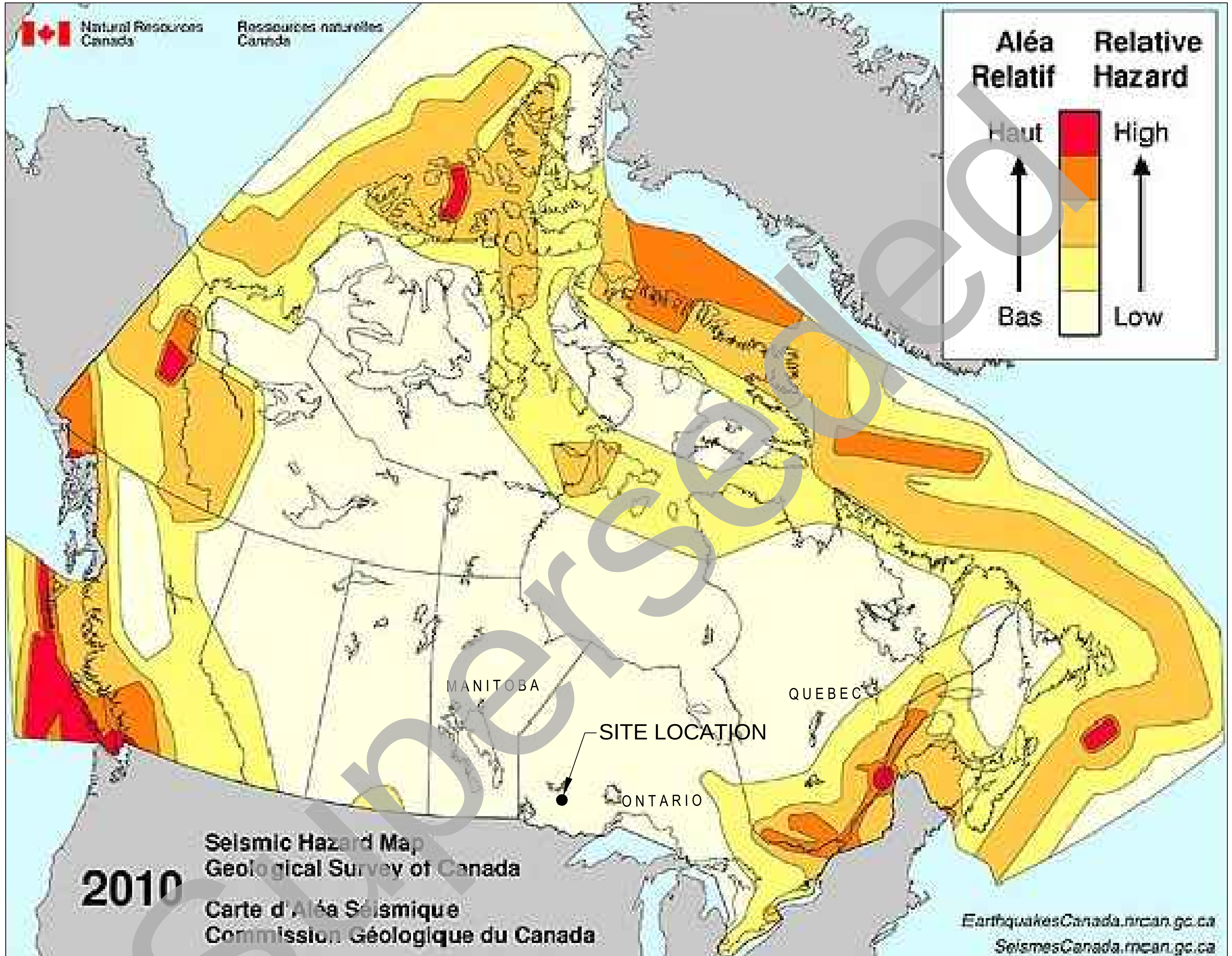
PROJECT:
TREASURY METALS - GOLIATH PROJECT
TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

TITLE:
REGIONAL STRUCTURAL GEOLOGY
AND LITHOLOGIC UNITS

PROJECT NO:	141-12598-00
SCALE:	1:30000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 2.2



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PROJECT: TREASURY METALS - GOLIATH PROJECT TAILINGS STORAGE FACILITY ALTERNATIVES ASSESSMENT	PROJECT NO: 141-12598-00		
	SCALE: NOT TO SCALE	ISSUE/REVISION: FINAL	0
TITLE: SEISMIC HAZARD MAP OF CANADA	DRAWN BY: G. HOOGWERF	ISSUE DATE: JULY 21, 2014	
	CHECKED BY: B. PLUMRIDGE	FIGURE NO: FIGURE 2.3	

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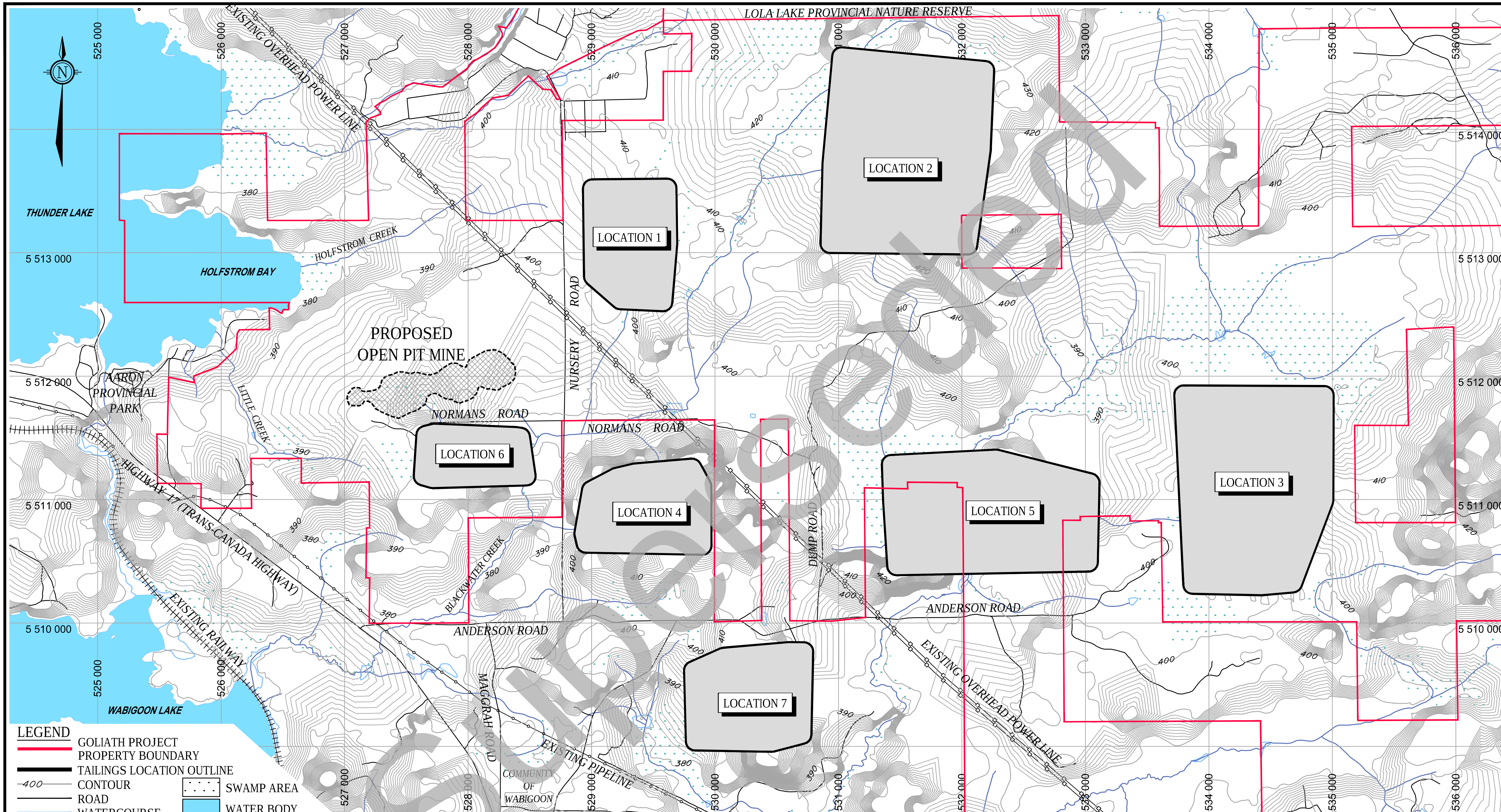

0 500 1000 metres

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NOTES:

- COORDINATES SHOWN REFER TO NAD83 UTM ZONE 15.
- CONTOURS SHOWN ARE 1m INTERPOLATED FROM ONTARIO BASE MAPPING 10m CONTOUR INTERVAL.
- TAILINGS FACILITY LOCATION OUTLINES UTILIZED FOR COMPLETION OF THE ALTERNATIVES ASSESSMENT.

TREASURY METALS INCORPORATED

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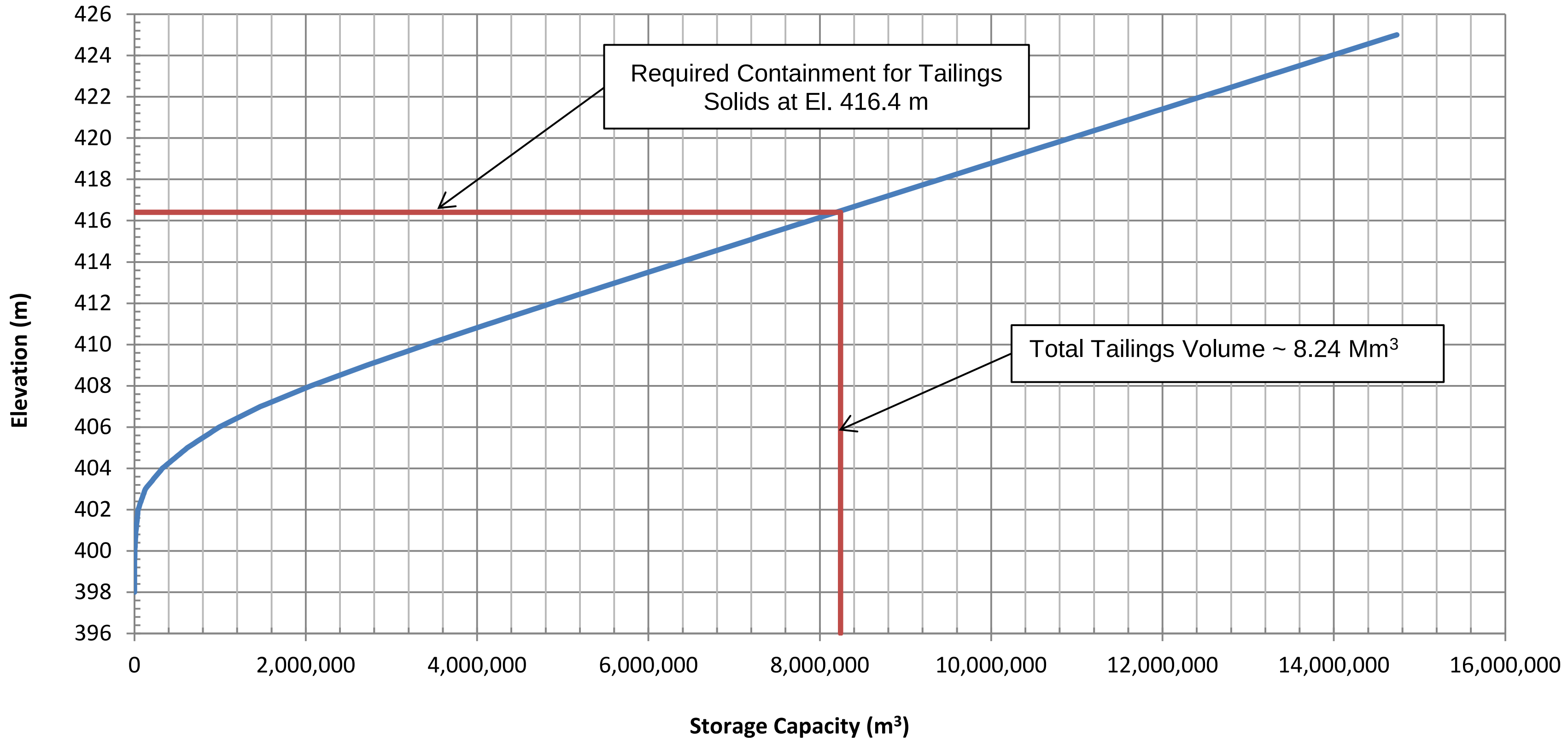
PROJECT: TREASURY METALS - GOLIATH PROJECT
TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

TITLE: TAILINGS STORAGE FACILITY
CANDIDATE LOCATIONS

PROJECT NO:	141-12598-00
SCALE:	1:30000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 4.1



Notes:

1. Capacity is based on preliminary alignment and flat tailings beach.
2. Tailings storage based on conventional tailings with co-disposal of tailings solids into underground mine working after Year 5 of the operations.
3. Based on Option 1D of Alternatives Assessment.

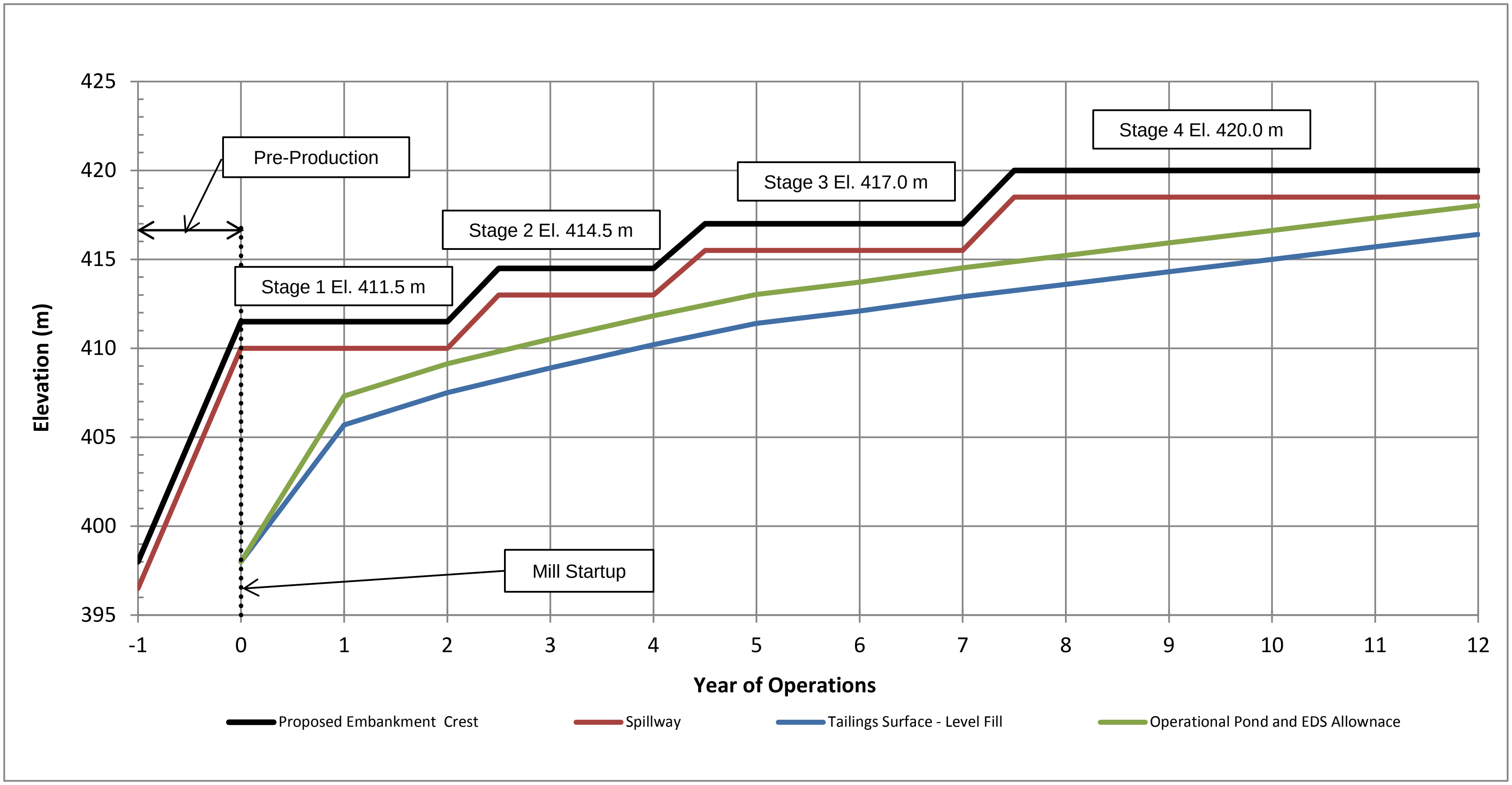
Prepared By:	BRP	Checked By:	HBW	Approved By:	HBW

TREASURY METALS INC.

GOLIATH PROJECT

LOCATION 1
STAGE-STORAGE CURVE

FIGURE 5.1	Project No.: 141-12598-00	Ref. No.: 0



<u>Notes:</u>

1. Proposed emabnkment staging is preliminary and is based on infomration avaialble.
2. Tailings surface is based on level fill.
3. Allowance for Operational Pond and Environmental Design Storm (EDS) for operatioinal and stormwater management and to maintian water cover over tailings.

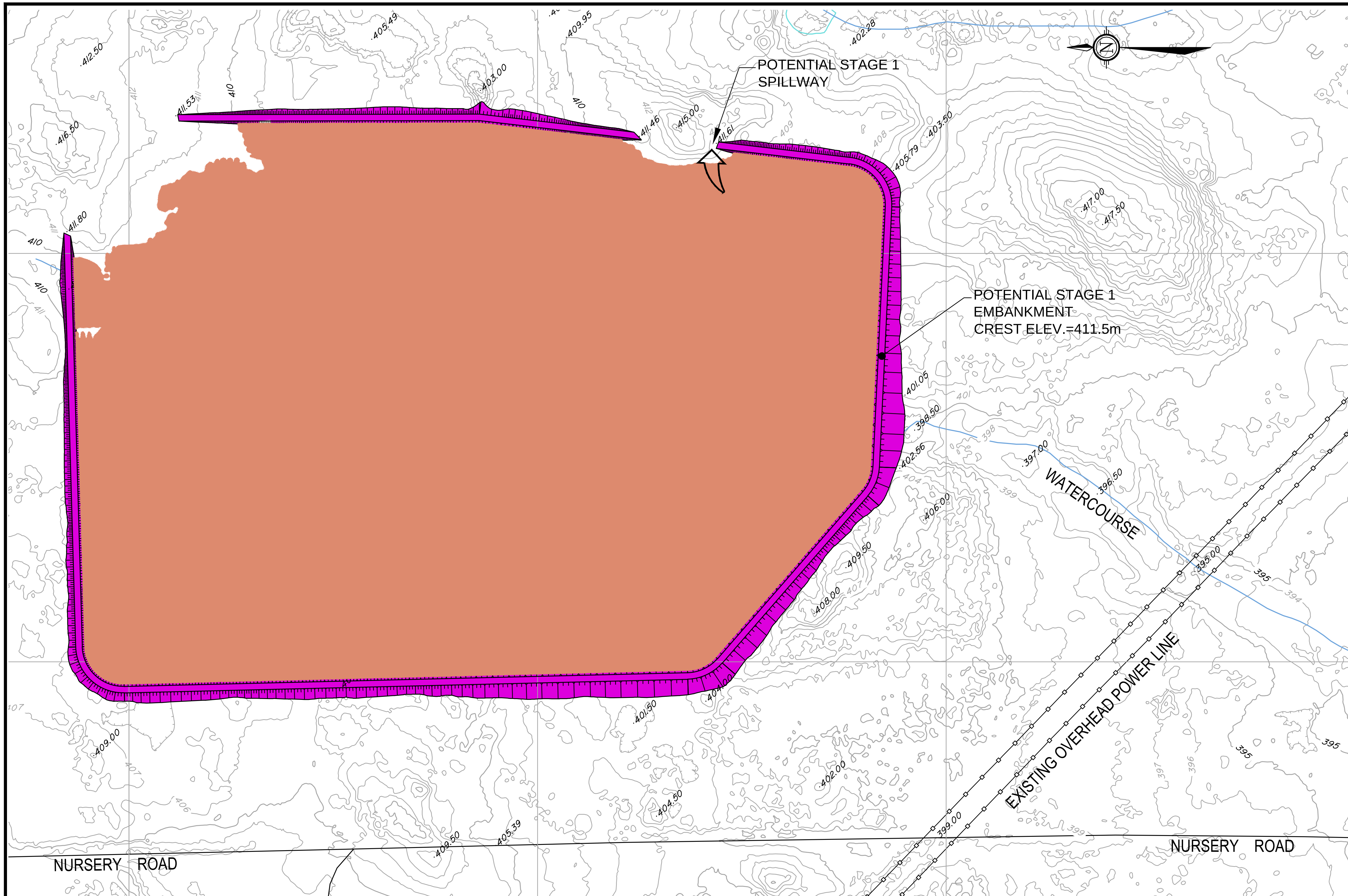
Prepared By:	BRP	Checked By:	HBW	Approved By:	HBW

TREASURY METALS INC.

GOLIATH PROJECT
ALTERNATIVES ASSESSMENT

LOCATION 1
EMBANKMENT STAGING

FIGURE 5.2	Project No.: 141-12598-00	Ref. No.: 0



LEGEND

- CONTOUR
- ROAD
- WATERCOURSE
- POWER LINE
- PROPOSED SPILLWAY
- PROPOSED TAILINGS FILL AREA
- PROPOSED EMBANKMENT

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. PRELIMINARY STAGE 1 EMBANKMENT FOR ALTERNATIVE 1D (LOCATION 1 WITH FUTURE CO-DISPOSAL OF TAILINGS).
3. INFORMATION PRESENTED IS PRELIMINARY ONLY AND NOT INTENDED FOR CONSTRUCTION.

WSP

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0 50 100 150 200 250 metres

TREASURY METALS INCORPORATED

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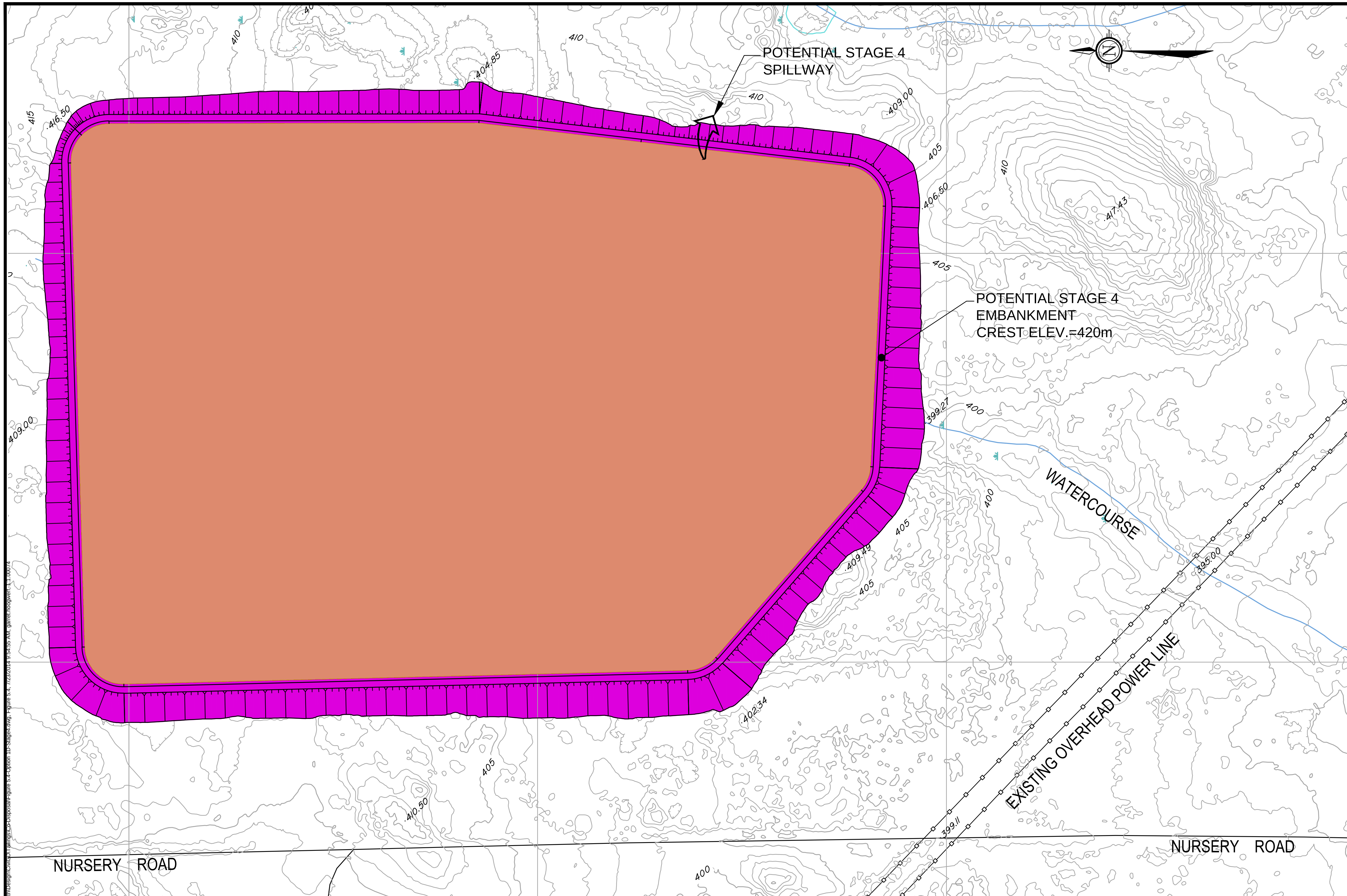
PROJECT:	TREASURY METALS - GOLIATH PROJECT TAILINGS STORAGE FACILITY ALTERNATIVES ASSESSMENT
TITLE:	LOCATION 1, STAGE 1 PLAN
PROJECT NO:	141-12598-00
SCALE:	1:5000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 5.3



LEGEND

- CONTOUR
- ROAD
- WATERCOURSE
- POWER LINE
- PROPOSED SPILLWAY
- PROPOSED TAILINGS FILL AREA
- PROPOSED EMBANKMENT

NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. PRELIMINARY STAGE 4 EMBANKMENT FOR ALTERNATIVE 1D (LOCATION 1 WITH FUTURE CO-DISPOSAL OF TAILINGS).
3. INFORMATION PRESENTED IS PRELIMINARY ONLY AND NOT INTENDED FOR CONSTRUCTION.

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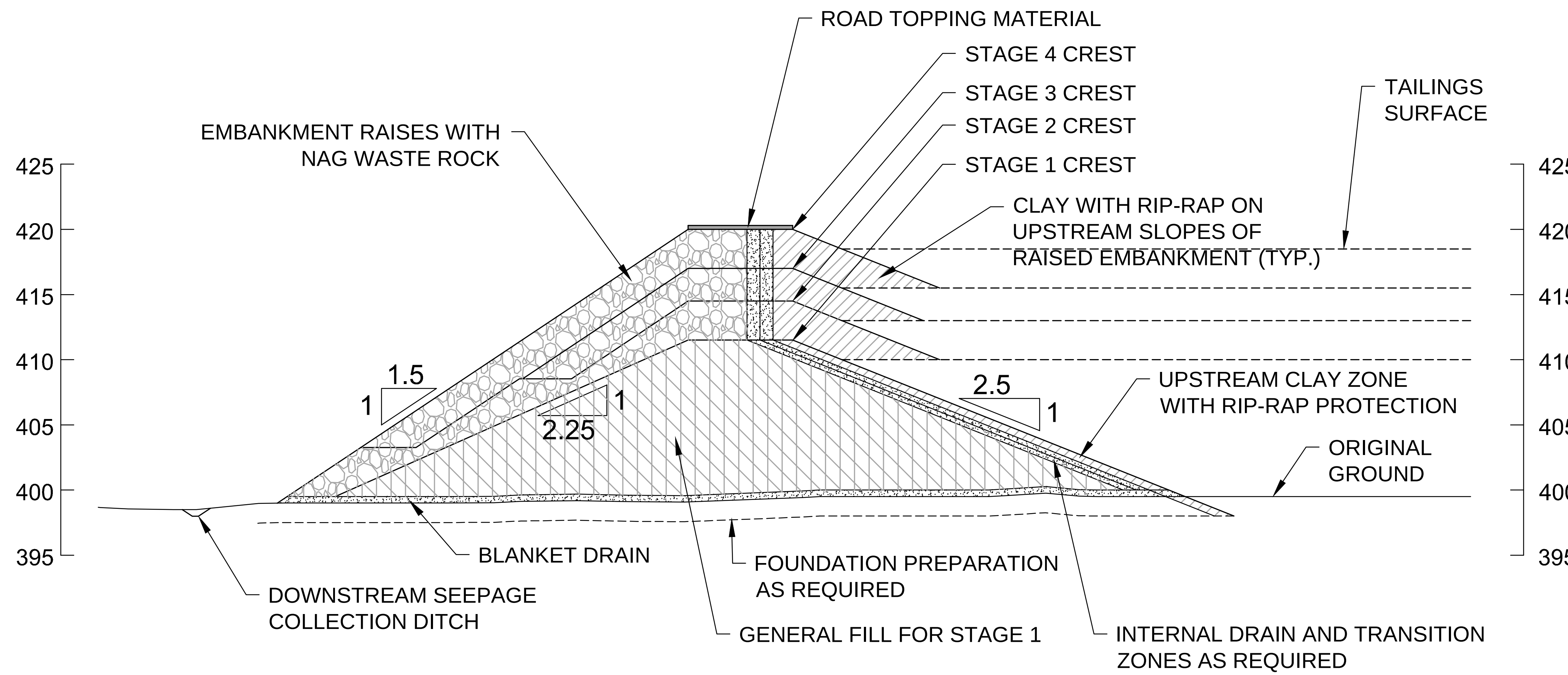
PROJECT:	TREASURY METALS - GOLIATH PROJECT TAILINGS STORAGE FACILITY ALTERNATIVES ASSESSMENT
TITLE:	LOCATION 1, STAGE 4 PLAN
PROJECT NO:	141-12598-00
SCALE:	1:5000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 5.4



NOTES:

1. DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONCEPT SHOWN IS PRELIMINARY AND NOT INTENDED FOR CONSTRUCTION. THIS CONCEPT ASSUMES CENTRELINE STYLE FOR EMBANKMENT RAISE.
3. EMBANKMENT STAGING AND STYLE OF RAISE TO BE CONFIRMED / OPTIMIZED WITH SUBSEQUENT LEVELS OF DESIGN.
4. CONCEPT SHOWN IS FOR LOCATION 1 ONLY.
5. FOUNDATION PREPARATION TO BE DETERMINED WITH SITE INVESTIGATION.
6. EMBANKMENT DIMENSIONS AND SLOPES TO BE CONFIRMED WITH DETAILED STABILITY. ASSESSMENT.

LEGEND

- GENERAL FILL
- NAG WASTE ROCK
- LOW PERMEABLE MATERIAL (CLAY)
- DRAIN AND TRANSITION

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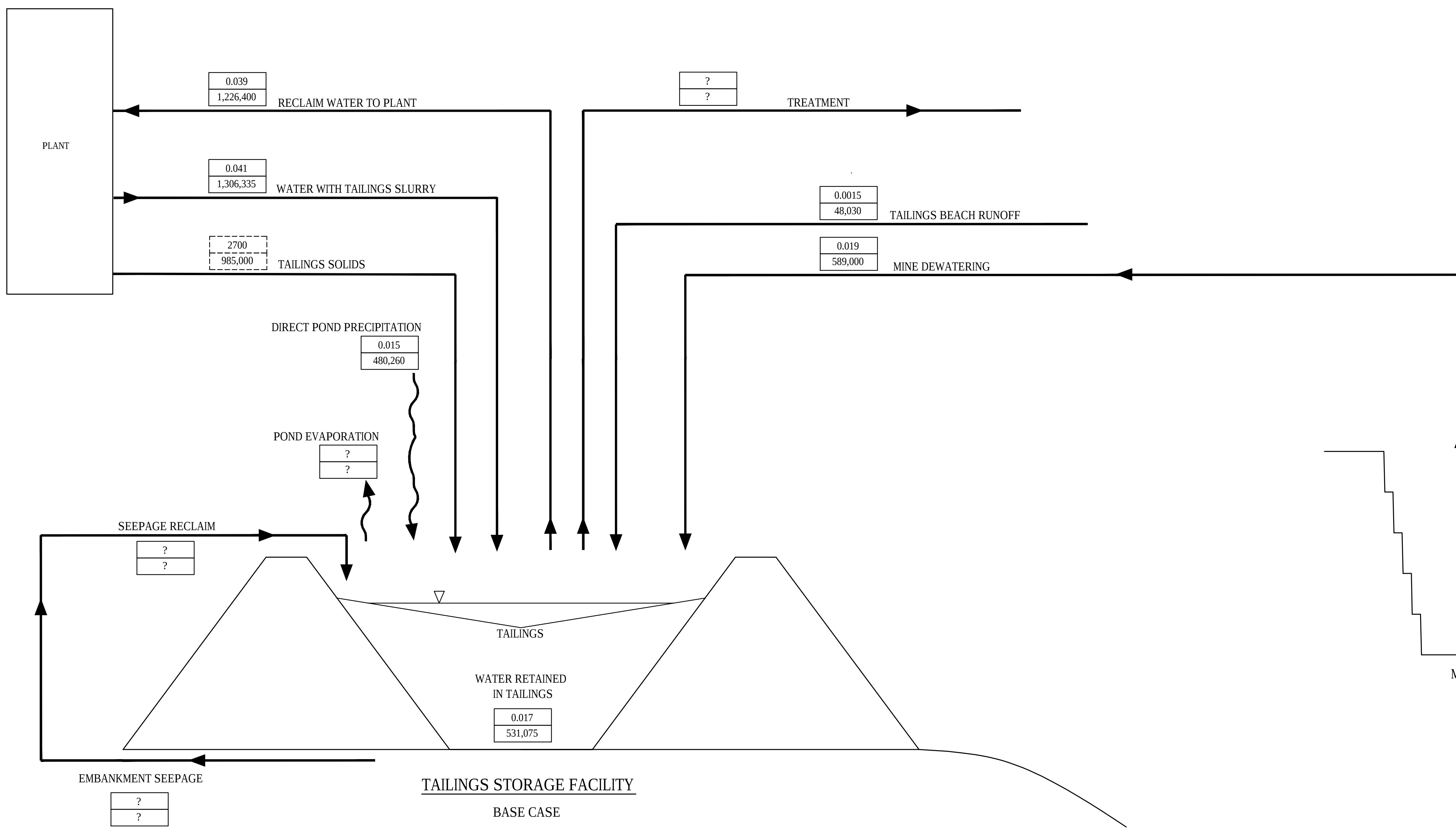
PROJECT:	TREASURY METALS - GOLIATH PROJECT TAILINGS STORAGE FACILITY ALTERNATIVES ASSESSMENT
TITLE:	LOCATION 1 POTENTIAL CROSS SECTION
PROJECT NO:	141-12598-00
SCALE:	AS SHOWN
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 5.5



LEGEND

FLOW RATE m³/s	DTPD
ANNUAL VOLUME m³	DTPA

NOTES:

1. INFORMATION SHOWN IS PRELIMINARY AND IS PROVIDED FOR DISCUSSION AND CONFIRMATION.
2. PROJECT BASE CASE SHOWN CONSISTING OF CONVENTIONAL TAILINGS DEPOSTION TO LOCATION No.1.
3. EMBANKMENT SEEPAGE WILL BE DEPENDENT ON INCLUSION OF A LINER CONTAINMENT SYSTEM.
4. BASED ON OPERATION 365 DAYS PER YEAR.
5. PRECIPITATION INTO TAILINGS STORAGE FACILITY IS BASED ON PRELIMINARY ESTIMATES OF LAYOUT AND SIZE.
6. ? IDENTIFIES VALUES TO BE DETERMINED AS THE PROJECT IS ADVANCED.

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PROJECT: TREASURY METALS - GOLIATH PROJECT
TAILINGS STORAGE FACILITY
ALTERNATIVES ASSESSMENT

TITLE: WATER/SOLIDS BALANCE SCHEMATIC

PROJECT NO:	141-12598-00
SCALE:	NOT TO SCALE
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE 5.6

APPENDIX

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MEMO

TO:	TREASURY METALS	**DATE:**	**July 21, 2014**
FROM:	**WSP**		Job No.: 141-12598-00
SUBJECT:	GOLIATH PROJECT – 2014 SITE INVESTIGATION - FACTUAL SOILS SUMMARY		

1. Introduction

The Treasury Metals, Goliath Property, is located near the City of Dryden in Ontario. Exploration drilling is currently on-going at the site to support the future development of a gold mine. The mine, when in operations, will consist of open-pit followed by underground mining developments with on-site processing and mine waste storage. A small scale site investigation was completed in March/April of 2013 for the purpose of supporting the future planned pre-feasibility design for the plant site and on-land tailings storage facility. The site investigation was used to investigate the sub-surface soil conditions in two (2) potential Tailings Storage Facility (TSF) areas, consisting of Location 1 and Location 6, being considered as part of the projects Alternative Assessment study as well as in potential locations for the processing plant site.

The site investigation work was completed between March 25 and April 2, 2014. TBT Engineering Ltd. (TBTE) completed the investigations with site supervision completed by Treasury Metals site representatives. The geotechnical investigation consisted of advancing geotechnical boreholes along with performing in situ testing to facilitate the collection of data and soil samples for identification and laboratory testing, and also to determine the in situ densities, level of compaction and relative in place strength of the materials present. TBTE also completed field sample identification and also prepared Borehole Logs for the project. The Borehole Logs are currently in Draft and can be updated to reflect the results of the laboratory program and the project is advanced to the design phase. The following sections provide the factual soils information collected from the site investigation. The information presented below can be used to support design activities as the project is advanced.

2. Drilling

The site investigation program included advancement of twenty (20) boreholes at the property, consisting of seven (7) in TSF Location 1 Area, three (3) in the TSF Location 6 Area, five (5) at the Plant Site Option 1 and five (5) at the Plant Site Option 2. These have been identified as BH14-01 to BH14-21 and summary details are provided in the Table, below. A planned borehole, identified as BH14-16 was not completed as part of the site investigation program due the presence of snow that limited access to the proposed area. The locations of the Boreholes advanced during the site investigation program are shown on Figure A1, attached.

Advancement of the boreholes utilized a CME 55 drill (3.25" hollow stem auger), mounted on a Marooka track machine The depth of Borehole advancement ranged from a minimum of 1.05 m below ground surface in BH14-02 to 18.6 m in BH13-15. All Boreholes were advanced to depths of auger refusal, with the exception of BH-13 for which drilling was ceased if refusal was not achieved below 9.0 m. The site investigation included discreet interval sampling, standard penetration testing, and shear vane testing where soft, cohesive soils were encountered. Soil samples were collected in a 50 mm outside diameter split-spoon sampler, for identification and laboratory testing. A summary of the boreholes advanced as part of the site investigation program is provided as Table A1, attached.

Borehole	Date	Borehole Depth (m)	General Location
BH14-01	March 27, 2014	1.5	TSF Option 1
BH14-02	March 27, 2014	1.05	TSF Option 1
BH14-03	March 26, 2014	6.0	TSF Option 1
BH14-04	March 26, 2014	8.1	TSF Option 1
BH14-05	March 25, 2014	13.75	TSF Option 1
BH14-06	March 26, 2014	9.9	TSF Option 1
BH14-07A	March 27, 2014	12.3	TSF Option 1
BH14-08	April 2, 2014	9.0	TSF Option 6
BH14-09A	April 2, 2014	7.5	TSF Option 6
BH14-10A	April 3, 2014	1.35	TSF Option 6
BH14-11	March 30, 2014	11.1	Plant Site Option 1
BH14-12	March 30, 2014	9.6	Plant Site Option 1
BH14-13	March 31, 2014	9.6	Plant Site Option 1
BH14-14	March 31, 2014	9.15	Plant Site Option 1
BH14-15	March 29, 2014	18.6	Plant Site Option 1
BH14-16	Not drilled due to access restrictions		
BH14-17	March 28, 2014	2.7	Plant Site Option 2
BH14-18	March 28, 2014	2.7	Plant Site Option 2
BH14-19	March 28, 2014	3.75	Plant Site Option 2
BH14-20	March 28, 2014	10.5	Plant Site Option 2
BH14-21	March 28, 2014	5.1	Plant Site Option 2

3. Sampling

Split spoon samples from the Standard Penetration Tests (SPT's) were collected for potential laboratory testing from all Boreholes advanced during the site investigation program with the exception of BH14-02 and BH14-10A. Borehole BH14-02 was drilled to 1.05 m and was stopped due to auger and split spoon refusal. Borehole BH14-10A was drilled to 1.35 m entirely within non-native fill material and was suspended due to auger refusal.

All samples were stored in plastic bags to preserve the natural moisture content. A summary of the field samples collected during the site investigation program are provided on Table A2, attached. Soil samples were selected by an experienced geotechnical engineer for additional geotechnical index testing that was completed by the TBT Engineering Limited geotechnical laboratory in Thunder Bay, Ontario.

4. In Situ Testing

In situ testing was completed during the site investigation program that consisted of SPT's in all boreholes advanced during the site investigation program, with the exception of BH14-02, and BH14-10A. Split spoons were advanced with the CME550 drill for the purpose of sample collection and "N" counts were recorded. Vane Shear testing was also completed in a Clay layer in boreholes BH14-06 to BH14-09A, BH14-11 to BH14-17, BH14-19 and BH14-20. The SPT's were completed using a standard split spoon sampler, 50 mm in diameter and 600 mm in length, which was driven ahead of the augers or casing by the force exerted by a 63.5 kg hammer free falling through a distance of 750 mm. The use of the split spoon facilitated collection of the soil samples in addition to obtaining SPT "N" values, which are shown on the borehole logs, attached. The recorded SPT "N" values can be used to provide an indication of soil density and strength. The SPT "N" values are summarized on Table A3. The "N" value provides an indication of the soils in situ density, stiffness and strength that can be correlated to the resistance to penetration of the sampler. This method is recommended for sandy material but should be used with caution for cohesive soil material.

A total of 56 in situ Field Vane Shear tests were performed as part of the site investigation activities. The Vane Shear Test is a measurement of the in situ undrained shear strength of cohesive materials. The vane is advanced into the soil layer ahead of the augers and then rotated and the torsional force required to cause shearing is used to calculate the undrained shear strength. The vane is then re-torqued to determine the remolded strength of the soil. The results of the in situ Field Vane Shear Tests are provided on Table A3, attached.

5. Laboratory Testing

Geotechnical laboratory index testing was performed on selected samples of the materials collected during the site investigation program for general characterization and determination of in situ parameters. Testing was completed by the TBT laboratory in Thunder Bay and was limited to natural moisture content determination, grain size analysis and Atterberg Limits. A summary of the laboratory testing results is provided in Table A4, attached. The laboratory analysis results as provided from TBTE are attached.

6. Geotechnical Summary

The following sections provide a geotechnical summary of the material encountered during the site investigation completed at the Goliath Property. The subsurface soil descriptions have been generalized into the geological units and are presented below.

- Fill
- Topsoil – Organics
- Sand
- Silt
- Clay

6.1. Fill

Fill material was encountered in BH14-10A and was described as being sand, some gravel and occasional cobbles. The Fill material extended from the surface of the borehole to a depth of 1.35 m at auger refusal. Two (2) auger samples were collected in the Fill material. No in situ testing or laboratory testing was completed on the fill material as part of the site investigation program.

6.2. Topsoil – Organics

A surface organic layer or topsoil was encountered in BH14-01 to BH14-09A, BH14-11 to BH14-15 and BH14-17 to BH14-21. The organic layer was generally described as being black to brown and was frozen in BH14-14 and BH14-15. Roots were noted in the layer in BH14-05 and BH14-20. Sand was noted within the layer in BH14-19. The organic layer was encountered at the surface and generally extended to a depth of 0.1 m below the original ground with a maximum depth of 1.5 m in BH14-14.

6.3. Sand

Sand layers were encountered during the site investigation at the site that consisted of upper and lower layers. The upper layer was encountered underlying the Topsoil-Organics layer in BH14-01 to BH14-07, BH14-09A, BH14-11 to BH14-13, BH14-15, BH14-17, BH14-18, BH14-20 and BH14-21. The lower layer was encountered underlying the Silt layer in BH13-04 and BH14-05 and underlying the Clay layer in BH14-09A, BH14-13 and BH14-17. The Sand layer was generally described as being silty to some and silt to trace silt, brown to black to grey. Rock fragments were noted at depth in BH14-05. Clay content was noted in the layer in BH14-09A. The upper sand layer was encountered below the organic layer at a depth of 0.1 m and extended to a maximum depth of 3.8 m in BH14-05. The lower sand layer was encountered at a minimum depth, underlying the clay layer, in BH14-17 and extended to a depth of 2.7 m below the original ground to auger refusal. The lower sand layer was encountered at a maximum depth below the original ground at 9.0 m, underlying the clay layer, and extended to auger refusal at a depth of 9.6 m.

A total of 14 (fourteen) moisture content tests were completed on selected samples of the Sand material and the results are provided in the laboratory results attached. The minimum moisture content was 15.8%, maximum was 26.1%, with an average of 20.5%. One (1) grain size test was completed on the Sand layer and the results are provided on Figure A2, attached.

A total of 30 in situ SPT's were completed in the sand layer during the site investigation program. The resultant SPT N values ranges from a minimum of 2 to a maximum of greater than 50 with an average of 15 indicating a very loose to very dense material consistency.

6.4. Silt

Silt layers were encountered at various depths below the original ground during the site investigation activities. The Silt layer was encountered underlying the Sand layer in BH14-03 to BH14-7A and BH14-11 and underlying the Clay layer in BH14-14, BH14-15, BH14-18, BH14-19 and BH14-21. The Silt Layer was underlain by Sand in BH14-04 and BH14-05 and was underlain by a Clay layer in BH14-06 to BH14-08, BH14-15 and BH14-21. The Silt layer ranged in depth, below the upper Sand layer from 0.6 m below the original ground in BH14-11 and extended to a maximum depth of 12 m in Bh14-15 below the original ground. The Silt layer encountered below the Clay layer extended from a minimum depth of 4.5 m below the original ground in BH14-21 to a maximum depth of 18.6 m (auger refusal) in BH14-15. The Silt layer extended to the maximum advancement or auger refusal in BH14-03 (6.0 m), BH14-06 (9.9 m), BH14-15 (18.6 m) and BH14-21 (5.1 m).

The Silt layer was generally described as consisting of Silt and Sand and Clay, trace sand to sandy to some sand, trace to some clay and is generally grey in color, layered with red clay and grey silt and grey clay seems.

A total of 20 moisture content tests were completed on selected samples of the Silt material and the results are attached in the Laboratory Results. The minimum moisture content was 13.5%, maximum was 30.3%, with an average of 22.5%. Six (6) grain size analysis tests were completed on the Silt in BH14-03 to BH14-06 inclusive and the results are provided on Figure A3, attached.

A total of 30 in situ SPT's were completed in the Silt layer during the site investigation program. The resultant SPT N values ranges from no reading (weight of hammer) to >50 with an average of 9 indicating a very loose to very dense material that is generally loose. One (1) in situ shear vane test was completed in the silt layer with a result of greater than 100 kPa.

6.5. Clay

Clay layers were encountered at various locations and depths during the site investigation program. Clay was encountered underlying the Topsoil-Organics layer in BH14-08, 14-09A, BH14-13, BH14-14 and BH14-19. The Clay layer was also encountered underlying the Silt layer in BH14-06, BH14-07A, BH14-11 and BH14-21 and underlying the Sand layer in BH14-12, BH14-15, BH14-17, BH14-18 and BH14-20. The Clay layer extended from a minimum depth of 0.1 m in BH14-08 and BH14-09A to a depth of 10.5 m in BH14-20. A layer of Clay was also encountered underlying the Silt layer in BH14-15 and extended from depths of 12 m to 15 m below the original ground level. The Clay layer extended to refusal or maximum advancement in BH14-02 (1.05 m), BH14-07A (12.3 m), BH14-08 (9.0 m), BH14-11 (11.1 m), BH14-12 (9.6 m), and BH14-20 (10.5 m).

The Clay layer was generally described as being clay and silt to silt and clay to silty, brown and grey to grey (dark to light) to reddish grey in color and was occasionally layered. Red clay and grey (dark to light) clay to silt layers were observed in BH14-06. Some gravel and rock fragments were observed at depth in layer in BH14-07A. Sand seems were observed in BH14-12. The Clay layer was described as consisting of clay, silt, sand and gravel at depth in BH14-11. Silt seems were observed in BH14-14 and BH14-15 at a depth of 3.0 m.

A total of 20 moisture content tests were completed on selected samples of the Clay material and the results are attached in the Laboratory Results. The minimum moisture content was 16.5%, maximum was 46.2%, with an average of 33.6%.

Two Atterberg Limits tests were completed on samples of the Clay. The results from BH14-06, Sample No. SS7 had a liquid limit of 25%, Plastic Limit of 19.1% and Plasticity Index of 6.0 indicating a USCS Classification of CL-ML. The Atterberg Limits test result from BH14-08, Sample No. SS3 had a liquid limit of 46%, Plastic Limit of 22% and Plasticity Index of 24 indicating a USCS Classification of CL. The results of the Atterberg Limits testing are provided as Figure A4, attached. Two (2) grain size analysis was completed on the Clay material and the results are provided on Figure A5, attached.

A total of 73 in situ SPT's were completed in the Clay layer during the site investigation program. The resultant SPT N values ranges from no reading (weight of hammer) to >50 with an average of 3. SPT values of >50 were most likely influenced by the underlying layer, that was close to refusal, and therefore have not been included as inputs for material strength indications. The maximum SPT value, not including the refusal value, was 17. The results of the field SPT's indicate a very soft to very stiff material range with an average of soft. A total of 56 in situ shear vane tests were completed to identify the undrained shear strength. The results indicated a minimum value of 20 kPa and maximum value of greater than 100 kPa with an average value of 73 kPa. A total of 46 re-shear tests were completed with a minimum value of 3 kPa, maximum value of 70 kPa and average value of 21 kPa.

7. Summary

The site investigation completed at the Goliath Project site near Dryden, Ontario consisted on 20 boreholes advanced in two (2) potential TSF areas and also in two (2) potential plant site locations. Soil thicknesses of up to 13.75 m were identified within BH14-05 in the proposed area of Location 1 tailings storage facility. A small scale laboratory testing program was completed on selected samples and were concentrated in the potential tailings storage facility areas. The Borehole Logs were generated by TBTE and are currently in Draft and will require updating to reflect the results of the laboratory testing program and will be completed once the design phase of the project has been initiated. The results of the site investigation program will be used to advance the planned design phases of the project and will form the basis for development of future site investigation programs that are anticipated to include test pitting of potential fill materials for construction activities.

Attachments:

- Table A1 – Summary of Borehole Details
- Table A2 – Summary of Field Samples
- Table A3 – Summary of In Situ Testing
- Table A4 – Borehole Samples Lab Testing Results
- Figure A1 – Site Investigation Locations
- Figure A2 – Grain Size Results – Sand
- Figure A3 – Grain Size Results – Silt
- Figure A4 – Plasticity Chart – Clay

- Figure A5 – Grain Size Results – Clay
- TBTE Borehole Logs (Draft)
- Laboratory Testing

TABLE A1

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF BOREHOLE DETAILS

Drillhole No.	Coordinates		Depth of Drillhole (m)	General Location
	Northing (m)	Easting (m)		
BH14-01	5512562	529491	1.50	Tailings Storage Facility Location 1, Southeast Corner
BH14-02	5512932	529632	1.05	Tailings Storage Facility Location 1, East Side
BH14-03	5513400	529660	6.00	Tailings Storage Facility Location 1, Northeast Corner
BH14-04	5513576	529264	8.10	Tailings Storage Facility Location 1, North Side
BH14-05	5513425	528949	13.75	Tailings Storage Facility Location 1, Northwest Corner
BH14-06	5512942	528957	9.90	Tailings Storage Facility Location 1, West Side
BH14-07A	5512321	529150	12.30	Tailings Storage Facility Location 1, Soutwest Corner
BH14-08	5511549	528132	9.00	Tailings Storage Facility Location 6, North side
BH14-09A	5511570	528374	9.00	Tailings Storage Facility Location 6, Northeast Side
BH14-10A	5511168	527763	1.35	Tailings Storage Facility Location 6, South side
BH14-11	5512098	529026	11.10	Plant Site 1 - East Side
BH14-12	5512093	528978	9.60	Plant Site 1 - North Side
BH14-13	5512121	528957	9.60	Plant Site 1 - Northwest Corner
BH14-14	5512062	528933	9.15	Plant Site 1 - West Side
BH14-15	5511938	528962	18.60	Plant Site 1 - South Side
BH14-17	5512879	528077	2.70	Plant Site 2 - West Side
BH14-18	5512748	528151	2.70	Plant Site 2 - South Side
BH14-19	5512845	528233	3.75	Plant Site 2 - Southeast Corner
BH14-20	5513035	528118	10.50	Plant Site 2 - Northwest Corner
BH14-21	5512927	528282	5.10	Plant Site 2 - Northeast Corner

TABLE A2

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF FIELD SAMPLES

Drillhole No.	Sample No.	Depth		Sample Type	Geological Unit
		From (m)	To (m)		
BH14-01	AS1	0.4	0.60	Auger	Sand
BH14-01	SS2	0.8	1.30	Split Spoon	Sand
BH14-02	AS1	0.4	0.60	Auger	Sand
BH14-02	AS2	0.6	1.00	Auger	Clay
BH14-03	AS1	0.4	0.80	Auger	Sand
BH14-03	SS2	0.80	1.25	Split Spoon	*Silt* [1]
BH14-03	SS3	1.50	2.10	Split Spoon	Silt
BH14-03	SS4	2.40	2.80	Split Spoon	Silt
BH14-03	SS5	3.00	3.40	Split Spoon	Silt
BH14-03	SS6	4.60	5.20	Split Spoon	Silt
BH14-04	AS1	0.40	0.80	Auger	Sand
BH14-04	SS2	0.80	1.20	Split Spoon	Sand
BH14-04	SS3	1.60	2.00	Split Spoon	Sand
BH14-04	SS4	2.60	3.00	Split Spoon	Sand
BH14-04	SS5	3.00	3.40	Split Spoon	Sand
BH14-04	SS6	4.60	5.00	Split Spoon	Silt
BH14-04	SS7	6.00	6.40	Split Spoon	Silt
BH14-04	SS8	7.70	8.10	Split Spoon	Sand
BH14-05	AS1	0.40	0.80	Auger	Sand
BH14-05	SS2	0.80	1.20	Split Spoon	Sand
BH14-05	SS3	1.60	2.00	Split Spoon	Sand
BH14-05	SS4	2.40	3.00	Split Spoon	Sand
BH14-05	SS5	3.00	3.40	Split Spoon	Sand
BH14-05	SS6	3.80	4.20	Split Spoon	Silt
BH14-05	SS7	4.50	4.90	Split Spoon	Silt
BH14-05	SS8	5.40	4.80	Split Spoon	Silt
BH14-05	SS9	6.00	6.40	Split Spoon	Silt
BH14-05	SS10	6.80	7.20	Split Spoon	Silt
BH14-05	SS11	7.60	8.00	Split Spoon	Silt
BH14-05	SS12	8.20	8.60	Split Spoon	Silt
BH14-05	SS13	9.00	9.40	Split Spoon	Silt
BH14-05	SS14	9.20	10.20	Split Spoon	Silt
BH14-05	SS15	10.50	10.90	Split Spoon	Sand

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<u>TABLE A2</u>

TREASURY METALS
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2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF FIELD SAMPLES

Drillhole No.	Sample No.	Depth		Sample Type	Geological Unit
		From (m)	To (m)		
BH14-05	SS16	11.30	11.70	Split Spoon	Sand
BH14-05	SS17	12.00	12.40	Split Spoon	Sand
BH14-05	SS18	12.80	13.20	Split Spoon	Sand
BH14-05	SS19	13.40	13.60	Split Spoon	Sand
BH14-06	AS1	0.40	0.80	Auger	Sand
BH14-06	SS2	0.80	1.20	Split Spoon	Sand
BH14-06	SS3	1.60	2.00	Split Spoon	Sand
BH14-06	SS4	2.20	2.60	Split Spoon	Sand
BH14-06	SS5	3.00	3.40	Split Spoon	Silt
BH14-06	SS6	4.50	4.90	Split Spoon	Clay
BH14-06	SS7	6.00	6.40	Split Spoon	Clay
BH14-06	SS8	7.50	7.90	Split Spoon	Silt
BH14-06	SS9	9.10	9.50	Split Spoon	Silt
BH14-07A	AS1	0.40	0.80	Auger	Sand
BH14-07A	SS2	0.80	1.20	Split Spoon	Sand
BH14-07A	SS3	1.60	2.00	Split Spoon	Sand
BH14-07A	SS4	2.40	2.80	Split Spoon	Sand
BH14-07A	SS5	3.00	3.40	Split Spoon	Silt
BH14-07A	SS6	4.50	4.90	Split Spoon	Clay
BH14-07A	SS7	6.00	6.40	Split Spoon	Clay
BH14-07A	SS8	7.60	8.00	Split Spoon	Clay
BH14-07A	SS9	9.00	9.40	Split Spoon	Clay
BH14-07A	S10A	10.70	11.00	Split Spoon	Clay
BH14-07A	S10B	11.00	11.20	Split Spoon	Clay
BH14-07A	SS11	12.00	12.30	Split Spoon	Clay

TABLE A2

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF FIELD SAMPLES

Drillhole No.	Sample No.	Depth		Sample Type	Geological Unit
		From (m)	To (m)		
BH14-08	AS1	0.40	0.80	Auger	Clay
BH14-08	SS2	0.80	1.20	Split Spoon	Clay
BH14-08	SS3	1.60	2.00	Split Spoon	Clay
BH14-08	SS4	2.40	2.80	Split Spoon	Clay
BH14-08	SS5	3.00	3.40	Split Spoon	Clay
BH14-08	SS6	4.50	4.90	Split Spoon	Clay
BH14-08	SS7	7.20	7.60	Split Spoon	Clay
BH14-08	SS8	7.70	8.10	Split Spoon	Clay
BH14-09	AS1	0.20	0.60	Auger	Clay
BH14-09	SS2	0.80	1.40	Split Spoon	Clay
BH14-09	SS3	1.60	2.00	Split Spoon	Clay
BH14-09	SS4	2.00	2.40	Split Spoon	Clay
BH14-09	SS5	4.50	4.90	Split Spoon	Clay
BH14-09	SS6	6.00	6.40	Split Spoon	Clay
BH14-09	SS7	7.50	7.90	Split Spoon	Sand
BH14-10A	AS1	0.20	0.60	Auger	Fill
BH14-10A	AS2	0.80	1.20	Auger	Fill
BH14-11	AS1	0.30	0.70	Auger	Sand
BH14-11	SS2	0.70	1.10	Split Spoon	Silt
BH14-11	SS3	1.50	2.00	Split Spoon	Clay
BH14-11	SS4	2.40	2.70	Split Spoon	Clay
BH14-11	SS5	3.00	3.40	Split Spoon	Clay
BH14-11	SS6	4.80	5.20	Split Spoon	Clay
BH14-11	SS7	6.00	6.40	Split Spoon	Clay
BH14-11	SS8	7.50	7.90	Split Spoon	Clay
BH14-11	SS9	9.00	9.40	Split Spoon	Clay
BH14-11	SS10	10.60	11.00	Split Spoon	Clay

TABLE A2

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF FIELD SAMPLES

Drillhole No.	Sample No.	Depth		Sample Type	Geological Unit
		From (m)	To (m)		
BH14-12	AS1	0.30	0.70	Auger	Sand
BH14-12	SS2	0.70	1.10	Split Spoon	Silt
BH14-12	SS3	1.50	2.00	Split Spoon	Clay
BH14-12	SS4	2.40	2.70	Split Spoon	Clay
BH14-12	SS5	3.00	3.40	Split Spoon	Clay
BH14-12	SS6	4.80	5.20	Split Spoon	Clay
BH14-12	SS7	6.00	6.40	Split Spoon	Clay
BH14-12	SS8	7.50	7.90	Split Spoon	Clay
BH14-12	SS9	9.00	9.40	Split Spoon	Clay
BH14-13	AS1	0.30	0.70	Auger	Clay
BH14-13	SS2	0.70	1.40	Split Spoon	Clay
BH14-13	SS3	1.60	2.00	Split Spoon	Clay
BH14-13	SS4	2.20	2.60	Split Spoon	Clay
BH14-13	SS5	3.00	3.40	Split Spoon	Clay
BH14-13	SS6	4.50	4.90	Split Spoon	Clay
BH14-13	SS7	6.00	6.40	Split Spoon	Clay
BH14-13	SS8	7.50	7.90	Split Spoon	Clay
BH14-13	SS9	9.00	9.40	Split Spoon	Sand
BH14-14	AS1	0.30	0.70	Auger	Organics
BH14-14	SS2	0.70	1.40	Split Spoon	Organics
BH14-14	SS3	1.60	2.00	Split Spoon	Clay
BH14-14	SS4	2.40	2.80	Split Spoon	Clay
BH14-14	SS5	3.00	3.40	Split Spoon	Clay
BH14-14	SS6	4.50	4.90	Split Spoon	Clay
BH14-14	SS7	6.00	6.40	Split Spoon	Clay
BH14-14	SS8	7.50	7.90	Split Spoon	Clay
BH14-14	SS9	9.00	9.20	Split Spoon	Silt

TABLE A2

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF FIELD SAMPLES

Drillhole No.	Sample No.	Depth		Sample Type	Geological Unit
		From (m)	To (m)		
BH14-15	AS1	0.30	0.70	Auger	Organics
BH14-15	SS2	0.70	1.30	Split Spoon	Sand
BH14-15	SS3	1.60	2.00	Split Spoon	Sand
BH14-15	SS4	2.20	2.60	Split Spoon	Clay
BH14-15	SS5	3.10	3.50	Split Spoon	Clay
BH14-15	SS6	4.60	5.00	Split Spoon	Clay
BH14-15	SS7	6.00	6.40	Split Spoon	Clay
BH14-15	SS8	7.60	8.00	Split Spoon	Clay
BH14-15	SS9	9.00	9.40	Split Spoon	Silt
BH14-15	SS10	10.50	10.90	Split Spoon	Silt
BH14-15	SS11	12.00	12.40	Split Spoon	Clay
BH14-15	SS12	13.60	14.00	Split Spoon	Clay
BH14-15	SS13	15.00	15.40	Split Spoon	Silt
BH14-15	SS14	16.50	16.90	Split Spoon	Silt
BH14-15	SS15	18.00	18.60	Split Spoon	Silt
BH14-17	AS1	0.30	0.70	Auger	Organics
BH14-17	SS2	0.70	1.30	Split Spoon	Sand
BH14-17	SS3	1.50	2.10	Split Spoon	Clay
BH14-17	SS4	2.30	2.70	Split Spoon	Sand
BH14-18	AS1	0.30	0.70	Auger	Sand
BH14-18	SS2	0.90	1.40	Split Spoon	Clay
BH14-18	SS3	1.60	2.00	Split Spoon	Clay
BH14-18	SS4	2.30	2.70	Split Spoon	Silt
BH14-19	AS1	0.40	0.80	Auger	Organics
BH14-19	SS2	0.80	1.40	Split Spoon	Clay
BH14-19	SS3	1.60	2.10	Split Spoon	Clay
BH14-19	SS4	2.30	2.90	Split Spoon	Clay
BH14-19	SS5	3.00	3.60	Split Spoon	Clay/Silt

TABLE A2

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF FIELD SAMPLES

Drillhole No.	Sample No.	Depth		Sample Type	Geological Unit
		From (m)	To (m)		
BH14-20	AS1	0.40	0.70	Auger	Organics
BH14-20	SS2	0.70	1.30	Split Spoon	Sand
BH14-20	SS3	1.50	1.90	Split Spoon	Clay
BH14-20	SS4	2.20	2.60	Split Spoon	Clay
BH14-20	SS5	3.00	3.50	Split Spoon	Clay
BH14-20	SS6	4.50	5.00	Split Spoon	Clay
BH14-20	SS7	6.00	6.50	Split Spoon	Clay
BH14-20	SS8	7.60	8.10	Split Spoon	Clay
BH14-20	SS9	9.00	9.40	Split Spoon	Clay
BH14-21	AS1	0.40	0.80	Auger	Sand
BH14-21	SS2	0.80	1.20	Split Spoon	Sand
BH14-21	SS4	1.50	2.10	Split Spoon	Silt
BH14-21	SS5	2.30	2.70	Split Spoon	Clay
BH14-21	SS6	3.00	3.40	Split Spoon	Clay
BH14-21	SS7	4.50	5.10	Split Spoon	Silt

Note:
1. Geological units presented above are based on field obervations provided on BH Logs by TBTE with changes based on lab testing results (identified in italics). BH Logs are in Draft and require updating to reflect lab testing restults.

TABLE A3

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF IN SITU TESTING

Drillhole No.	Depth		Geological Unit	Standard Penetration Test (SPT)	Vane Shear Test	
	From (m)	To (m)		N Blows per Foot	Initial kPa	Reshear kPa
BH14-01	0.80	1.30	Sand	7		
BH14-03	0.80	1.25	*Silt* [3]	13		
BH14-03	1.50	2.10	Silt	8		
BH14-03	2.40	2.80	Silt	7		
BH14-03	3.00	3.40	Silt	6		
BH14-03	4.60	5.20	Silt	5		
BH14-04	0.80	1.20	Sand	13		
BH14-04	1.60	2.00	Sand	16		
BH14-04	2.60	3.00	Sand	21		
BH14-04	3.00	3.40	Sand	12		
BH14-04	4.60	5.00	Silt	7		
BH14-04	6.00	6.40	Silt	6		
BH14-04	7.70	8.10	Sand	8		
BH14-05	0.80	1.20	Sand	14		
BH14-05	1.60	2.00	Sand	32		
BH14-05	2.40	3.00	Sand	23		
BH14-05	3.00	3.40	Sand	3		
BH14-05	3.80	4.20	Silt	10		
BH14-05	4.50	4.90	Silt	4		
BH14-05	5.40	4.80	Silt	6		
BH14-05	6.00	6.40	Silt	3		
BH14-05	6.80	7.20	Silt	4		
BH14-05	7.60	8.00	Silt	6		

TABLE A3

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF IN SITU TESTING

Drillhole No.	Depth		Geological Unit	Standard Penetration Test (SPT)	Vane Shear Test	
	From (m)	To (m)		N Blows per Foot	Initial kPa	Reshear kPa
BH14-05	8.20	8.60	Silt	7		
BH14-05	9.00	9.40	Silt	4		
BH14-05	9.20	10.20	Silt	4		
BH14-05	10.50	10.90	Sand	8		
BH14-05	11.30	11.70	Sand	12		
BH14-05	12.00	12.40	Sand	25		
BH14-05	12.80	13.20	Sand	12		
BH14-05	13.40	13.60	Sand	>50		
BH14-06	0.80	1.20	Sand	11		
BH14-06	1.60	2.00	Sand	10		
BH14-06	2.20	2.60	Sand	9		
BH14-06	3.00	3.40	Silt	2		
BH14-06	4.50	4.90	Clay	1		
BH14-06	6.00	6.40	Clay	3		
BH14-06	7.50	7.90	Silt	6	39	4
BH14-06	9.10	9.50	Silt	14		
BH14-07A	0.80	1.20	Sand	13		
BH14-07A	1.60	2.00	Sand	17		
BH14-07A	2.40	2.80	Sand	7		
BH14-07A	3.00	3.40	Silt	4		
BH14-07A	4.50	4.90	Clay	0	52	4
BH14-07A	6.00	6.40	Clay	0	24	9
BH14-07A	7.60	8.00	Clay	9	>100	37
BH14-07A	9.00	9.40	Clay	2	75	9

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TREASURY METALS
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2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF IN SITU TESTING

Drillhole No.	Depth		Geological Unit	Standard Penetration Test (SPT)	Vane Shear Test	
	From (m)	To (m)		N Blows per Foot	Initial kPa	Reshear kPa
BH14-07A	10.70	11.00	Clay	17		
BH14-07A	12.00	12.30	Clay, silty	>50		
BH14-08	0.80	1.20	Clay	4	>100	
BH14-08	1.60	2.00	Clay	5	>100	
BH14-08	2.40	2.80	Clay	6	>100	
BH14-08	3.00	3.40	Clay	5		
BH14-08	4.50	4.90	Clay	4	>100	47
BH14-08	7.20	7.60	Clay	3	62	12
BH14-08	7.70	8.10	Clay	2	>100	
BH14-09A	0.80	1.40	Clay	6		
BH14-09A	1.60	2.00	Clay	6	>100	70
BH14-09A	2.00	2.40	Clay	7		
BH14-09A	4.50	4.90	Clay	5		
BH14-09A	6.00	6.40	Clay	1	>100	44
BH14-09A	7.50	7.90	Sand	6		
BH14-11	0.70	1.10	Silt	0		
BH14-11	1.50	2.00	Clay	0	22	3
BH14-11	2.40	2.70	Clay	0	25	4
BH14-11	3.00	3.40	Clay	0	25	4
BH14-11	4.80	5.20	Clay	1	22	4
BH14-11	6.00	6.40	Clay	0	87	20
BH14-11	7.50	7.90	Clay	2	60	11
BH14-11	9.00	9.40	Clay	3	>100	44
BH14-11	10.60	11.00	Clay	10		

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TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF IN SITU TESTING

Drillhole No.	Depth		Geological Unit	Standard Penetration Test (SPT)	Vane Shear Test	
	From (m)	To (m)		N Blows per Foot	Initial kPa	Reshear kPa
BH14-12	0.70	1.10	Silt	3		
BH14-12	1.50	2.00	Clay	3		
BH14-12	2.40	2.70	Clay	5	>100	
BH14-12	3.00	3.40	Clay	4	>100	33
BH14-12	4.80	5.20	Clay	2	>100	58
BH14-12	6.00	6.40	Clay	0	70	14
BH14-12	7.50	7.90	Clay	1	58	23
BH14-12	9.00	9.40	Clay	10	>100	
BH14-13	0.70	1.40	Clay	1		
BH14-13	1.60	2.00	Clay	3	>100	7
BH14-13	2.20	2.60	Clay	2	>100	44
BH14-13	3.00	3.40	Clay	3	>100	28
BH14-13	4.50	4.90	Clay	3	>100	14
BH14-13	6.00	6.40	Clay	2	62	14
BH14-13	7.50	7.90	Clay	1	55	11
BH14-13	9.00	9.40	Sand	5	>100	20
BH14-14	0.30	0.70	Organics	2		
BH14-14	1.60	2.00	Clay	2	>100	65
BH14-14	2.40	2.80	Clay	3	>100	23
BH14-14	3.00	3.40	Clay	0	82	
BH14-14	4.50	4.90	Clay	1		
BH14-14	6.00	6.40	Clay	1	62	9
BH14-14	7.50	7.90	Clay	1	>100	70
BH14-14	9.00	9.20	Silt	>50		

TABLE A3

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF IN SITU TESTING

Drillhole No.	Depth		Geological Unit	Standard Penetration Test (SPT)	Vane Shear Test	
	From (m)	To (m)		N Blows per Foot	Initial kPa	Reshear kPa
BH14-15	0.70	1.30	Sand	2		
BH14-15	1.60	2.00	Sand	5		
BH14-15	2.20	2.60	Clay	0	40	5
BH14-15	3.10	3.50	Clay	0	50	7
BH14-15	4.60	5.00	Clay	0	42	5
BH14-15	6.00	6.40	Clay	0	60	15
BH14-15	7.60	8.00	Clay	1	35	8
BH14-15	9.00	9.40	Silt	12		
BH14-15	10.50	10.90	Silt	2		
BH14-15	12.00	12.40	Clay	1	82	14
BH14-15	13.60	14.00	Clay	1		
BH14-15	15.00	15.40	Silt	1	25	16
BH14-15	16.50	16.90	Silt	2	>100	
BH14-15	18.00	18.60	Silt	13		
BH14-17	0.70	1.30	Sand	9		
BH14-17	1.50	2.10	Clay	2		
BH14-17	2.30	2.70	Sand	>50	55	9
BH14-18	0.90	1.40	Clay	7		
BH14-18	1.60	2.00	Clay	8		
BH14-18	2.30	2.70	Silt	>50		
BH14-19	0.80	1.40	Clay	7		
BH14-19	1.60	2.10	Clay	13	>100	
BH14-19	2.30	2.90	Clay	3	>100	23
BH14-19	3.00	3.60	Clay/Silt	4	>100	35

TABLE A3

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

SUMMARY OF IN SITU TESTING

Drillhole No.	Depth		Geological Unit	Standard Penetration Test (SPT)	Vane Shear Test	
	From (m)	To (m)		N Blows per Foot	Initial kPa	Reshear kPa
BH14-20	0.70	1.30	Sand	7		
BH14-20	1.50	1.90	Clay	5	>100	
BH14-20	2.20	2.60	Clay	5	>100	28
BH14-20	3.00	3.50	Clay	3	70	9
BH14-20	4.50	5.00	Clay	2	45	12
BH14-20	6.00	6.50	Clay	3	55	12
BH14-20	7.60	8.10	Clay	2	50	22
BH14-20	9.00	9.40	Clay	0	22	5
BH14-21	0.80	1.20	Sand	19		
BH14-21	1.50	2.10	Silt	10		
BH14-21	2.30	2.70	Clay	4		
BH14-21	3.00	3.40	Clay	2		
BH14-21	4.50	5.10	Silt	5		

Notes:

1. Blanks indicate no testing completed.
2. Site Investigation completed by TBT Engineering.
3. Geological units presented above are based on field observations provided on BH Logs by TBTE with changes based on lab testing results (identified in italics). BH Logs are in Draft and require updating to reflect lab testing restults.

TABLE A4

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

BOREHOLE SAMPLES LAB TESTING RESULTS

Drillhole No.	Sample No.	Sample Type	Geological Unit	Natural Moisture Content (%)	Atterberg Limits			Grain Size Distribution				
					LL (%)	PL (%)	PI (%)	Cobbles >75mm	Gravel (19mm-No.4)	Sand (No. 4-#200)	Silt (<No. 200)	Clay (< No. 200)
BH14-01	AS1	Auger	Sand									
BH14-01	SS2	Split Spoon	Sand									
BH14-02	AS1	Auger	Sand									
BH14-02	AS2	Auger	Clay									
BH13-03	AS1	Auger	Sand	26.2								
BH14-03	SS2	Split Spoon	*Silt* [4]	20.2				0.00	0.0	13.2	78.8	8.0
BH14-03	SS3	Split Spoon	Silt	25.7								
BH14-03	SS4	Split Spoon	Silt	27.2								
BH14-03	SS5	Split Spoon	Silt	22.1								
BH14-03	SS6	Split Spoon	Silt	22.3				0.00	0.0	5.6	62.4	32.0
BH14-04	AS1	Auger	Sand									
BH14-04	SS2	Split Spoon	Sand	20.1								
BH14-04	SS3	Split Spoon	Sand	20.4								
BH14-04	SS4	Split Spoon	Sand	21.4								
BH14-04	SS5	Split Spoon	Sand	23.3								
BH14-04	SS6	Split Spoon	Silt	23.6				0.00	0.0	6.3	73.7	20.0
BH14-04	SS7	Split Spoon	Silt	25.2								
BH14-04	SS8	Split Spoon	Sand	20.9								
BH14-05	AS1	Auger	Sand									
BH14-05	SS2	Split Spoon	Sand	19.1								
BH14-05	SS3	Split Spoon	Sand									
BH14-05	SS4	Split Spoon	Sand	15.8								
BH14-05	SS5	Split Spoon	Sand									
BH14-05	SS6	Split Spoon	Silt	18.9								
BH14-05	SS7	Split Spoon	Silt	23.5				0.00	0.0	1.1	83.9	15.0
BH14-05	SS8	Split Spoon	Silt	19.6								
BH14-05	SS9	Split Spoon	Silt	27.0				0.00	0.0	0.3	64.7	35.0
BH14-05	SS10	Split Spoon	Silt	25.5								
BH14-05	SS11	Split Spoon	Silt									
BH14-05	SS12	Split Spoon	Silt	14.1								
BH14-05	SS13	Split Spoon	Silt									
BH14-05	SS14	Split Spoon	Silt	13.5								
BH14-05	SS15	Split Spoon	Sand									
BH14-05	SS16	Split Spoon	Sand									
BH14-05	SS17	Split Spoon	Sand									
BH14-05	SS18	Split Spoon	Sand									
BH14-05	SS19	Split Spoon	Sand									

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TABLE A4

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

BOREHOLE SAMPLES LAB TESTING RESULTS

Drillhole No.	Sample No.	Sample Type	Geological Unit	Natural Moisture Content (%)	Atterberg Limits			Grain Size Distribution				
					LL (%)	PL (%)	PI (%)	Cobbles >75mm	Gravel (19mm-No.4)	Sand (No. 4-#200)	Silt (<No. 200)	Clay (< No. 200)
BH14-06	AS1	Auger	Sand									
BH14-06	SS2	Split Spoon	Sand	21.3								
BH14-06	SS3	Split Spoon	Sand	19.6								
BH14-06	SS4	Split Spoon	Sand	20.5								
BH14-06	SS5	Split Spoon	Silt	21.7				0.00	0.0	18.0	71.0	11.0
BH14-06	SS6	Split Spoon	Clay	32.3								
BH14-06	SS7	Split Spoon	Clay	27.1	25.0	19.1	6.0	0.00	0.0	1.0	54.0	45.0
BH14-06	SS8	Split Spoon	Silt	23.3								
BH14-06	SS9	Split Spoon	Silt	19.8								
BH14-07A	AS1	Auger	Sand									
BH14-07A	SS2	Split Spoon	Sand	15.8								
BH14-07A	SS3	Split Spoon	Sand	23.0				0.00	0.0	46.8	47.2	6.0
BH14-07A	SS4	Split Spoon	Sand	19.5								
BH14-07A	SS5	Split Spoon	Silt	25.7								
BH14-07A	SS6	Split Spoon	Clay	22.2								
BH14-07A	SS7	Split Spoon	Clay	46.2								
BH14-07A	SS8	Split Spoon	Clay	31.1								
BH14-07A	SS9	Split Spoon	Clay									
BH14-07A	SS10	Split Spoon	Clay									
BH14-07A	SS11	Split Spoon	Clay									
BH14-08	AS1	Auger	Clay	26.0								
BH14-08	SS2	Split Spoon	Clay	33.0				0.00	0.0	1.9	26.1	72.0
BH14-08	SS3	Split Spoon	Clay	35.7				0.00	0.0	1.9	26.1	72.0
BH14-08	SS4	Split Spoon	Clay	36.3	46.0	22.0	24.0					
BH14-08	SS5	Split Spoon	Clay	39.2								
BH14-08	SS6	Split Spoon	Clay	31.7								
BH14-08	SS7	Split Spoon	Clay	34.9								
BH14-08	SS8	Split Spoon	Clay									

TABLE A4

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

BOREHOLE SAMPLES LAB TESTING RESULTS

Drillhole No.	Sample No.	Sample Type	Geological Unit	Natural Moisture Content (%)	Atterberg Limits			Grain Size Distribution				
					LL (%)	PL (%)	PI (%)	Cobbles >75mm	Gravel (19mm-No.4)	Sand (No. 4-#200)	Silt (<No. 200)	Clay (< No. 200)
BH14-09A	AS1	Auger	Clay									
BH14-09A	SS2	Split Spoon	Clay									
BH14-09A	SS3	Split Spoon	Clay									
BH14-09A	SS4	Split Spoon	Clay									
BH14-09A	SS5	Split Spoon	Clay									
BH14-09A	SS6	Split Spoon	Clay									
BH14-09A	SS7	Split Spoon	Sand									
BH14-10A	AS1	Auger	Fill									
BH14-10A	AS2	Auger	Fill									
BH14-11	AS1	Auger	Sand									
BH14-11	SS2	Split Spoon	Silt									
BH14-11	SS3	Split Spoon	Clay									
BH14-11	SS4	Split Spoon	Clay									
BH14-11	SS5	Split Spoon	Clay									
BH14-11	SS6	Split Spoon	Clay									
BH14-11	SS7	Split Spoon	Clay									
BH14-11	SS8	Split Spoon	Clay									
BH14-11	SS9	Split Spoon	Clay									
BH14-11	SS10	Split Spoon	Clay									
BH14-12	AS1	Auger	Sand									
BH14-12	SS2	Split Spoon	Clay	39.1								
BH14-12	SS3	Split Spoon	Clay	45.7								
BH14-12	SS4	Split Spoon	Clay	41.8								
BH14-12	SS5	Split Spoon	Clay	32.0								
BH14-12	SS6	Split Spoon	Clay									
BH14-12	SS7	Split Spoon	Clay	31.3								
BH14-12	SS8	Split Spoon	Clay									
BH14-12	SS9	Split Spoon	Clay	16.1								

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TABLE A4

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

BOREHOLE SAMPLES LAB TESTING RESULTS

Drillhole No.	Sample No.	Sample Type	Geological Unit	Natural Moisture Content (%)	Atterberg Limits			Grain Size Distribution				
					LL (%)	PL (%)	PI (%)	Cobbles >75mm	Gravel (19mm-No.4)	Sand (No. 4-#200)	Silt (<No. 200)	Clay (< No. 200)
BH14-13	AS1	Auger	Clay									
BH14-13	SS2	Split Spoon	Clay									
BH14-13	SS3	Split Spoon	Clay									
BH14-13	SS4	Split Spoon	Clay									
BH14-13	SS5	Split Spoon	Clay									
BH14-13	SS6	Split Spoon	Clay									
BH14-13	SS7	Split Spoon	Clay									
BH14-13	SS8	Split Spoon	Clay									
BH14-13	SS9	Split Spoon	Sand									
BH14-14	AS1	Auger	Organics									
BH14-14	SS2	Split Spoon	Organics									
BH14-14	SS3	Split Spoon	Clay									
BH14-14	SS4	Split Spoon	Clay									
BH14-14	SS5	Split Spoon	Clay									
BH14-14	SS6	Split Spoon	Clay									
BH14-14	SS7	Split Spoon	Clay									
BH14-14	SS8	Split Spoon	Clay									
BH14-14	SS9	Split Spoon	Silt									
BH14-15	AS1	Auger	Organics									
BH14-15	SS2	Split Spoon	Sand									
BH14-15	SS3	Split Spoon	Sand									
BH14-15	SS4	Split Spoon	Clay									
BH14-15	SS5	Split Spoon	Clay									
BH14-15	SS6	Split Spoon	Clay									
BH14-15	SS7	Split Spoon	Clay									
BH14-15	SS8	Split Spoon	Clay									
BH14-15	SS9	Split Spoon	Silt									
BH14-15	SS10	Split Spoon	Silt									
BH14-15	SS11	Split Spoon	Clay									
BH14-15	SS12	Split Spoon	Clay									
BH14-15	SS13	Split Spoon	Silt									
BH14-15	SS14	Split Spoon	Silt									
BH14-15	SS15	Split Spoon	Silt									
BH14-17	AS1	Auger	Organics									
BH14-17	SS2	Split Spoon	Sand									
BH14-17	SS3	Split Spoon	Clay									
BH14-17	SS4	Split Spoon	Sand									
BH14-18	AS1	Auger	Sand									
BH14-18	SS2	Split Spoon	Clay									
BH14-18	SS3	Split Spoon	Clay									
BH14-18	SS4	Split Spoon	Silt									

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July 21, 2014

TABLE A4

TREASURY METALS
GOLIATH PROJECT

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

BOREHOLE SAMPLES LAB TESTING RESULTS

Drillhole No.	Sample No.	Sample Type	Geological Unit	Natural Moisture Content (%)	Atterberg Limits			Grain Size Distribution				
					LL (%)	PL (%)	PI (%)	Cobbles >75mm	Gravel (19mm-No.4)	Sand (No. 4-#200)	Silt (<No. 200)	Clay (< No. 200)
BH14-19	AS1	Auger	Organics									
BH14-19	SS2	Split Spoon	Clay									
BH14-19	SS3	Split Spoon	Clay									
BH14-19	SS4	Split Spoon	Clay									
BH14-19	SS5	Split Spoon	Clay/Silt									
BH14-20	AS1	Auger	Organics									
BH14-20	SS2	Split Spoon	Sand									
BH14-20	SS3	Split Spoon	Clay									
BH14-20	SS4	Split Spoon	Clay									
BH14-20	SS5	Split Spoon	Clay									
BH14-20	SS6	Split Spoon	Clay									
BH14-20	SS7	Split Spoon	Clay									
BH14-20	SS8	Split Spoon	Clay									
BH14-20	SS9	Split Spoon	Clay									
BH14-21	AS1	Auger	Sand									
BH14-21	SS2/3	Split Spoon	Sand to Silt	21.9/20.8								
BH14-21	SS4	Split Spoon	Silt	30.3								
BH14-21	SS5	Split Spoon	Clay	32.8								
BH14-21	SS6	Split Spoon	Clay	36.5								
BH14-21	SS7	Split Spoon	Silt	20.6								

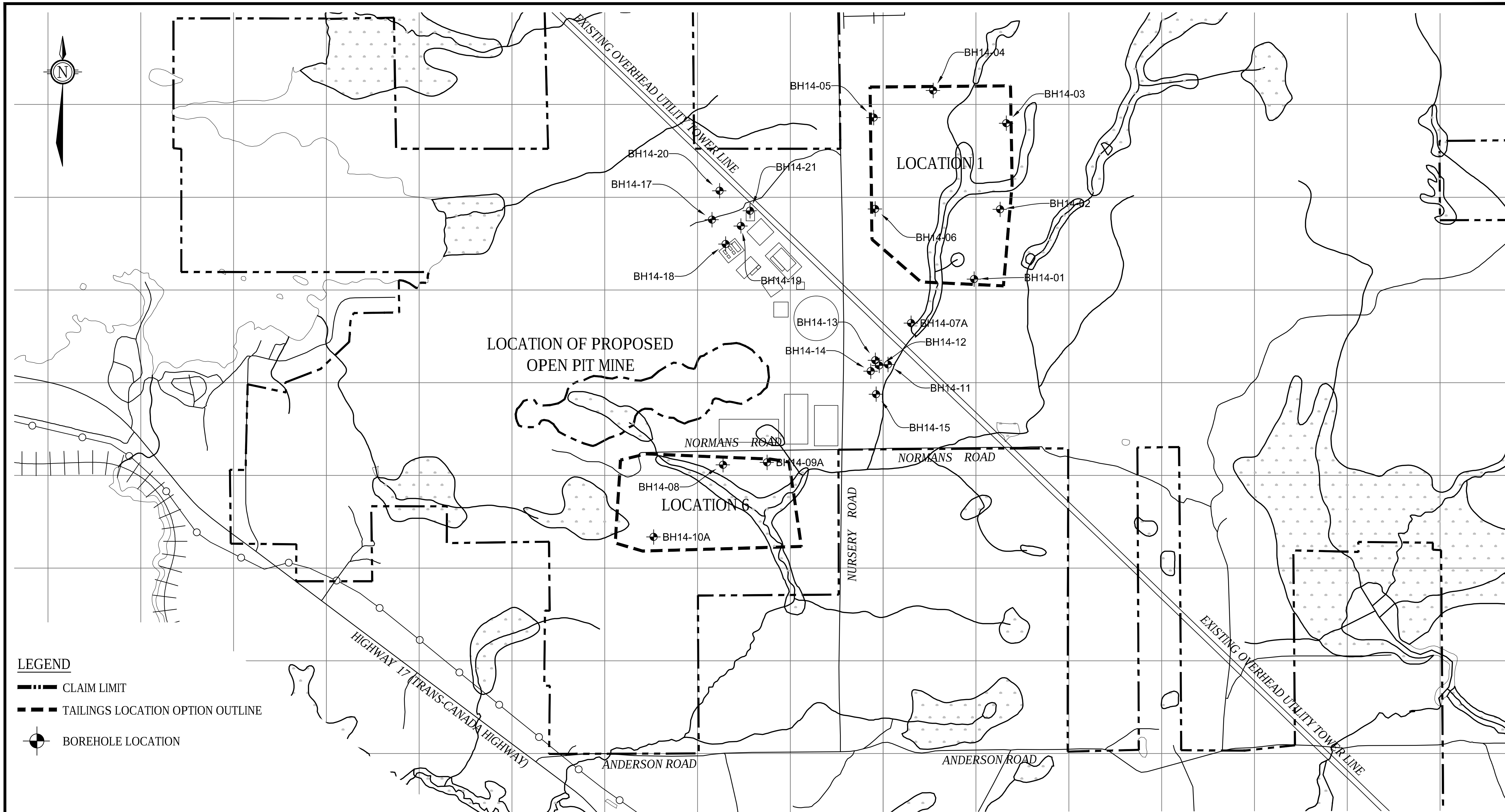
Notes:

1. Samples collected during 2014 Site Investigation.

2. Lab testing completed by TBT Engineering Limited Laboratory in Thunder Bay, ON.

3. Blanks indicate no testing completed.

4. Geological units presented above are based on field obervations provided on BH Logs by TBTE with changes based on lab testing results (identified in italics). BH Logs are in Draft and require updating to reflect lab testing restults.



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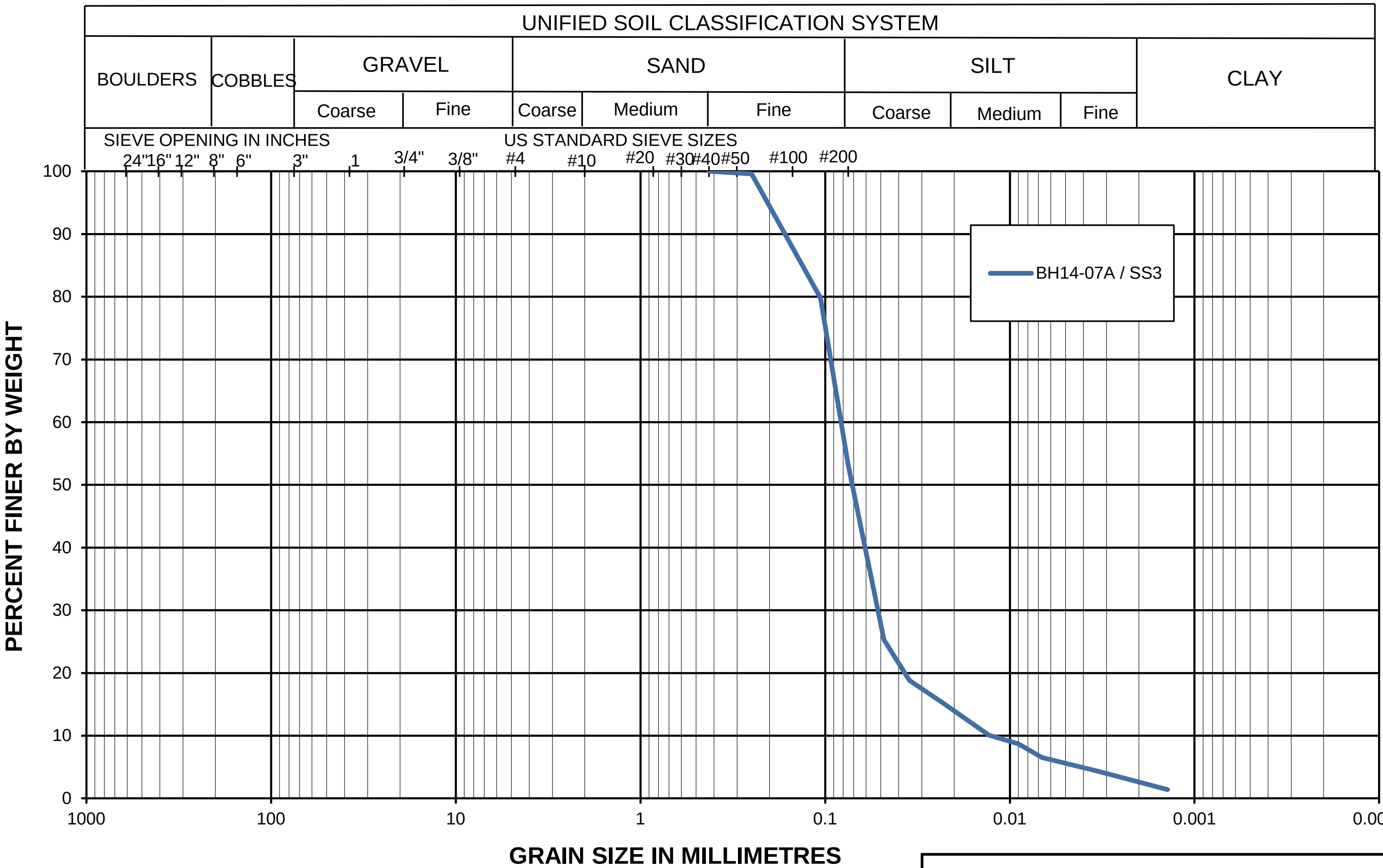
0 500 1000 metres

PROJECT:
TREASURY METALS - GOLIATH PROJECT
TAILINGS ALTERNATIVES ASSESSMENT

TITLE:
2014 SITE INVESTIGATION
BOREHOLE LOCATIONS

PROJECT NO:	141-12598-00
SCALE:	1:20000
DRAWN BY:	G. HOOGWERF
CHECKED BY:	B. PLUMRIDGE
ISSUE/REVISION:	FINAL 0
ISSUE DATE:	JULY 21, 2014
FIGURE NO:	FIGURE A1



Notes

1. Samples collected during 2014 site investigation program.
2. Lab testing completed by TBT Engineering in Thunder Bay, ON.

TREASURY METALS

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

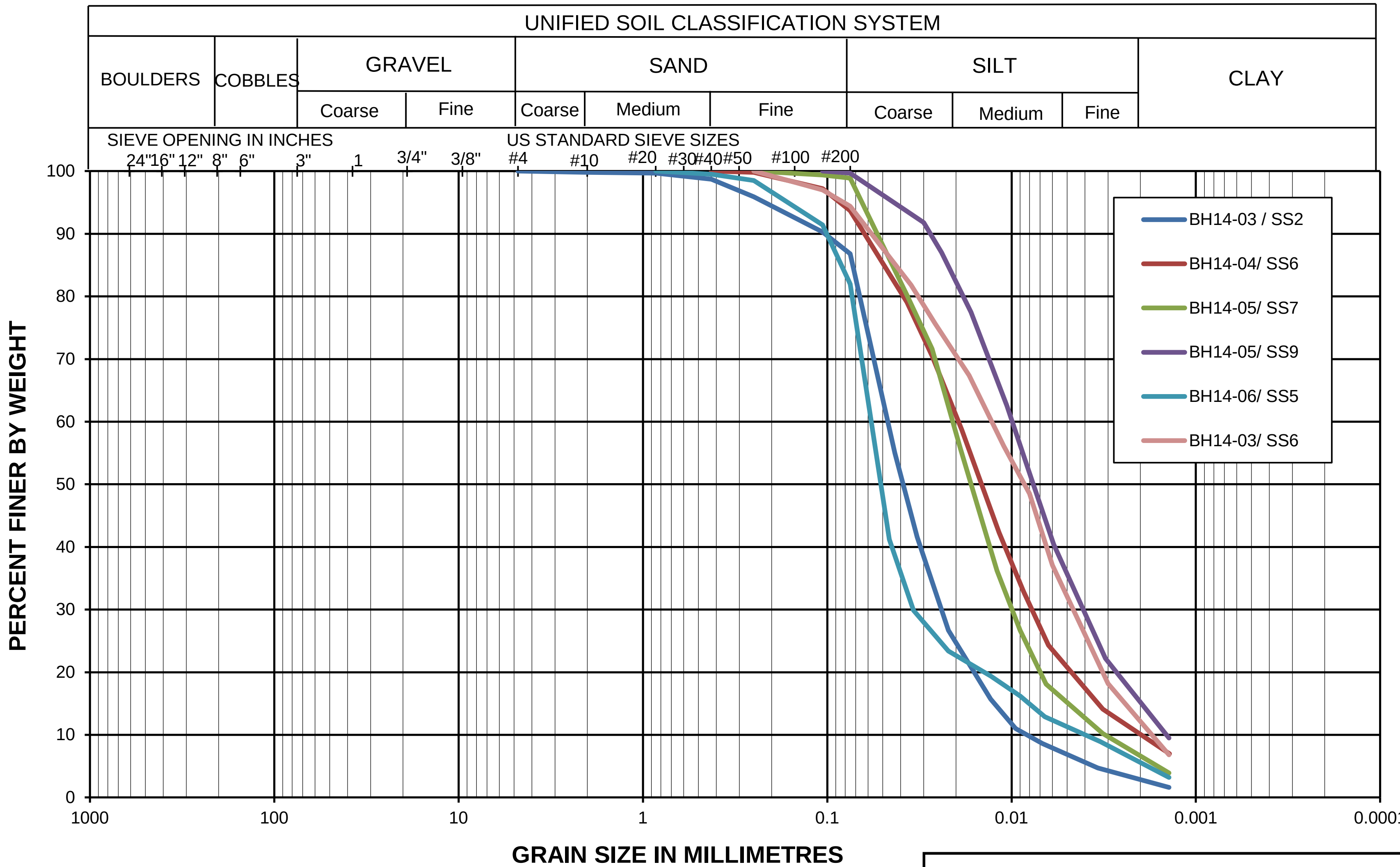
GRAIN SIZE RESULTS
SAND

WSP

141-12598-00

REV. 0

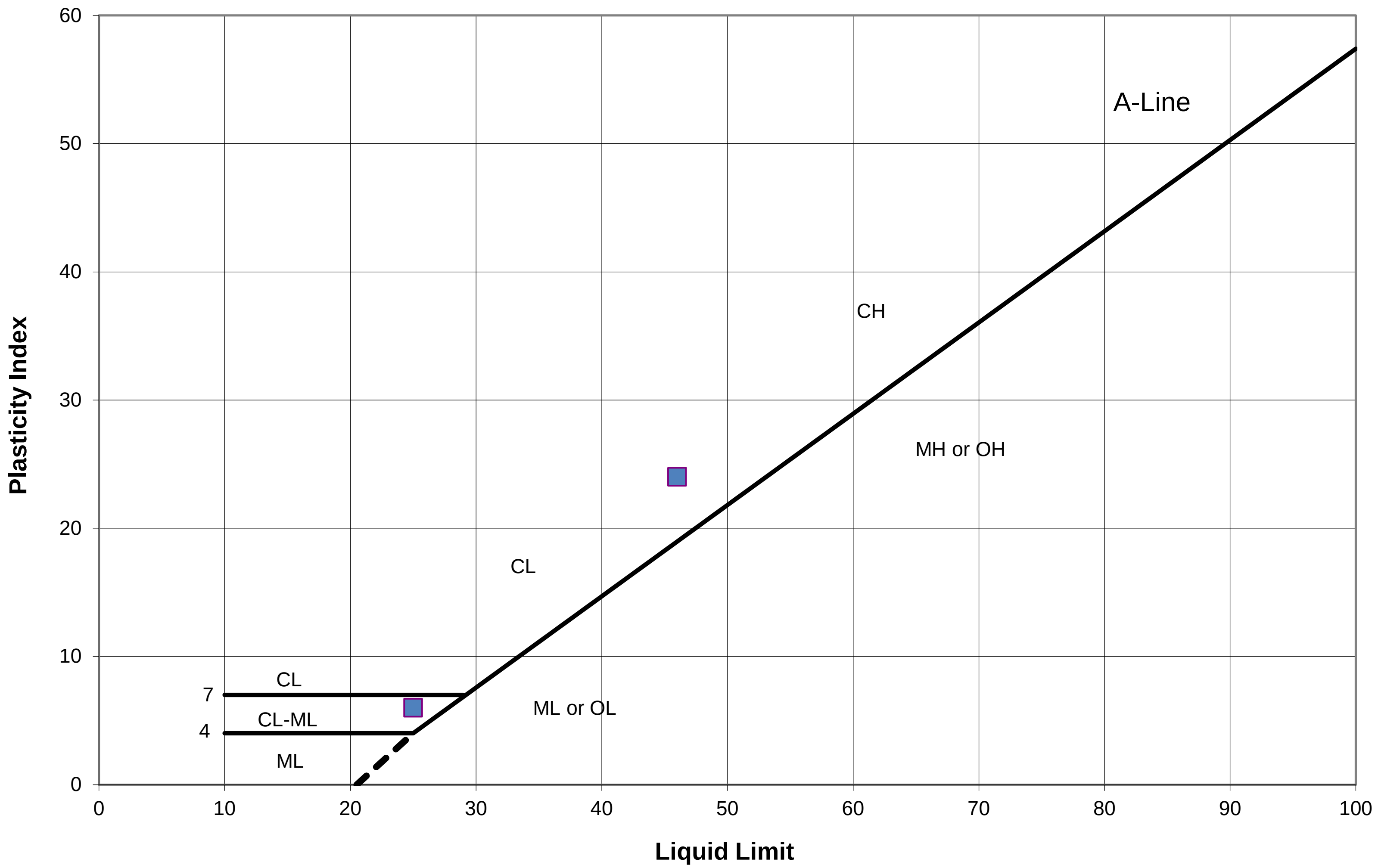
FIGURE A2



Notes

1. Samples collected during 2014 site investigation program.
2. Lab testing completed by TBT Engineering in Thunder Bay, ON.

TREASURY METALS	
2014 SITE INVESTIGATION **FACTUAL SOILS SUMMARY**	
GRAIN SIZE RESULTS **SILT**	
WSP	141-12598-00 — REV. 0
	FIGURE A3

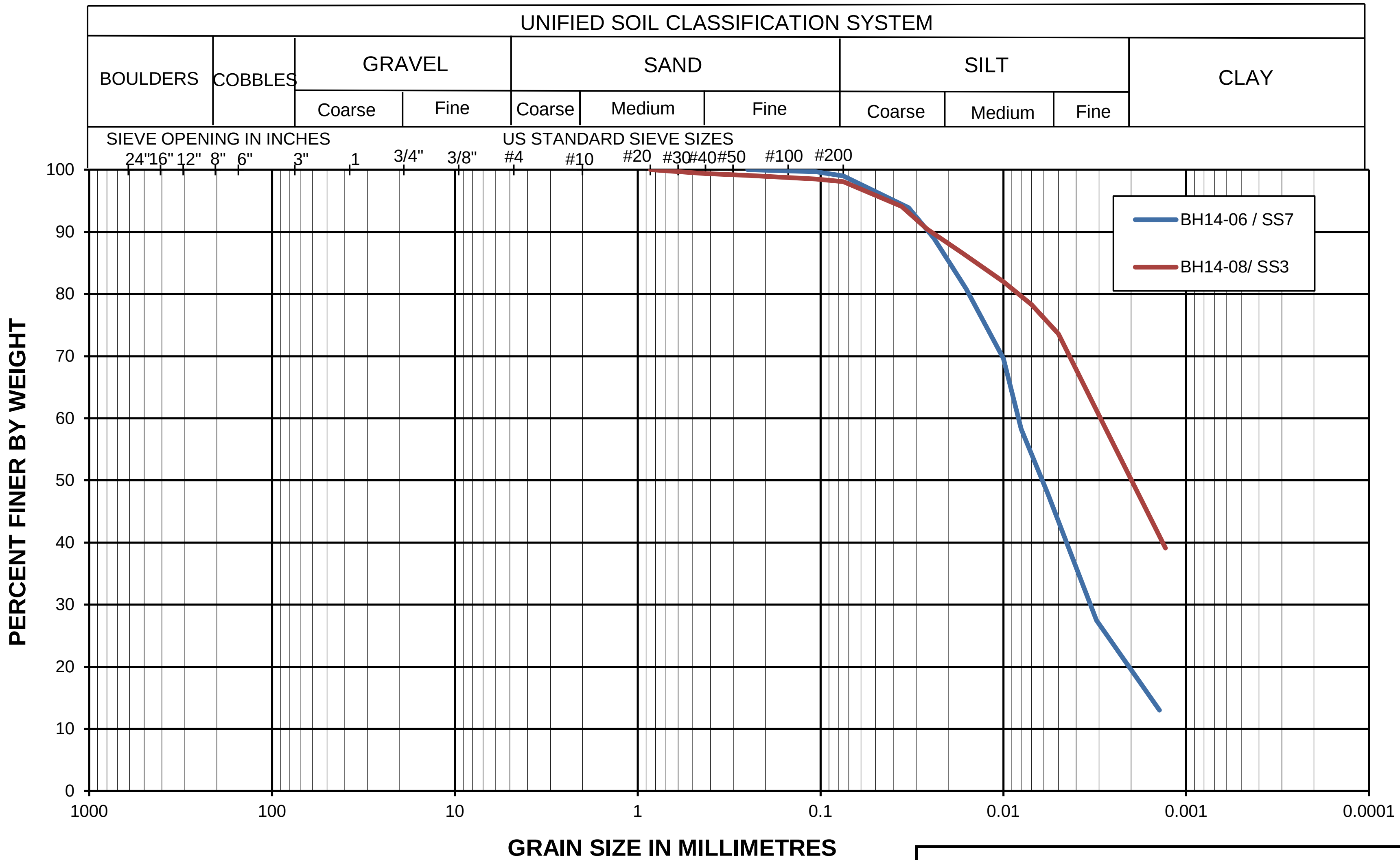


TREASURY METALS

2014 SITE INVESTIGATION

PLASTICITY CHART
CLAY

WSP	FIGURE A4	Project No. 141-12598-00	REV. 0



Notes

1. Samples collected during 2014 site investigation program.
2. Lab testing completed by TBT Engineering in Thunder Bay, ON.

TREASURY METALS

2014 SITE INVESTIGATION
FACTUAL SOILS SUMMARY

GRAIN SIZE RESULTS
CLAY

WSP

141-12598-00 | REV. 0

FIGURE A5

LOG OF BOREHOLE 14-01

TBT REF. No.: **14-035**
CLIENT: **Treasury Metals Incorporated**
PROJECT: **Goliath Project**
LOCATION: **Tree Nursery Road, Dryden, Ontario**

SURFACE ELEV.: **metres**
COORDINATES: **UTM 15 N 5512562 E 529491**
EQUIPMENT: **HS Auger**
DIAMETER: **80mm ID**
DATE: **2014 March 27**

DEPTH	ELEV.	DESCRIPTION	STRAT PLOT	% RECOVERY	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH SCALE	REMARKS
		ORGANICS, black							Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
		SAND, trace Silt, brown			AS1				
1		SAND, Silty, grey and brown			SS2	7		1	
2		End of Borehole @ 1.5 m. Auger refusal.						2	

Chart headings: CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100. PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60. GRAIN SIZE DISTRIBUTION (%) GR SA SI CL.

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 1

LOG OF BOREHOLE 14-02

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512932 E 529632**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 27**

SOIL PROFILE / SAMPLES / CPT (kPa) 300 600 900 1200 1500 (kPa) / FIELD SHEAR (kPa), Lab Shear (kPa), SPT (N), DCPT 0 20 40 60 80 100 / PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60

DEPTH	ELEV.	DESCRIPTION	STRAT PLOT	% RECOVERY	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH SCALE	REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		ORGANICS, black							Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
		SAND, trace Silt, brown			AS1				
		CLAY and SILT, grey			AS2				
1		End of Borehole @ 1.05 m. Auger and Split Spoon refusal.						1	
2								2	
3								3	
4								4	
5								5	
6								6	
7								7	
8								8	
9								9	
10								10	
11								11	
12								12	
13								13	
14								14	

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Web: www.tbte.ca

SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 2

LOG OF BOREHOLE 14-03

TBT REF. No.: **14-035**
CLIENT: **Treasury Metals Incorporated**
PROJECT: **Goliath Project**
LOCATION: **Tree Nursery Road**
Dryden, Ontario

SURFACE ELEV.: **metres**
COORDINATES: **UTM 15 N 5513400 E 529660**
EQUIPMENT: **HS Auger**
DIAMETER: **80mm ID**
DATE: **2014 March 26**

DEPTH (m)	SOIL PROFILE – DESCRIPTION	SAMPLE TYPE	"N" VALUES	GROUND WATER CONDITIONS
0.0	ORGANICS, black			Standpipe
0.1	SAND, some Silt, brown	AS1		Standpipe
		SS2	13	Standpipe
1.5	SILT and SAND, trace Clay, layered, grey	SS3	8	Standpipe
		SS4	7	Standpipe to 2.9 m
3.0	SILT, some Clay and Sand, grey	SS5	6	
4.5	SILT and CLAY, grey	SS6	5	
6.0	End of Borehole @ 6.0 m. Auger refusal.			

CPT (kPa): 300 600 900 1200 1500 (kPa)
× FIELD SHEAR (kPa) ⊗ Lab Shear (kPa)
■ SPT (N) ◆ DCPT
0 20 40 60 80 100

PLASTIC LIMIT w_P – NATURAL MOISTURE CONTENT w – LIQUID LIMIT w_L
WATER CONTENT (%): 20 40 60

REMARKS – GRAIN SIZE DISTRIBUTION (%): GR SA SI CL

Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing. Standpipe installed to 2.9 m.

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SAMPLE TYPE LEGEND

Code	Sample Type
AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

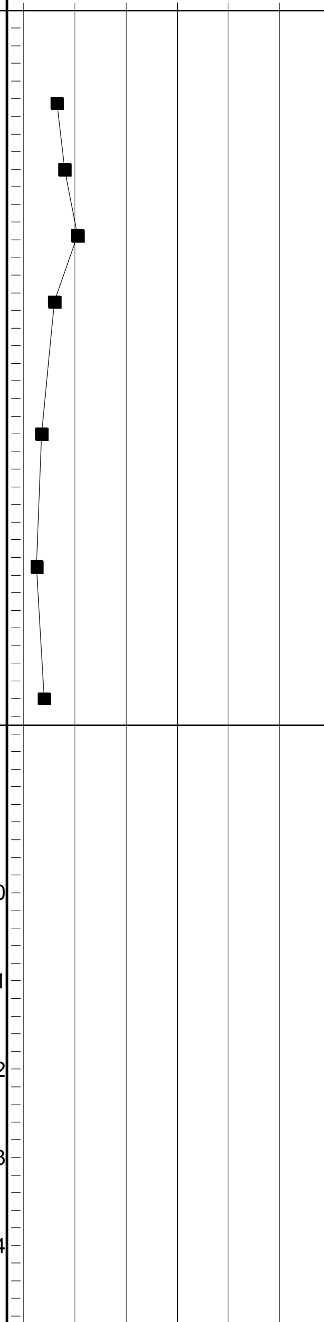
ENCLOSURE 3

LOG OF BOREHOLE 14-04

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5513576 E 529264**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 26**

DEPTH (m)	ELEV.	SOIL PROFILE – DESCRIPTION	SAMPLE TYPE	"N" VALUES	GROUND WATER CONDITIONS
0		ORGANICS, black			
		SAND, trace Silt, brown	AS1		
1		- - - - - - grey	SS2	13	
1.8			SS3	16	
2.5			SS4	21	
3.3			SS5	12	
4.5		SILT, trace Clay, grey	SS6	7	
6.0		SILT and SAND, trace Clay, grey	SS7	5	
7.5		SAND, trace Silt, grey	SS8	8	
8.1		End of Borehole @ 8.1 m. Auger refusal.			

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500; (kPa) ✕ FIELD SHEAR (kPa) ⊗ Lab Shear (kPa) ■ SPT (N) ◆ DCPT, 0 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L, WATER CONTENT (%) 20 40 60; REMARKS – GRAIN SIZE DISTRIBUTION (%) GR SA SI CL



REMARKS: Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

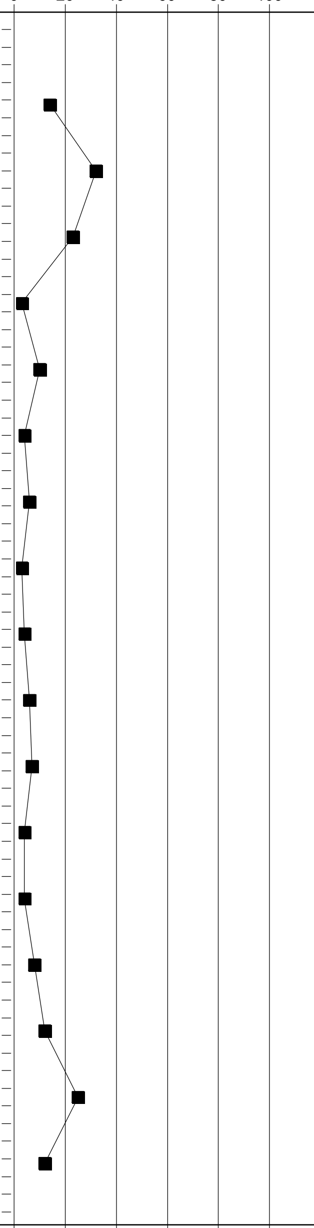
ENCLOSURE 4

LOG OF BOREHOLE 14-05

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5513425 E 528949**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 25**

Depth (m)	Soil Profile Description	Sample Type	"N" Values
0	ORGANCIS, roots, black		
	SAND, some Silt, brown	AS1	
1	SAND, Silty, grey	SS2	14
		SS3	32
		SS4	23
3		SS5	3
4	SILT, Sandy, grey	SS6	10
	SILT, trace Sand, grey	SS7	4
		SS8	6
6	SILT and CLAY, grey	SS9	3
	SILT, some Clay, grey	SS10	4
		SS11	6
		SS12	7
		SS13	4
		SS14	4
	SAND, Silty, grey	SS15	8
	SAND, trace Silt, grey	SS16	12
		SS17	25
		SS18	12
	- rock fragments in split spoon	SS19	>50
13.75	End of Borehole @ 13.75 m. Split spoon refusal.		

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa) ■ SPT (N) ◆ DCPT 0 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L, WATER CONTENT (%) 20 40 60; REMARKS, GRAIN SIZE DISTRIBUTION (%) GR SA SI CL



REMARKS: Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.

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SAMPLE TYPE LEGEND
- AS Auger Sample
- SS Split Spoon Sample
- TW 70mm Thin Wall Tube
- CC Concrete Core
- RC Rock Core
- PS Ponar Sample
- CB Core Barrel
- HS Hiller Sample
- AC Asphalt Core

NOTES:

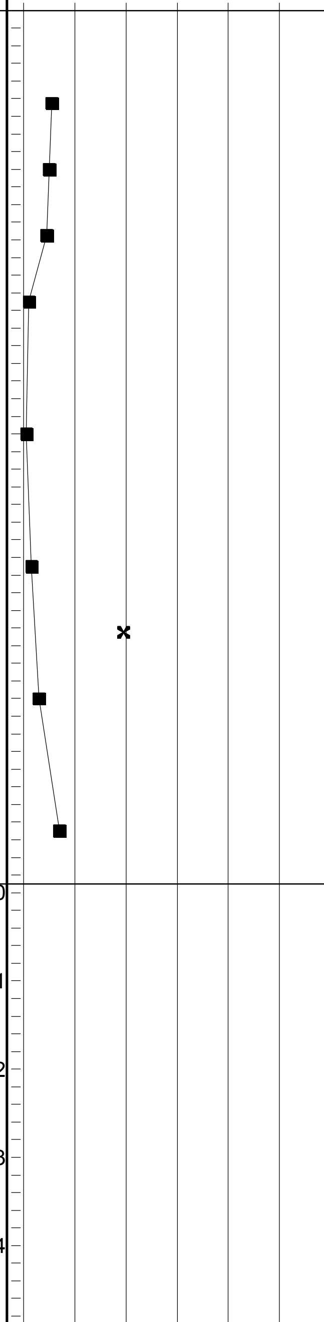
ENCLOSURE 5

LOG OF BOREHOLE 14-06

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512942 E 528957**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road Dryden, Ontario**	DIAMETER:	**80mm ID**
		DATE:	**2014 March 26**

Depth (m)	Elev.	Soil Profile – Description	Sample Type	"N" Values	Remarks
0		ORGANICS, black			Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
		SAND, some Silt, black	AS1		
0.75		SAND, trace Silt, brown	SS2	11	
			SS3	10	
			SS4	9	
3.0		SILT and CLAY, trace sand, layered - red clay and grey silt layers	SS5	2	
4.5		CLAY and SILT, layered - dark grey clay and light grey silt layers	SS6	1	
6.0		CLAY, grey	SS7	3	
					Remold shear vane test = 4 KPa
7.5		SILT, some Clay and Sand, layered, grey	SS8	6	
			SS9	14	
9.9		End of Borehole @ 9.9 m. Auger refusal.			

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT 0 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL



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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

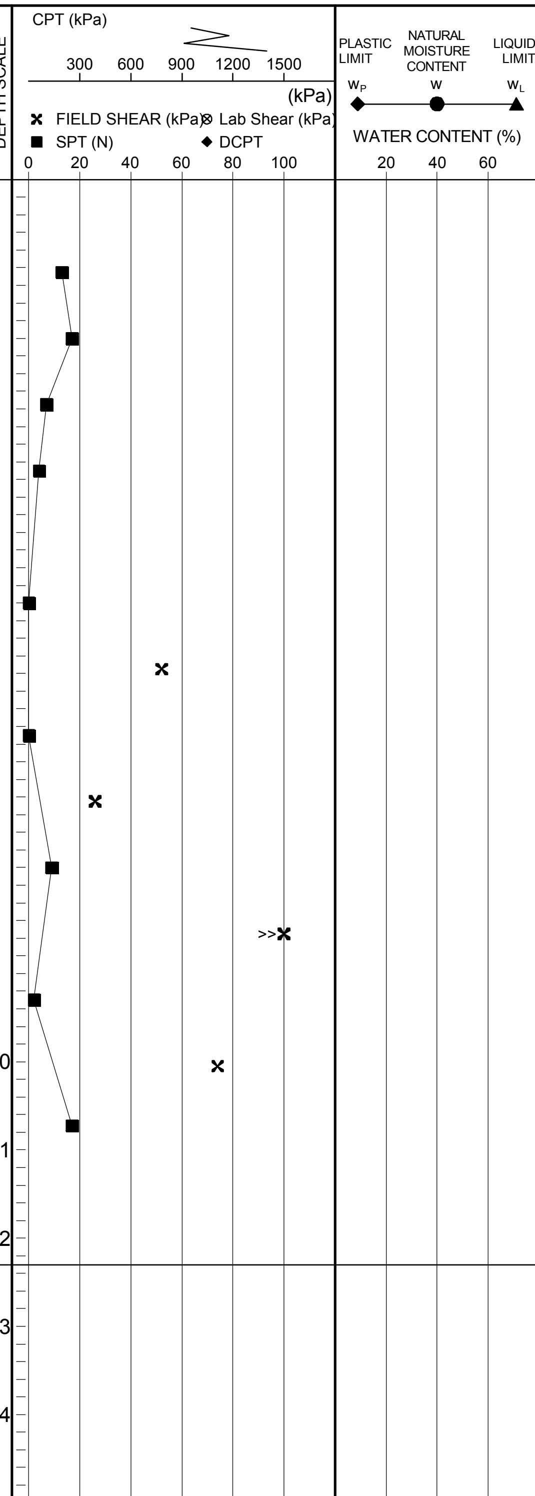
NOTES:

ENCLOSURE 6

LOG OF BOREHOLE 14-07A

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512321 E 529150**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 27**

Depth (m)	Soil Profile – Description	Sample Type	Sample No.	"N" Values	Remarks
0	ORGANICS, black				Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
	SAND, trace Silt, brown	AS	AS1		
1	- - - - - - grey	SS	SS2	13	
2		SS	SS3	17	
		SS	SS4	7	
3	SILT and CLAY, trace Sand, grey	SS	SS5	4	
4.5	CLAY, Silty, layered, grey	SS	SS6	0	
					Remold shear vane test = 4 KPa
		SS	SS7	0	
					Remold shear vane test = 9 KPa
		SS	SS8	9	
					Remold shear vane test = 37 KPa
		SS	SS9	2	
					Remold shear vane test = 9 Kpa
		SS	SS10A	17	
11	Clay, Silty, some gravel and rock fragments, grey	SS	SS10B		Rock fragments in split spoon sample (SS10B)
		SS	SS11	>50	
12.3	End of Borehole @ 12.3 m. Spoon and auger refusal.				



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SAMPLE TYPE LEGEND
AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

NOTES:

ENCLOSURE 7

LOG OF BOREHOLE 14-08

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5511549 E 528132**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road** **Dryden, Ontario**	DIAMETER:	**80mm ID**
		DATE:	**2014 April 2**

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Depth (m)	Description	Sample Type	"N" Value
0	ORGANICS, black		
	CLAY, brown and grey	AS1	
		SS2	4
		SS3	5
		SS4	6
		SS5	5
4.5	CLAY and SILT, layered, grey	SS6	4
6.0	Clay, grey	SS7	3
		SS8	2
9.0	End of Borehole @ 9.0 m. Auger refusal.		

Field shear: >> (beyond scale) at approx. 1.35 m, 2.1 m, 2.85 m, 5.5 m and 8.5 m; approx. 62 kPa at 7.0 m.

REMARKS:

Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.

Shear vanes attempted at 1.35 m, 2.1 m and 2.85 m, vane refused when pushing

Remold shear vane test = 47 KPa

Remold shear vane test = 12 KPa

No shear of vane during test.

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 8

LOG OF BOREHOLE 14-09A

TBT REF. No.: **14-035**
CLIENT: **Treasury Metals Incorporated**
PROJECT: **Goliath Project**
LOCATION: **Tree Nursery Road**
Dryden, Ontario

SURFACE ELEV.: **metres**
COORDINATES: **UTM 15 N 5511570 E 528374**
EQUIPMENT: **HS Auger**
DIAMETER: **80mm ID**
DATE: **2014 April 2**

SOIL PROFILE – DESCRIPTION	SAMPLES – TYPE	"N" VALUES	Field Shear (kPa)
ORGANICS, black			
CLAY, brown and grey	AS1		
	SS2	6	
	SS3	6	>>×
	SS4	7	
CLAY and SILT, red clay with grey silt seams			
CLAY and SILT, layered, grey	SS5	5	
	SS6	1	
			>>×
SAND, SILT, and CLAY, grey	SS7	6	
End of Borehole @ 7.5 m. Auger refusal.			

Column headings: DEPTH; ELEV.; DESCRIPTION; STRAT PLOT; % RECOVERY; TYPE; "N" VALUES; GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

REMARKS:

Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.

Remold shear vane test = 70 KPa

Remold shear vane test = 44 KPa

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SAMPLE TYPE LEGEND

AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

NOTES:

ENCLOSURE 9

LOG OF BOREHOLE 14-10A

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5511168 E 527763**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 April 3**

DEPTH	ELEV.	DESCRIPTION (SOIL PROFILE)	STRAT PLOT	% RECOVERY (SAMPLES)	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH SCALE	CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100	PLASTIC LIMIT w_P ◆ NATURAL MOISTURE CONTENT w ● LIQUID LIMIT w_L ▲; WATER CONTENT (%) 20 40 60	REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
		FILL - SAND, some Gravel, occasional cobbles			AS1						Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing. Borehole location appears to be on an old access road.
1					AS2			1			
		End of Borehole @ 1.35 m. Auger refusal.									
2								2			
3								3			
4								4			
5								5			
6								6			
7								7			
8								8			
9								9			
10								10			
11								11			
12								12			
13								13			
14								14			

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SAMPLE TYPE LEGEND

AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

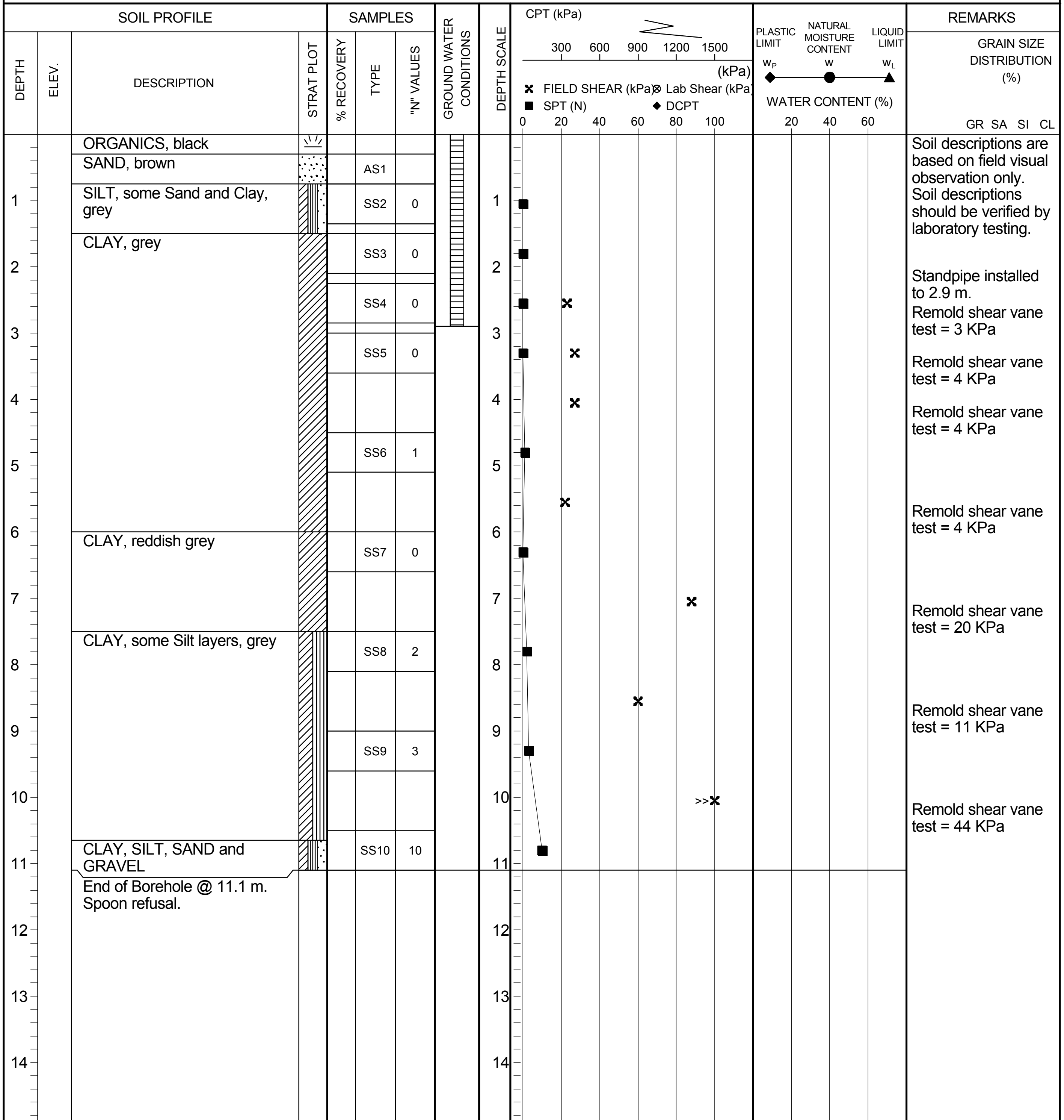
NOTES:

ENCLOSURE 10

LOG OF BOREHOLE 14-11

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512098 E 529026**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 30**

SOIL PROFILE: DESCRIPTION	SAMPLES: TYPE	"N" VALUES	REMARKS
ORGANICS, black			Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
SAND, brown	AS1		
SILT, some Sand and Clay, grey	SS2	0	
CLAY, grey	SS3	0	Standpipe installed to 2.9 m.
	SS4	0	Remold shear vane test = 3 KPa
	SS5	0	Remold shear vane test = 4 KPa
			Remold shear vane test = 4 KPa
	SS6	1	
			Remold shear vane test = 4 KPa
CLAY, reddish grey	SS7	0	
			Remold shear vane test = 20 KPa
CLAY, some Silt layers, grey	SS8	2	
			Remold shear vane test = 11 KPa
	SS9	3	
			Remold shear vane test = 44 KPa
CLAY, SILT, SAND and GRAVEL	SS10	10	
End of Borehole @ 11.1 m. Spoon refusal.			



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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 11

01A-2 STANDARD BH 14-035 TREASURY METALS DRYDEN.GPJ TBT.GDT 14/4/16

LOG OF BOREHOLE 14-12

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512093 E 528978**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 30**

SOIL PROFILE: DEPTH | ELEV. | DESCRIPTION | STRAT PLOT
SAMPLES: % RECOVERY | TYPE | "N" VALUES
GROUND WATER CONDITIONS | DEPTH SCALE
CPT (kPa) 300 600 900 1200 1500 (kPa)
× FIELD SHEAR (kPa) ⊗ Lab Shear (kPa)
■ SPT (N) ◆ DCPT
0 20 40 60 80 100
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) 20 40 60
REMARKS: GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Description	Sample Type	"N" Values	Remarks
ORGANICS, black			Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
SAND, brown	AS1		
CLAY, some Sand and Silt seams, brown and grey	SS2	3	
CLAY and SILT, layered, grey and brown	SS3	3	
	SS4	5	Soil did not shear on shear vane test. (field shear >>)
	SS5	4	Remold shear vane test = 33 KPa (field shear >>)
			Remold shear vane test = 58 KPa (field shear >>)
CLAY and SILT, layered, grey	SS6	2	
			Remold shear vane test = 14 KPa
	SS7	0	
			Remold shear vane test = 23 KPa
	SS8	1	
			Vane refused (field shear >>)
	SS9	10	
CLAY, SILT, SAND and GRAVEL, grey			
End of Borehole @ 9.6 m. Spoon refusal.			

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

01A-2 STANDARD BH 14-035 TREASURY METALS DRYDEN.GPJ TBT.GDT 14/4/16

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 12

LOG OF BOREHOLE 14-13

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512121 E 528957**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 31**

DEPTH (m)	DESCRIPTION	SAMPLE TYPE	"N" VALUES	FIELD SHEAR (kPa)	REMARKS
0	ORGANICS, black				Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
0.3	CLAY and SILT, layered, brown and grey	AS1			
1		SS2	1		
2		SS3	3	>>100	Remold shear vane test = 7 KPa
2.5		SS4	2	>>100	Remold shear vane test = 44 KPa
3	CLAY, grey	SS5	3	>>100	Remold shear vane test = 28 KPa
4				>>100	
4.5	CLAY, reddish grey	SS6	3		
5.5				~60	Remold shear vane test = 14 KPa
6	CLAY and SILT, layered, grey	SS7	2		
7				~55	Remold shear vane test = 11 KPa
8		SS8	1		
8.5				>>100	Remold shear vane test = 20 KPa
9	SAND, trace Silt, grey	SS9	5		
9.6	End of Borehole @ 9.6 m. Refusal not achieved.				Client instructed TBTE to cease drilling this borehole at 9.0m if refusal was not achieved.

Chart columns: CPT (kPa) 300 600 900 1200 1500; × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100. PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60. GRAIN SIZE DISTRIBUTION (%) GR SA SI CL.

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SAMPLE TYPE LEGEND
AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

NOTES:

ENCLOSURE 13

LOG OF BOREHOLE 14-14

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512062 E 528933**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 31**

DEPTH	DESCRIPTION	TYPE	"N" VALUES	FIELD SHEAR (kPa)	REMARKS
0	ORGANICS, black	AS1			Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
1	- - - - - - frozen	SS2	2		
1.5	CLAY, grey	SS3	2		
		SS4	2	>>	Remold shear vane test = 65 KPa
3	CLAY, some Silt seams, grey	SS5	3	>>	Remold shear vane test = 23 KPa
4.5	CLAY, reddish grey	SS6	0		
6	CLAY, grey	SS7	1		Remold shear vane test = 9 KPa
		SS8	1	>>	Remold shear vane test = 70 KPa
9	SILT and SAND, some Clay	SS9	>50		
9.15	End of Borehole @ 9.15 m. Spoon refusal.				

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500; × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT (0 20 40 60 80 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; REMARKS, GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

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SAMPLE TYPE LEGEND
AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

NOTES:

ENCLOSURE 14

LOG OF BOREHOLE 14-15

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5511938 E 528962**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 29**

DEPTH (m)	ELEV.	SOIL PROFILE – DESCRIPTION	SAMPLE TYPE	"N" VALUES	REMARKS
0.0		ORGANICS, frozen, black	AS1		Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
0.75		SAND, some ORGANICS, trace Silt, grey	SS2	2	
			SS3	5	
2.25		CLAY, reddish grey, occasional Silt seams	SS4	0	
			SS5	0	Remold shear vane test = 5 KPa
					Remold shear vane test = 7 KPa
			SS6	0	
					Remold shear vane test = 5 KPa
			SS7	0	
					Remold shear vane test = 15 KPa
			SS8	1	
					Remold shear vane test = 8 KPa
9.0		SILT, grey	SS9	12	
10.5		SILT, some Clay seams, grey	SS10	2	
12.0		CLAY. grey	SS11	1	
					Remold shear vane test = 14 KPa
			SS12	1	
					Remold shear vane

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100; PLASTIC LIMIT W_P – NATURAL MOISTURE CONTENT W – LIQUID LIMIT W_L; WATER CONTENT (%) 20 40 60; REMARKS – GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 15

LOG OF BOREHOLE 14-15

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5511938 E 528962**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road Dryden, Ontario**	DIAMETER:	**80mm ID**
		DATE:	**2014 March 29**

Legend: CPT (kPa) 300 600 900 1200 1500; × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100. PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60. REMARKS: GRAIN SIZE DISTRIBUTION (%) GR SA SI CL.

DEPTH (m)	ELEV.	DESCRIPTION	% RECOVERY	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS
~15.3–16.5		SILT, grey		SS13	1		test = 16 KPa
16.5–18.6		SILT and CLAY, layered, grey		SS14	2		
							No soil shear on vane test. (Field shear >>100 kPa at ~17.5 m)
				SS15	13		
18.6		End of Borehole @ 18.6 m. Spoon refusal.					

Depth scale: 16 – 29 m

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SAMPLE TYPE LEGEND
AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

NOTES:

ENCLOSURE 16

LOG OF BOREHOLE 14-17

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512879 E 528077**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 28**

DEPTH (m)	ELEV.	DESCRIPTION	SAMPLE TYPE	"N" VALUES	REMARKS
0–0.7		ORGANICS, black	AS1		Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
0.7–1.4		SAND, trace Silt, brown	SS2	9	
1.4–2.5		CLAY, some Silt, grey	SS3	2	
2.5–2.7		SAND, some Clay, Silt and Gravel, grey	SS4	>50	Remold shear vane test = 9 KPa
		End of Borehole @ 2.7 m. Auger refusal.			

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa) 300 600 900 1200 1500 (kPa); × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa) ■ SPT (N) ◆ DCPT 0 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L, WATER CONTENT (%) 20 40 60; REMARKS, GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

ENCLOSURE 17

LOG OF BOREHOLE 14-18

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512748 E 528151**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 28**

SOIL PROFILE | SAMPLES | GROUND WATER CONDITIONS | DEPTH SCALE | CPT (kPa) 300 600 900 1200 1500; × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT; 0 20 40 60 80 100 | PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 20 40 60 | REMARKS: GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

DEPTH	ELEV.	DESCRIPTION	STRAT PLOT	% RECOVERY	TYPE	"N" VALUES	GROUND WATER CONDITIONS	DEPTH SCALE	REMARKS
		ORGANICS, black							Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
		SAND, trace Silt, brown			AS1				
1		CLAY and SILT, layered, grey			SS2	7		1	
2					SS3	8		2	
		SILT, trace Sand and Clay, grey			SS4	>50			
3		End of Borehole @ 2.7 m. Auger refusal.						3	

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

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SAMPLE TYPE LEGEND
AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

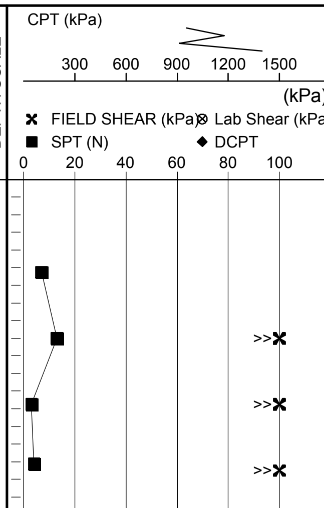
NOTES:

ENCLOSURE 18

LOG OF BOREHOLE 14-19

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512845 E 528233**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 28**

DEPTH	ELEV.	DESCRIPTION	TYPE	"N" VALUES
0		ORGANICS and SAND, brown	AS1	
0.6		CLAY and SILT, layered, grey	SS2	7
			SS3	13
2.3		CLAY. grey	SS4	3
			SS5A	4
3.5		SILT, some Sand and Clay	SS5B	
3.75		End of Borehole @ 3.75 m. Auger refusal.		



PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60

REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.

No soil shear on vane test.

Remold shear vane test = 23 KPa

remold shear vane teast = 35 KPa

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

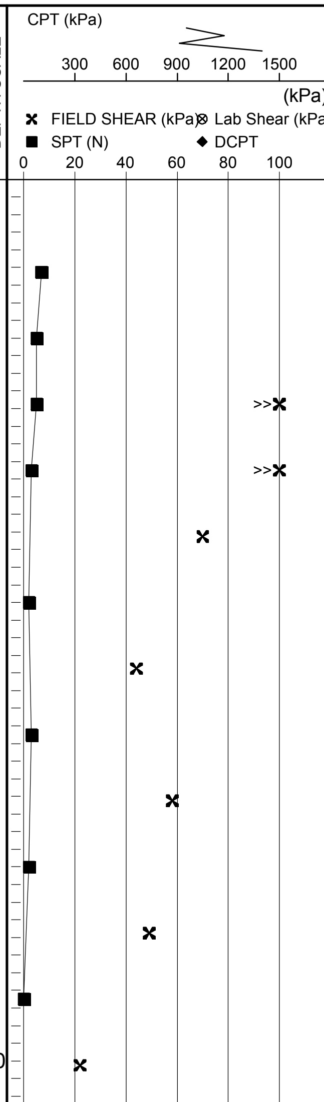
ENCLOSURE 19

LOG OF BOREHOLE 14-20

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5513035 E 528118**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 28**

DEPTH	ELEV.	DESCRIPTION (SOIL PROFILE)	SAMPLE TYPE	"N" VALUES	REMARKS
0		ORGANICS, roots, black	AS1		Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.
1		SAND, trace SIlt, brown	SS2	7	
1.5		CLAY and SILT, layered, grey and brown	SS3	5	
			SS4	5	No soil shear in vane test.
			SS5	3	Remold shear vane test = 28 KPa
					Remold shear vane test = 9 KPa
			SS6	2	
					Remold shear vane test = 12 KPa
			SS7	3	
					Remold shear vane test = 12 KPa
			SS8	2	
					Remold shear vane test = 22 KPa
			SS9	0	
					Remold shear vane test = 5 KPa
10.5		End of Borehole @ 10.5 m. Spoon and auger refusal.			

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE; CPT (kPa); PLASTIC LIMIT w_P – NATURAL MOISTURE CONTENT w – LIQUID LIMIT w_L, WATER CONTENT (%) 20 40 60; REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI CL



Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

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SAMPLE TYPE LEGEND

AS	Auger Sample
SS	Split Spoon Sample
TW	70mm Thin Wall Tube
CC	Concrete Core
RC	Rock Core
PS	Ponar Sample
CB	Core Barrel
HS	Hiller Sample
AC	Asphalt Core

NOTES:

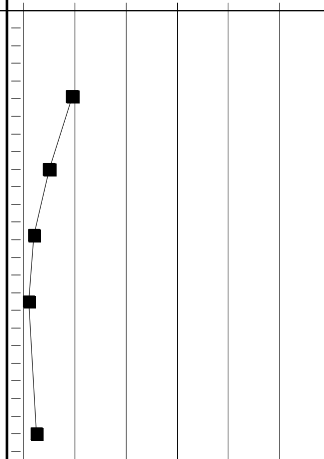
ENCLOSURE 20

LOG OF BOREHOLE 14-21

TBT REF. No.:	**14-035**	SURFACE ELEV.:	**metres**
CLIENT:	**Treasury Metals Incorporated**	COORDINATES:	**UTM 15 N 5512927 E 528282**
PROJECT:	**Goliath Project**	EQUIPMENT:	**HS Auger**
LOCATION:	**Tree Nursery Road**	DIAMETER:	**80mm ID**
	Dryden, Ontario	DATE:	**2014 March 28**

DESCRIPTION	SAMPLE TYPE	"N" VALUES
ORGANICS, black		
SAND, trace Silt, brown	AS1	
	SS2A	19
SAND, some Silt, grey	SS2B	
SILT, trace Clay and Sand	SS4	10
CLAY and SILT, layered, grey	SS5	4
	SS6	2
SILT, trace Sand, grey	SS7	5
End of Borehole @ 5.1 m. Auger refusal.		

Column headings: SOIL PROFILE (DEPTH, ELEV., DESCRIPTION, STRAT PLOT); SAMPLES (% RECOVERY, TYPE, "N" VALUES); GROUND WATER CONDITIONS; DEPTH SCALE (0–14 m); CPT (kPa) 300 600 900 1200 1500; × FIELD SHEAR (kPa) ⊗ Lab Shear (kPa); ■ SPT (N) ◆ DCPT 0 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 20 40 60; REMARKS: GRAIN SIZE DISTRIBUTION (%) GR SA SI CL



REMARKS: Soil descriptions are based on field visual observation only. Soil descriptions should be verified by laboratory testing.

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SAMPLE TYPE LEGEND

AS Auger Sample
SS Split Spoon Sample
TW 70mm Thin Wall Tube
CC Concrete Core
RC Rock Core
PS Ponar Sample
CB Core Barrel
HS Hiller Sample
AC Asphalt Core

NOTES:

ENCLOSURE 21

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Natural Moisture Content Determination

Client:	Treasury Metals	TBTE Project No.:	14-048
Client Project No.:	Goliath Project	Tested By/Date:	F. Valela / April 22, 2014
Project Description:	Tailings Storage Facility	Reported By:	Forch Valela
Report To:	Mark Wheeler	Reviewed By:	Forch Valela FV

Lab No.	BH / TP No.	Sample No.	Depth (m)	Moisture	Remarks
14-915	**BH 3**	AS 1	**0.5**	**26.7**	
14-916	**BH 3**	SS 2	**0.8**	**20.2**	
14-917	**BH 3**	SS 3	**1.5**	**25.7**	
14-918	**BH 3**	SS 4	**2.3**	**27.2**	
14-919	**BH 3**	SS 5	**3.0**	**22.1**	
14-920	**BH 3**	SS 6	**4.5**	**22.3**	
14-921	**BH 4**	SS 2	**0.8**	**20.1**	
14-922	**BH 4**	SS 3	**1.5**	**20.4**	
14-923	**BH 4**	SS 4	**2.3**	**21.4**	
14-924	**BH 4**	SS 5	**3.0**	**23.3**	
14-925	**BH 4**	SS 6	**4.5**	**23.6**	
14-926	**BH 4**	SS 7	**6.0**	**25.2**	
14-927	**BH 4**	SS 8	**7.5**	**20.9**	
14-928	**BH 5**	SS 2	**0.8**	**19.1**	
14-929	**BH 5**	SS 4	**2.3**	**15.8**	
14-930	**BH 5**	SS 6	**3.8**	**18.9**	
14-931	**BH 5**	SS 7	**4.5**	**23.5**	
14-932	**BH 5**	SS 8	**5.3**	**19.6**	
14-933	**BH 5**	SS 9	**6.0**	**27.0**	
14-934	**BH 5**	SS 10	**6.8**	**25.5**	
14-935	**BH 5**	SS 12	**8.3**	**14.1**	
14-936	**BH 5**	SS 14	**9.8**	**13.5**	
14-937	**BH 6**	SS 2	**0.8**	**21.3**	
14-938	**BH 6**	SS 3	**1.5**	**19.6**	
14-939	**BH 6**	SS 4	**2.3**	**20.5**	
14-940	**BH 6**	SS 5	**3.0**	**21.7**	
14-941	**BH 6**	SS 6	**4.5**	**32.3**	
14-942	**BH 6**	SS 7	**6.0**	**27.1**	
14-943	**BH 6**	SS 8	**7.5**	**23.3**	
14-944	**BH 6**	SS 9	**9.0**	**19.8**	
14-945	**BH 7A**	SS 2	**0.8**	**15.8**	
14-946	**BH 7A**	SS 3	**1.5**	**23.0**	
14-947	**BH 7A**	SS 4	**2.3**	**19.5**	
14-948	**BH 7A**	SS 5	**3.0**	**25.7**	
14-949	**BH 7A**	SS 6	**4.5**	**22.2**	
14-950	**BH 7A**	SS 7	**6.0**	**46.2**	
14-951	**BH 7A**	SS 8	**7.5**	**31.1**	

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Natural Moisture Content Determination

Client:	Treasury Metals	TBTE Project No.:	14-048
Client Project No.:	Goliath Project	Tested By/Date:	F. Valela / April 22, 2014
Project Description:	Tailings Storage Facility	Reported By:	Forch Valela
Report To:	Mark Wheeler	Reviewed By:	Forch Valela

Lab No.	BH / TP No.	Sample No.	Depth (m)	Moisture	Remarks
14-952	**BH 8**	SS 2	**0.8**	**26.0**	
14-953	**BH 8**	SS 3	**1.5**	**33.0**	
14-954	**BH 8**	SS 4	**2.3**	**35.7**	
14-955	**BH 8**	SS 5	**3.0**	**36.3**	
14-956	**BH 8**	SS 6	**4.5**	**39.2**	
14-957	**BH 8**	SS 7	**6.0**	**31.7**	
14-958	**BH 8**	SS 8	**7.5**	**34.9**	
14-959	**BH 12**	SS 2	**0.8**	**39.1**	
14-960	**BH 12**	SS 3	**1.5**	**45.7**	
14-961	**BH 12**	SS 4	**2.3**	**41.8**	
14-962	**BH 12**	SS 5	**3.0**	**32.0**	
14-963	**BH 12**	SS 7	**6.0**	**31.3**	
14-964	**BH 12**	SS 9	**9.0**	**16.1**	
14-965	**BH 21**	SS 2A	**0.8**	**21.9**	
14-966	**BH 21**	SS 2B	**1.2**	**20.8**	
14-967	**BH 21**	SS 3	**1.5**	**30.3**	
14-968	**BH 21**	SS 4	**2.4**	**32.8**	
14-969	**BH 21**	SS 5	**3.0**	**36.5**	
14-970	**BH 21**	SS 6	**4.5**	**20.6**	

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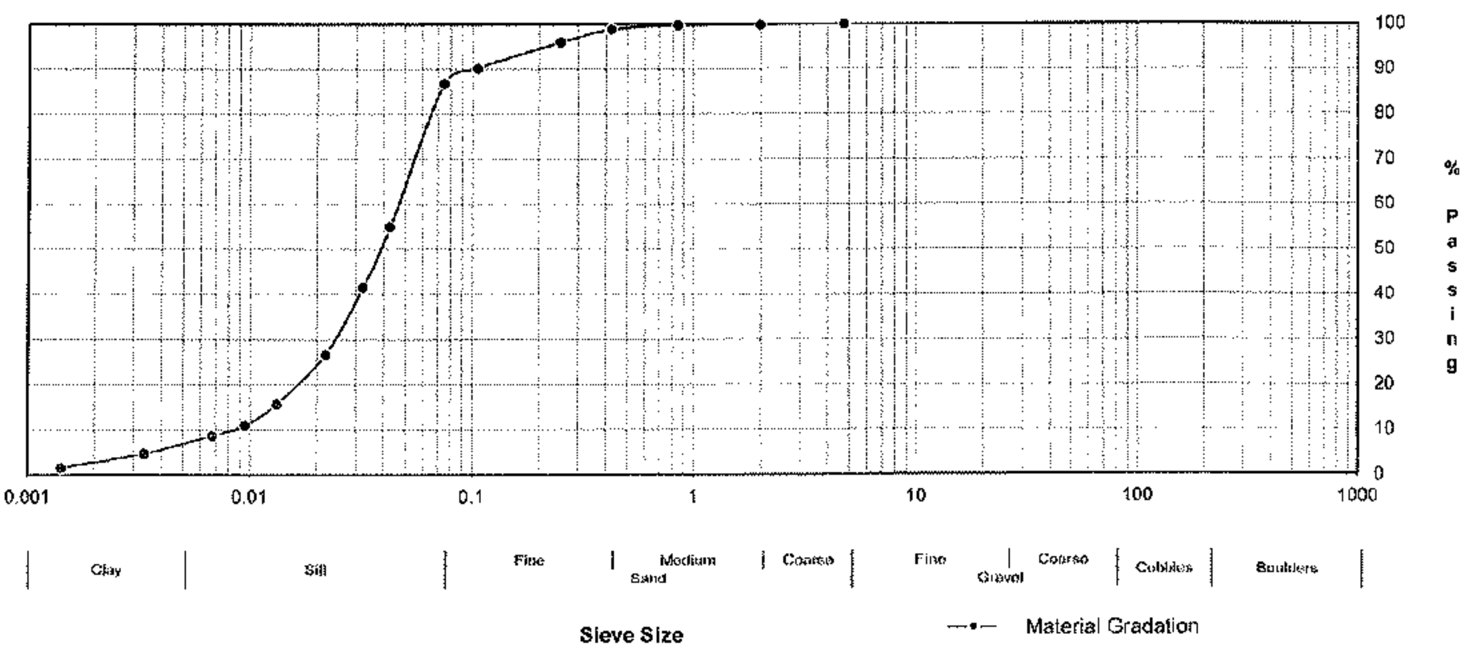
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-916
Location:	Tailings Storage Facility	Sample Location	BH 3 SS 2 0.75m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis		Hydrometer Analysis	
Sieve (mm)	% Passing	Diameter (mm)	% Finer
100			
50.0			
37.5		$0.042960	55.0
25.0		$0.032480	41.6
19.0		$0.021933	26.7
13.2		$0.013223	15.7
9.5		$0.009515	11.0
4.75	100.0	$0.006786	8.6
2.00	99.8	$0.003350	4.7
0.850	99.7	$0.001420	1.6
0.425	98.7		
0.250	95.9	5 µm	8.0
0.106	90.3	2 µm	2.0
0.075	86.8		

Grain Size Analysis



%Gravel		% Silt	78.8	% NMC	20.2	Frost Heave Susc.		Material Suitability	
% Sand	13.2	% Clay	8.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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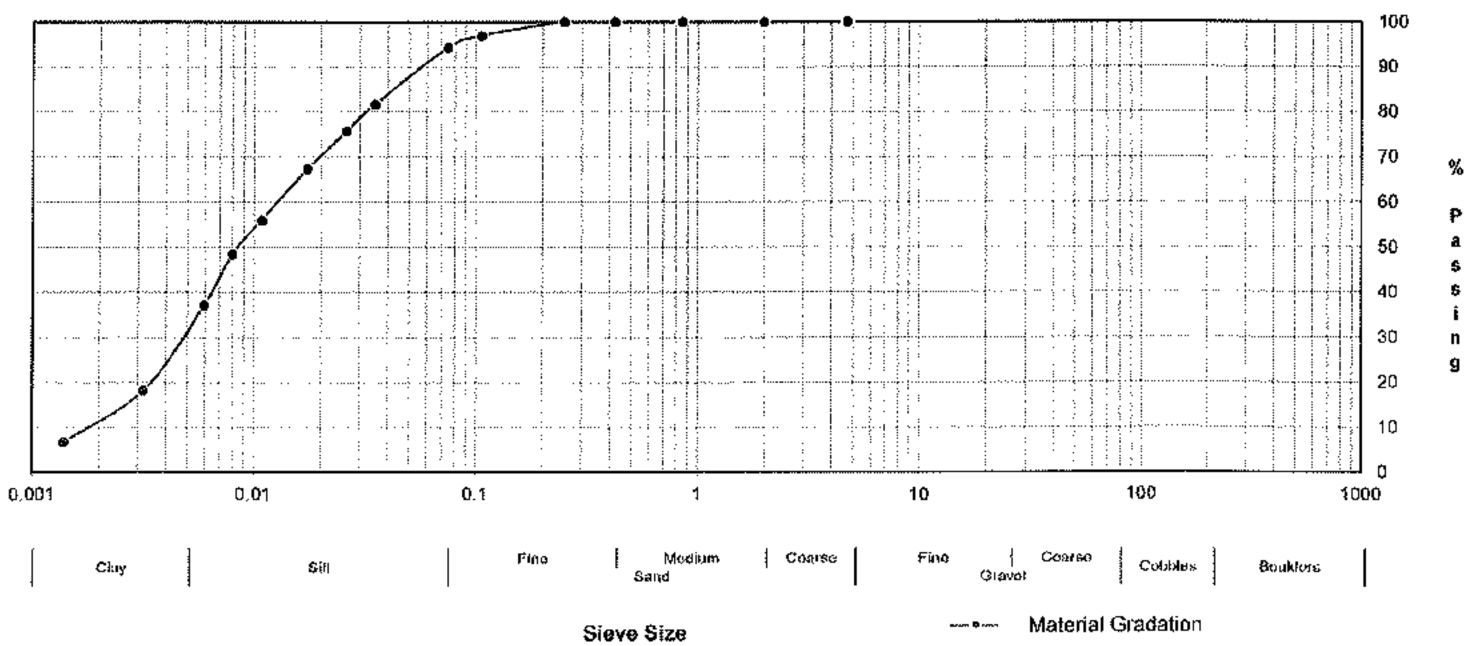
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-920
Location:	Tailings Storage Facility	Sample Location	BH 3 SS 6 4.5m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis: Sieve (mm)	% Passing	Hydrometer Analysis: Diameter (mm)	% Finer
100			
50.0			
37.5		$0.035058	81.8
25.0		$0.025999	75.7
19.0		$0.017440	67.4
13.2		$0.010805	56.1
9.5		$0.007968	48.5
4.75	100.0	$0.005965	37.1
2.00	100.0	$0.003174	18.2
0.850	100.0	$0.001390	6.8
0.425	100.0		
0.250	100.0	5 µm	32.0
0.106	97.0	2 µm	11.0
0.075	94.4		

Grain Size Analysis



%Gravel		% Silt	62.4	% NMC	22.3	Frost Heave Susc.		Material Suitability	
% Sand	5.6	% Clay	32.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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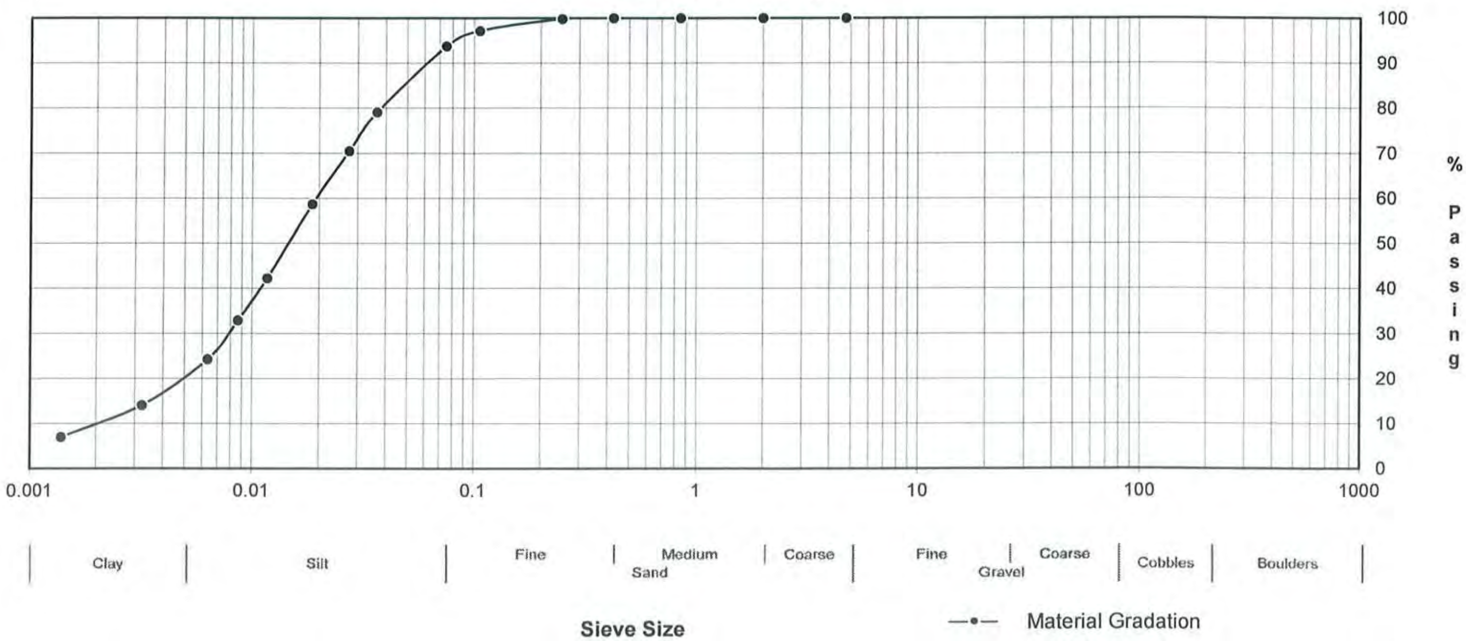
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-925
Location:	Tailings Storage Facility	Sample Location	BH 4 SS 6 4.5m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela AV

Sieve Analysis: Sieve (mm)	% Passing	Hydrometer Analysis: Diameter (mm)	% Finer
100			
50.0			
37.5		$0.036512	79.1
25.0		$0.027405	70.5
19.0		$0.018614	58.7
13.2		$0.011704	42.3
9.5		$0.008639	32.9
4.75	100.0	$0.006335	24.3
2.00	100.0	$0.003230	14.1
0.850	100.0	$0.001389	7.0
0.425	100.0		
0.250	99.8	5 µm	20.0
0.106	97.2	2 µm	10.0
0.075	93.7		

Grain Size Analysis



%Gravel		% Silt	73.7	% NMC	23.6	Frost Heave Susc.		Material Suitability	
% Sand	6.3	% Clay	20.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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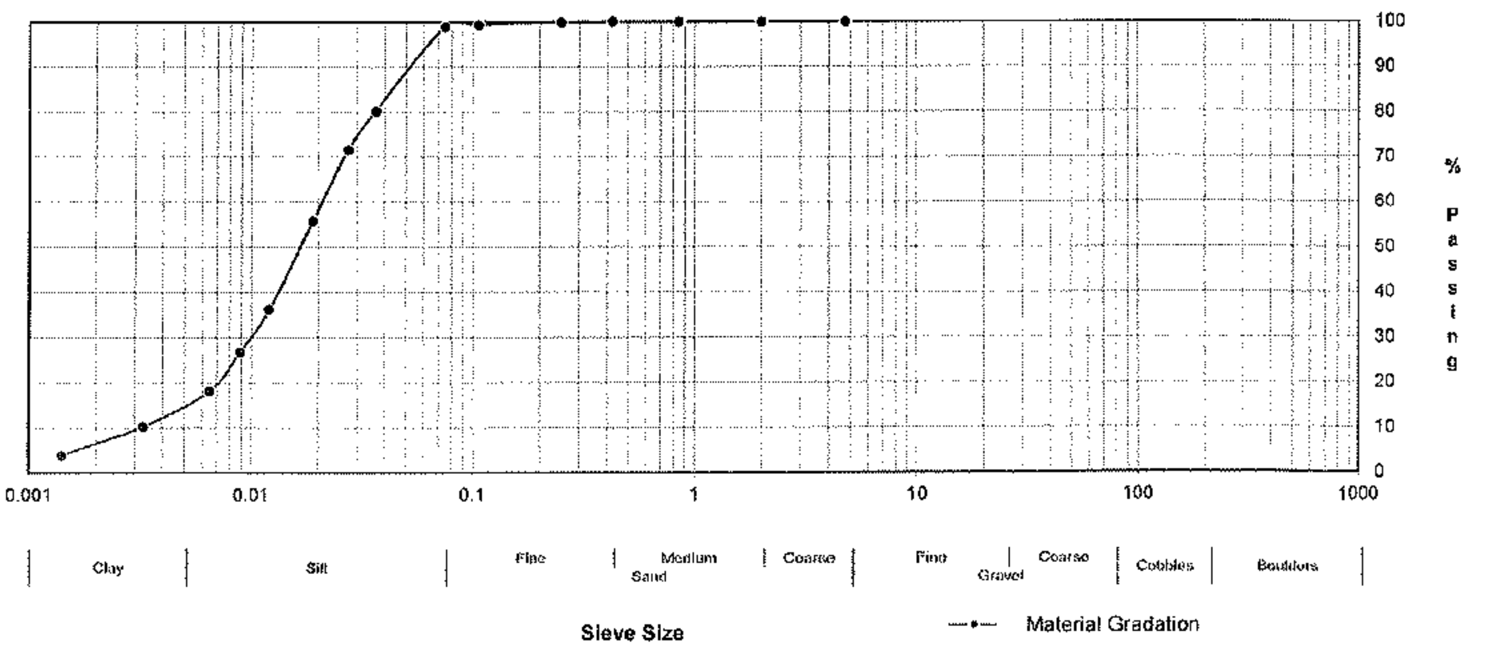
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-931
Location:	Tailings Storage Facility	Sample Location	BH 5 SS 7 4.5m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis Sieve (mm)	% Passing	Hydrometer Analysis Diameter (mm)	% Finer
100			
50.0			
37.5		$0.036339	80.2
25.0		$0.027289	71.6
19.0		$0.018955	55.8
13.2		$0.012056	36.2
9.5		$0.008878	26.7
4.75	100.0	$0.006498	18.1
2.00	100.0	$0.003278	10.2
0.850	100.0	$0.001406	3.9
0.425	100.0		
0.250	100.0	5 µm	15.0
0.106	99.4	2 µm	7.0
0.075	98.9		

Grain Size Analysis



%Gravel		% Silt	83.9	% NMC	23.5	Frost Heave Susc.		Material Suitability	
% Sand	1.1	% Clay	15.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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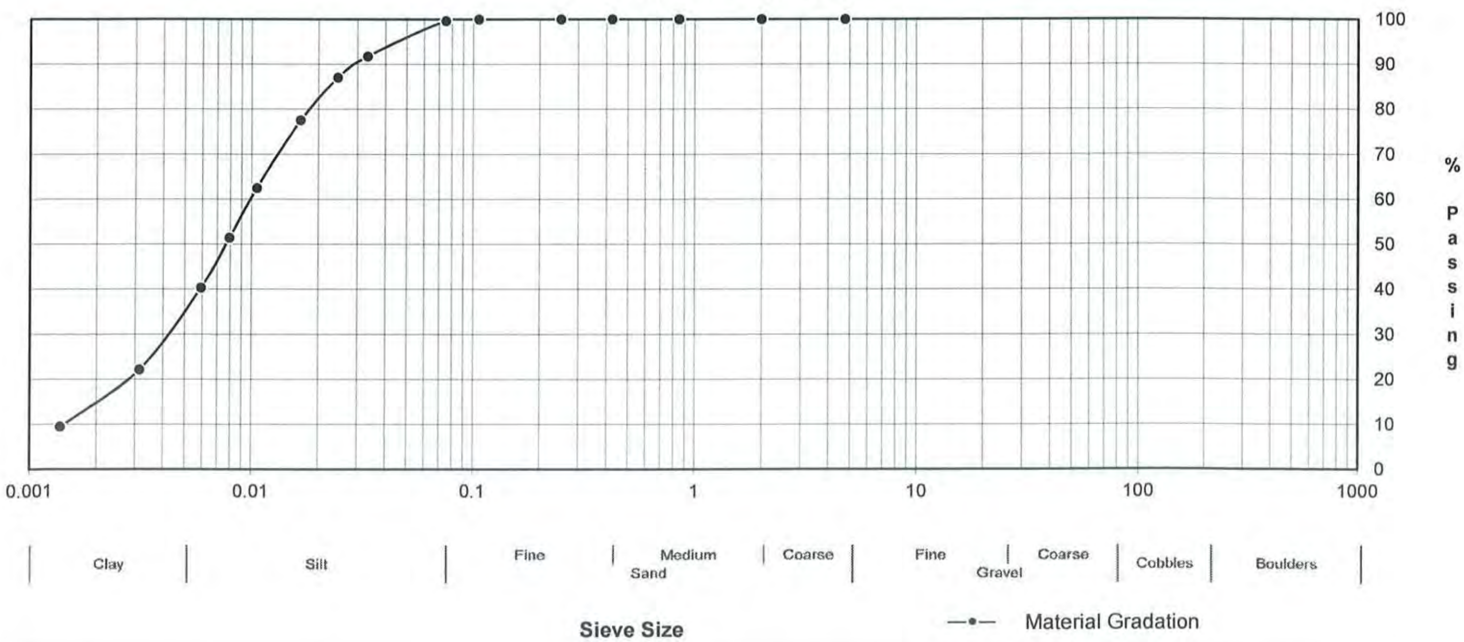
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-933
Location:	Tailings Storage Facility	Sample Location	BH 5 SS 9 6.0m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis Sieve (mm)	% Passing	Hydrometer Analysis Diameter (mm)	% Finer
100			
50.0			
37.5		$0.033220	91.8
25.0		$0.024451	87.0
19.0		$0.016613	77.5
13.2		$0.010557	62.5
9.5		$0.007930	51.4
4.75	100.0	$0.005918	40.4
2.00	100.0	$0.003134	22.2
0.850	100.0	$0.001378	9.5
0.425	100.0		
0.250	100.0	5 µm	35.0
0.106	100.0	2 µm	14.0
0.075	99.7		

Grain Size Analysis



%Gravel		% Silt	64.7	% NMC	27.0	Frost Heave Susc.		Material Suitability	
% Sand	0.3	% Clay	35.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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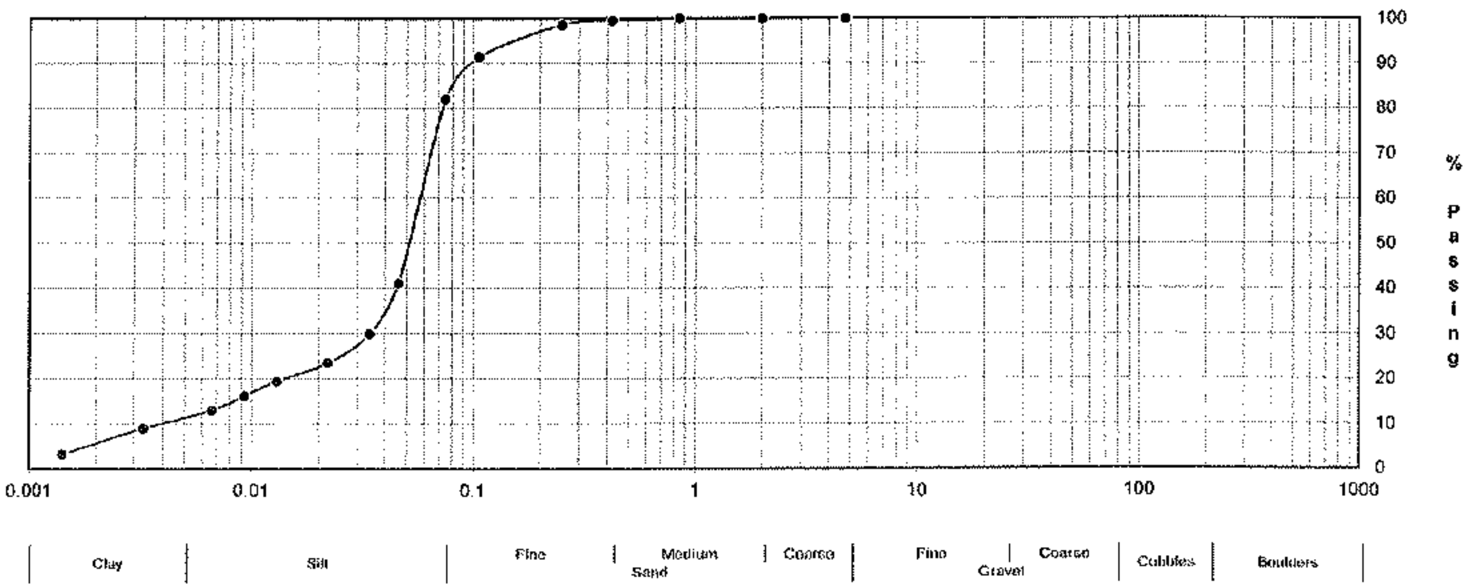
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-940
Location:	Tailings Storage Facility	Sample Location	BH 6 SS 5 3.0m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis: Sieve (mm)	% Passing	Hydrometer Analysis: Diameter (mm)	% Finer
100			
50.0			
37.5		$0.045956	41.2
25.0		$0.034110	29.9
19.0		$0.022135	23.4
13.2		$0.012978	19.4
9.5		$0.009288	16.2
4.75	100.0	$0.006645	12.9
2.00	100.0	$0.003302	8.9
0.850	100.0	$0.001412	3.2
0.425	99.5		
0.250	98.5	5 µm	11.0
0.106	91.4	2 µm	6.0
0.075	82.0		

Grain Size Analysis



%Gravel		% Silt	71.0	% NMC	21.7	Frost Heave Susc.		Material Suitability	
% Sand	18.0	% Clay	11.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

CCIL & CSA Certified

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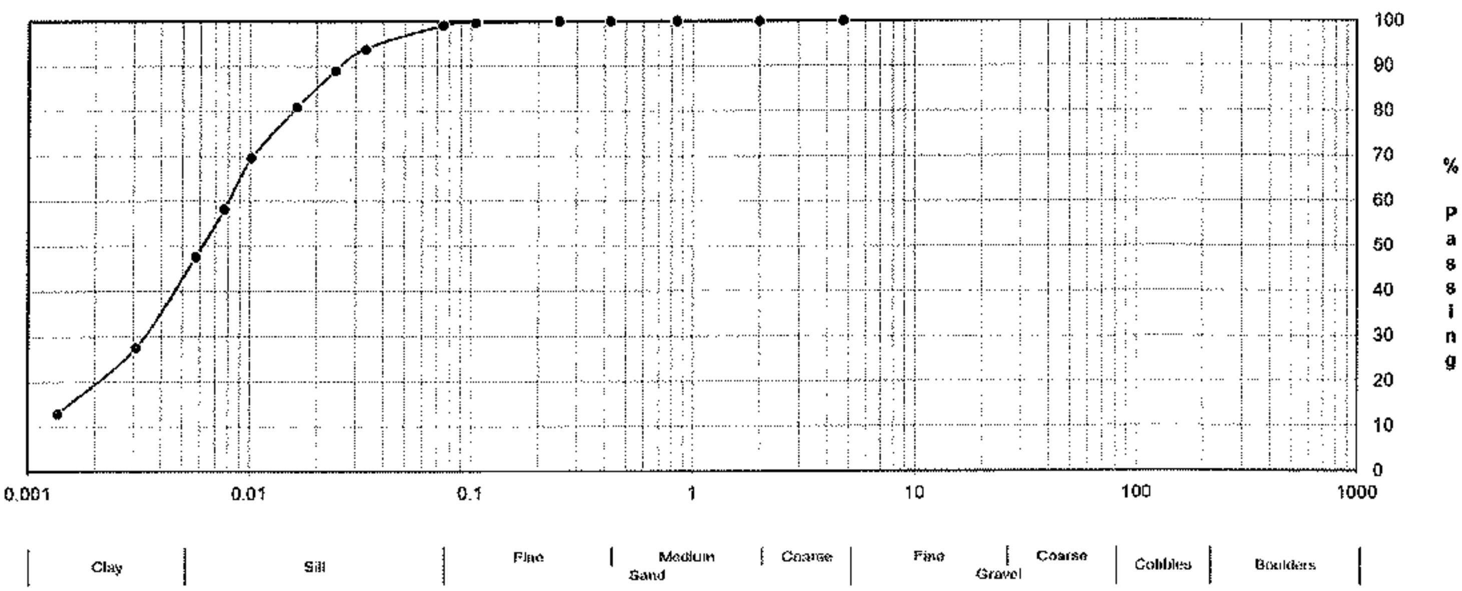
E-Mail: tbte@tbte.ca

Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-942
Location:	Tailings Storage Facility	Sample Location	BH 6 SS 7 6.0m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis: Sieve (mm)	% Passing	Hydrometer Analysis: Diameter (mm)	% Finer
100			
50.0			
37.5		$0.033209	93.9
25.0		$0.024443	89.0
19.0		$0.016423	80.9
13.2		$0.010209	69.6
9.5		$0.007699	58.3
4.75	100.0	$0.005742	47.8
2.00	100.0	$0.003074	27.5
0.850	100.0	$0.001362	13.0
0.425	100.0		
0.250	100.0	5 µm	45.0
0.106	99.7	2 µm	20.0
0.075	99.0		

Grain Size Analysis



%Gravel		% Silt	54.0	% NMC	27.1	Frost Heave Susc.		Material Suitability	
% Sand	1.0	% Clay	45.0	PI	6.0	Erodibility (k)		Soil Classification	CL-ML

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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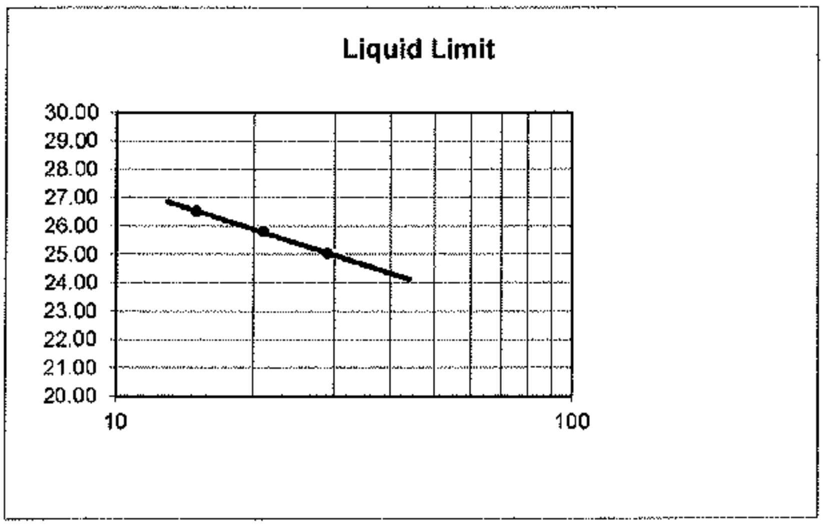
E-Mail: tbte@tbte.ca

Atterberg Limits

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-942
Location:	Tailings Storage Facility	Sample Location:	BH 6 SS 7 6.0m
Reported To:	Mark Wheeler	Tested By/Date:	G.Homac / April 21, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Liquid Limit Determination

Dish No.:	21	P	4		Liquid Limit 25 Blows
Wet Soil + Dish:	37.36	37.306	38.551		
Dry Soil + Dish:	34.216	33.893	35.18		
Moisture:	3.144	3.413	3.371		
Dish:	22.358	20.675	21.716		
Dry Soil:	11.858	13.218	13.464		
% Moisture:	26.51	25.82	25.04		
No. of Blows:	15	21	29		
Liquid Limits:	25	25	25		25



Liquid Limit, %:	25
Plastic Limit, %:	19
Plasticity Index:	6

Plastic Limit Determination

Dish No.:	1	2			Natural Moisture TT
Wet Soil + Dish:	27.631	27.108			965
Dry Soil + Dish:	26.392	25.886			800.1
Moisture:	1.239	1.222			164.9
Dish:	19.895	19.484			191.8
Dry Soil:	6.497	6.402			608.3
% Moisture:	19.07	19.09			27.1
Average:	19				

Test Method : ASTM: D4318, D2216

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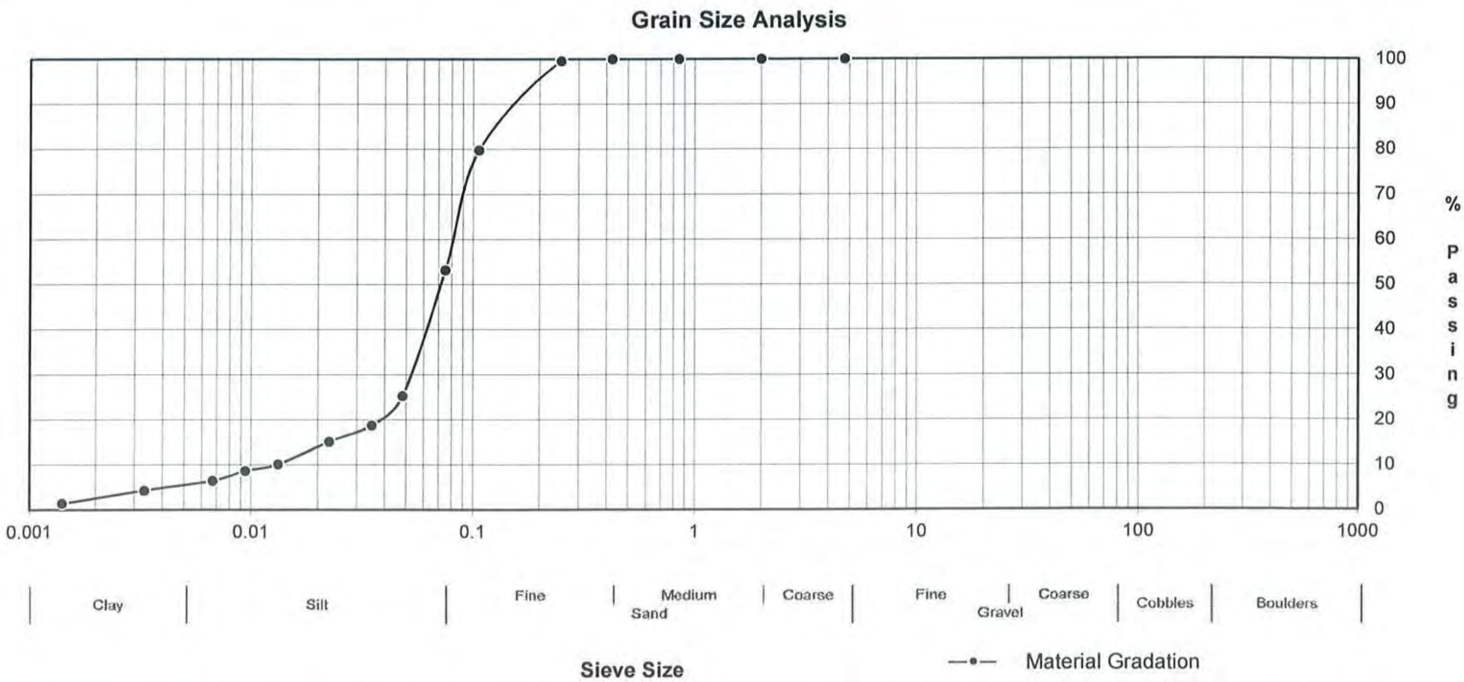
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-946
Location:	Tailings Storage Facility	Sample Location	BH 7A SS 3 1.5m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis: Sieve (mm)	% Passing	Hydrometer Analysis: Diameter (mm)	% Finer
100			
50.0			
37.5		$0.048185	25.3
25.0		$0.035059	18.8
19.0		$0.022513	15.2
13.2		$0.013267	10.1
9.5		$0.009435	8.7
4.75	100.0	$0.006728	6.5
2.00	100.0	$0.003324	4.3
0.850	100.0	$0.001417	1.4
0.425	100.0		
0.250	99.6	5 µm	6.0
0.106	79.8	2 µm	2.5
0.075	53.2		



%Gravel		% Silt	47.2	% NMC	23.0	Frost Heave Susc.		Material Suitability	
% Sand	46.8	% Clay	6.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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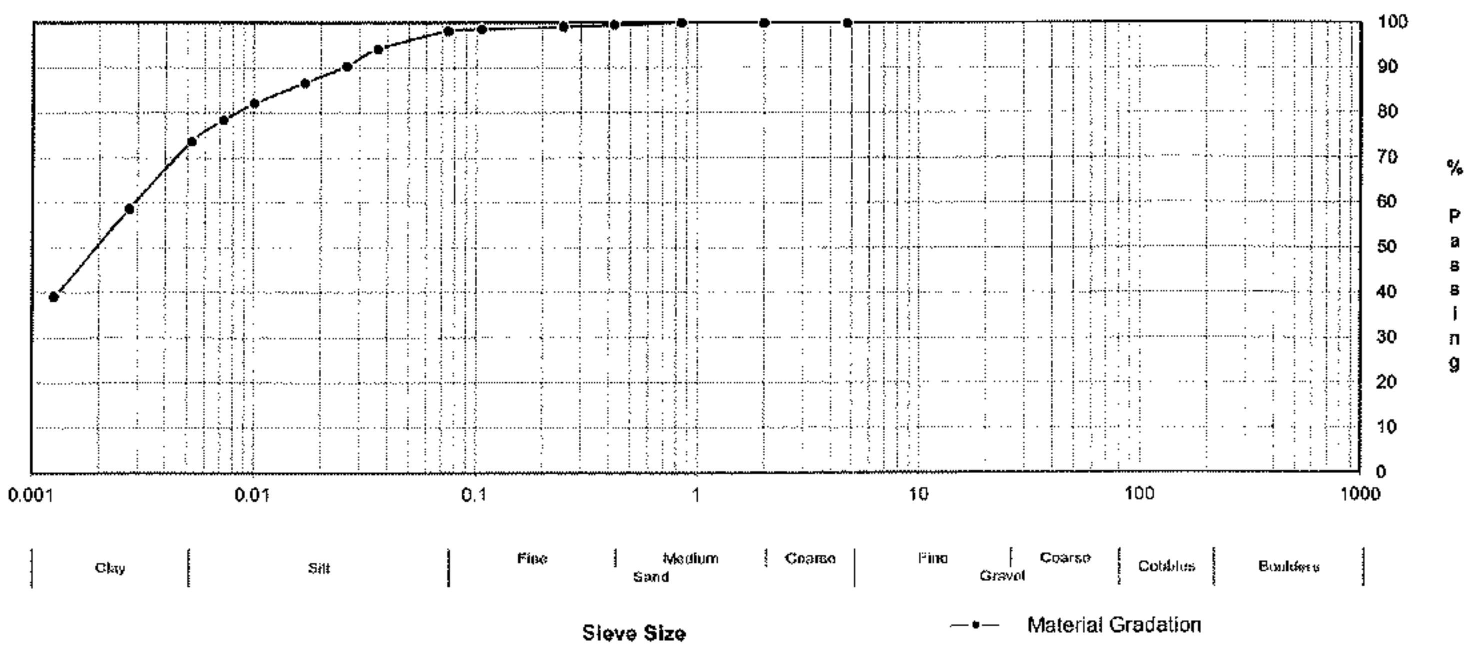
Grain Size Analysis of Soil By Hydrometer

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-953
Location:	Tailings Storage Facility	Sample Location	BH 8 SS 3 1.5m
Reported To:	Mark Wheeler	Tested By/Date:	F.Valela / G.Homac / April 22, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Sieve Analysis: Sieve (mm)	% Passing	Hydrometer Analysis: Diameter (mm)	% Finer
100			
50.0			
37.5		$0.036325	94.1
25.0		$0.026269	90.4
19.0		$0.016975	86.7
13.2		$0.010055	82.0
9.5		$0.007251	78.3
4.75	100.0	$0.005249	73.6
2.00	100.0	$0.002754	58.7
0.850	100.0	$0.001255	39.1
0.425	99.4		
0.250	99.1	5 μm	72.0
0.106	98.5	2 μm	51.0
0.075	98.1		

Grain Size Analysis



%Gravel		% Silt	26.1	% NMC	33.0	Frost Heave Susc.		Material Suitability	
% Sand	1.9	% Clay	72.0	PI		Erodibility (k)		Soil Classification	

Remarks: Test Method LS 701, 702, ASTM D2216, D4318

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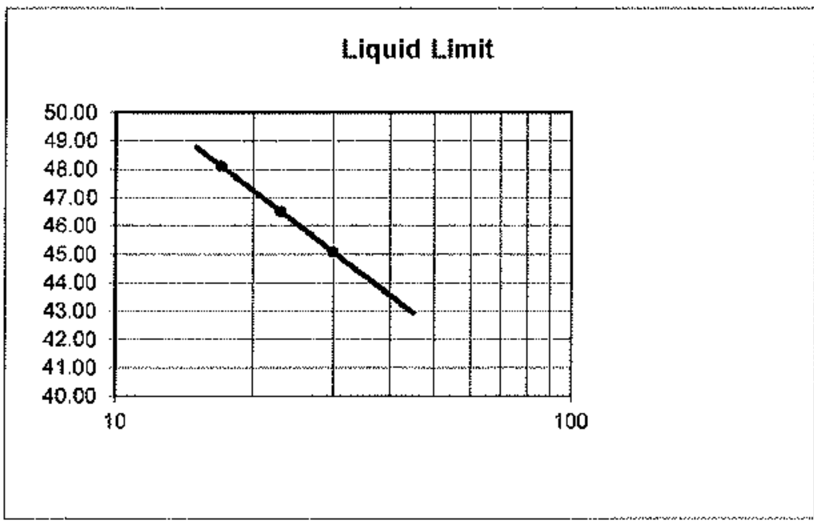
Atterberg Limits

Client:	Treasury Metals	TBTE Project No.:	14-048
Project:	Goilath Project	Lab No.:	14-954
Location:	Tailings Storage Facility	Sample Location:	BH 8 SS 4 2.25m
Reported To:	Mark Wheeler	Tested By/Date:	G.Homac / April 21, 2014
Sampled By/Date:	Craig Johnson	Reviewed By:	Forch Valela

Liquid Limit Determination

Dish No.:	37	T	15		Liquid Limit 25 Blows
Wet Soil + Dish:	37.927	35.616	35.762		
Dry Soil + Dish:	33.103	31.145	31.449		
Moisture:	4.824	4.471	4.313		
Dish:	22.406	21.531	22.486		
Dry Soil:	10.697	9.614	8.963		
% Moisture:	45.10	46.51	48.12		
No. of Blows:	30	23	17		
Liquid Limits:	46	46	46		46



Liquid Limit, %:	46
Plastic Limit, %:	22
Plasticity Index:	24

Plastic Limit Determination

Dish No.:	4	5			Natural Moisture T
Wet Soil + Dish:	27.331	26.161			613.8
Dry Soil + Dish:	26.073	24.904			501.3
Moisture:	1.258	1.257			112.5
Dish:	20.239	19.093			186.6
Dry Soil:	5.834	5.811			314.7
% Moisture:	21.56	21.63			35.7
Average:	22				

Test Method : ASTM: D4318, D2216

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MEMO

1269 Premier Way, Thunder Bay, ON P7B 0A3
Telephone: 807-625-6700 ~ Fax: 807-623-4491 ~ www.wspgroup.com

TO:	MARK WHEELER (TREASURY METALS)	**DATE:**	**September 15, 2014**
FROM:	**BEN PLUMRIDGE (WSP)**		141-12598-00.01
SUBJECT:	GOLIATH PROJECT – TAILINGS MANAGEMENT, SUMMARY SECTIONS, REV. 1		

Mark,

As per your request, we have revised the summary sections for the proposed Goliath Project, Tailings Storage Facility (TSF) located in Dryden, Ontario. The summary sections were previously provided on July 9, 2014 and the revision addresses updated information for the NAG rock availability. Please review and let us know if there are revisions or additions that are required. ▲R1

Regards,

Ben Plumridge, P. Eng.
Senior Engineer – Mining

Pre-Production Phase

The Pre-Production Phase of the project for the Tailings Storage Facility (TSF) will be completed prior to commissioning the plant site and the start of processing of ore from the mining facilities. The preliminary plan for tailings management at the Goliath site will consist of establishing a starter dam to provide storage for tailings waste during the initial years of operation. This will be followed by subsequent raising of the impoundment embankments (dams) to accommodate future storage of tailings during the operations.

The Pre-Production Phase of the project will consist of construction activities to establish the starter dam for storage of tailings storage, operational and stormwater management. Contractors will mobilize plant and equipment required for the construction activities. There are existing access roads to the site that will be utilized during the mobilization and construction activities. Temporary construction roads or accesses will be established as required during the construction activities. Access roads that are no longer required once the construction activities are completed will be removed and the areas rehabilitated while other access roads, that are needed to provide access to the TSF, will be left in-place during the mining operations. The contractor will establish a laydown area for plant and equipment during the construction activities. The established laydown areas can be left in-place for subsequent construction programs for the dam raises during the operations followed by rehabilitation after the closure activities have been completed.

The proposed area for the TSF is currently undeveloped and therefore will require site preparation activities prior to embankment construction. The TSF site area will be cleared of all trees and shrubs from the site and embankment dam footprint areas. Merchantable timber can sold to local forestry operations while other non-merchantable materials can be chipped and spread at the site.

The footprint areas of the basin and embankment will be stripped and grubbed to remove all organic material and to expose the in situ foundation materials. The material from the stripping and grubbing activities will be stockpiled at the site for future closure and reclamation activities. The exposed footprint areas for the starter dam (embankment) will be inspected once exposed and areas consisting of soft, saturated or unsuitable material will be excavated and replaced with competent fill materials. The final foundation footprint areas will be proof rolled in preparation for fill placement for the embankments.

The embankment starter dam will be constructed of zoned earthfill consisting of an upstream low-permeable clay material with graded filter and transition zones while the downstream shell zone will be constructed using local borrow material. The clay zone will be keyed into the basin foundation materials to provide a seepage cut-off and thus decrease potential risk of seepage from the facility. The clay material is anticipated to be provided from borrow sources on the Goliath site (i.e. overburden stripping from the open pit mine area) and the graded filter and transition zones will be provided from gravel pits in the Dryden area. The downstream shell zone will be provided from local borrow sources or alternatively from gravel pits in the Dryden area if local fill materials are not suitable or if there is insufficient fill volumes available. Non-woven geotextile may be used between the drain and transition zones, as required, to provide sufficient support and permeability between the fill materials. The final surface of the embankment will be finished with road topping material to provide protection from traffic and also to provide protection of the clay zone. The upstream slope will be protected from wave and ice damage with layer of riprap while the downstream slope can be vegetated to prevent surface erosion damage.

The basin area of the TSF is anticipated to consist of clay materials. Areas where in situ clay is not found to be present or other higher permeable in situ materials are encountered will require treatment to minimize potential seepage from the basin area. Engineered low-permeability liner products can be placed in these areas and tied into the in situ clays or alternatively clay from borrow sources at the site can be used to provide the low permeable lining.

The starter dam will include an emergency overflow spillway to prevent water from overtopping the embankments in the event that significant storms are encountered. The alignment along the downstream toe will have collection ditches to collect seepage in the event that seepage flows occur through the dam. The collection ditches will be routed to a collection point that will have a sump and pump system that will return the seepage water to the TSF impoundment area. The starter dam will also have monitoring wells installed in the crest and downstream of the dam to monitor the phreatic surface within the dam and to collect samples for water quality monitoring.

Operations Phase

The TSF starter dam will be completed by the end of the Pre-Production Phase and will be used for tailings solids storage as well as storage of operational and stormwater as part of site water management during the operations phase. Tailings solids will be routed to the TSF from the plant site via a high density polyethylene (HDPE) pipeline. A HDPE tailings delivery pipeline will be used to deliver the tailings to the TSF and a tailings distribution pipeline will be used to deposit tailings solids into the facility. The tailings distribution pipeline will be aligned on the embankment crest and will be equipped with spigot off-takes. A low height berm will be established on the crest and behind the pipeline to prevent tailings solids from being discharged to the environment in the event of a spill or line break. Deposition of tailings solids from the crest will be by spigotting. A series of spigots will be open to allow for uniform deposition into the facility. The deposition area will subsequently be moved around the full perimeter of the TSF by systematically closing one (1) spigot and opening another spigot at the far end of the spigot series. This type of deposition will provide for deposition of tailings solids in controlled lifts to provide optimize potential in situ density and maximum utilization of the storage available.

Water management for the TSF will address need for both operational and stormwater management. The tailings solids have been classified as potentially acid generating and therefore a water cover has been planned to cover the tailings during the operating period. Maintaining a cover of water over the tailings solids beach will restrict contact with the atmosphere and reduce the potential for the tailings to generate acid. Other operational water management requirements at the TSF will consist ensuring that there is sufficient reclaim water available to be directed to the ore processing facility as well as removal of excess or surplus water to the final effluent point. Reclaim water will be returned to processing plant by pumping from either a floating barge or stationary system via an HDPE pipeline to the processing plant.

Raising of the TSF perimeter embankments will also need to occur during the operational phase of the project and will require a construction program that will be similar to the Pre-Production Phase. The number of construction programs that will be required to raise the dams during the Operational Phase of the project will be dependent on the anticipated life of mine as well as the ore processing rate during the operations. Raising of the TSF perimeter embankments will utilize an embankment method that is stable (i.e. downstream, center-line, modified center-line) and that will provide the required storage capacity for tailings solids, along with operational and stormwater volumes. The road topping material on the dam will be removed to expose the existing clay zone in order for the new raise material to tie-in to the fill material (clay) for the embankment raise. The low permeable upstream clay zone and internal drains and transition zones will be extended to the required heights for each embankment raise. Preliminary assumption have been assigned for the downstream shell zone for the embankment raises during the operation phase that consisted of utilizing mine waste rock provided from the mining operations. This assumption is dependent on the availability of the mine waste rock consist of ▲R1 non-acid generating (NAG) material the ability to sort and remove the potential acid generating (PAG) mine waste rock at the source. The Alternative Assessment for the location of the TSF was completed utilizing the assumption that NAG mine waste rock would be available in the operations phase of the project. Other construction fill materials will be considered if insufficient NAG rock for use in construction is identified as the project is advanced and additional information becomes available. Other fill materials will consist of local borrow materials at the Goliath site as well as fill materials supplied from local gravel pits in the Dryden area. The design of the dam, consisting of footprint layout, downstream slope and filter grading, will reflect the type of material available and used in the dams downstream shell zone to ensure that the dam has acceptable stability factors of safety. Erosion protection measures for the downstream slopes will be designed based on the material type that is utilized for the downstream shell zone of the dam structure.

Each raise of the TSF embankment will require decommissioning of the existing emergency overflow spillway and subsequent construction of a new spillway. Existing monitoring wells would also require extending and the downstream seepage collection ditches would require re-establishing to accommodate the new embankment toe alignment with each embankment raise.

Monitoring of the dam structure and the water management will be completed during the Operational Phase of the project. Monitoring of the dam will consist of daily inspections and recording of findings by TM staff. This will consist of a visual inspection of the dam, water levels and tailings placement operations consisting tailings deposition rate and location. Treasury Metals staff will complete more detailed inspections on a monthly basis that will consist of a visual inspection and preparation of condition rating of the dam and its components. A photo record will also be completed as part of the monthly inspections. A Dam Safety Inspection will be completed on an annual basis by a qualified engineer and a full Dam Safety Review will also be completed at the required interval as defined by the Hazard Potential Classification in accordance with the Canadian Dam Safety Guidelines and the Ministry of Natural Resources Best Management Practices. Monitoring activities at the dam will also include recoding water levels in the monitoring wells as well as collection of water samples for laboratory analysis.

Tailings deposition and water management will continue until mining activities are completed. After the mining activities are completed, the TSF will enter the Closure and Reclamation Phase of the project.

Closure and Reclamation Phase

The closure phase of the project for the TSF will be initiated once the mining activities and ore processing have been completed. Closure and reclamation of the TSF will consist of capping the final tailings beach surface and reclamation of the facility. Standing water that is present at the end of the operations will be removed and the final tailings beach surface regraded, as required to ensure it is totally free draining. Grading of the final tailings beach surface will be completed in conjunction with placement of a pioneer or base/stabilization layer over the tailings surface for access. A low permeable layer of clay will then be placed over the pioneer layer. The clay layer can be tied into the embankment upstream clay zone to provide complete encapsulation of the tailings surface. A granular shedding layer will be placed over the clay layer to allow runoff the shed from the surface. A layer of topsoil, stockpiled from the site preparation activities, will then be placed over the granular and the final surface will be vegetated. The downstream slopes of the embankments will also be regraded and covered with topsoil and revegetated.

The water reclaim pump, reclaim pipeline and tailings delivery and distribution pipelines will be decommissioned and removed from the site. The emergency overflow spillway will be decommissioned. The monitoring wells present in the crest of the dam can remain in-place as well as the monitoring wells located on the downstream area of the dam for use during the closure monitoring phase. Access roads that are no longer required will be scarified and revegetated.

Monitoring of the closed facility will be completed and will consist of annual Dam Safety Inspections of the closed facility as well as Dam Safety Reviews at the required timeline interval, as discussed above for the Operations Phase.

APPENDIX D-2

MULTIPLE ACCOUNTS ANALYSIS

DRAFT

GOLIATH GOLD PROJECT
ASSESSMENT OF ALTERNATIVES
FOR STORAGE OF MINE WASTE

Pursuant to the:
Metal Mining Effluent Regulations and
Guidelines for the Assessment of Alternatives
for Mine Waste Disposal

Submitted to:
Treasury Metals Incorporated
130 King Street West, Suite 3680
P.O. Box 99
Toronto, Ontario, M5X 1B1
Canada

Submitted by:
Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited
160 Traders Blvd. East., Suite 110
Mississauga, Ontario, L4Z 3K7
Canada

August 2017
TC160516

August 31, 2017
TC160516

Mark Wheeler
Director, Projects
130 King Street West, Suite 3680
P.O. Box 99
Toronto, Ontario, M5X 1B1

Dear Mr. Wheeler:

Amec Foster Wheeler is pleased to submit the attached Draft Assessment of Alternatives for Storage of Mine Waste for the Goliath Gold Project. The report identifies and assesses alternatives considered for the storage of mine waste (tailings and mine water) for the Goliath Gold Project, using the multiple accounts assessment methodology required by Environment and Climate Change Canada, in accordance with the Guidelines for the Assessment of Alternatives for Mine Waste Disposal.

Results of the assessment found that overall, the preferred alternative is a conventional slurry tailings storage facility with an adjoining minewater pond, located to the northeast of the process plant.

We greatly appreciate the opportunity to provide support for your Goliath Gold Project. Should you have any questions regarding the study, please do not hesitate to contact us.

Yours sincerely,
Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited

Don Carr, M.Sc.
Senior Environmental Scientist

Sheila Daniel, M.Sc., P. Geo.
Principal, Mining Environmental

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GLOSSARY AND ABBREVIATIONS

Amec Foster Wheeler	Amec Foster Wheeler Environment & Infrastructure
ARD	acid rock drainage
CEAA	Canadian Environmental Assessment Agency
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPR	Canadian Pacific Railway
DFO	Fisheries and Oceans Canada
DST	DST Consulting Engineers Inc.
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
ESA	*Endangered Species Act*
GHG	greenhouse gas
HONI	Hydro One Networks Inc.
KBM	KBM Resources Group
KCB	Klohn Crippen Berger
LSA	local study area
MAA	multiple accounts analysis
ML	metal leaching
MMER	Metal Mine Effluent Regulations
MNDM	Ministry of Northern Development and Mines
MNRF	Ministry of Natural Resources and Forestry
MOECC	Ministry of the Environment and Climate Change
MWP	minewater pond
NP	neutralization potential
NPR	neutralization potential ratio
PWQO	Provincial Water Quality Guidelines
RSA	regional study area
SAR	species at risk
SARA	Species at Risk Act
the alternatives	Alternatives A, B, C and D
the Guidelines	Guidelines for the Assessment of Alternatives for Mine Waste Disposal
the Project	the Goliath Gold Project
Treasury Metals	Treasury Metals Incorporated
TSF	Tailings Storage Facility
WRSA	Waste Rock Storage Area

UNITS

°C	degrees Celsius
dBA	'A'-weighted decibels
ha	hectares
kg	kilograms
km	kilometres
m	metres
m^2	square metres
m^3	cubic metres
masl	metres above sea level
mm	millimetres
t	tonnes

EXECUTIVE SUMMARY

Treasury Metals Incorporated (Treasury Metals) is proposing to develop the Goliath Gold Project (the Project), a proposed open pit and underground gold mine. The Project site is approximately 4 kilometres (km) northwest of the Village of Wabigoon, 20 km east of Dryden and 2 km north of the Trans-Canada Highway 17. Access to the Project property is via Tree Nursery Road and Anderson Road which originates at Highway 17, west of the village of Wabigoon.

An Environmental Impact Statement (EIS) for the Project was previously submitted to the Canadian Environmental Assessment Agency (CEAA) pursuant to a Federal environmental assessment process. Information requests on the prior EIS were received from the CEAA. Based on the information requests and direction from the CEAA, a revised EIS has been prepared in tandem with this Assessment of Alternative for Storage of Mine Waste report, and this report is being submitted as part of the revised EIS.

Two components of the Project (a Tailings Storage Facility [TSF] and a minewater pond [MWP]) will overprint waters frequented by fish and are subject to a regulatory amendment of Schedule 2 of the Metal Mining Effluent Regulations (MMER). At Treasury Metals' request, Amec Foster Wheeler has prepared this document to satisfy the Environment and Climate Change Canada (ECCC) requirement for an assessment of alternatives for mine waste disposal, pursuant to a regulatory amendment of Schedule 2 of the MMER.

This document outlines the potential storage methods / locations, selection criteria and methodology used to identify a preferred alternative for tailings impoundment and minewater storage. A multiple accounts analysis (MAA) has been prepared which follows the methodology outlined in the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (the Guidelines), prepared by ECCC. This analysis has been used to examine and compare different effects from mine waste storage alternatives, and to provide a decision-making tool which is transparent and defensible. A sensitivity analysis is provided to allow for different weightings of key MAA components and to evaluate differing values on potential environmental, technical, economic and social impacts.

The assessment considered five candidate tailings storage methods, nine candidate tailings storage locations and nine candidate MWP locations. Following a pre-screening analysis, two of the tailings storage methods, three tailings storage locations and four MWP locations were retained for further consideration through the MAA. Four alternatives were developed using each of the candidate tailing storage methods and various locations.

The MAA considered the four alternatives (Alternatives A, B, C and D) from four perspectives; environmental, technical, project economics and socio-economics. From an environmental perspective Alternatives A and B were equally preferred. Alternative A was the sole preferred alternative from a technical, project economics and socio-economics perspectives.

The MAA found that Alternative A was the preferred overall alternative with an alternative merit rating of 4.3 out of a maximum of 6.0. The runner-up alternative (Alternative B) was similar with an alternative merit rating of 4.2 Alternatives C and D had alternative merit ratings of 3.6 and 3.5 respectively.

A sensitivity analysis was conducted to test the robustness of the assessment and the following scenarios were considered through the sensitivity analysis:

- Environment Canada and Climate Change base case (prioritize environment, minimize project economics);
- All accounts weighted equally (reduce weighting bias);
- All accounts, sub-accounts and indicators weighted equally (remove weighting bias); and
- Prioritize people, environment strongly considered (Socio-economics account weighted six, environmental account weighted four, technical account weighted two, project economics weighted one).

The sensitivity analysis found that the relative preferences between alternatives did not change to any appreciable extent between the various scenarios, with Alternative A remaining the preferred alternative in all scenarios.

1.0 INTRODUCTION

1.1 Background

Treasury Metals Incorporated (Treasury Metals) is proposing to develop the Goliath Gold Project (the Project), a 2,700 tonnes (t) per day open pit and underground gold mine. The Project site is approximately 4 kilometres (km) northwest of the village of Wabigoon, 20 km east of Dryden and 2 km north of the Trans-Canada Highway 17 (Figure 1-1). Access to the Project property is via Tree Nursery Road and Anderson Road which originates at Highway 17, west of the village of Wabigoon.

Treasury Metals has been exploring the Project site since 2008. Beginning at that time, Treasury Metals commenced extensive environmental, geotechnical, metallurgical, engineering, socio-economic, and logistical studies with the goal of advancing the Project towards commissioning and operation.

An Environmental Impact Statement (EIS) for the Project was submitted to the Canadian Environmental Assessment Agency (CEAA) in April of 2015. Information requests on the EIS were received from the CEAA in June of 2015. Based on the information requests and direction from the CEAA, a revised EIS has been prepared in tandem with this Assessment of Alternative for Storage of Mine Waste report. This report is being submitted as part of the revised EIS in response to information requests.

Two of the Project facilities (a Tailings Storage Facility [TSF] and a minewater pond [MWP]) will overprint waters frequented by fish and are subject to a regulatory amendment of Schedule 2 of the Metal Mining Effluent Regulations (MMER). A previous report titled "Tailings Storage Facility Alternatives Assessment Goliath Project" (WSP, 2014), was submitted with the original EIS, and was prepared pursuant to a regulatory amendment of the MMER for the Project TSF. Based on comments received on the original assessment of alternatives report, an updated Project layout, and an evolving understanding of the MMER Schedule 2 regulatory amendment process, this new Assessment of Alternatives for Storage of Mine Waste report has been prepared for all Project facilities anticipated to require a MMER Schedule 2 listing in order to be constructed and to operate. This report replaces WSP (2014) and in addition to tailings storage considered in that report, the MWP is also considered herein.

This document outlines the potential mine waste storage methods / locations, selection criteria and methodology used to identify preferred alternatives for mine waste storage (tailings and mine water). A multiple accounts analysis (MAA) following the methodology outlined in the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Guidelines; Environment Canada 2011) has been used to examine and compare, different aspects and effects from mine waste storage, and to provide a decision-making tool which is transparent and defensible. A sensitivity analysis is provided to test the robustness of the MAA. The sensitivity analysis allowed for different weightings of key MAA components and to evaluate differing values on potential environmental, technical, economic and social impacts.

1.2 Assessment of Alternatives Overview

As per Environment Canada (2011):

> *The MMER stipulates that for mine waste to be deposited in a natural, fish-bearing waterbody, the waterbody must be listed in Schedule 2 of the Regulations, designating it as a tailings impoundment area (TIA). In the context of these guidelines, a TIA is a natural waterbody frequented by fish into which tailings, waste rock, low-grade ore, overburden and any effluent that contains any concentration of the deleterious substances specified in the MMER, and of any pH, are disposed.*

Amec Foster Wheeler, on behalf of Treasury Metals, has prepared this assessment of alternatives for storage of mine waste, in support of a future regulatory amendment to list portions of Blackwater Creek Tributary 2 to Schedule 2 of the MMER. The assessment of alternatives is based on engineering and environmental baseline studies, comments received from stakeholders during environmental assessment and engagement processes, proponent input, and consultant experience with previous MAA assessments. The purpose of this assessment of alternatives is to objectively and rigorously assess feasible options for mine waste disposal at the Project site in accordance with the Guidelines. The assessment of alternatives is broken into the following seven steps as described in the Guidelines:

Step 1. Identify candidate alternatives. Involves determining which methods and sites could be used for the storage of mine waste.

Step 2. Pre-screening assessment to screen out any alternatives which have a fatal flaw, ensuring at least one alternative does not overprint natural waters frequented by fish.

Step 3. Alternative characterization. Describe the alternatives from environmental, technical, project economics and socio-economic perspectives.

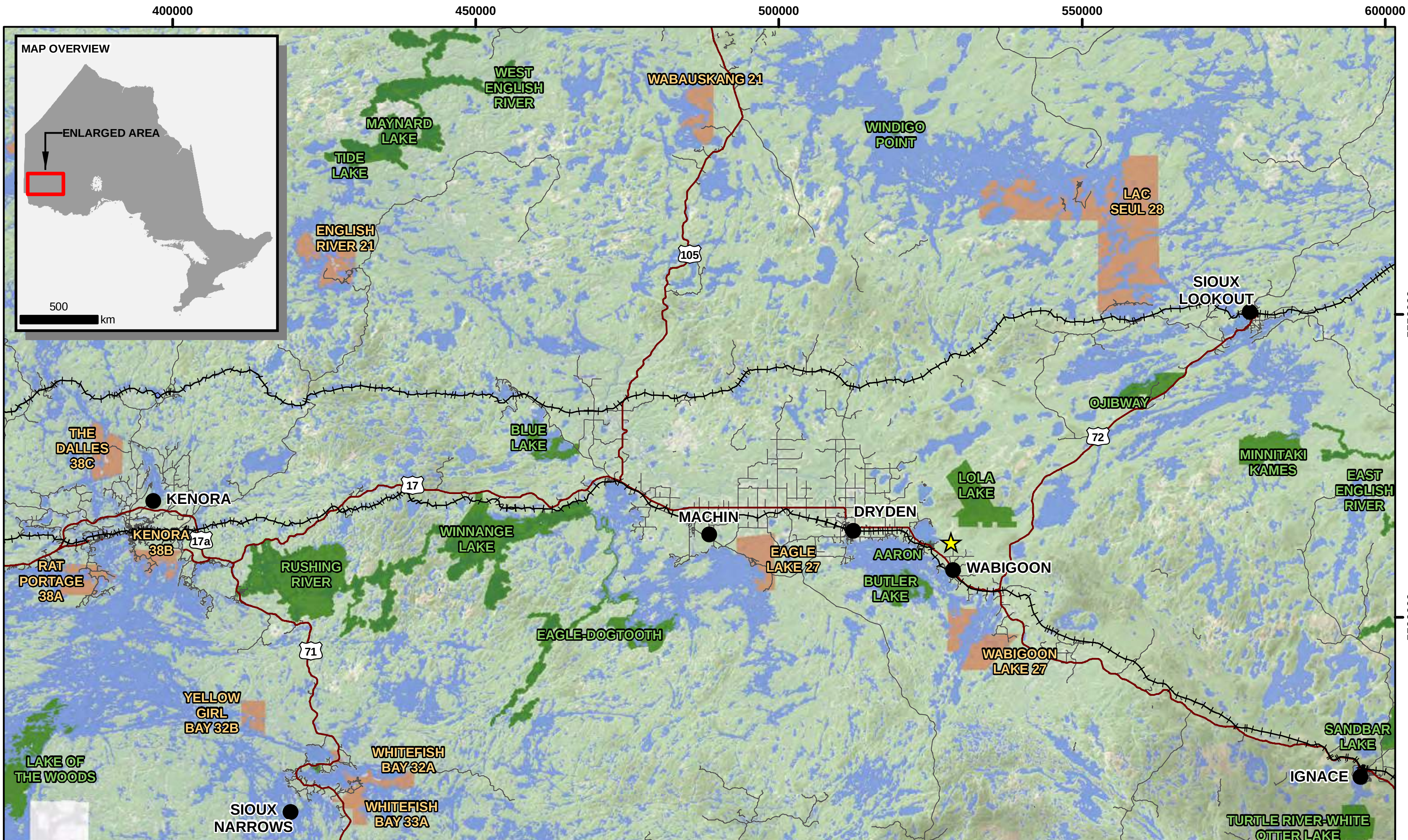
Step 4. Multiple-accounts ledger. The beginning of the MAA and includes setting up a ledger of evaluation criteria and measurement criteria (sub-accounts and indicators respectively).

Step 5. Value-based decision process. Each sub-account and indicator is assigned a value and weighted in importance (valuating, weighting and quantitative analysis).

Step 6. Sensitivity analysis, which is an analysis that tests the robustness of the assessment and recognises that all stakeholders will not place the same importance on each effect.

Step 7. Document results.

The assessment of alternatives presented in this document, has been structured into six sections that reflect the above steps (report Sections 5.0 to 10.0). Results for each step as required by Step 7, are documented in each section.



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LEGEND

- Site Location
- Towns / Cities
- First Nation Reserves
- Provinicial Parks
- Railway
- Highway
- Local Road
- Waterbody

0 10 20 40 60 80 100 Km

NOTES:
- Topographic data extracted from Land Information Ontario, MNRF.

Datum: NAD83
Projection: UTM Zone 15N

N W E S

amec foster wheeler

GOLIATH GOLD PROJECT

Site Location

PROJECT Nº: TC160516	FIGURE: 1-1
SCALE: 1:880,000	DATE: August 2017

2.0 ENVIRONMENTAL CONDITIONS

A summary of environmental baseline conditions pertinent to the assessment of alternatives is provided below. The summary is based on details provided in the Amended EIS. A complete description of the Project baseline conditions are provided in the individual baseline study reports referenced fully and provided in the Revised EIS.

2.1 Regional and Local Setting

The Project is located within with the Kenora Mining Division in north western Ontario (Figure 1-1). The Project site is approximately 4 km northwest of the village of Wabigoon, 20 km east of Dryden and 2 km north of the Trans-Canada Highway 17. Access to the Project property is via Tree Nursery Road and Anderson Road which originates at Highway 17, west of the village of Wabigoon.

The Project area is generally flat, but exhibits undulating terrain and is drained principally by Blackwater Creek and its associated minor tributaries. The Project site is located in a low density rural area within the Hartman and Zealand Townships, with limited local agriculture focused on cattle, as well as logging activities in the area. Immediate adjacent areas show mainly secondary growth poplar-dominated forests and wetlands.

Regionally the closest major city center to the Project is Thunder Bay (population 108,359) which is located approximately 335 km east-southeast of the site. The closest communities and local populations to the Project are located in Wabigoon (population 430; 4 km southeast of site), and Dryden (population 7,500; 20 km west of site). Of local significance is the population proximal to the site located on Thunder Lake Road, East Thunder Lake Road, Tree Nursery Road, and Anderson Road.

There are no Areas of Natural and Scientific Interest or Provincially Significant Wetlands within or proximal to the general Project site area. Treasury Metals has not been informed of any sites of paleontological or paleobiological interest in the area. There are no Federal Parks near the Project site. Two Provincial Nature Reserves are located proximal to the Project site, Lola Lake Nature Reserve (5 km northwest), and Butler Lake Nature Reserve (10 km southwest). Aaron Provincial Park is located adjacent to the Project boundary to the west (Figure 1-1).

The Project is located within the area covered by Treaty 3. Treaty 3 includes approximately 142,450 square kilometres in Ontario ranging from the vicinity of Upsala in the east, following the Canada-United States border in the south, and extending past the Ontario-Manitoba border in the west. Treaty 3 includes 28 First Nations communities and a number of villages and towns including Wabigoon, Dryden, Eagle River, Vermillion Bay, Sioux Lookout, Atikokan, Fort Frances, and Kenora. The Project is also located within an area identified by the Métis Nation of Ontario as the Treaty 3 / Lake of the Woods / Lac Seul / Rainy River / Rainy Lake traditional harvesting territories, also named Region 1.

There is no proposed or anticipated Federal funding associated with the Project and no facilities or activities are proposed on Federal lands, including First Nation Communities or lands under land claim. Wabigoon Lake Ojibway Nation and Eagle Lake First Nation are the closest reserve Indigenous communities to the Project site (Figure 1-1).

2.2 Geology

The site geology was described by Klohn Crippen Berger (KCB) in the Environmental Baseline Study (KCB 2012). The Project area is located within the volcano-plutonic Eagle-Wabigoon-Manitou Greenstone Belt in the Wabigoon Subprovince of the Archaean Superior Province, and is on the north side of the regional Wabigoon fault. This Greenstone Belt consists of a 150 km-wide domain that has an exposed strike extent of 700 km. The full strike length of the Greenstone Belt is unknown since it is overlain by Palaeozoic strata on both ends.

Major lithological units within the project area were identified on the basis of visual examination of rock type in outcrops, drill core, and trenches. These rocks have been grouped into the Thunder Lake Assemblage; a volcanogenic-sedimentary complex of felsic metavolcanic rocks and clastic metasedimentary rocks that underlies much of the Project area, and the Thunder River Mafic metavolcanic rocks, which are generally massive but are pillowed locally and include amphibolite and mafic dykes, characterized as chlorite schists, and underlie the south part of the project area.

Three major rock groupings are consistently recognized from south to north at the Project site, and consist of the following:

- A hanging-wall unit of altered felsic metavolcanic rocks (sericite schist, biotite-muscovite schist) and metasedimentary rocks;
- A central unit of approximately 100 m to 150 m true thickness, which hosts the most significant gold concentrations and consists of intensely deformed and variably altered felsic, fine to medium grained, quartz-feldspar-sericite schist and biotite-quartzfeldspar-sericite schist with minor metasedimentary rocks; and
- A footwall unit of predominantly metasedimentary rocks with some porphyritic units and minor felsic gneiss and schist.

2.3 Geochemistry

A preliminary geochemical assessment of the tailings material was completed in 2012 by EcoMetrix Incorporated (EcoMetrix 2014) using a composite tailings sample expected to be produced during the mill process. Characterization work included both static testing (acid base accounting (ABA), elemental content analysis and short-term metal leaching assessment) and kinetic testing programs (laboratory humidity cells).

The results of the ABA identified the composite tailings sample as PAG with low neutralization potential (NP). The sample had 1.5% total sulphur and 0.3% sulphate with a NP and carbonate NP of 5.1 and 0.3 kilograms (kg) $CaCO_3$/t respectively. The Neutralization Potential Ratio (NPR) and carbonate NPR were 0.13 and 0.01 respectively. Elemental content results for the sample was enriched in antimony, arsenic, bismuth, cadmium, lead, silver and zinc, when compared to the 10 times crustal abundance screening criteria. The deionized water shake flask extraction test on average exceeded the current Provincial Water Quality Objectives (PWQO) for protection of aquatic life for cadmium, cobalt, lead and zinc.

Duplicated humidity cells were operated using the composite tailings material for a minimum of 59 weeks. One of the two duplicate cells was continued to 78 weeks. The pH for both cells exhibited an initial decline from pH 8 reaching a short plateau above pH 6 from about week 25 to week 40 for both cells. After week 40, pH continued to steadily decline to the end of testing (week 78 for tailings cell 1). The minimum recorded pH in this cell was 3.6. Sulphate and metal release exhibited increasing rates generally consistent with the observed declines in pH. Notably elevated release of cadmium, lead and zinc were observed in the tailings cells after week 40.

The conclusion of the geochemical testing is that acidification of the tailings would be likely unless properly managed, and that the onset of acidification could occur as rapidly as a few years after exposure. The results of the available testing did not provide definitive answers as to whether the results from the available testing was a transient rate during the initial stages of testing or long-term steady state rates. As a result, the Project would proceed in a caution manner for managing ARD until additional test results can be obtained.

2.4 Climate

The Project site is located in the west-central portion of the Boreal Shield Ecozone, experiencing a continental climate, generally characterized by short mild summers and long cold winters with relatively low precipitation. The terrain is generally flat and absent of orographic features which can block air masses or produce localized increases in precipitation. Climate stations considered for the climate baseline include: Dryden (1914-1997 record); Dryden A (1999-2010 record); and Sioux Lookout A (1938-2007 record).

Air temperatures in the region follows an annual sinusoidal pattern typical of northern continental climates at mid-latitude with minimum average daily temperature occurring in January and maximum average daily temperature occurring in July. The mean daily temperatures in July is approximately 19 degrees Celsius (°C) with an average daily maximum near 24°C and an average daily minimum near 13°C. The mean daily temperature in January is -18°C with an average daily maximum near -13°C and an average daily minimum near -23°C. Temperatures are typically below freezing between November and March. The diurnal temperature range is similar during spring, summer and winter (approximately 10°C) but is less during the fall (7°C).

Based on historical observations at Dryden (ECCC stations: Dryden and Dryden A), mean annual precipitation at the Project site is estimated to be 705 millimetres (mm), of which, between 20% to 24% falls as snow. The 24-hour rainfall depths range from 44 mm for a 2-year return event to 113 mm for a 100-year return event. The maximum 24-hour rainfall depth recorded in 82 years at Dryden was 111.6 mm which is just under the 100-year event.

Lake evaporation data from the Rawson Lake monitoring station (6036904) was used to estimate annual and monthly lake evaporation for the project. The Rawson Lake monitoring station is located approximately 80 km west of the site and collected lake evaporation data between 1969 and 1999. Mean annual lake evaporation at Rawson Lake is approximately 549 mm, which compares with the Hydrological Atlas of Canada (1978) which indicates a range of lake evaporation values between 500 to 600 mm. Lake evaporation and potential evapotranspiration are both upper bounds of actual evaporation and evapotranspiration, respectively. Actual evaporation and evapotranspiration are limited by the availability of moisture stored in the soil or by vegetal water consumption.

2.5 Drainage

The hydrology of the site was described by Hydrology Baseline Study (DST 2014). The Project study area is comprised of a number of sub watersheds that are a part of the larger Thunder Lake watershed and Wabigoon Lake watersheds. Blackwater Creek, along with its associated minor tributaries, drain to Kelpyn Bay of Wabigoon Lake. Hughes Creek and Nugget Creek along with its minor tributaries meet at a confluence and drain to Barrett Bay of Wabigoon Lake. The minor creeks and tributaries to the west of the Project (Hoffstrom’s Bay Tributary and Little Creek) drain into Hoffstrom’s Bay of Thunder Lake. Thunder Lake Tributaries 2 and 3 have catchment areas that extend north of the Project and meet at a confluence that drains to Thunder Lake.

2.6 Vegetation

The vegetation survey was completed by KCB in 2010/2011 (KCB 2012) and used a five kilometre radius from the ore body as the local study area (LSA). The regional study area (RSA) was defined by the Thunder Lake watershed boundary to the north, south and east of the Project and the LSA boundary to the west. The Project site is located within the Lake Wabigoon Ecoregion (Ecoregion 4S), which extends from northern Lake of the Woods, east to Lac Seul and Dryden within the Ontario Shield Ecozone (Crins et al. 2009). Landcover in the LSA consists of 62% forest, 21% water, 9% developed land, 8% wetland, and <1% barren land. A wide range of soil types within the RSA and LSA allows for a relatively diverse range of ecosites (39 and 38 respectively).

The most prevalent ecosites found in the RSA and LSA are; hardwood-fir-spruce mixed wood with fresh, fine loamy-clayey soil (ES29) making up 15% and 18% of the RSA and LSA respectively, spruce-pine / feathermoss with fresh, sandy-coarse loamy soil (ES20) making up 8% and 5% of the RSA and LSA respectively, spruce-pine / feathermoss with fresh, fine loamy-clayey soil (ES26) making up 8% and 8% RSA and LSA respectively and Jack pine-conifer with dry, moderately fresh, sandy soil (ES13) make up 7% and 6% of RSA and LSA respectively. The remainder of the 33 ecosites make up less than 2% each of the LSA.

The forest composition of both the LSA and RSA is 95% black spruce, jack pine and trembling aspen dominated forests. Almost 70% of the forest in the LSA is between the ages of 60 and 100 years old, with the oldest age class consisting of black spruce forest in the Lola Lake wetlands at >160 years old. Forest ecosites with moist soils to fresh clay soils (ES26 to ES33) dominate at the south of the LSA and RSA and make up approximately 29% and 34% of the RSA and LSA, respectively. These ecosites are mostly comprised of mixed wood stands with trembling aspens (ES29, ES32, ES33) or black spruce (ES26, ES31). These stands have a dense understory of mountain maple and hazel, are rich in herb and shrub and have a wide diversity of grasses, sedges and forbs. Jack pine, black spruce and trembling aspen forests with sandy soils (ES13 to ES16) dominate the north of the LSA and cover approximately 8% of both the RSA and LSA. The understory of these ecosites are moderately species-rich with blueberries, pin cherry, lichens and feathermoss occurring. Approximately 9% and 6% of the RSA and LSA respectively, is made up of conifer swamp forest dominated by black spruce and larch on organic soils over glaciolacustrine clay (ES34 to ES38). These ecosites usually have ericaceous shrubs, speckled alder, sedges and Sphagnum mosses present.

Wetland ecosites make up the second largest vegetated area of both the RSA and LSA and consist of treed and open fen, thicket swamp, and meadow marsh (ES34 to ES50). Due to the diversity of wetland ecosites within the LSA, each site makes up a small portion of the overall area (<1% to 3% each). Wetland species vary greatly from upland to lowland areas and wetland classifications. Although wetlands within the RSA have not been evaluated under the Ontario Wetland Evaluation System, Lola Lake Wetland, Hughes Creek Wetland, Thunder Lake Wetland, Thunder Creek Wetland, Blackwater Creek Wetland, and Nugget Creek Wetland all have the potential to provide significant ecological function.

Developed land occurs throughout the LSA. The former tree nursery to the north of the LSA covers several hundred hectares of cedar hedge rows, young black spruce and red pine plantations. Agricultural habitats are dominated by introduced forage species and native graminoids.

There were 270 vascular plant species identified in the LSA during field investigations, 25 of which are introduced species that are associated with disturbed habitats. Most the remaining species are characteristic of Ontario's southern boreal forest with no species at risk (SAR) observed during field surveys, or are thought to occur in the LSA. Floating marsh marigold is a Provincially rare plant species (S2) and was observed during the field investigation in the Thunder Creek wetlands at the mouth of Thunder Creek. Two Provincially rare species (heart-leaved Alexander and Vasey's rush) and three locally rare species (yellow birch, bur oak and white elm) have been documented to occur in the Dryden Forest, however none of these species were observed at the LSA.

Wild rice marshes occur at the mouths of Nugget, Thunder and Blackwater creeks and at Hughes Pond, which are culturally significant for local First Nations communities. Approximately 12.8 hectares (ha) of wild rice communities have been delineated from field observations to occur within the LSA. It is likely that these sites have been used historically for wild rice harvesting given their relatively easy access from Wabigoon Lake and Highway 17. However, current wild rice harvesting activities are not available.

2.7 Terrestrial Biology

Treasury Metals retained KCB (KCB 2012), DST (DST 2014d) and KBM (KBM 2017b) in 2011, 2012, and 2015-2016 respectively, to gather baseline data on the terrestrial biology of the Project site. These baseline investigations included surveys for breeding birds, Whip-Poor-Wills, waterfowl, marsh birds, amphibians, reptiles and small mammals in the LSA and RSA. The LSA was initially determined to be a five kilometre radius circle centered on the main ore deposit, which was used for the studies from 2010-2013. As the project footprint became more defined, the LSA boundaries were selected to be the boundaries of the Blackwater Creek watershed that the Project footprint was located within. The RSA is defined by the boundaries of the Wabigoon Ecoregion. The objective of these surveys was to describe wildlife within the LSA and RSA, identify rare species and SAR that are known or potentially occurring in the LSA and RSA, and identify important habitat as defined by the Ministry of Natural Resources and Forestry (MNRF).

2.7.1 Birds

During the terrestrial wildlife baseline investigation of the LSA, 121 bird species were observed collectively over all the surveys, and 102 of these species are known or suspected to nest in the LSA. Of these 121 species, 8 were identified as SAR. Barn Swallow, Common Nighthawk, Canada Warbler, and olive-sided flycatcher were observed in the LSA and are presumed to be probable nesters in the area. Bald Eagle and Black Tern were observed foraging and Peregrine Falcon and Rusty Blackbird were observed as migrants in the LSA, although no nesting was observed of these four species. Three other SAR bird species including Yellow Rail, Short-Eared Owl and Least Bittern had suitable habitat occur in the LSA, but were not observed during the field surveys. Along with the SAR, Red-Necked Grebe and Black Billed Magpie were also observed in the LSA, which are two Provincially rare bird species.

Neither Whip-Poor-Will nor Bobolink were detected in the LSA after intensive surveys. There is little suitable habitat in the LSA for either of this species, and it was determined that they probably do not occur. Waterfowl staging habitat was identified to be in wild rice marshes where Blackwater, Nugget and Thunder creeks enter Wabigoon Lake.

2.7.2 Amphibians

There was a total of seven amphibian species observed in the LSA during the 2011 and 2012 field surveys, including; tetraploid grey treefrog, northern spring peeper, wood frog, eastern American toad, boreal chorus frog, mink frog and blue-spotted salamander. Although they were not observed during the field surveys, leopard frogs, green frogs and central newt are known to occur in the Dryden area. None of the species observed in the LSA are considered SAR.

2.7.3 Reptiles

The western painted turtle and the eastern garter snake were the only two species of reptiles observed in the LSA during the three field surveys. Neither of these species are SAR. Snapping turtle are known to occur in the Dryden area, although there were none observed in the LSA during field investigations.

2.7.4 Mammals

There were twenty mammal species observed in the LSA during field investigations, most of which were incidental sightings. Of these twenty species, nocturnal bat sound recordings and small mammal trapping were the only targeted surveys which identified; Southern Red-backed Vole, Deer Mouse, Northern Short-tailed Shrew, Red Squirrel, Least Chipmunk, Meadow Jumping Mouse, Hoary Bat, Little Brown Myotis, Big Brown Bat and Northern Myotis. Mammals that were observed in the LSA by incidental sightings were; moose, White-tailed Deer, Black Bear, Grey Wolf, Mink, River Otter, Red Fox, Muskrat, Woodchuck, and Snowshoe Hare.

White-tailed Deer were the most common ungulate species in the LSA. There is little habitat for Moose in the LSA with the observed Moose aquatic feeding areas given a rank of 2. High deer density has potentially increased the incidence of brainworm, therefore Moose appear to be uncommon in the LSA. Through field investigations, areas of calving/fawning sites for Caribou, Moose, or Deer in the LSA were not present, however Moose wintering areas and calving sites are present in the RSA.

White-tailed Deer were the most common ungulate species found in the LSA during field surveys. Wetlands within the LSA were surveyed to determine Moose aquatic feeding area rankings based on the direction provided in Selected Wildlife and Habitat Features: Inventory Manual (Ranta 1998). Wetlands within the LSA that were surveyed received rankings of 2 or less, out of a maximum ranking of 4, indicating moderately suitable Moose aquatic feeding areas. Additionally, the high deer density has potentially increased the incidence of brainworm, which can affect the presence of Moose; therefore moose appear to be uncommon in the LSA. Through field investigations, areas of calving/fawning sites for Caribou, moose, or deer in the LSA were not present, however Moose wintering areas and calving sites are present in the RSA.

Two of the four species of bat that were recorded in the LSA are classified as Endangered under the *Federal Species at Risk Act* (SARA) and the Provincial *Endangered Species Act* (ESA), including Little Brown Myotis and Northern Myotis. The ultrasonic recorders only indicate the presence or absence of species of bats, and are unable to determine the quantity of specific species. However, three separate locations in 2011 and five in 2012 recorded Little Brown Myotis, and one location in 2012 recorded Northern Myotis. Further investigation was done to determine suitable roosting habitat in the LSA using the MNR Guidelines for Wind Power Projects (MNR 2011), which found five snags in the LSA to have a ranking of high. During the investigation of these five snags, only one was observed to have bats leaving the snag, however the species of bat was unknown.

2.8 Aquatic Biology

There were two baseline investigations of fish and fish habitat conducted at the Project site by KCB in 2010 and 2011 (KCB 2012) and by DST in 2012 and 2013 (DST 2014a). Additional fish sampling was conducting in 2014 by Treasury Metals staff, along with side-scan sonar investigations of Keplyn’s Bay on Wabigoon Lake and an unnamed bay of Thunder Lake done by C. Portt and Associates in 2016. The initial investigation done by KCB included Hughes and

Nugget creeks, where the subsequent studies only looked at Blackwater and Thunder creek watersheds.

2.8.1 Blackwater Creek System

The Blackwater Creek system is comprised of a main channel with a number of tributaries feeding into it. The main channel discharges into the eastern side of Wabigoon Lake at Keplyn Bay. Blackwater Creek has a sinuous channel, with a low gradient making for a series of runs and pools morphology. Substrate in Blackwater Creek is primarily fine silty clay, although there are sections of gravel at road crossings thought to be an artifact of road construction and maintenance.

The fish community observed in Blackwater Creek is dominated by Northern Redbelly Dace, Finescale Dace, Brook Stickleback and Pearl Dace. White Sucker spawning habitat was observed in 2011 within the Blackwater Creek system, but was isolated to road crossings where gravel from roadways provided suitable spawning substrates. It is unclear if the White Sucker spawning is from stream-resident populations or if there are spawning runs from populations in Wabigoon Lake. There was no observed Walleye spawning habitat in the Blackwater Creek system. The benthic invertebrate community at most sites in the Blackwater Creek system were dominated by chironomids.

2.8.2 Little Creek and Hoffstrom's Bay Tributary

Little Creek and Hoffstrom's Bay tributaries are located north and west of the Project and flow into Hoffstrom's Bay of Thunder Lake. The substrate and stream morphology is similar to Blackwater Creek with a silty clay substrate, and a low gradient sinuous channel. The mouth of these two watercourses provide wetland habitat along the shores of Hoffstrom's Bay and is suitable spawning habitat for Northern Pike. The watercourses themselves have fish communities dominated by Finescale Dace, Brook Stickleback and Pearl Dace. Yellow Perch was the most abundant fish observed at the mouth of Hoffstrom's Bay Tributary.

2.8.3 Hughes and Nugget Creek System

Nugget Creek and Hughes Creek are located east of the Blackwater Creek watershed. The two creeks meet at their confluence where they flow as Nugget Creek into Barrett Bay of Wabigoon Lake. The two creeks have similar substrate to the Blackwater Creek System, comprised of silty clay with gravel substrate at road crossings allowing for diverse fish spawning areas. There are short sections of Hughes Creek consisting of cobble and boulder substrate, allowing for riffle-pool morphology. Upstream of the transmission lines, the creek widens out and forms a shallow marshy channel just downstream of Hughes Pond. This section of stream bed is soft sedimentary organic material.

A total of 1,239 fish were captured in Hughes Creek belonging to nine different species. Finescale dace were the most abundant with a total capture of 50%. Although the dominant fish species were comparable to Blackwater Creek, four species were observed in Hughes Creek that were not observed in Blackwater Creek (Walleye, Common Shiner, Blacknose Shiner, and Johnny Darter). There were also more white suckers observed in Hughes Creek (126) than Blackwater Creek (20). Both walleye and white suckers spawning was also observed in Hughes Creek, with 12 and 58 eggs respectively collected during surveys.

The mouth of Nugget Creek at Barrett Bay is designated a Provincial Fish Sanctuary to protect spawning walleye and is closed from fishing from April 1 to May 31.

2.8.4 Thunder Lake

Thunder Lake is located west of the Project site and supports a diverse coldwater fish community including Lake Trout, Lake Whitefish and Lake Cisco, along with coolwater fish populations including Walleye, Northern Pike, Yellow Perch and Smallmouth Bass. The mean depth of the lake is 11.1 m with a maximum depth of 23.5 m. The eastern shore of the lake has two bays that are separated by a bedrock point with cobble and boulder shoals. This area is a known spawning ground for Lake Trout, Lake Whitefish and likely Walleye, but this has not been confirmed.

2.8.5 Wabigoon Lake

Wabigoon Lake is located southwest of the Project site and supports coolwater fish community including Walleye, Sauger and Muskellunge. The mean depth is 6.1 m with a maximum depth of 14.6 m. There are two fish sanctuaries that were created to protect known Walleye and Sauger spawning areas, one of which is located just west of the mouth of Blackwater Creek around Christie Island and the other is at the mouth of Hughes Creek. Wabigoon Lake also supports an active sports fishery focused on Walleye and Muskellunge angling.

3.0 ENGAGEMENT

As part of the engagement process which began in 2009, Treasury Metals has engaged with the following Indigenous communities, stakeholders and government agencies:

- Wabigoon Lake Ojibway Nation;
- Eagle Lake First Nation;
- Noatkamegwanning (Whitefish Bay) First Nation;
- Wabauskang First Nation;
- Lac Seul First Nation;
- Lac Des Mille Lacs First Nation;
- Grassy Narrows First Nation;
- Grand Council Treaty #3;
- Métis Nation of Ontario;
- Aboriginal People of Wabigoon
- City of Dryden;
- Village of Wabigoon;
- Thunder Lake and local area residents;
- CEAA;
- Fisheries and Oceans Canada (DFO);
- Ministry of the Environment and Climate Change (MOECC);
- ECCC; and
- MNRF.

Consultation to date has included the following activities:

June 2009

- Provided a notice of the 2009 summer exploration program to Wabigoon Lake Ojibway Nation, Eagle Lake First Nation, and Grand Council Treaty 3.

October 2012

- Provided invitations for an investor update meeting to the Wabigoon Lake Ojibway Nation, Eagle Lake First Nation, and Métis Nation of Ontario.

November 2012

- Provided a letter to Aboriginal peoples to inform that a project description for the Project had been submitted to CEAA and that the process to complete an EA for the Project had begun. This notice was sent to Wabigoon Lake Ojibway Nation, Eagle Lake First Nation, Lac Seul First Nation, Wabauskang First Nation, Whitefish Bay First Nation, Grassy Narrows First Nation, the Aboriginal People of Wabigoon and the Métis Nation of Ontario.

June 2013

- Registered letter provided to Indigenous communities identified by the Ministry of Northern Development and Mines (MNDM) and CEAA to advise each community of Treasury Metals' obligation to consult.
- An information package relating to the Project was provided to Indigenous communities and Treasury Metals invited comments about the Project.
- Provided letter to all identified Indigenous communities to inform them that the Agency had accepted the Project Description and had issued EIS Guidelines for the required EIS. The letter listed websites where the Project description and EIS Guidelines could be found.

January 2014

- Letter provided to all identified Indigenous communities seeking input to the Project baseline wetlands assessment. The letter requested comments from the groups about any specific wetlands that hold special values to their communities. No comments were provided by any of the Indigenous communities.

April 2014

- Treasury Metals provided copies of the baseline reports to identified Aboriginal peoples.

June 2014

- Hosted a meeting in Dryden inviting the identified Aboriginal peoples to raise concerns or questions about the Project.

October 2014

- Provided letter to all Aboriginal communities to inform them that the Project EIS for the Project had been submitted to the Agency.
- An electronic copy of the EIS was sent to each Aboriginal community.

February 2015

- Treasury Metals received a letter from CEAA that listed project-related concerns collected in meetings with various communities between February 10th and 12th, 2015. Concerns were listed that had been specifically raised by Eagle Lake First Nation, Wabauskang First

Nation, Naotkameganning (Whitefish Bay) First Nation, and Wabigoon Lake Ojibway Nation.

April 2015

- Provided letter to all identified Aboriginal communities indicating that the EIS for the Project conformed to the EIS Guidelines set out by CEAA.

May 2015

- Meeting with Eagle Lake First Nation, City of Dryden, and Village of Wabigoon in support of the engagement process for the EIS. These meetings provided an update to the communities and provided a venue to voice concerns. CEAA also provided a presentation in support of these meetings. In conjunction to the Treasury Metals provided an additional meeting with local residents located proximal to site to ensure their comments was captured.

April 2017

- Meeting with Wabigoon Lake Ojibway Nation, Eagle Lake First Nation, Whitefish Bay First Nation, Grand Council Treaty 3 and CEAA with regards to water management. Representatives from all parties participated in providing concerns to both Treasury Metals and government regulators.

July 2017

- Treasury Metals provided a document known as the Impact Footprints and Effects Area report to each Indigenous community and invited comments. This document was intended to provide an opportunity to discuss the potential impacts to traditional land use.

In addition to the above, Treasury Metals has made numerous presentations to all the identified Aboriginal communities. The presentations included a description of Treasury Metals, the Project location and geology, mine plan, environmental studies and review process, employment, training and business opportunities (including labour demand and spending forecasts), and a discussion surround the overall effects of the Project as they relate to traditional land uses.

A summary of concerns related to the TSF and MWP raised during consultation, along with the responses provided by Treasury Metals, is included in Table 3-1.

Table 3-1: Summary of Consultation

Concerns	Response / How the Comment was Addressed
Concern about relocation of fish from waterbodies within the Project area	Consultation with MNRF will determine where fish will be relocated. It is expected that the fish would be transferred to other locations within the Blackwater Creek system using accepted standard practices.
Close proximity of mine to residents	The Project will be required to obtain an ECA from the MOECC to meet environmental requirements for the site (e.g., air quality, noise). There will be no exceedances allowed as part of the ECA permitting process.
Lola Lake in close proximity to the Project	Lola Lake is located upstream of the Project in a separate watershed from where Treasury Metals will be discharging. Therefore, water quality at Lola Lake will not be effected. Water for the process plant will be taken intermittently from Thunder Lake Tributaries 2 and 3, which Lola Lake drain into. However, water taking will be less than 5% of the flows going into the tree nursery ponds and will not have an effect on Lola Lake.
View of the Project from Thunder Lake	Development area will be more than 300 m from Thunder Lake and will be designed to be as short as possible to mitigate aesthetic effects.
How will archaeological resources / grave sites be managed if discovered?	An archaeological assessment did not find any graves or anything else of significance on the site. The area was the site of homesteads over 100 years and most of the site has been logged in the recent past. Treasury Metals is proposing Wabigoon Lake Ojibway Nation and Eagle Lake First nation complete traditional knowledge studies on the site. The Elders of Wabigoon Lake Ojibway Nation have indicated that archaeological resources be curated in situ. The Archaeological and Cultural Heritage Resource Management Plan that will be created prior to the start of construction will reflect this preference. Policies and procedures will be created that dictate the procedures and contact requirements if archaeological resources or grave sites are discovered by site personnel.
Eagle Lake First Nation Elder identified he picks blueberries where the TSF will be located	There is a known area where blueberries grow on the east and west sides of Tree Nursery Road that will be within the operations area. However, this area will be overprinted by the process plant and part of the open pit and not in the preferred TSF location.
What will the height of the tailings dam be?	The height of the TSF will increase over the life of the Project, with an ultimate elevation of the crest of the embankment at about 22 m above the foot of the embankment or 420 metres above sea level (masl).
TSF situated over highly porous substrate and will flow to Thunder Lake tributaries.	The TSF is largely located on a sand over clay/silt over sand sequence within the Blackwater Creek watershed. Seepage modelling has determined that once dewatering has ceased and groundwater levels return to pre-development levels, some seepage from the TSF will report to Thunder Lake. However, the amount of seepage indicated from modelling is not sufficient enough to cause an impact to water quality in Thunder Lake.
Mercury levels in the fish of Thunder Lake	No mercury will be used at the Project site and any discharge from the Project will either meet PWQO or be less than background. Additionally, no discharges will be to the Thunder Lake watershed. There may be potential for seepage from the TSF to report to Thunder Lake following closure, however; the extremely low amounts of seepage that will get to Thunder Lake will not have a measurable effect.
Is there potential for the tailings pond to breach into Thunder Lake	Treasury Metals advised that the area around the preferred TSF does not drain toward Thunder Lake. In the unlikely event of a dam break, the spill would follow the Blackwater Creek basin and tailings would not reach Wabigoon Lake.
Access restriction concerns	Treasury Metals has not changed access to Treaty lands as much of the Project site has been private property for some time and the Tree Nursery Road has historically been gated. Treasury Metals has permitted minnow trapping on the Tree Nursery ponds and will consider future requests to continue the practice.

Concerns	Response / How the Comment was Addressed
Fox dens in TSF area	In collecting environmental baseline data, consideration was given to the possible presence of dens, mast areas, and the distribution of wildlife populations. No dens were specifically noted during field surveys, however, to the extent possible, the information that was shared with Treasury Metals was considered in preparing the EIS.
TSF area is good nesting habitat for birds	In collecting environmental baseline data, consideration was given to nesting habitat for birds. Although no habitat has been identified specifically, Treasury Metals does acknowledge that this area will be lost as nesting habitat until the post-closure phase of the Project, for the dry cover closure scenario. At this time the TSF would be vegetated with native species and will provide new habitat for nesting birds.
Potential impact on right to hunt	Treasury Metals has made an effort to locate mine infrastructure on private property; the project will affect less than 100 ha of Crown land. There are no reports of hunting activities in the area of the mine and no known camp sites or hunt zones in the immediate area.
Impact on drinking water in Wabigoon and Dryden	Treasury Metals will ensure that water discharged from the site will meet Provincial water quality standards; options for treatment will be discussed in the EIS. Water quality downstream of the mine will not be adversely affected by the mine for drinking or fishing.

4.0 METHODOLOGY

The methodology utilized to assess mine waste alternatives follows from and is intended to be compliant with that prepared by Environment Canada (2011).

4.1 Identify Candidate Alternatives

The first stage of the assessment of alternatives is to determine possible mine waste disposal alternatives. This could include different approaches or technologies for mine waste disposal, such as the level of tailings dewatering, as well as possible locations for the storage of tailings and management of mine water.

4.2 Pre-Screening Assessment

The pre-screening assessment allows those candidate approaches or locations that do not meet minimum specifications to be removed from the assessment process. By not meeting these minimum requirements, the candidate is considered to contain a fatal flaw that is so unfavourable or severe that it eliminates the disposal method or site as a candidate mine waste disposal alternative. Pre-screening criteria are formulated such that a “yes” or “no” response is possible. There must be no reasonable mitigation strategy that would eliminate a fatal flaw.

The deliverable for the pre-screening assessment is a summary table which shows all candidate alternatives and whether they are carried forward to the characterization step, or eliminated based on the fatal flaw analysis.

The pre-screening assessment is designed up to return candidate technologies, as well as TSF and MWP locations that have not been screened out. Each of the alternatives will be established utilizing one of the technologies / approaches, combined with a TSF location and a MWP location. As one of the intents of the pre-screening assessment is to allow the characterization set to focus on feasible alternatives, developing alternatives based on all possible combinations of approach / technology, TSF location and MWP location, would result in an onerous number of alternatives to carry through the MAA. To avoid a cumbersome quantity of alternatives, several alternatives are selected utilizing the remaining candidate approaches / technologies and locations, from a mine development perspective. This includes at least one alternative using locations that do not overprint water.

4.3 Alternative Characterization

The reduced number of alternatives remaining after the pre-screening assessment are then characterized to:

- Ensure that all aspects of the alternative are properly considered; and
- Allow direct comparison between alternatives, ensuring complete transparency of the alternatives assessment process.

As described in the Guidelines, there is no ideal number of alternatives that should be carried through, but there should be at least three or more alternatives remaining and determined to be worthy of detailed assessment. At least one of these alternatives should not impact a natural waterbody that is frequented by fish, unless it can be demonstrated that this possibility does not reasonably exist based on site-specific circumstances.

Alternatives are characterized based on environmental, technical, project economic and socio-economic categories (accounts). Characterization criteria are selected by a multidisciplinary team representative of the above accounts.

Deliverables for the alternatives characterization include a description of each alternative, and a table of environmental, technical, project economics and socio-economic criteria.

4.4 Multiple Accounts Ledger

Preliminary screening of alternatives can be used to eliminate alternatives with any fatal flaws, which can occur with minimal judgement. However, evaluation criteria used in the MAA considers the material impact, such as a benefit or loss, associated with each alternative.

A multiple accounts ledger includes a three-level hierarchy comprised of accounts, sub-accounts and indicators. Accounts identify the general area of consideration and include:

- Environmental;
- Technical;
- Project economic; and
- Socio-economic.

Each account is split into evaluation criteria (sub-accounts) that are used to determine the level of impact to the account. For example, an environmental account could contain sub-accounts that include terrestrial ecosystem impacts, aquatic ecosystem impacts, impacts to groundwater and impacts to air quality. Sub-accounts should conform to the following criteria detailed by Environment Canada (2011):

- Sub-accounts need to be impact driven;
- The sub-account must differentiate one alternative from another;
- The sub-account must be relevant to the account;
- The sub-account must be understandable, and unambiguously defined for clarity;
- Sub-accounts must not be redundant; and
- Sub-accounts should be judgmentally independent (one sub-account cannot depend on the value of another sub-account).

While sub-accounts measure impacts between the alternatives, they are often not easy to quantify and rank in a transparent manner. Measurement criteria (indicators) allow qualitative or quantitative measurement of the impact associated with each sub-account.

For the purposes of this MAA, each indicator has a six-point scale established that details how an alternative is valued, as suggested in the Guidelines (Environment Canada 2011). Based on consultant experience with other recent assessments of alternatives, a six-point scale is utilized for indicators measured by quantitative data, to reflect and maximize the relative differences between each alternative. Typically, this results in one alternative with the best indicator value of six, one alternative with the lowest indicator value of one, while the remaining alternatives are in the middle of the scale depending on their relative characteristics.

Qualitative scales are established to cover a wider range of scenarios for added clarity and to ensure that an independent reviewer would also assign the same values. Typically, this results in the alternatives tending to have values towards the middle of the scale.

Deliverables for the multiple accounts ledger include a comprehensive list of accounts, sub-accounts and indicators, including rational for selection, and six-point value scales for each of the indicators.

4.5 Value-Based Decision Process

4.5.1 Valuing

Each alternative is assigned a value for each indicator ranging from one to six. A six is assigned when the alternative meets the best criteria on the indicator value scale; one is assigned when the alternative meets the worst criteria.

The deliverable for valuation is a summary table of values determined for each indicator.

4.5.2 Weighting

An experienced multidisciplinary team with representatives from Treasury Metals and Amec Foster Wheeler held a workshop to determine appropriate weightings for the sub-accounts and indicators. Applicable views of external stakeholders identified during engagement activities were incorporated when determining weights.

Weights were applied to each sub-account and indicator on a scale of one to six based on the relative importance of each sub-account and indicator. A weight of two is considered twice as important as a weight of one; similarly, a weight of four is twice as important as a weight of two. By design of the scale, no sub-account or indicator can be weighted more than six times more important than another sub-account or indicator.

4.5.2.1 Indicators and Sub-accounts

The weights of indicators are comparable within each individual sub-account and cannot influence separate sub-accounts. In the event of only one indicator in a given sub-account, a weight of one was applied. Sub-account weights are only applicable within a given account and are not comparable across accounts.

The deliverable for weighting is a summary table of all weights assigned to the sub-accounts and indicators, including rationale for the selection of each weight.

4.5.2.2 Accounts

The base case account weights as suggested by Environment Canada (2011; Section 2.6.2 therein) are as follows:

- Environment – 6;
- Technical – 3;
- Socio-economic – 3; and
- Project economics – 1.5.

As provided in the Guidelines, the base case includes weighting the environment account twice as important as the technical and socio-economic accounts, which in turn are weighted twice as important as the project economics account.

4.5.3 Quantitative Analysis

The MAA follows the methodology provided in Environment Canada (2011):

> *For each indicator, the indicator value (S) of each alternative is listed in one column. The weighting factor (W) is listed in another column and the combined indicator merit score (S × W) is calculated as the product of these values.*
>
> *Indicator merit scores can be directly compared across alternatives, and likewise sub-account merit scores (Σ{S × W}) can be directly compared across alternatives. However, to allow comparison of these values against values for other sub-accounts, the scores must be normalized to the same six-point scale used to score each indicator value. This is achieved by dividing the sub-account merit score by the sum of the weightings (ΣW) to yield a sub-account merit rating (Rs = (Σ{S×W}/ ΣW). This will again be a value between 1 and 6. This normalization is necessary to balance out different numbers of indicators and sub-accounts for each account. Without this normalization, the number of indicators associated with each sub-account, and the number of sub-accounts associated with each account, would have to be identical, otherwise the analysis will be skewed by accounts with more sub-accounts or indicators.*

The same procedure of weighting and normalization is followed to determine account merit scores (Σ{Rs×W}), and account merit ratings (Ra = Σ(Rs×W)/ ΣW). This process is repeated one final time, and an alternative merit score (Σ{Ra×W}), and an alternative merit rating (A = Σ(Ra×W)/ ΣW), is determined for each of the alternatives.

The deliverables for the quantitative analysis are summary tables showing calculations for the sub-account merit ratings, account merit ratings and alternative merit ratings.

4.6 Sensitivity Analysis

In addition to the base case, additional scenarios are considered in order to evaluate the robustness of the analytical process and to determine the degree to which various options are influenced by the choice of weightings.

5.0 CANDIDATE ALTERNATIVES

5.1 Tailings Candidate Alternatives

5.1.1 Tailings Storage Method

5.1.1.1 Underground Storage

Underground mines often require backfill to reduce the potential for subsidence and localized collapse. The Project underground stopes will be backfilled using a consolidated waste rock fill, with the option to use paste fill if required by mine conditions. If waste rock is utilized as underground backfill, there will be no meaningful potential for the storage of tailings solids in the underground. Should a paste backfill be required, there is potential for tailings to be utilized in a paste backfill mix, if it can meet technical requirements and is economically feasible. If paste backfill is required and a tailings component is feasible, this would allow for the storage of a portion of the tailings over the life of the Project.

5.1.1.2 Open Pit Storage

The Project includes a three-lobed open pit, to be mined from west to east based on the current mine plan. Open pits, when completed, form a basin which can potentially be used for the deposition of mine waste, including waste rock and tailings. Similarly, a lobe of the open pit can be used for the deposition of mine waste when completed if appropriate topographic control is present, so long as underground workings are effectively isolated from the deposition area, and the waste is stored in a manner that does not allow movement to active mining areas in the open pit.

5.1.1.3 Filtered Tailings

Filtered tailings production involves using a variety of dewatering and filtration systems to produce a relatively dry (unsaturated) tailings (typically about 20% moisture), which can be trucked or conveyed to a tailings stockpile (sometimes called a dry-stack or filtered stack) on surface. This method of tailings management is primarily utilized in drier climates where water conservation is a critical issue, areas of high seismic activity not suitable for dams, as well as at some northern settings where the stacked tailings remain in an inert frozen state within permafrost. With filtered tailings, conventional dam containment is not required, as the tailings essentially become a pile of fine sand- and silt-sized material that can be contoured as a stockpile. Low height berms may be required along the downstream toe of the stockpile to provide stability. Runoff capture / recycle systems will be required in Canada.

5.1.1.4 Thickened Tailings

Thickened (partially dewatered or paste) tailings production involves using a variety of dewatering systems to produce partially dewatered tailings, which can be pumped to a storage area by pipeline. Unlike filtered tailings, conventional tailings dams are required to contain the filtered tailings. Thickened tailings deposition is typically used where there is an advantage to developing a steeper tailings beach, such as against a natural slope draining towards a downstream tailings dam. In such an instance, more tailings can be stored with less dam volume, as opposed to developing a flatter deposited tailings profile.

5.1.1.5 Conventional Slurry Tailings

The standard method of tailings disposal for northern Ontario gold mining operations is a permanent surface impoundment, surrounded as necessary with dams to ensure containment. Tailings are pumped to the TSF via pipeline and discharged into the impoundment. Tailings flow downgradient in the TSF to form a beach, with effluent reporting to a pond which can be used for water recycle and effluent aging. Developing a lower angle tailings beach promotes overall tailings surface stability, and makes it easier to revegetate exposed tailings beaches.

5.1.2 Potential TSF Locations

Nine potential tailings impoundment locations have been identified as shown in Figure 5-1.

Seven of the tailings impoundment locations (Locations 1 through 7) were selected based on previous engineering studies and the prior assessment of alternatives report (WSP 2014). Criteria for the selection of these sites generally included:

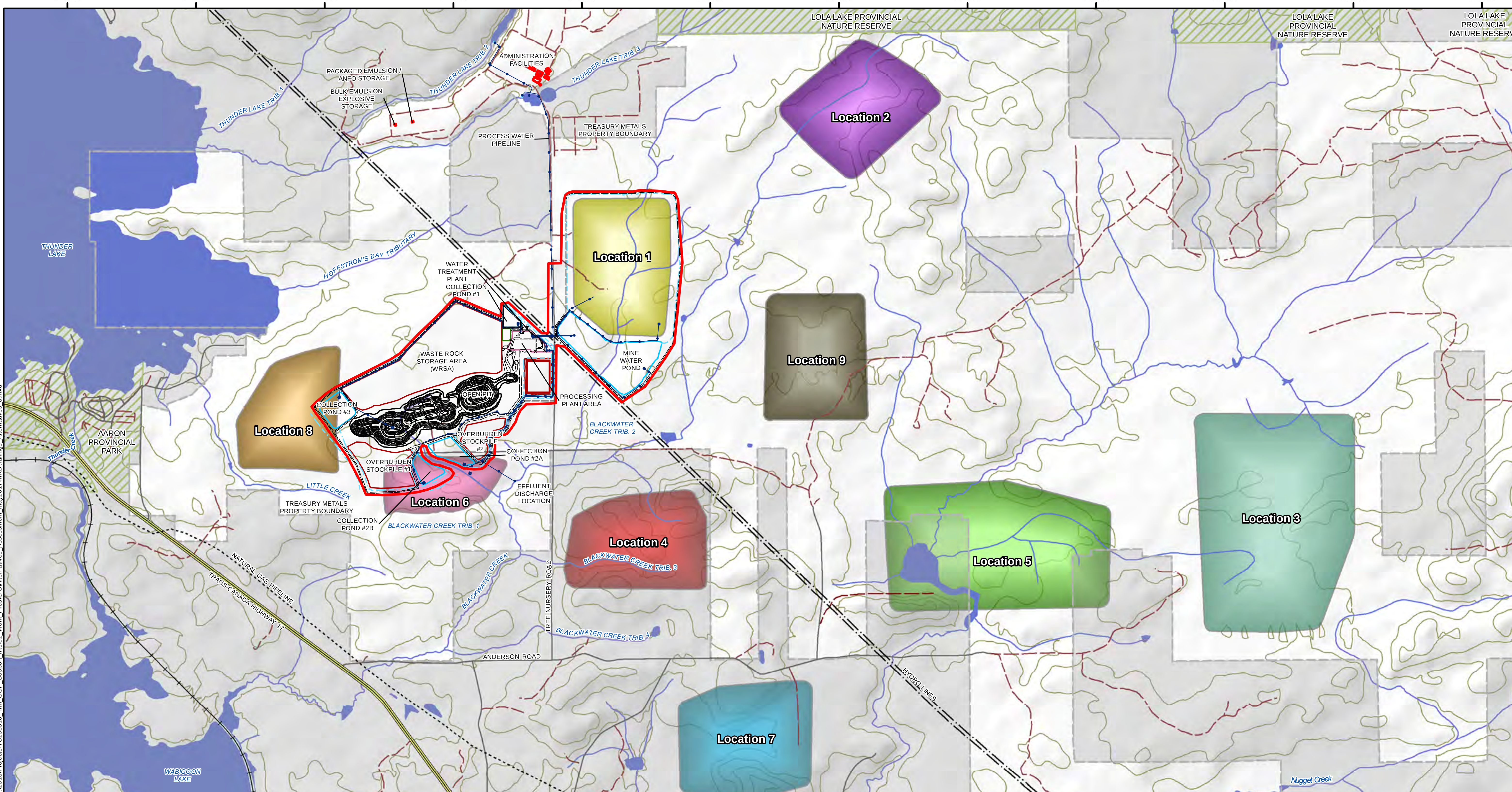
- Avoiding protected areas;
- Avoiding sites distant from the mine; and
- Excluding sites based on legal boundaries and corporate policy.

Two additional sites (Location 8 and Location 9) have been included as candidate alternatives as they do not overprint water, are generally located near the Project site and are situated on property held by Treasury Metals.

5.2 Potential MWP Locations

Nine potential MWP locations have been identified as shown in Figure 5-2. Selection criteria for the MWP candidate alternatives include:

- Located entirely on the Treasury Metals property;
- Generally located adjacent or near to the Project site such that the site ditching can be extended around the MWP to facilitate water management; and
- Additional considerations such as sites that avoid water, or dual purpose with other infrastructure to reduce site footprint.



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LEGEND

- Railway
- Hydro Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Provincial Park / Nature Reserve
- Watercourse
- Waterbody
- Contours (10 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Tailings Alternatives

- Location 1
- Location 2
- Location 3
- Location 4
- Location 5
- Location 6
- Location 7
- Location 8
- Location 9

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Security Fence
- Proposed Minewater and Collection Ponds
- Stockpile

NOTES:
- Topographic data extracted from Land Information Ontario, MNRF.

Datum: NAD83
Projection: UTM Zone 15N

0 0.5 1 2 3 4 5 Kilometres

amec foster wheeler

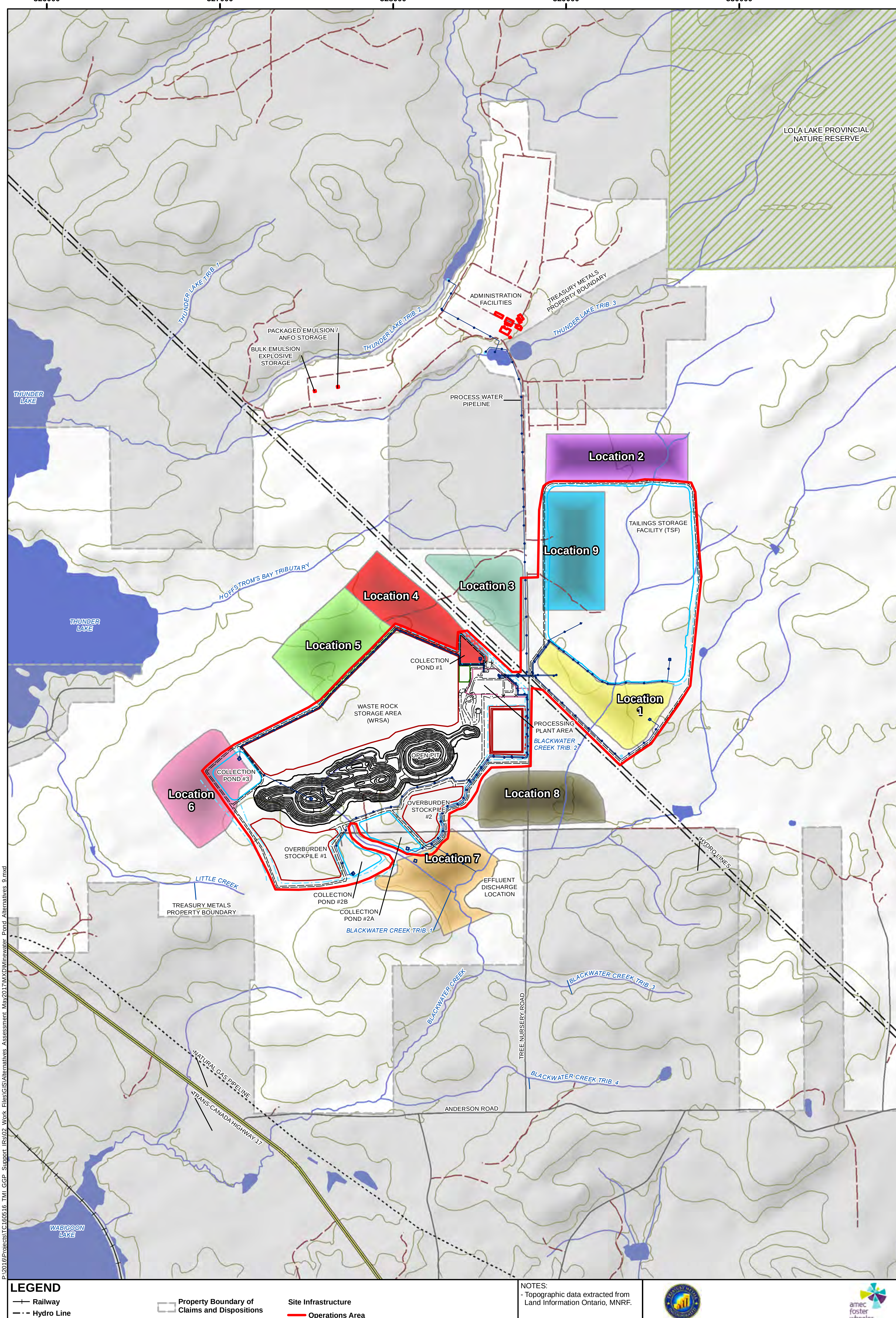
GOLIATH GOLD PROJECT

Candidate Tailings Storage Facility Locations

DRAFT

PROJECT Nº: TC160516 | **FIGURE: 5-1**

SCALE: 1:28,500 | DATE: August 2017



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LEGEND

- Railway
- Hydro Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Provincial Park / Nature Reserve
- Watercourse
- Waterbody
- Contours (10 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Minewater Pond Alternatives

- Location 1
- Location 2
- Location 3
- Location 4
- Location 5
- Location 6
- Location 7
- Location 8
- Location 9

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Security Fence
- Proposed Tailings Storage Facility and Collection Ponds
- Stockpile

0 0.25 0.5 1 1.5 Kilometres

NOTES:
- Topographic data extracted from Land Information Ontario, MNRF.

Datum: NAD83
Projection: UTM Zone 15N

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GOLIATH GOLD PROJECT

Candidate Minewater Pond Locations

DRAFT

PROJECT Nº: TC160516	FIGURE: 5-2
SCALE: 1:20,000	DATE: August 2017

6.0 PRE-SCREENING ASSESSMENT

Prior to completing a comprehensive MAA, a pre-screening assessment is applied to determine whether any alternatives (method or location) have an inherent fatal flaw. If an alternative has a fatal flaw then it is not carried forward to the MAA.

6.1 Tailings Pre-screening Assessment

6.1.1 Pre-Screening Criteria

Pre-screening criteria applicable to the tailings locations are:

- Does the alternative allow for disposal of a meaningful quantity of tailings? (yes/no);
- Is the alternative method a conventional technology in Ontario, or provide a substantial benefit of conventional technologies? (yes/no);
- Is the alternative reasonably close to the Project site (<4 km)? (yes/no);
- Is the alternative located on the Treasury Metals property boundary, or on lands which Treasury Metals can readily acquire? (yes/no);
- Does the alternative avoid unnecessary effects to the Thunder Lake watershed in accordance with Treasury Metals commitments? (yes/no); and
- Does the alternative avoid unnecessary effects to Provincial Parks and Nature Reserves (>1 km distant)? (yes/no).

A summary of the advantages and disadvantages for each alternative tailings method and location is provided in Table 6-1. The results of the pre-screening assessment for candidate tailings alternatives are provided in Table 6-3.

6.1.2 Pre-Screening of Tailings Storage Methods

6.1.2.1 Underground Storage

From an environmental and socio-economic perspective, the use of tailings as part of a paste backfill to augment underground stability is ideal as it has minimal adverse environmental effects although there are additional power requirements. The unit cost for tailings in backfill is much higher compared to surface impoundment due to higher material handling costs, and requirements for a filtration / paste plant.

The Project, as proposed, utilizes waste rock from the open pit underground as backfill and there is minimal space available for additional tailings backfill. Even it a paste backfill utilizing tailings is employed as backfill, the underground mine would not hold a sufficient quantity of tailings to alleviate the need for a new surface impoundment. As the underground mine will be used for the storage of mine waste and cannot store a sufficient quantity of tailings to remove the need for a surface impoundment and the use of underground storage as a candidate tailings disposal method has been eliminated from further consideration in the MAA.

6.1.2.2 Open Pit Storage

The Project open pit is a single pit with three connected lobes. These lobes could provide basins for the impoundment of tailings provided that tailings and supernatant are excluded from active mining areas. However, due to pit geometry, the majority of the storage capacity available in the open pit is above the elevation where the lobes connect. As the lobes have a relatively small volume, only a small portion of tailings could be stored in each lobe without emplacement of engineering structures within the operating pit. This is further compounded by the need to have sufficient supernatant storage above the tailings to account for high precipitation events / periods. Should open pit storage be utilized for tailings, only a small portion of the overall tailings stream could be directed to the open pit, necessitating a surface impoundment, and the open pit may not be available for the deposition of waste rock. Additionally, due to underground mining scheduled to occur at the same time as potentially filling the open pit with tailings it is not certain that the underground area will be possible to sufficiently separate from the open pit tailings disposal and would create an undue risk to the operations personnel. For these reasons, Treasury Metals proposes to backfill portions of the open pit with waste rock. Waste rock allows for the development of benches and slopes, and can utilize a much larger proportion of the open pit void without impacting the safety of mine workers. The use of the open pit for storage of tailings has been screened out.

6.1.2.3 Filtered Tailings

Filtered tailings are best suited for arid sites which have a very limited supply of water and require maximum water recycle, areas of high seismic potential that are not suited to large dams, or arctic sites where a dry stack can be encapsulated by permafrost to minimize acid rock drainage (ARD) / metal leaching (ML). These conditions are not applicable to the Project and used of filtered tailings technology is unproven in northern Ontario at an operational scale. Filtered tailings have an advantage over conventional slurry tailings as the tailings are dewatered at the plant site and no large tailings pond, positioned over tailings is required. This eliminates the potential for a dam breach releasing tailings and effluent with a high potential energy into the environment. No fatal flaws are apparent for the use of filtered stack tailings and this candidate tailings storage method has been carried forward to the MAA.

6.1.2.4 Thickened Tailings

The use of thickened tailings at a mine can offer some advantages over conventional slurry discharge as settled dry densities can be slightly higher with less water lost to tailings void space, and tailings can be deposited with a steeper beach. The topography around the Project does not require the use of thickened tailings for steeper tailings beaches and thickening of the tailings will not substantially reduce dam requirements. As thickened tailings storage methods do not lend any significant advantages over a conventional slurry and have additional power requirements / economic considerations, further review of thickened tailings is not warranted and this alternative has been screened from consideration in the MAA.

6.1.2.5 Conventional Slurry Tailings

The use of conventional slurry for deposition of tailings is standard practice at northern Ontario gold mines. Where required, tailings and effluent from the processing plant can be pre-treated using the SO_2 / air process to destroy cyanide and to precipitate heavy metals to concentration levels that are manageable through further effluent aging in a tailings pond. Alternatively, supernatant liquid or effluent can be treated at the TSF.

The tailings slurry produced at the processing plant can be pumped via pipeline to a surface impoundment which uses natural topography and constructed dams to contain the tailings slurry. A tailings pond forms on top of the tailings which is recycled back to the process plant. No fatal flaws are apparent for the use of conventional tailings slurry in a new TSF and this candidate tailings storage method has been carried forward to the MAA.

6.1.3 Pre-Screening of Alternative Tailings Locations

Nine TSF locations were identified at the preliminary stage (Figure 5-1).

All of the alternative locations were located within 4 km of the mine / process plant, except for Location 3, which is located over 5 km from the process plant. As this location provided no additional benefit, and due to this unnecessary distance which would increase environmental and social effects while driving up Project costs, Location 3 was eliminated as a candidate for further consideration.

Candidate locations located off property could be difficult or impossible to acquire while meeting Project timelines and should be excluded from further consideration. Location 4 is located entirely off property and has been removed from further consideration. Similarly, Location 7 is located on lands held by others and situated near the village of Wabigoon, and has been eliminated as a candidate. Location 5 is partially located off property, and while not a fatal flaw, it is located over a large pond which poses an unnecessary environmental effect. For these reasons, Location 5 has also been removed as a candidate location.

Through the environmental assessment and consultation processes, Treasury Metals has made commitments to avoid placing infrastructure in the Thunder Lake watershed, to the extent practicable. This is to reduce effects to residents on Thunder Lake as well as to reduce potential environmental effects to the lake. Location 8 is the only TSF candidate location located in the Thunder Lake watershed and for that reason is not considered further.

The final criteria is whether the alternative avoids unnecessary effects to Provincial Parks and other protected lands. The Treasury Metals property boundary is bound by Aaron Provincial Park in the west, and Lola Lake Provincial Nature Reserve to the north. Alternatives located proximal to these protected areas have the potential to have greater effect on the parks than more distant alternatives. For the purposes of this assessment, alternatives within 1 km of Aaron Provincial Park or Lola Lak Provincial Nature Reserve are excluded from further analysis. Both Location 2 and Location 8 meet this criterion and have been screened out.

Based on the pre-screening analysis, three locations, Location 1, Location 6 and Location 9 are retained for consideration in the MAA.

6.2 MWP Pre-Screening Assessment

6.2.1 Pre-Screening Criteria

Pre-screening criteria applicable to the MWP candidates are:

- Does the alternative avoid conflicts with existing infrastructure / land use? (yes/no);
- Does the alternative avoid unnecessary effects to permanent watercourses? (yes/no);
- Is the alternative technically feasible? (yes/no); and
- Does the alternative avoid unnecessary effects to Thunder Lake watershed in accordance with Treasury Metals commitments? (yes/no).

A summary of the advantages and disadvantages for each alternative MWP location is provided in Table 6-2. The results of the pre-screening assessment for candidate MWP alternatives are provided in Table 6-4.

6.2.2 Pre-Screening of MWP Candidates

The Project MWP is considerably smaller than the TSF, and accordingly has greater flexibility with regards to placement. Where a TSF or WRSA may require the relocation of existing infrastructure, a MWP has flexibility to be placed in manner that avoids major changes to existing infrastructure. MWP Location 8 for example, would require a >1 km realignment of Tree Nursery Road, the primary access road to the Project site. This would be onerous for all incoming / outgoing traffic and Location 8 has been excluded from further analysis. Similarly, Location 2 overprints a portion of the MNRF tree nursery that is currently growing hybrid trees. As Treasury Metals intends on minimizing tree nursery clearing, Location 2 is also excluded from further analysis.

Similar to the rational for avoiding infrastructure above, the MWP should avoid permanent watercourses where practicable, unless unavoidable. Location 7 would overprint a section of Blackwater Creek, a permanent watercourse, and a large realignment would need to be blasted through high ground. Due to the unnecessary negative effects on Blackwater Creek associated with Location 7, it has been screened out.

Location 4 is intended to make dual use of Collection Pond #1 as a runoff collection pond and as a mine water pond. However, due to the topography of the location, the entire pond would have large excavation requirements to passively capture runoff from the adjacent WRSA. This is further complicated by the adjacent Hydro One Networks Inc. (HONI) transmission line which would result in an inefficient design. Due to the technical challenges, Location 4 has been screened from further consideration.

Through the environmental assessment and consultation processes, Treasury Metals has made commitments to avoid placing infrastructure in the Thunder Lake watershed, to the extent practicable. This is to reduce effects to residents on Thunder Lake as well as to reduce potential environmental effects to the lake. As Location 5 is located entirely within the Hoffstrom's Bay

Tributary / Thunder Lake watershed, it has been screened out as there is no valid rationale for preferring this location. Although Locations 3 and 6 are partially located within the Thunder Lake watershed, they have not been screened out by this criterion. Alternative 3 is located in the Blackwater Creek watershed to the extent possible given the location constraints. Alternative 6 was selected to make dual use of the Collection Pond #3 area to reduce the overall site footprint. It is also split between the watersheds for Hoffstrom's Bay Tributary and Little Creek, which will reduce the flow reduction effects to both sub-watersheds.

Based on the pre-screening analysis, four locations: Location 1, Location 3, Location 6 and Location 9, are retained for consideration in the MAA.

6.3 Alternatives for the Multiple Accounts Analysis

Based on the two tailings storage methods, three tailings storage locations and four MWP locations identified as potentially practicable based on the pre-screening assessment (Sections 6.1 and 6.2), a total of 24 possible alternatives exist. In the interest of having a focused and manageable MAA, consistent with the Guidelines (Environment Canada 2011), rather than assessing every possible combination, alternatives which make the most sense from a mine development perspective have been developed for consideration in the MAA. All candidates not eliminated in the pre-screening step are considered through the alternatives carried forward to the MAA.

6.3.1 Alternative A

Alternative A is the tailings and MWP approach presented through the Revised EIS (Treasury Metals 2017). It utilizes conventional slurry tailings, deposited at TSF Location 1. Minewater would be managed in a pond adjacent to the TSF at MWP Location 1. Both the TSF and MWP would require a MMER Schedule 2 regulatory amendment.

6.3.2 Alternative B

A variant of Alternative A, Alternative B uses the same conventional slurry tailings, deposited subaerially at TSF Location 1. MWP Location 3 was selected, as it is situated near TSF Location 1, and avoids the need for a MMER Schedule 2 regulatory amendment for the MWP. The TSF would require a MMER Schedule 2 regulatory amendment.

6.3.3 Alternative C

Filtered stack tailings was one of the deposition methods carried forward from the pre-screening assessment. The previous assessment of alternatives report (WSP 2014) found that the highest rated filtered stack location was at TSF Location 6. Accordingly, Alternative C utilizes filtered stack tailings deposition at TSF Location 6. MWP Location 6 has been identified as the best MWP location for a filtered stack at TSF Location 6, as it maintains a compact site footprint by not placing mine wastes to the east of Tree Nursery Road. Alternative C will require a MMER Schedule 2 regulatory amendment for the TSF, but not for the MWP.

6.3.4 Alternative D

Alternative D was selected as the best alternative that avoids placing mine waste over waters frequented by fish, and accordingly has no MMER Schedule 2 requirements. It utilizes conventional slurry tailings, deposited subaerially at TSF Location 9. A MWP at Location 9 was selected as it does not overprint water frequented by fish, has favorable terrain for a pond and is located near TSF Location 9.

Table 6-1: Tailings Storage Method and Location Advantages and Disadvantages

Tailings Storage Method / Location	Advantages	Disadvantages
Tailings Storage Method		
Underground Storage	• Reduced effects to the natural and human environment compared to a surface impoundment • Improves stability in the underground workings compared to a no backfill scenario	• Backfill can only be placed once mining is completed in any particular area • Insufficient capacity to store all tailings underground due to swell factor of hard rock to finely ground tailings, the addition of a binder, and tailings from open pit ore • High cost to produce tailings backfill (filtration / paste production plant required) • Unable to store large quantities of waste rock underground (as currently planned) if underground voids are backfilled with tailings
Open Pit Storage	• Reduced effects to the natural and human environment compared to a surface impoundment • Open pits can provide excellent containment and avoid the need for impoundment dams if the pit design is conducive	• As only a single pit is proposed, there are no fully completed open pits available for storage and tailings deposition would be into an active open pit • Increased risks to worker safety • Tailings deposition would not allow potential extraction of low grade mineral resources not currently proposed to be mined in the vicinity of the open pit • Tailings could only be placed once mining in each lobe is complete and a surface impoundment would still be required until the first lobe was available, and due to the insufficient overall capacity in the pit to store tailings • Difficult or impossible to separate open pit from underground operations to facilitate tailings storage while underground operations continue • Could entail higher costs to double handle tailings, if the tailings were first deposited in a surface impoundment and transferred to the pit later • If utilizing a conventional slurry, this open pit lobes have a very small capacity to store tailings without flooding active mining areas • If utilizing filtered tailings, winter deposition could be technically challenging due to material freezing before being properly compacted • If the open pit is used for tailings storage, utilized space would be unavailable for waste rock storage, as currently envisioned

Tailings Storage Method / Location	Advantages	Disadvantages
Filtered Tailings	• Maximum water recycle from the filtration plant will reduce the volume of water bound to the tailings, and will help maintain flows in the Blackwater Creek system as excess water in the site inventory will be treated and discharged • Filtered tailings eliminate the need for a reclaim pond positioned over tailings, and potential TSF failures are less severe • Large tailings dams are not required	• Filtered tailings are typically used in arid environments where water is scarce or in arctic environments where filtered tailings are encapsulated in permafrost, these conditions do not apply to the Project site • Filtration / dewatering systems are expensive to construct and operate • Fugitive dust from the TSF could make regulatory approvals difficult or impossible to acquire • Tailings must be transported by truck or conveyer which requires more equipment and handling than slurry transport • Filtered stacks require continuous construction • Filtered stacks can be technically challenging to construct in winter conditions • Larger runoff collection ditches and ponds compared to thickened and conventional slurry tailings as more water will runoff the stockpile during precipitation events • A larger (and more expensive) water treatment plant will be required
Thickened Tailings	• Thickened tailings allow for the development of steeper tailings slopes, which can reduce the size and cost of tailings dams, depending on topography • Improved water recycle from the dewatering plant will reduce the volume of water bound to the tailings, and will help reduce flow losses in Blackwater Creek as excess water in the site inventory will be treated and discharged • Tailings can be transported via pipeline which is less costly and requires less equipment / maintenance • Potential TSF dam failures have a slightly reduced severity compared to conventional slurry as there is less water to aid in the transport of tailings downslope	• Fugitive dust emissions are greater than conventional slurry tailings • Steeper tailings slopes are more prone to erosion and are more difficult to revegetate at closure • Does not eliminate the need for large tailings dams • Does not eliminate the need for a reclaim pond positioned over tailings • Thickening systems are expensive to construct and operate • Does not notably reduce the TSF footprint compared to a conventional slurry • Deposition scheduling is dependent on dam raises • A larger (and more expensive) water treatment plant will be required • Higher operating costs due to dewatering of tailings greater pumping costs (positive displacement pumps may be required) • More technically challenging to deposit thickened tailings beaches compared to conventional slurry tailings
Conventional Slurry Tailings	• A conventional technology that is commonly used in Ontario • Lower fugitive dust emissions compared to filtered and thickened tailings, particularly advantageous as the Project has nearby receptors • Typically, lower construction and operating costs compared to filtered and thickened tailings • Tailings can be transported via pipeline	• More water bound in the tailings compared to filtered / thickened tailings (this is an advantage from a technical perspective as extra water will require treatment / discharge to the environment) • Dam construction for complete containment can be costly • Deposition scheduling dependent on dam raises • Although unlikely, TSF failures are likely to be more severe compared to filtered and thickened tailings

Tailings Storage Method / Location	Advantages	Disadvantages
Tailings Storage Facility Locations		
TSF Location 1	• Engineering design is well advanced; this location is proposed in the EIS process and in community engagement, which reduces duplication of engineering design and reduces risk of delays in the environmental assessment process. • Topography is relatively good from a dam design perspective • Location is easily accessible from Tree Nursery Road, avoiding the need for a new access corridor • Located within 1 km of processing plant • Location has been previously logged and has a low proportion of mature forest • Located on Treasury Metals property boundary • Groundwater seepage will be drawn to the open pit drawdown cone during operations and will similarly flow into the pit after closure • Site is contiguous with the open pit / processing plant location allowing for activity to remain within the bermed perimeter • Mostly avoids the Thunder Lake watershed	• Will overprint an intermittent watercourse (Blackwater Creek Tributary 2) • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed • Will restrict public access along Tree Nursery Road during construction / operations
TSF Location 2	• Located in a natural valley that will reduce dam requirements along high ground • Located within Blackwater Creek watershed • Located further from human receptors compared to southern locations	• Limited geotechnical information on this location • Limited access by an indirect resource / recreation trail and a new access corridor through an undeveloped area would be required • Adjacent to Lola Lake Provincial Nature Reserve • Will overprint an the headwaters of Blackwater Creek • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed • Overprints a large wetland • Location is not contiguous with the main Project site
TSF Location 3	• Does not overprint water • A resource / recreation trail provides access near Location 3, which could be expanded to a haul road • Relatively flat topography and is acceptable from a dam design perspective	• Furthest location from the processing plant • Overprints a large area of mature forest • Located in the Hughes Creek / Nugget Creek watershed • Adjacent to three watercourses and runoff management could be challenging • Could affect access to logging areas

Tailings Storage Method / Location	Advantages	Disadvantages
TSF Location 4	• Located within 2 km of processing plant • Location is easily accessible from Tree Nursery Road • Located within the Blackwater Creek watershed	• Located entirely off the Treasury Metals property boundary • Bedrock outcrops will reduce storage efficiency • Will overprint two intermittent watercourses • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed • Will restrict public access along Tree Nursery Road and require displacement of a provide residence to the northwest of Location 4 • Overprints a large area of mature forest • Located near residents on Anderson Road and Tree Nursery Road
TSF Location 5	• Topography is acceptable from a dam design perspective • A resource / recreation trail provides access to Location 5	• Remote from process plant (>2 km) • Overprints numerous watercourses and a waterbody • MMER Schedule 2 Considerations • Several watercourse realignments required • Hughes Creek / Nugget Creek watershed • Overprints a large wetland • Wetland could complicate the initial dam construction schedule if winter conditions are required • Partially located off of the Treasury Metals property boundary
TSF Location 6	• Located approximately 1 km from processing plant • Adjacent to open pit and contiguous with the site perimeter allowing for activity to remain within the bermed perimeter • Located on Treasury Metals property boundary • Primarily located within Blackwater Creek watershed • Location is partially cleared of trees • Groundwater seepage will be drawn to the open pit drawdown cone during operations and will similarly flow into the pit after closure	• Overprints a permanent watercourse (Blackwater Creek) and an intermittent watercourse (Blackwater Creek Tributary 1) • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed • Located near residents along Tree Nursery Road • Will displace part of the overburden stockpiles and their runoff collection ponds • Will require a realignment of Blackwater Creek
TSF Location 7	• Does not overprint watercourses • Easily accessible from Anderson Road • High ground to north and south could provide some natural topographic containment, reducing dam requirements and improve TSF storage efficiency	• Located near Village of Wabigoon • Located adjacent to residents along Anderson Road • Located entirely off the Treasury Metals property boundary • Positioned over the Wabigoon Fault, which could increase the dam construction requirements to meet required factors of safety, and could increase seepage rates under the TSF

Tailings Storage Method / Location	Advantages	Disadvantages
TSF Location 8	• Does not overprint watercourses • Contiguous with the site perimeter allowing for activity to remain within the bermed perimeter • Located within 2 km of processing plant • Flat topography is acceptable from a dam design perspective • Located on Treasury Metals property boundary • Groundwater seepage will be drawn to the open pit drawdown cone during operations and will similarly flow into the pit after closure	• Located in the Thunder Lake watershed, which Treasury Metals is attempting to avoid • Located near residents along Thunder Lake (~200 m) • Located near Aaron Provincial Park (<1 km) • Would require a minor redesign of Waste Rock Storage Area (WRSA) and Collection Pond #3 • Loss of flows through Little Creek because the headwater area would be overprinted • Primarily located over forest (with some cleared areas) which would require clearing
TSF Location 9	• Located within 2 km of processing plant • Does not overprint watercourses • Accessible via Dump Road • Located on Treasury Metals property boundary	• Will require a realignment of Dump Road • Located in the Hughes Creek / Nugget Creek watershed • Primarily mature forest which would require clearing

Table 6-2: MWP Location Advantages and Disadvantages

MWP Location	Advantages	Disadvantages
MWP Location 1	• Near open pit and processing plant • Shares a dam with TSF to reduce overall dam construction requirements • High ground along east dam will reduce overall dam construction requirements • Located in Blackwater Creek watershed • Location is already cleared of trees in the southern area, with a partially cleared area in the north	• Will overprint an intermittent watercourse (Blackwater Creek Tributary 2), although part of the overprinted watercourse would have been overprinted by TSF seepage collection systems if the MWP were located elsewhere • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed
MWP Location 2	• Shares a dam with TSF to reduce overall dam construction requirements • Does not overprint any waterbodies frequented by fish • Partially in Blackwater Creek watershed	• Most distant alternative from open pit, distant from processing plant • Overprints a portion of the historic MNRF tree nursery that is currently growing hybrid trees • Less than 1 km from Lola Lake Provincial Nature Reserve • Located partly in the Thunder Lake watershed
MWP Location 3	• Does not overprint any waterbodies frequented by fish • Near open pit and processing plant • Northern portion has already been cleared of trees	• Location constrained by property boundary, and existing transmission lines and the Tree Nursery Road • Located partially in the Thunder Lake watershed • Triangular dam design (to fit in available area) and high ground in center of MWP will result in larger, costly dams with an inefficient design (poor storage volume to dam volume ratio) • Adjacent to property boundary • Will require a minor realignment of Tree Nursery Road (extended east to allow additional room for MWP) • Mature forest in southern portion which will require clearing
MWP Location 4	• Adjacent to processing plant and near open pit • Does not overprint any waterbodies frequented by fish Location is mostly cleared of trees • Replaces Collection Pond #1	• Located primarily in the Thunder Lake watershed • Due to the natural ground slope, and that the MWP would also act as collection pond for the WRSA in this area, the MWP would need to be dug out to passively receive runoff from the WRSA, which will increase material movement requirements and construction costs • Potentially would be visible from Thunder Lake.
MWP Location 5	• Near open pit and to the processing plant (although pipelines would need to extend around the active WRSA) • Does not overprint any waterbodies frequented by fish Location is mostly cleared of trees	• Located entirely in Thunder Lake watershed • Sloping terrain will reduce storage efficiency as larger dams will be required

MWP Location	Advantages	Disadvantages
MWP Location 6	• Removes need for Collection Pond #3 • Adjacent to open pit • Does not overprint any waterbodies frequented by fish	• Furthest location from processing plant • Located in the Thunder Lake watershed • Location is primarily mature forest, although a portion has been cleared • Within 600 m of residents on Thunder Lake
MWP Location 7	• Removes need for overburden collection ponds • Near open pit and processing plant • High ground to the south will provide natural containment and reduce dam requirements • Located in the Blackwater Creek watershed	• Overprints an intermittent watercourse (Blackwater Creek Tributary 1) and a permanent watercourse (Blackwater Creek) • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed • Will require a realignment of Blackwater Creek through high ground • Treated water discharge point would have to extended further down Blackwater Creek • Near local resident on Tree Nursery Road
MWP Location 8	• Located near open pit and processing plant • Located in the Blackwater Creek watershed • Does not overprint any waterbodies frequented by fish	• Overprints an intermittent watercourse (Blackwater Creek Tributary 2) • Will require listing to MMER Schedule 2, including potential risks to Project timelines if listing is delayed • Will require realignment of Tree Nursery Road, with an approximate 1 km longer route • Adjacent to property boundary • Will overprint a dwelling (unoccupied) north of Normans Road • Situated near local residents on Tree Nursery Road • Area is primarily forest
MWP Location 9	• Located near processing plant, although slightly further for open pit • Does not overprint any waterbodies frequented by fish • Natural terrain provides containment and will reduce dam construction requirements	• Not contiguous with the Project site and will require a separate runoff collection system • Partially located in the Thunder Lake watershed

Table 6-3: Tailings - Storage Method and Location Pre-Screening

Pre-Screening Criteria	Rationale	Tailings Storage Method					TSF Locations								
		Underground Storage	Open Pit Storage	Filtered Tailings	Thickened Tailings	Conventional Slurry Tailings	TSF Location 1	TSF Location 2	TSF Location 3	TSF Location 4	TSF Location 5	TSF Location 6	TSF Location 7	TSF Location 8	TSF Location 9
Does the alternative allow for disposal of a meaningful quantity of tailings? (yes/no)	Alternatives that can only manage a portion of the tailings generated are insufficient and will require other alternatives to be employed to meet Project needs.	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is the alternative method a conventional technology in Ontario, or provide a substantial benefit of conventional technologies? (yes/no)	Alternatives that are not suited for, or unproven in northern Ontario should not be considered, unless the alternative offers a substantial benefit over conventional approaches.	Yes	Yes	Yes	No	Yes	—	—	—	—	—	—	—	—	—
Is the alternative reasonably close to the Project site (<4 km)? (yes/no)	Alternatives that are located distant from the Project site will expand the Project footprint, increase environmental and social effects, will be technically more challenging and increase Project costs.	Yes	Yes	NA	NA	NA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Is the alternative located on the Treasury Metals property boundary, or on lands which Treasury Metals can readily acquire? (yes/no)	Alternatives that are located off the Treasury Metals property boundary will require Treasury Metals to acquire additional surface and mineral rights. This is expected to be difficult to achieve and will result in unacceptable Project delays.	Yes	Yes	NA	NA	NA	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes
Does the alternative avoid unnecessary effects to the Thunder Lake watershed in accordance with Treasury Metals commitments? (yes/no)	Throughout the environmental assessment and community engagement processes, Treasury Metals has heard that local residents want Treasury Metals to avoid effects to Thunder Lake as it is relatively pristine. Treasury Metals has committed to reducing effects to Thunder Lake and has moved major facilities from the watershed as practicable. Siting a TSF within the Thunder Lake watershed would be a violation of Treasury Metals' commitments.	Yes	Yes	NA	NA	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Does the alternative avoid unnecessary effects to Provincial Parks and Nature Reserves (>1 km distant)? (yes/no)	Alternatives located adjacent to Aaron Provincial Park or Lola Lake Nature Reserve would result in unnecessary Project related effects into these protected areas.	Yes	Yes	NA	NA	NA	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
	Carried forward to Alternatives Assessment?	No	No	Yes	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes

Table 6-4: Minewater - Storage Method and Location Pre-Screening

Pre-Screening Criteria	Rationale	MWP Locations								
		MWP Location 1	MWP Location 2	MWP Location 3	MWP Location 4	MWP Location 5	MWP Location 6	MWP Location 7	MWP Location 8	MWP Location 9
Does the alternative avoid conflicts with existing infrastructure / land use? (yes/no)	MWPs, while large, allow for more flexibility during placement, compared to WRSAs and tailings storage facilities. Due to this flexibility, alternatives that would conflict with existing infrastructure and land use are not necessary and can be eliminated from further consideration.	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Does the alternative avoid unnecessary effects to permanent watercourses? (yes/no)	Alternatives that encroach on permanent watercourses are not warranted at the Project as they would result in unnecessary effects to the aquatic ecosystem and there is sufficient suitable land available to avoid such effects.	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Is the alternative technically feasible? (yes/no)	Topography can improve or lessen the efficiency of a MWP. In some areas, topography could make a MWP very difficult or impossible to construct / operate. These locations should be excluded from further consideration.	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Does the alternative avoid unnecessary effects to Thunder Lake watershed in accordance with Treasury Metals commitments? (yes/no)	Throughout the environmental assessment and community engagement processes, Treasury Metals has heard that local residents want Treasury Metals to avoid effects to Thunder Lake as it is relatively pristine. Treasury Metals has committed to reducing effects to Thunder Lake and has moved major facilities from the watershed as practicable. Siting a MWP within the Thunder Lake watershed could be seen as a violation of Treasury's commitments, unless the location offered a clear advantage over locations not in the Thunder Lake watershed.	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
	Carried forward to Alternatives Assessment?	Yes	No	Yes	No	No	Yes	No	No	Yes

7.0 ALTERNATIVES CHARACTERIZATION

7.1 Alternative A

Alternative A utilizes conventional slurry tailings technology with a TSF located to the northeast of the open pit, within the Blackwater Creek Tributary 2 basin. The MWP is located adjacent to the TSF, sharing the south dam of the TSF. The focus in designing this alternative was to contain effects from the Project to within the Blackwater Creek watershed and avoid effects to Thunder Lake. As both the TSF and MWP overprint Blackwater Creek Tributary 2, both structures would require an MMER Schedule 2 regulatory amendment.

7.1.1 Environmental Characterization

The focus of designing the TSF and MWP for Alternative A from an environmental perspective was to contain effects from the Project to within the Blackwater Creek watershed. This design approach is largely successful, as Alternative A has the least amount of area that is outside the Blackwater Creek watershed (5.0 ha) compared to the other alternatives assessed. Alternative A will overprint more fish habitat in minor tributaries than the other alternatives (2,300 m of Blackwater Creek Tributary 2). This alternative does not overprint any main stem / river watercourse fish habitat and does not require new roadway watercourse crossings. A fish habitat compensation plan will be developed for the tributary fish habitat loss associated with Alternative A.

Alternative A will overprint 85.3 ha and 12.6 ha of forest and wetlands, respectively. The amount of overprinted forest is comparable to Alternative B (92.9 ha), higher than Alternative C (37.6 ha) and lower than Alternative D (117.3 ha). Alternative A will overprint the largest area of wetland (12.6 ha overprinted), compared to Alternatives B, C and D (10.9, 9.4 and 1.8, respectively).

During baseline studies of the LSA, a small number of SAR were identified as potentially inhabiting the Project area: Common Nighthawk, Barn Swallow, Little Brown Myotis and Northern Myotis. Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA), and may require habitat compensation. Alternative A was assessed with bat surveys, which identified that there is 5.1 ha of habitat that could potentially support bat maternity roosts.

There are three areas that have been assigned Provincial protection in relatively close proximity to the Project. Alternative A (and B) is situated the same distance to Lola Lake Provincial Nature Reserve and Aaron Provincial Park (1.2 km and 3.3 km, respectively). Additionally, Alternative A is located outside the Nugget / Hughes Creek watershed and will not affect the Provincial Fish Sanctuary in Barrett Bay.

7.1.2 Technical Characterization

Alternatives A and B share a TSF design with differing MWP designs. The location suitability of the TSF for Alternative A is very good with a storage volume to dam ratio of 3.6, higher than the other conventional slurry alternative with a ratio of 2.8 (Alternative D). The maximum TSF dam height of 23 m would occur on the south dam of the TSF, and is shorter than the maximum dam height of the other conventional slurry alternative at 31 m (Alternative D). The ground foundation at Alternatives A and B is the most suitable out of the four alternatives, as the conditions provide free draining materials with good foundation shear strength.

The hazard potential of the TSF is greatest for Alternative A (and B) out of the four alternatives, as there is infrastructure in the form of Tree Nursery Road and Normans Road downgradient of the TSF, which are occasionally used by local residents. The hazard potential of the MWP is fair for Alternative A, and has the potential to affect the same infrastructure as the TSF in the event of a dam failure.

Alternative A was designed with the MWP adjacent to the TSF to allow for the best flexibility of water management between the two structures out of the four alternatives. The alternative has the shortest length of perimeter ditching required (4.1 km). In additional to seepage capture infrastructure required by the MMER, Alternative A is almost entirely located within the 2 m groundwater drawdown zone created by mine dewatering, which will result in seepage draining to the mine during operations and closure, until the water table has risen to pre-development levels.

Alternative A has moderate expansion capabilities as TSF dams are partially constrained by the minewater pond to the south, Tree Nursery Road to the west and Blackwater Creek to the east. However, Alternative A has good economics for potential future dam expansions should they be required if additional resources are mineable, compared to the other alternatives due to favorable topography that lowers dam raise costs.

7.1.3 Project Economics Characterization

Alternative A is projected to have the lowest overall costs out of the four alternatives.

For the conventional slurry alternatives, the cost of building the TSF dams is greatest contributor to capital costs. Alternatives A and B will have the lowest TSF dam construction costs due to favorable topography which reduces the dam requirements.

The operational costs of conventional slurry tailings deposition are significantly less than that of filtered stack construction. The TSF and MWP of Alternative A, based on the short distance from the process plant to the TSF and the open pit to the MWP, have very low costs of tailings pumping and deposition compared to the other alternatives. Alternative A also has reduced water management costs as it has low dam heights that decreases the cost of pumping seepage back to the TSF and is situated close to the process plant for water recycle.

Closure costs and post-closure costs are not major contributors to overall costs for Alternative A (dominated by capital costs). Alternative A will impose additional costs for fish habitat compensation. Alternative A along with Alternative B, are believed to have the least financial risk to Treasury Metals, due to overall lower costs of tailings management and have a lower risk of Project delays, compared to Alternatives C and D.

7.1.4 Socio-Economic Characterization

Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. The configuration of Alternative A is anticipated to result in a lower reduction to traditional land access (743 ha of land). This area is comparable to Alternatives B (702 ha) and C (782 ha), and less than Alternative D (1,254 ha). Potential effects to wildlife abundance will be reduced as the TSF and MWP of Alternative A are contiguous with the mine site, maintaining a fairly compact Project site. Thunder Lake was identified by First Nations as culturally important and this alternative limits potential effects to Thunder Lake watershed as Alternative A has the smallest TSF / MWP footprint in the watershed (5.0 ha).

The Project is located in a populated area with nearby residents. The Alternative A TSF and MWP is situated approximately 4.0 km away from the Village of Wabigoon, 2.5 km away from the residents and cottagers on Thunder Lake, 0.8 km away from nearby rural residents and 3.2 km away from Aaron Provincial Park. These distances are comparable to Alternative B and D with slight distance variations between the individual operations area and the four receptors. Alternative C was significantly closer to each of the four receptors compared to Alternative A as described in Section 7.3, and has a much greater probability of leading to operational effects.

7.2 Alternative B

Alternative B utilizes conventional slurry tailings technology and has a TSF to the northeast of the open pit, within the Blackwater Creek Tributary 2 basin. The MWP is located to the west of the TSF, between the existing transmission line and Tree Nursery Road. The focus in designing this alternative was to contain effects from the TSF to within the Blackwater Creek watershed as much as practicable, while ensuring the MWP does not overprint watercourses frequented by fish. For this alternative, only the TSF overprints Blackwater Creek Tributary 2 and would require an MMER Schedule 2 regulatory amendment.

7.2.1 Environmental Characterization

The Alternative B design results in 16.8 ha of the TSF and MWP outside of the Blackwater Creek watershed. The greatest anticipated flow reductions are to Hoffstrom’s Bay Tributary. Alternative B will overprint a shorter length of Blackwater Creek Tributary 2 (2 km) compared to Alternative A (2.3 km), as the MWP does not overprint the watercourse. This alternative does not overprint any main stem / river fish habitat and does not require road watercourse crossings. A fish habitat compensation plan is expected to be required to offset and compensate for fish habitat losses.

Alternative B will overprint 92.9 ha and 10.9 ha of forest and wetlands respectively. The amount of overprinted forest is comparable to Alternative A (85.3 ha), higher than Alternative C (37.6 ha) and lower than Alternative D (117.3 ha). Alternative B will overprint the second largest area of wetland at 10.9 ha compared to Alternatives A, C and D (12.6, 9.4 and 1.8 respectively).

During baseline studies of the LSA, a small number of SAR species were identified as potentially inhabiting the Project area: Common Nighthawk, Barn Swallow, Little Brown Myotis, Northern Myotis). Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA). It was identified during bat surveys that Alternative B would overprint 5.1 ha of habitat that could potentially support bat maternity roosts.

Alternative B (and A) is situated the same distance to Lola Lake Provincial Nature Reserve and Aaron Provincial Park at 1.3 km and 3.3 km, respectively. Additionally, Alternative B is located outside the Nugget / Hughes Creek watershed and accordingly, will not affect the Provincial Fish Sanctuary in Barrett Bay.

7.2.2 Technical Characterization

Alternatives A and B share a TSF design with differing MWP designs. The location suitability of the TSF for Alternative B is very good with a storage volume to dam ratio of 3.6, higher than the other conventional slurry alternative with a ratio of 2.8 (Alternative D). The maximum TSF dam height of 23 m (south dam) is shorter than the maximum dam height of Alternative D (31 m). The dam foundations of Alternative B (and A) is the most suitable out of the four alternatives as the conditions provide free draining materials with good foundation shear strength. The MWP dam height would be significantly shorter than the TSF, but the MWP dam for Alternative B is the second tallest (12.0 m) of all the alternatives.

The hazard potential of the TSF is greatest for Alternative B (and A) of the four alternatives assessed, as there is infrastructure in the form of Tree Nursery Road and Normans Road downgradient of the TSF, which are occasionally used by local residents. Additionally, the hazard potential of the MWP is fair for Alternative B, and has the potential to affect the same infrastructure as the TSF in the of a dam failure, and could also fail towards a property not owned by Treasury Metals located adjacent to the MWP.

Alternative B was designed with the MWP in close proximity to the TSF while not overprinting water frequented by fish. The close proximity of these two structures allows for good flexibility of water management, but it is not as flexible as Alternative A. Additionally, as Alternative B does not have a shared TSF and MWP dam, a longer (5.8 km) perimeter ditch would be required to capture runoff (as opposed to 4.1 km for Alternative A). In additional to seepage capture infrastructure required by the MMER, Alternative B is almost entirely located within the 2 m groundwater drawdown zone created by mine dewatering, which will result in seepage draining to the mine during operations and closure, until the water table has risen to pre-development levels.

The Alternative B TSF has a large capacity for expansion should it be needed, and good economics for expansion due to topographic conditions at the TSF.

7.2.3 Project Economics Characterization

Alternative B is projected to have the second lowest overall costs out of the four alternatives after Alternative A.

For conventional slurry alternatives, the capital cost of building the TSF dams is the greatest cost of the alternative. Alternative B (and A) will have the lowest TSF dam construction costs due to favorable topography, although Alternative C will not require TSF dams. Alternative B will have higher MWP dam construction costs compared to Alternative A due to less favorable topography and the presence of high ground in the proposed MWP area.

The operational costs of conventional slurry tailings deposition are significantly less than that of filtered stack construction. The TSF and MWP of Alternative B, based on the short distance from the process plant to the TSF and the open pit to the MWP, have very low costs of tailings pumping and deposition compared to the other alternatives. Additionally, Alternative B has reduced water management costs, as it has low dam heights that reduce the cost of pumping seepage back to the TSF and is situated close to the process plant for water recycle.

Closure costs and post-closure costs are not major contributors to overall costs for Alternative A (dominated by capital costs). Alternative B assumes additional costs for fish habitat compensation and a realignment of Tree Nursery Road. Alternative B along with Alternative A, are believed to have the least financial risk to Treasury Metals, due to overall lower costs of tailings management and have a lower risk of Project delays, compared to Alternatives C and D.

7.2.4 Socio-Economic Characterization

Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. The configuration of Alternative B is anticipated to result in limited traditional access to approximately 702 ha of land, which is slightly less than Alternatives B (702 ha) and C (782 ha), and considerably less than Alternative D (1,254 ha). Potential effects to wildlife abundance will be reduced as the TSF and MWP of Alternative B are generally contiguous with the mine site, maintaining a fairly compact Project site. Alternative B has a notable TSF and MWP footprint within the Thunder Lake watershed (16.8 ha). Thunder Lake was identified by First Nations as culturally important and effects from the Project should be limited at this lake.

The Project is located in a populated area where nearby residents could experience potential effects (air, noise and aesthetics) from some of the alternative configurations. The Alternative B TSF and MWP is situated approximately 4.4 km away from the Village of Wabigoon, 1.9 km away from the residents and cottagers on Thunder Lake, 1.1 km away from nearby rural residents and 2.7 km away from Aaron Provincial Park. These distances are comparable to Alternative A and D with slight distance variations between the individual operations area and the four receptors. Alternative C was significantly closer to each of the four receptors compared to Alternative A, and has a much greater probability of leading to operational effects due.

7.3 Alternative C

Alternative C utilizes filtered stack tailings with the TSF located south of the open pit, within the basin of both Blackwater Creek and Blackwater Creek Tributary 1. The MWP is located to the west of the open pit and provides a contiguous site footprint that minimizes the Project footprint. The focus in designing this alternative was to place the TSF in close proximity to the process plant and maintain a compact site footprint, while utilizing a TSF without a tailings pond located over impounded tailings. As the TSF overprints two watercourses frequented by fish, Alternative C would require an MMER Schedule 2 regulatory amendment.

7.3.1 Environmental Characterization

The focus of designing the TSF and MWP for Alternative C from an environmental perspective was to maintain a compact site footprint. Although the TSF is located win the Blackwater Creek watershed, modifications to the site layout result in other aspects of the Project (overburden stockpile and runoff collection pond) being located in the Thunder Lake watershed. Alternative C results in larger flow reductions to nearby watercourses compared to the other alternatives and Little Creek will experience approximately 23% flow reductions. Although Alternative C will overprint significantly less tributary fish habitat than Alternatives A and B at 750 m of Blackwater Creek Tributary 1, it may require realignment of 415 m of the Blackwater Creek main stem, depending on size requirements of the TSF runoff collection ponds. A fish habitat compensation plan would need to be developed for the tributary and main stem fish habitat loss for Alternative C.

The alternatives vary significantly between the amount of terrestrial resources that each overprint. Alternative C will overprint 37.6 ha and 9.4 ha of forest and wetlands respectively. The amount of overprinted forest is considerably less than all the other alternatives with the second least overprinting 85.3 ha (Alternative A). Alternative C will overprint the third largest area of wetland at 10.9 ha compared to Alternatives A, B and D with 12.6 ha, 10.9 ha and 1.8 ha respectively.

During baseline studies of the LSA, a small number of SAR were identified as potentially inhabiting the Project area including: Common Nighthawk, Barn Swallow, Little Brown Myotis and Northern Myotis. Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA) and may require habitat compensation. Alternative C was the only alternative that was found to not overprint habitat supporting potential bat maternity roosts.

Alternative C is situated the greatest distance away from Lola Lake Provincial Park (3.5 km) but the closest alternative to Aaron Provincial Park (1.9 km). Alternative C is located outside the Nugget / Hughes Creek watershed and will not have any effect on the Provincial Fish Sanctuary in Barrett Bay.

7.3.2 Technical Characterization

Alternative C utilizes a filtered stack approach to tailings management, such that there is no tailings pond. The location suitability of the TSF for Alternative C is good, although a moderate length haul route from the dewatering plant to the filtered stack will be required. The foundation of Alternative C is the least suitable of the four alternatives, as the conditions provide low permeable material with only fair foundation shear strength. The MWP storage volume to dam volume ratio for Alternative C is the same as Alternative A of 3.9, greater than Alternative B (2.5) and less than Alternative D (5.1).

As Alternative C uses filtered stack technology, large containment dams would not be required around the TSF. As such, the potential of the dry stack failure is generally limited to slope failure, or collection pond failure. Potential risks to public safety are reduced compared to the other alternatives. The hazard potential of the MWP is higher, as it is situated on high ground near residents along Thunder Lake, which could be affected by a failure.

Alternative C has the least flexibility to manage water of the alternatives, as the filtered stack option has less available water storage capacity to manage upset conditions, such as higher than anticipated sediments, or during periodic maintenance on the water treatment plant. Also, the MWP overprints a waste rock storage area collection pond and the design requires mixing of waste rock runoff with mine water. As filtered stack construction requires extensive dewatering of the tailings slurry from the process plant, the maximized water recycle will increase the amount of water on site requiring treatment before discharge. This may require Treasury Metals to increase the size of the treatment plant to accommodate the excess water. In additional to seepage capture infrastructure required by the MMER, Alternative C is located entirely within the 2 m groundwater drawdown zone created by mine dewatering, which will result in seepage draining to the mine during operations and closure, until the water table has risen to pre-development levels.

The location of the TSF will require a realignment of Blackwater Creek Tributary 1 as well as Blackwater Creek main stem; requiring the most extensive watercourse realignment of the four alternatives. A relatively short perimeter ditch (4.4 m) would need to be built around the TSF, which is slight longer than Alternative A (4.1 m), which has the shortest perimeter ditch requirements.

Alternative C has large expansion capabilities with good economics and is comparable with Alternative B as the best alternatives for expansion. Using filtered stack tailings deposition does not require the raising of dams, and allows for the tailings pile to be built higher without having to increase the land area overprinted.

Alternative C will utilize filtered stack technology, which has a much greater potential to generate fugitive dust emissions compared to conventional slurry technology. Additionally, the TSF will be located near the property boundary, which does not provide a buffer to reduce effects from dust emissions outside the property. That stated, it is unlikely that Alternative C will be able to meet the regulatory requirements for air quality at the property boundary, and may not be possible to obtain the necessary environmental approvals.

7.3.3 Project Economics Characterization

Alternative C is projected to have the highest overall costs out of the four alternatives.

Capital costs for Alternative C are lower than the conventional slurry alternatives, as costly embankment dams for the TSF are not required. A filtration plant capable of dewatering the tailings to an unsaturated state will be required at a lower cost than the dams.

Operational costs for Alternative C are much higher than the other alternatives as a result of several factors including: tailings dewatering at the filtration plant, transportation of filtered tailings by truck, spreading tailings and constructing the stockpile, and treating excess water.

Although relatively minor compared to capital and operational costs, Alternative C has the highest closure costs of the four alternatives. Alternative C is the only alternative that requires a dry TSF cover, which will require more material movement compared to the other alternatives. Alternative C will have additional costs associated with fish habitat compensation.

Due to the high overall costs associated with Alternative C, there is an increased risk that fluctuations in the price of gold would could result in Project delays, entering a care and maintenance phase, or forced early shutdown. Alternative C also has the greatest risk of EA or environmental approval delays or rejection due to potential compliance issues with fugitive dust emissions from the TSF. Additionally, Alternative C has the greatest risk of displacing nearby rural residents due to exceedances in health guidelines for fugitive dust at sensitive receptors. Treasury Metals may have to buy the land, or go through lengthy court battles that could take years to acquire the land, resulting in Project delays.

7.3.4 Socio-Economic Characterization

Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. The configuration of Alternative C is anticipated to result in limited traditional access to approximately 782 ha of land. Effects to wildlife abundance will be reduced as the TSF and MWP of Alternative C allow for the most compact Project site of the alternatives. Alternative C has the largest TSF / MWP footprint in the Thunder Lake watershed, and also moves other mine infrastructure (overburden stockpile and a runoff collection pond) into the Thunder Lake watershed (37.8 ha). Thunder Lake was identified by First Nations as culturally important and effects from the Project should be limited at this lake.

The Project is located in a populated area where nearby residents could experience potential effects (air, noise and aesthetics) if approvals for the alternative could be obtained. As Alternative C utilizes a filtered stack for TSF storage, the drier tailings will result in greater fugitive dust emissions, resulting in increased air quality and aesthetic effects. The drier tailings are also expected to result in increased particulate matter concentrations in the air, in excess of guidelines for the protection of human health, likely requiring the relocation of two nearby residents if approvals could be obtained. TSF construction will also be continuous, resulting in continuous noise emissions associated with TSF construction, unlike the conventional slurry alternatives, which will require occasional dam raises, predominately during daytime hours.

The Alternative C TSF and MWP are closer to nearby dwellings compared to the other alternatives; situated approximately 3.1 km away from the Village of Wabigoon, 0.5 km away from the residents and cottagers on Thunder Lake, 0.5 km away from nearby rural residents and 3.2 km away from Aaron Provincial Park.

7.4 Alternative D

Alternative D utilizes conventional slurry tailings technology with the TSF to the east of the open pit and the MWP to the northeast of the open pit. It has the largest site footprint with both the TSF and MWP located the furthest away from the centroid of the open pit of all the alternatives. The focus in designing Alternative D was to have an alternative that does not overprint any waters frequented by fish.

7.4.1 Environmental Characterization

The main focus of designing the TSF and MWP for Alternative D was to not overprint waters frequented by fish. To avoid these waters however, there is 91.1 ha of the Alternative D TSF and MWP outside the Blackwater Creek watershed and the alternative affects multiple watersheds in the area including Hoffstrom's Bay Tributary, Blackwater Creek and the Hughes Creek / Nugget Creek system. Two haul road watercourse crossings will also be required over Blackwater Creek and Blackwater Creek Tributary 2, which could result in an increased effect to the aquatic environment at the crossings.

Alternative D will overprint 117.3 ha of forest and 1.3 ha of wetlands. The amount of overprinted forest is the largest of the alternatives, but Alternative D will overprint the smallest area of wetland (1.8 ha compared to Alternatives A, B and C with 12.6, 10.9 and 9.4 respectively).

During baseline studies of the LSA, a small number of SAR species were identified as potentially inhabiting the Project area including: Common Nighthawk, Barn Swallow, Little Brown Myotis and Northern Myotis. Of these species, the Little Brown Myotis and Northern Myotis are the only species that are classified as Endangered both Provincially (ESA) and Federally (SARA) and may require habitat compensation. The Alternative D MWP will overprint 2.9 ha of habitat that could potentially support bat maternity roosts. The TSF is located in a forested area that was not assessed during bat surveys.

Alternative D will have the greatest greenhouse gas emissions of the alternatives based on diesel fuel emissions associated with haul truck traffic for TSF construction. Over the projected life of the mine, Alternative D will have an estimated 1,330,000 km of total haul distance, compared to 181,000 km for Alternatives A and B and 877,000 km for Alternative C.

There are three areas that have been assigned Provincial protection in relatively close proximity to the Project. Alternative D is situated 1.9 km away from Lola Lake Provincial Park and is the furthest alternative to Aaron Provincial Park (4.7 km). However, a portion of Alternative D is located within the Nugget / Hughes Creek watershed and it could potentially affect the Provincial Fish Sanctuary in Barret Bay.

7.4.2 Technical Characterization

As a requirement of the Schedule 2 process, Alternative D was designed to not overprint any water frequented by fish. This design approach significantly impacts the technical aspects of the alternative. This alternative has the worst location suitability of the TSF alternative considered, with a storage volume to dam ratio of 2.8, which is lower than the other conventional slurry alternatives with a ratio of 3.6 (Alternatives A and B). The maximum TSF dam height of 31 m would be built on the south dam of the TSF and is the largest dam that would be built out of the four alternatives. The foundation of Alternative D is rated fair as conditions provide moderately free draining material with moderate foundation shear strength. The MWP dam height would however, be the shortest of the alternatives with a maximum height at 8.0 m.

The hazard potential of the TSF for Alternative D is better than the other conventional slurry alternatives (Alternatives A and B), as a dam failure would only affect a forestry road seldom used by local residents. Additionally, the hazard potential of the MWP is poor for Alternative D, as a dam break has the potential to affect local infrastructure occasionally used by local residents (Tree Nursery Road and Normans Road).

As Alternative D was designed to not overprint water, a location could not be found which allowed the TSF and MWP to be situated in close proximity to each other. Alternative D has the least flexibility of water management of the conventional slurry alternatives (Alternative A and B), as there is a considerably greater distance for water to be pumped between the TSF and processing plant / MWP area. Although seepage capture infrastructure required by the MMER, unlike the other alternatives, Alternative C is located entirely outside of the 2 m groundwater drawdown zone created by mine dewatering, and seepage that bypasses the seepage collection system would report to the Nugget Creek / Hughes Creek system.

The overall size of the TSF for Alternative D requires the longest perimeter ditch system (6.0 km) to capture runoff. However, the benefit of Alternative D is that it does not overprint water, and it is also the only alternative that does not require a watercourse realignment.

Alternative D has large expansion capabilities with poor economics and is a slightly worse alternative compared to Alternatives B and C for expansion. The TSF dams can be raised on all sides without affecting existing mine infrastructure and is much less likely to require a second TSF in the event more ore was viable for processing. However, to cost to raise the dams would be significant primarily because of the large southern dam.

Alternative D will utilize conventional slurry technology, which has a lower potential to generate fugitive dust emissions compared to filtered stack technology. Additionally, the TSF will be located away from the property boundary, which provides a large buffer from dust emissions affecting outside the property. As such, Alternative D has the greatest likelihood of meeting all regulatory requirements for air quality at the property boundary and complying with environmental approvals.

7.4.3 Project Economics Characterization

Alternative D is projected to have the second highest overall costs out of the four alternatives.

For conventional slurry alternatives, the capital cost of building the TSF dams is the greatest cost of the alternative. Due to the selection of less favorable topography, which is required to avoid overprinting watercourses, Alternative D will have larger and more costly dams than the other conventional slurry alternatives. Alternative D is also further from the ore processing plant, requiring longer haul roads and pipeline infrastructure compared to the other alternatives, further increasing capital costs.

The operational costs of conventional slurry tailings deposition are significantly less than that of filtered stack construction. The TSF and MWP of Alternative D, based on the long distance from the process plant to the TSF and the open pit to the MWP, have higher costs of tailings deposition and pumping compared to the other conventional slurry alternatives.

Closure costs and post-closure costs are not major contributors to overall costs for Alternative D (dominated by capital costs). However, Alternative D will have relatively high closure costs in comparison to the other conventional slurry alternatives, primarily due to the larger TSF and MWP footprints, and additional haul road and pipeline infrastructure to be reclaimed.

Due to the high overall costs associated with Alternative D, there is an increased risk that fluctuations in the price of gold would could result in Project delays, entering a care and maintenance phase, or forced early shutdown.

7.4.4 Socio-Economic Characterization

Although no specific heritage sites were identified in the Project operations area to date by Aboriginal peoples, the intrinsic value of traditional uses of the land is understood by Treasury Metals. Due to the spread out nature of Alternative D, it is anticipated to result in greater areas where traditional access could be limited or restricted (1,254 ha) compared to the other alternatives, which range from 702 to 782 ha. Effects to wildlife abundance will be greater than the other alternatives, as the Project site will be larger and less compact, resulting in greater habitat loss and extending Project related effects into a relatively undisturbed area.

Alternative D is more remote from nearby residents than several of the other alternatives, as it is situated in a relatively undeveloped area, approximately 4.1 km away from the Village of Wabigoon, 2.5 km away from the residents and cottagers on Thunder Lake, 1.5 km away from nearby rural residents and 3.3 km away from Aaron Provincial Park.

Alternative D will require a minor realignment of a forest access road, and will require Normans Road to be closed to public traffic, in addition to Tree Nursery Road.

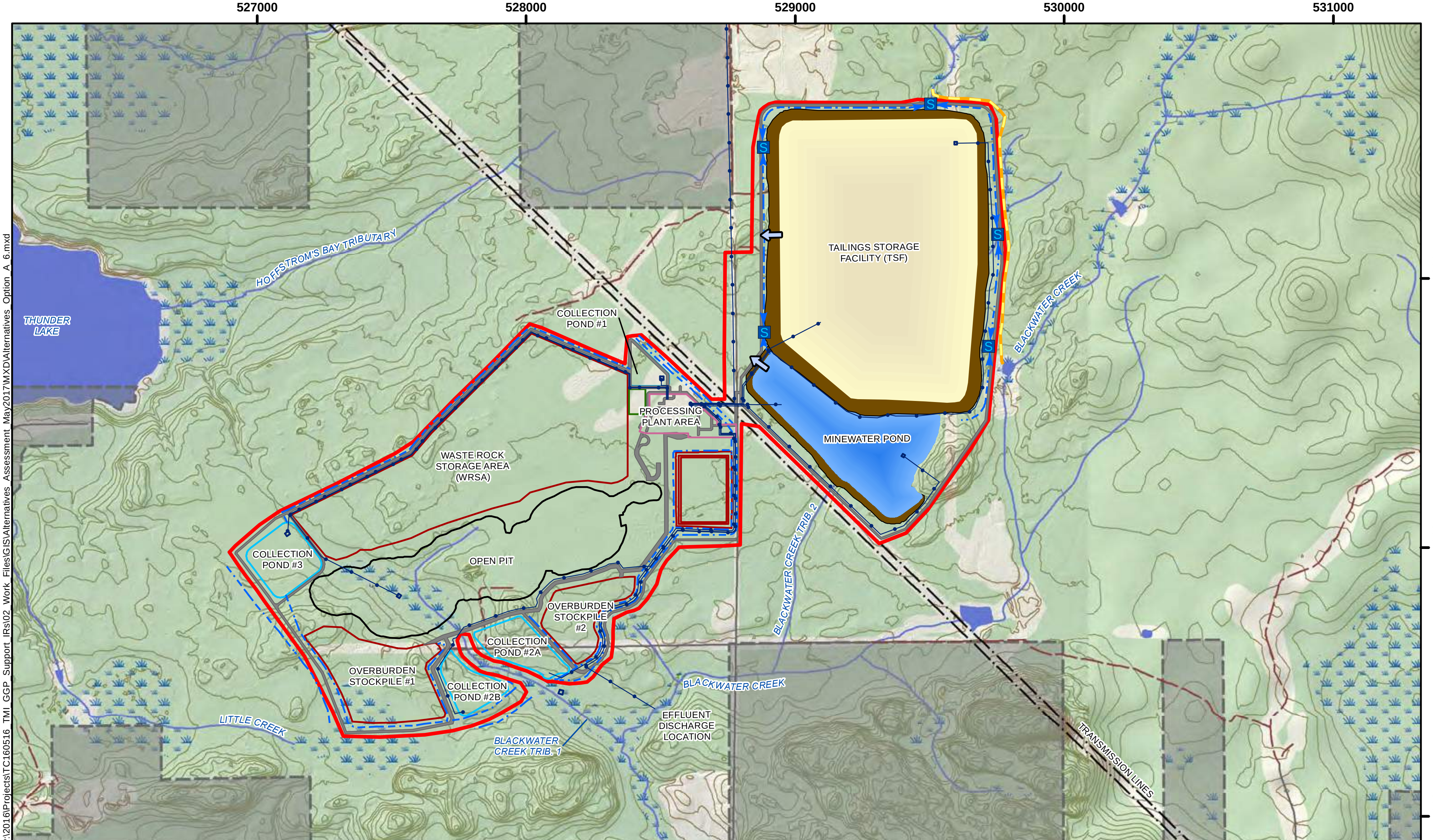
Table 7-1: Alternatives Characterization

Account	Sub-Account	Indicator	Parameter	Unit	Alternative A	Alternative B	Alternative C	Alternative D	Data Source
Environmental	Surface and Groundwater Quantity and Quality	Flow Loss	Qualitative scale	—	Fair	Fair	Very Poor	Very Good	Amec Foster Wheeler
		Flow Reductions Outside Blackwater Creek	Area outside Blackwater Creek watershed	ha	5.0	16.8	37.8	91.9	Amec Foster Wheeler
		Seepage Capture During Operations	Area located outside of the 2 m drawdown zone	ha	0.1	0.1	0.0	90.9	Amec Foster Wheeler – Appendix M
	Aquatic Resources	Tributary Fish Habitat Losses	Length of watercourse overprinted	m	2300	2003	750	0	DST, Klohn Crippen Berger & KBM Resource Group – Appendix Q Amec Foster Wheeler
		Main stem Watercourse Fish Habitat Losses	Length of watercourses overprinted	m	0	0	415	0	DST, Klohn Crippen Berger & KBM Resource Group – Appendix Q Amec Foster Wheeler
		Watercourse Crossings	Number of haul road crossings	#	0	0	0	2	Amec Foster Wheeler
	Terrestrial Resources	Forest Loss	Area of forest loss	ha	85.3	92.9	37.6	117.3	Amec Foster Wheeler – Ecological Land Classification
		Wetland Loss	Area of wetland loss	ha	12.6	10.9	9.4	1.8	Amec Foster Wheeler – Ecological Land Classification
		Use of Recently Disturbed Land	Area of forest disturbed	ha	9.2	5.2	10.8	0.0	Amec Foster Wheeler – Ecological Land Classification
	SAR	Common Nighthawk	Combined area of disturbed or partially disturbed sites	ha	9.2	5.2	10.8	0.0	DST Consulting Engineers, Klohn Crippen Berger & KBM Resource Group – Appendix Q Amec Foster Wheeler
		Barn Swallow	Total haul distance	km	181,000	181,000	887,000	1,133,000	DST, Klohn Crippen Berger & KBM Resource Group – Appendix Q Amec Foster Wheeler
		Bats	Qualitative scale	—	Good	Good	Excellent	Poor	DST, Klohn Crippen Berger & KBM Resource Group – Appendix Q Amec Foster Wheeler
	Atmospheric Emissions	Fugitive Dust	Qualitative scale	—	Excellent	Excellent	Poor	Very Good	Amec Foster Wheeler
		Noise Emissions	Qualitative scale	—	Excellent	Very Good	Fair	Good	Amec Foster Wheeler
		Greenhouse Gas (GHG) Emissions	Total haul distance	km	181,000	181,000	887,000	1,133,000	Amec Foster Wheeler
		Light Trespass	Qualitative scale	—	Very Good	Very Good	Fair	Good	Amec Foster Wheeler
	Protected Areas	Distance to Nature Reserve	Distance	m	1250	1250	3520	1920	Amec Foster Wheeler
		Distance to Provincial Park	Distance	m	3330	3330	1900	4740	Amec Foster Wheeler
		Provincial Fish Sanctuary	Qualitative scale	—	Excellent	Excellent	Excellent	Good	Amec Foster Wheeler
	Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	Distance from TSF to Thunder Lake	km	2.2	2.2	1.4	3.8	Amec Foster Wheeler

Account	Sub-Account	Indicator	Parameter	Unit	Alternative A	Alternative B	Alternative C	Alternative D	Data Source
Environmental (cont'd)	Closure / Post-Closure (cont'd)	Surface Water Discharges	Qualitative scale	—	Very Good	Very Good	Fair	Poor	Amec Foster Wheeler
Technical	Design Factors	TSF Location Suitability	Qualitative scale	—	Very Good	Very Good	Good	Fair	Amec Foster Wheeler
		MWP Location Suitability	Storage to Dam Volume Ratio	ratio	3.9	2.5	3.9	5.1	Amec Foster Wheeler
		Foundation Suitability	Qualitative scale	—	Good	Good	Poor	Fair	Amec Foster Wheeler
	Safety Factors	TSF Hazard Potential	Qualitative scale	—	Fair	Fair	Very Good	Good	Amec Foster Wheeler
		MWP Hazard Potential	Qualitative scale	—	Fair	Poor	Very Poor	Poor	Amec Foster Wheeler
		Maximum TSF Dam Height	Height	m	23	23	n/a	31	Amec Foster Wheeler
		Maximum MWP Dam Height	Height	m	12.5	12	8.5	8	Amec Foster Wheeler
		Worker Health	Qualitative scale	—	Very Good	Very Good	Very Poor	Excellent	Amec Foster Wheeler
	Water Management	Seepage During Operations	Percent of TSF located in the 2 m drawdown zone	%	99.9	99.9	100	0	Amec Foster Wheeler – Appendix M
		Runoff Management	Length of ditching	km	4.1	5.8	4.4	6.0	Amec Foster Wheeler
		Watercourse Realignments	Qualitative scale	—	Fair	Fair	Poor	Excellent	Amec Foster Wheeler
		Excess Water Management	Qualitative scale	—	Very Good	Very Good	Very Poor	Very Good	Amec Foster Wheeler
		Flexibility of Water Management	Qualitative scale	—	Very Good	Good	Very Poor	Poor	Amec Foster Wheeler
	Expansion Capacity	Expansion Capacity	Qualitative scale	—	Good	Excellent	Excellent	Very Good	Amec Foster Wheeler
	Compliance with Environmental Approvals	Dust Management	Qualitative scale	—	Very Good	Very Good	Very Poor	Excellent	Amec Foster Wheeler
Project Economics	Capital Costs	Clearing / Site Preparation	Cost (millions)	$	4.6	4.7	1.6	5.0	Amec Foster Wheeler
		TSF Dam Construction	Volume	m³	2,350,000	2,350,000	n/a	3,000,000	Amec Foster Wheeler
		Tailings Dewatering Infrastructure	Cost (millions)	$	Excellent	Excellent	Poor	Excellent	Amec Foster Wheeler
		MWP Construction	Dam volume	m³	260,000	405,000	300,000	200,000	Amec Foster Wheeler
		Roads	Length of haul roads	km	0.4	0.4	1.5	2.5	Amec Foster Wheeler
		Pumping Infrastructure	Length of pipelines	km	7.0	5.8	5.0	11.5	Amec Foster Wheeler
		Seepage Collection Infrastructure	Length of ditching	km	4.1	5.8	4.4	6.0	Amec Foster Wheeler
	Operating Costs	Tailings Deposition	Qualitative scale	—	Excellent	Excellent	Poor	Good	Amec Foster Wheeler
		TSF Water Management	Qualitative scale	—	Excellent	Excellent	Very Poor	Fair	Amec Foster Wheeler

Account	Sub-Account	Indicator	Parameter	Unit	Alternative A	Alternative B	Alternative C	Alternative D	Data Source
Project Economics (cont'd)	Operating Costs (cont'd)	MWP Pumping	Distance pumped	km	4.0	2.8	2.4	4.2	Amec Foster Wheeler
	Closure Costs	TSF Cover	Cost (millions)	$	2.4	2.4	7.1	2.5	Amec Foster Wheeler
		MWP Reclamation	Area to be reclaimed	m²	195,000	220,000	275,000	280,000	Amec Foster Wheeler
		Road Reclamation	Length of road	km	0.4	0.4	1.5	2.5	Amec Foster Wheeler
	Post-Closure Costs	Inspection / Maintenance / Monitoring	Qualitative Scale	—	Very Good	Very Good	Excellent	Very Poor	Amec Foster Wheeler
		Risk of Additional Treatment Facilities	Qualitative scale	—	Excellent	Excellent	Good	Very Poor	Amec Foster Wheeler
	Ancillary Costs	Fish Habitat Compensation	Length of watercourse overprinted	km	2300	2003	1168	0	Amec Foster Wheeler
		SAR Compensation	Area of bat habitat overprinted	ha	Good	Good	Excellent	Poor	Amec Foster Wheeler
		Road Realignment	Length of road realignment	m	0	560	0	1160	Amec Foster Wheeler
		Haul Distances for Overburden Stockpiles	Distance	m	156	156	170	156	Amec Foster Wheeler
	Risk	Risk of EA or Environmental Approval Delays or Rejection	Qualitative scale	—	Very Good	Very Good	Very Poor	Fair	Amec Foster Wheeler
		Risk Arising from TSF Costs	Qualitative scale	—	Good	Good	Very Poor	Fair	Amec Foster Wheeler
		Delays from Displacing Local Residents	Qualitative scale	—	Excellent	Excellent	Good	Excellent	Amec Foster Wheeler
Socio-Economic	Aboriginal Land Use and Heritage Value	Access Effected Areas	Area with limited access	ha	743	702	782	1254	Amec Foster Wheeler
		Wildlife Abundance	Qualitative scale	—	Good	Good	Very Good	Poor	Amec Foster Wheeler
		Loss of Undisturbed Habitat	Area of undisturbed habitat	ha	98	104	46	119	Amec Foster Wheeler
		Avoidance of Thunder Lake Watershed	Area located within Thunder Lake watershed	ha	5.0	16.8	37.8	6.6	Amec Foster Wheeler
	Land Use	Loss of Tree Stands	Area	ha	76	76	27	89	Amec Foster Wheeler
		Access Along Transmission Line	Qualitative scale	—	Very Good	Very Good	Excellent	Good	Amec Foster Wheeler
	Land Use (cont'd)	Area with Air Quality Above Health Based Guidelines	Area	ha	247	247	320	247	Amec Foster Wheeler
	Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	Distance	km	4.0	4.4	3.1	4.1	Amec Foster Wheeler
		Residents and Cottagers Around Thunder Lake	Distance	km	2.5	1.9	0.5	2.5	Amec Foster Wheeler
		Nearby Rural Residents	Distance	km	0.8	1.1	0.5	1.5	Amec Foster Wheeler
		Aaron Provincial Park	Distance	km	3.2	2.7	1.0	3.3	Amec Foster Wheeler
		Fugitive Dust	Qualitative scale	—	Excellent	Excellent	Poor	Very Good	Amec Foster Wheeler
		TSF Elevation	Elevation	masl	417.5	417.5	404.5	417.6	Amec Foster Wheeler

Account	Sub-Account	Indicator	Parameter	Unit	Alternative A	Alternative B	Alternative C	Alternative D	Data Source
Socio-Economic (cont'd)	Operational Impacts (Air, Noise and Aesthetics) (cont'd)	Frequency and Duration of Construction	Qualitative scale	—	Good	Good	Very Poor	Fair	Amec Foster Wheeler
	Local Infrastructure	Access Along Tree Nursery Road	Qualitative scale	—	Fair	Fair	Excellent	Poor	Amec Foster Wheeler
	Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	Distance to downgradient water well	m	2130	2130	930	2220	Amec Foster Wheeler
	Public Safety	Hazard Potential of TSF	Qualitative scale	—	Fair	Fair	Very Good	Good	Amec Foster Wheeler
		Hazard Potential of MWP	Qualitative scale	—	Fair	Poor	Very Poor	Poor	Amec Foster Wheeler
	Local Employment / Business	Risk to Local Economy	Qualitative scale	—	Good	Good	Very Poor	Fair	Amec Foster Wheeler
	Displacement of Residents	Potential for Displacing Local Residents	Qualitative scale	—	Excellent	Excellent	Good	Excellent	Amec Foster Wheeler



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LEGEND

- Transmission Line
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative A

- Emergency Spillway
- Sumps (Not to scale)
- Dam
- Minewater Pond
- Tailings
- Watercourse Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

0 0.25 0.5 1 1.5 Kilometres

Datum: NAD83
Projection: UTM Zone 15N

N E S W

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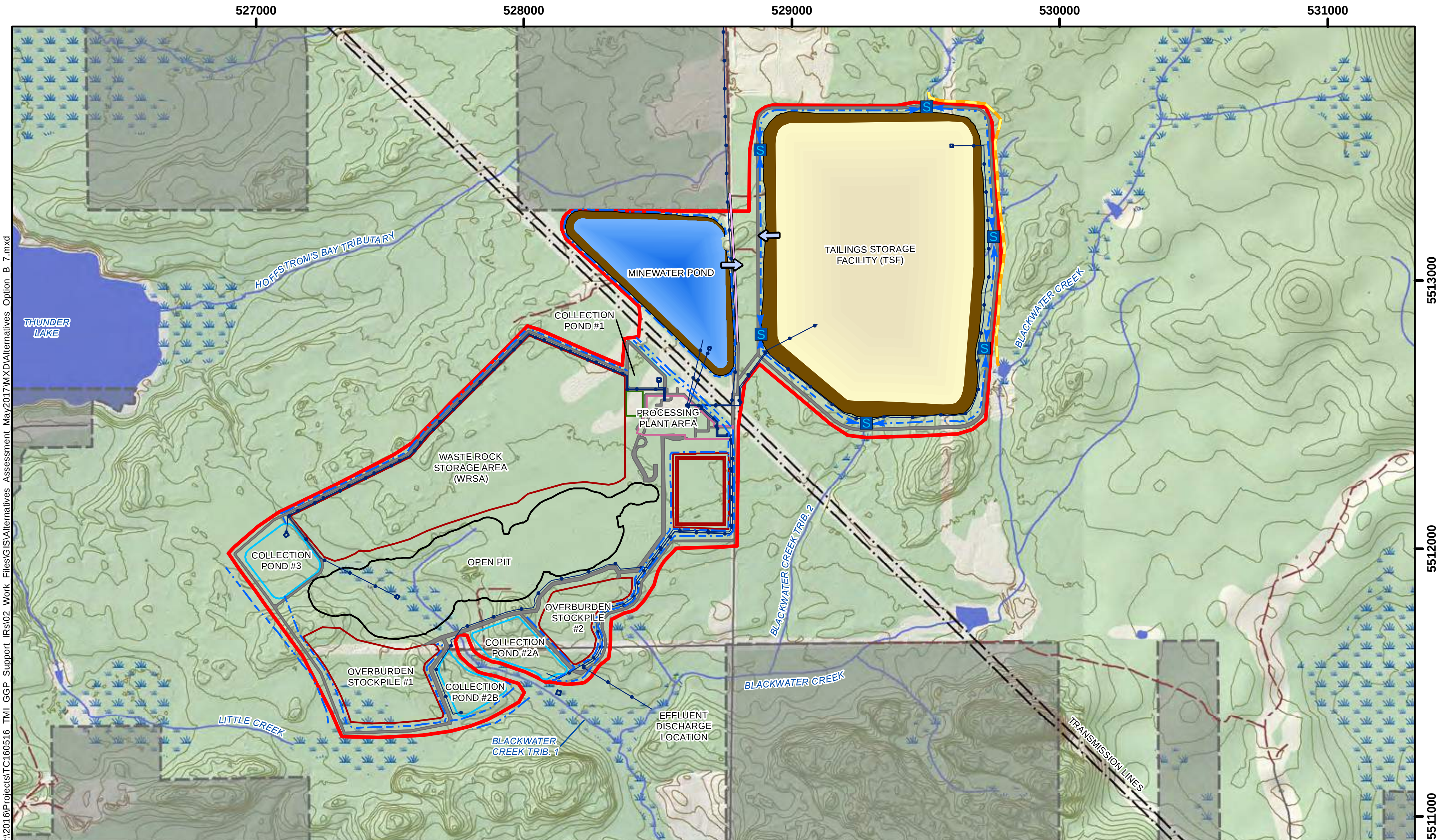
GOLIATH GOLD PROJECT

DRAFT

Alternative A Configuration

PROJECT N°: TC160516	**FIGURE: 7-1**
SCALE: 1:20,000	DATE: August 2017



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LEGEND

- Transmission Line
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative B

- Emergency Spillway
- Sumps (Not to scale)
- Dam
- Minewater Pond
- Tailings
- Watercourse Realignment
- Road Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

0 0.25 0.5 1 1.5 Kilometres

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

Datum: NAD83
Projection: UTM Zone 15N

N W E S

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GOLIATH GOLD PROJECT

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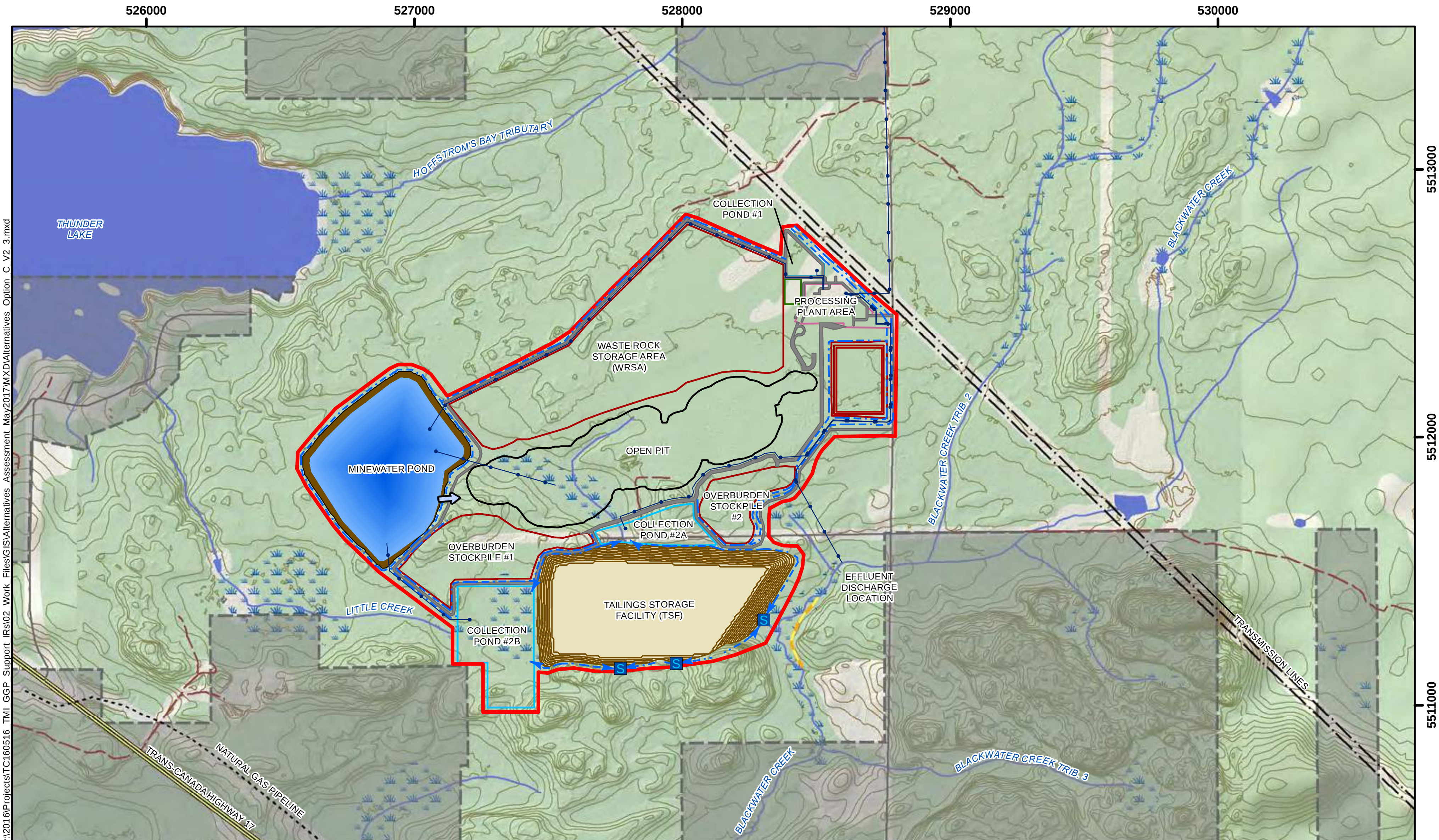
Alternative B Configuration

PROJECT Nº: TC160516	FIGURE: 7-2
SCALE: 1:20,000	DATE: August 2017



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LEGEND

- Transmission Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative C

- Emergency Spillway
- Sumps (Not to scale)
- TSF Contours (2 m interval)
- Dam
- Minewater Pond
- Tailings
- Potential Watercourse Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

Datum: NAD83
Projection: UTM Zone 15N

N E S W

0 0.25 0.5 1 1.5 Kilometres

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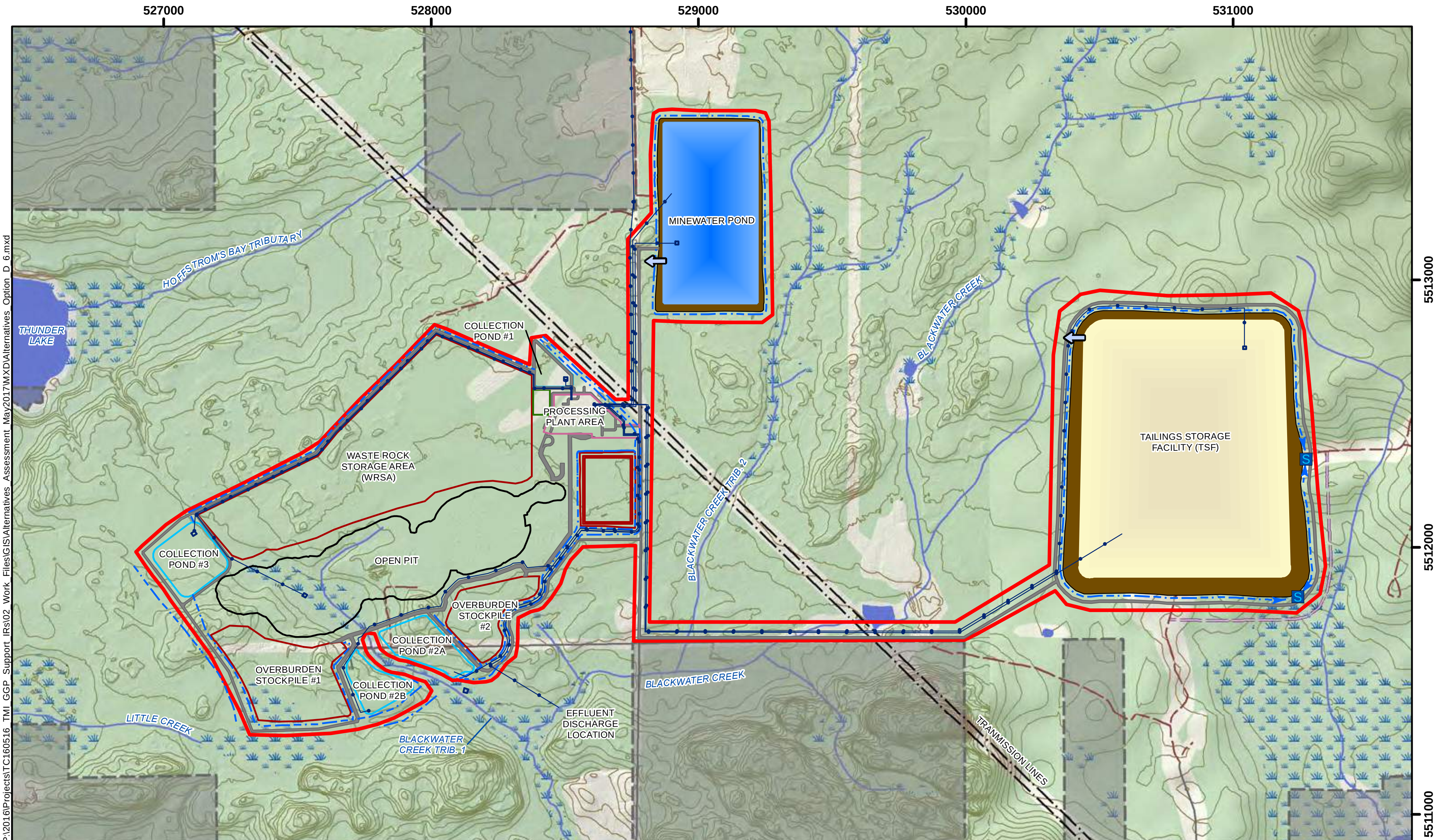
GOLIATH GOLD PROJECT

DRAFT

Alternative C Configuration

PROJECT Nº: TC160516	FIGURE: 7-3
SCALE: 1:20,000	DATE: August 2017



LEGEND

- Transmission Line
- Local Street
- Resource / Recreation Trail
- Wetland
- Watercourse
- Waterbody
- Contours (2 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Components of Alternative D

- Emergency Spillway
- Sumps (Not to scale)
- Dam
- Minewater Pond
- Tailings
- Trail Realignment

Site Infrastructure

- Operations Area
- Processing Plant Site
- Access Haul Roads
- Pipeline
- Ditching
- Open Pit
- Collection Ponds
- Stockpile

NOTES:
- Contours created from a combination Land Information Ontario (LIO) data and LiDAR data.
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

Datum: NAD83
Projection: UTM Zone 15N

N S W E

0 0.25 0.5 1 1.5 Kilometres

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GOLIATH GOLD PROJECT

DRAFT

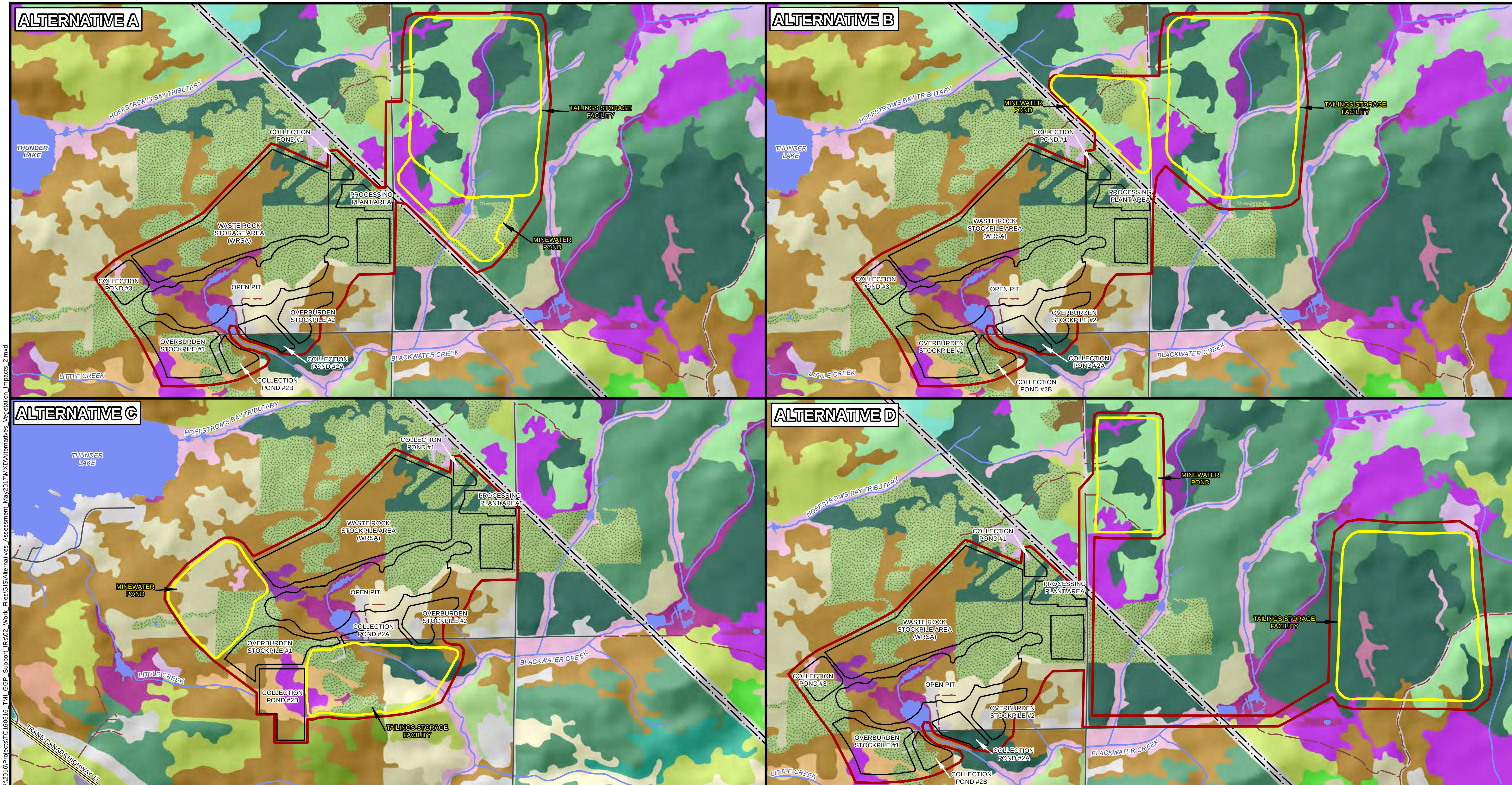
Alternative D Configuration

PROJECT Nº: TC160516

FIGURE: 7-4

SCALE: 1:20,000

DATE: August 2017



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LEGEND

- Proposed Mine Infrastructure
- Operations Area
- Proposed Mine Water Pond and Tailing Storage Facility Alternatives
- Transmission Line
- Highway
- Local Street
- Resource / Recreation Trail
- Watercourse
- Waterbody

Ecological Land Classification
- Developed
- Successional

Deciduous
- B055: Hardwood-Fir-Spruce Mixedwood: Fresh, Sandy-Coarse Loamy Soil
- B070: Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil
- B071: Hardwood-Fir-Spruce Mixedwood: Moist, Sandy-Coarse Loamy Soil
- B104: Hardwood-Fir-Spruce Mixedwood: Fresh, Silty Soil
- B119: Hardwood-Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil

Coniferous
- B012: Black Spruce-Jack Pine: Very Shallow Soil
- B049: Spruce-Pine/Feathermoss: Fresh, Sandy-Coarse Loamy Soil
- B050: Spruce-Pine/Feathermoss: Fresh, Sandy-Coarse Loamy Soil
- B052: Fir-Spruce Mixedwood: Fresh, Coarse Loamy Soil
- B065: Spruce-Pine/Ledum/Feathermoss: Moist, Sandy-Coarse Loamy Soil
- B097: Red Pine-White Pine: Fresh, Fine Loamy Soil
- B098: Spruce-Pine/Feathermoss: Fresh, Fine Loamy-Clayey Soil
- B099: Pine-Spruce/Feathermoss: Fresh, Silty Soil
- B101: Fir-Spruce Mixedwood: Fresh, Silty-Fine Loamy Soil
- B114: Spruce-Pine/Feathermoss: Moist, Silty-Clayey Soil
- B116: Fir-Spruce Mixedwood: Moist, Silty-Clayey Soil

Wetland
- B127: Poor Swamp: Black Spruce: Organic Soil
- B128: Intermediate Swamp: Black Spruce (Tamarack): Organic Soil
- B129: Rich Swamp: Cedar (Other Conifer): Organic Soil
- B130: Rich Swamp: Black Ash (Other Hardwood): Organic-Mineral Soil
- B135: Thicket Swamp: Organic-Mineral Soil
- B136: Treed Fen: Tamarack-Black Spruce/Sphagnum: Organic Soil
- B139: Open Poor Fen: Ericaceous Shrub/Sedge/Sphagnum: Organic Soil
- B142: Meadow Marsh: Organic-Mineral Soil
- B146: Shore Fen: Organic Soil

NOTES:

Datum: NAD83
Projection: UTM Zone 15N

0 0.5 1 2 3 4 5 Kilometres

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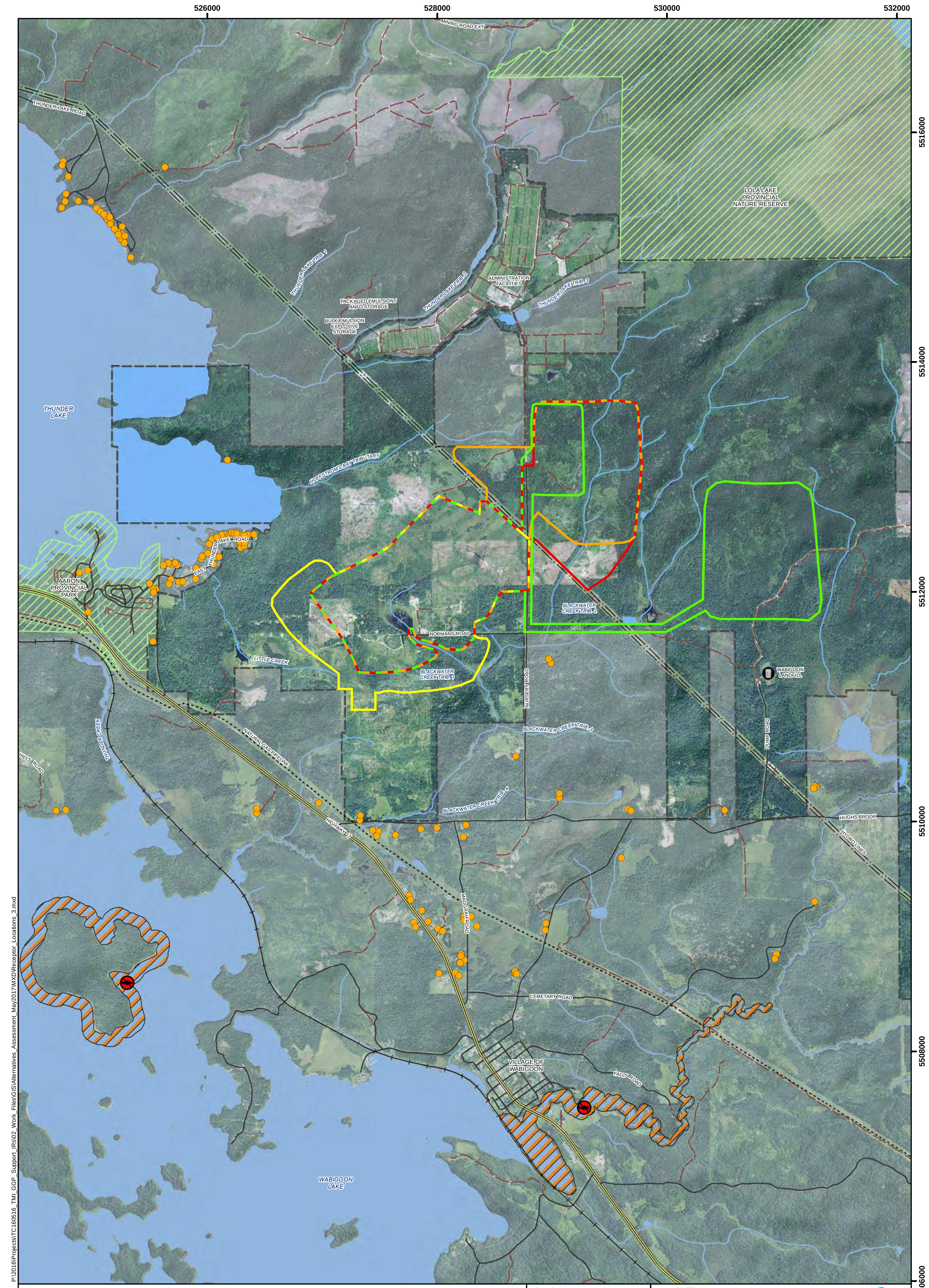
GOLIATH GOLD PROJECT

Ecological Land Classification at the Goliath Gold Project

PROJECT N°: TC160516	FIGURE: 7-5
SCALE: 1:23,000	DATE: August 2017



LEGEND

- Buildings
- Waste Management Site
- Fish Sanctuary
- Railway
- Transmission Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Provincial Park
- Watercourse
- Waterbody
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Operations Area

- Alternative A
- Alternative B
- Alternative C
- Alternative D

NOTES:
- Topographic data extracted from Land Information Ontario, MNRF.
- Aerial imagery extract from MNRF Forest Resource Inventory, 2015.

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GOLIATH GOLD PROJECT

DRAFT

Nearby Receptors

Datum: NAD83
Projection: UTM Zone 15N

N W E S

0 0.5 1 2 3 4 Kilometres

PROJECT N°: TC160516	**FIGURE: 7-6**
SCALE: 1:30,000	DATE: August 2017

8.0 MULTIPLE ACCOUNTS LEDGER

8.1 Selection of Sub-accounts and Indicators

Sub-accounts and indicators were chosen using the methodology described in Section 4.4 and in accordance with the Guidelines (Environment Canada 2011). Additional sub-accounts and indicators were chosen based on Project team experience with tailing impoundment areas, mine water ponds, and assessments of alternatives for other mining projects.

A complete list of sub-accounts and indicators used to develop the multiple accounts ledger, including the rationale for their selection, is provided in Table 8-1.

Sub-accounts and indicators were chosen such that they would reveal relative differences between the alternative locations. During characterization of the alternatives, it was noted that several indicators revealed little, or no, meaningful differences, between the alternatives. Therefore, in the interests of analyzing the alternatives relative to each other, and as per the Guidelines, these sub-accounts and indicators were removed from the MAA. Sub-accounts and indicators removed from the MAA include:

- Environmental: Surface and Groundwater Quantity and Quality: Surface Water Discharge Quality. Treasury Metals has committed that all surface water leaving the operations area will either meet PWQO or be less than background. As this commitment will not change, there would be no differentiation of surface water quality among the alternatives, it was removed.
- Environmental: Protected Areas: Christie Island Fish Sanctuary. This fish sanctuary is located in Wabigoon Lake and effects to this protected area do not materially differ between the alternatives. As the indicator does not assist in differentiating the alternatives, it was removed.
- Environmental: Protected Areas: Butler Lake Nature Reserve. Butler Lake Nature Reserve is located on the south side of Wabigoon Lake and effects to this protected area do not materially differ between the alternatives. As the indicator does not assist in differentiating the alternatives, it was removed.
- Socio-Economic: Land Use: Traplines. There is no identifiable difference in the number of traplines affected by the four alternatives. Alternatively, habitat loss and trapper access restrictions as a result of the different alternatives is effectively covered by other indicators and would be double counted as an indicator if included as the parameter for traplines. Therefore, this indictor was removed.

8.2 Valuating Criteria

Criteria used to calculate indicator values for each of the indicators in the multiple accounts ledger are provided in Table 8-2.

Table 8-1: Rationale for Selection of Sub-Accounts and Indicators

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Environmental	Surface and Groundwater Quantity and Quality	The construction of large water retaining structures, such as TSFs and MWPs will capture surface runoff, altering the quantity of surface water reporting to nearby watercourses. Similarly, TSFs have the potential to alter groundwater quantity and quality.	Flow Loss	During TSF and MWP operations, precipitation will be captured into the site water balance and will result in the loss of catchment area to nearby watercourses. Alternatives resulting in greater flow reductions, measured at the nearest downstream permanent watercourse, could negatively affect hydrological regimes and reduce fish and fish habitat and should therefore be avoided.
			Flow Reductions Outside Blackwater Creek	To maintain a compact site footprint and limit the extent of environmental effects, Treasury Metals has agreed to keep the majority of the Project footprint within the Blackwater Creek watershed, to the extent practicable. Alternatives that extend outside of the Blackwater Creek watershed could affect surface water and ground water quantities. Alternatives that are contained within the Blackwater Creek watershed are preferred.
			Seepage Capture During Operations	Although the MWP and TSF will be designed with a seepage collection system, alternatives located within the mine dewatering drawdown cone will have the added benefit of having any potential seepage captured and drain towards the open pit. Alternatives with area outside the drawdown zone will not have this added benefit and are less preferable.
	Aquatic Resources	All the alternatives considered through the MAA have been sited to avoid lakes and large rivers. However, several of the alternatives would overprint waters frequented by fish, resulting in a change to fish habitat that would require fish habitat offset in accordance with the *Fisheries Act* and the MMER.	Tributary Fish Habitat Losses	Several tributaries around the Project site have been classified as intermittent watercourses and do not have permanent flow throughout the year. Baseline studies determined these creeks to be fish bearing, and overprinting would affect fish and fish habitat. Alternatives that overprint tributary watercourses should be avoided.
			Main stem Watercourse Fish Habitat Losses	In addition to tributary watercourses, there are watercourses around the Project site that flow throughout the year and are considered main channel to these tributaries. Baseline studies determined these creeks to be fish bearing, and overprinting would affect fish and fish habitat. Alternatives that overprint main stem watercourses should be avoided.
			Watercourse Crossings	Haul roads and pipelines that cross watercourses have the potential to affect fish habitat by altering the embankments, channel and substrate characteristics. Vehicle traffic over crossings can further affect the quality of fish habitat. Alternatives that do not require roads or pipelines to cross watercourses are preferred.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Environmental (cont'd)	Terrestrial Resources	Overprinting of land for the TSF, MWP and ancillary infrastructure results in direct habitat loss, although some habitat can be restored at closure. Terrestrial ecosystems vary within the Project site from dense forests to cleared land and can be assigned an ecological value. Alternatives that allow for a more compact site footprint and overprint areas that avoid higher value habitat would have less of an impact on the terrestrial ecosystem.	Forest Loss	Forests have a high ecological value due to their importance to the local fauna and flora. Historical land use changes in the area, including forestry, agriculture and permanent settlements, have altered the natural ecosystem within the Project site from predominantly forested pre-industrial conditions. Due to their ecological value, areas covered by dense or mature forests should be avoided.
			Wetland Loss	Wetlands have a high ecological value due to their productivity and large fauna and flora diversity. Alternatives that overprint wetlands should be avoided.
			Use of Recently Disturbed Land	Large areas around the Project have previously been cleared or partially cleared for agriculture, forestry and mineral exploration, and remain today as meadows and sparsely covered forests. Cleared and partially cleared lands have a relatively low ecological value to other ecosystems and are overrepresented relative to pre-industrial conditions. Alternatives that utilize lands previously cleared of vegetation for other uses are preferred.
	SAR	Some species are at risk from disappearing in Ontario or in Canada and have been afforded special protections. Alternatives that have greater potential to harm these species should be avoided.	Common Nighthawk	Common Nighthawk have been observed near the Project site and potentially nest near the Project site. Common Nighthawk are listed as Threatened through the Federal SARA and are Provincially listed as Special Concern through the ESA. Common Nighthawk prefers open woodlands with rock outcrops, clearcuts, burns, gravel pits and minimal vegetation.
			Barn Swallow	Barn Swallow have been observed foraging near the Project site. They are designated Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), but not listed to the Federal SARA. They are listed as Threatened through the Provincial ESA. Barn Swallow are aerial insectivores, which makes them vulnerable to collisions with equipment within the operations area. Alternatives with reduced hauling requirements lessen the potential effects to these species and are preferred.
			Bats	Little Brown Myotis and Northern Myotis have been observed within the Project area. They are listed as Endangered under both the Federal SARA and Provincial ESR. These bats require a high density of mature cavity trees for summer roosting sites and maternity roosting sites. Alternatives that avoid overprinting mature forests, where mature cavity trees are likely to occur, are preferred.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Environmental (cont'd)	Atmospheric Emissions	Pollution and other materials that are released into the atmosphere could alter aspects of the physical atmospheric environment, which could sequentially affect flora, fauna, and people.	Fugitive Dust	Alternatives have the potential to result in fugitive dust emissions when tailings are mechanically disturbed by air currents, or by ground disturbance during hauling of materials or construction activities. In addition to reducing air quality, fugitive dust could be deposited in nearby lakes and rivers, affecting aquatic species, as well as on nearby vegetation. Alternatives that generate less fugitive dust, or contain fugitive dust emissions to near the affected Project area, will result in less disturbance to the atmosphere and are preferred from an air quality perspective.
			Noise Emissions	Construction / operation of the TSF will result in noise emissions that increase ambient sound levels. Published literature has identified that sound emissions levels from 50 to 60 'A'-weighted decibels (dBA) can masking important communication signals in wildlife (Dooling and Popper, 2007). The ECCC 'Avoiding harm to migratory birds' website (ECCC, 2017) suggests sound levels exceeding 50 dBA are disruptive to wildlife, especially migratory birds. Alternatives with a compact footprint and limited construction windows will reduce noise emissions and are preferred.
			Greenhouse Gas (GHG) Emissions	Treasury Metals recognizes that GHG emissions are a global problem partially resulting from the burning of fossil fuels. Although emissions from the Project will not affect the immediate surrounding area, they add to global GHG emissions and ultimately contribute to climate change. Alternatives with reduced hauling requirements will emit less GHGs and are therefore preferred.
			Light Trespass	Light trespass has been shown to act as an attractant to some wildlife, therefore increasing the probability of Project-wildlife interactions. Alternatives that have a compact site footprint and will not require construction at night are preferred.
	Protected Areas	Three areas in close proximity to the Project have been assigned Provincial protection due to their recreational, ecological, or unique geological value. Alternatives that are more likely to affect these protected areas should be avoided.	Distance to Nature Reserve	Lola Lake Provincial Nature Reserve is located northeast of the Project and is designed to protect the unique geology of the area. The nature reserve also provides extensive peatland habitat for a diverse array of flora and fauna. Greater distance from the alternatives to the nature reserve are preferred to minimize any potential effects.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Environmental (cont'd)	Protected Areas (cont'd)	See rationale on previous page	Distance to Provincial Park	Aaron Provincial Park is a recreational park located west of the Project site that allows for camping at Thunder Lake / Thunder Creek, and also provides habitat for local flora and fauna. A greater distance from the alternatives to the Provincial Park is preferred to minimize potential effects on the park.
			Provincial Fish Sanctuary	The lower reaches of Nugget Creek at Barrett Bay (between Hughes Creek and the Canadian Pacific Railway (CPR) crossing at Wabigoon Lake) is designated as a Provincial Fish Sanctuary to protect spawning walleye and is closed from fishing from April 1 to May 31. Alternatives that avoid the watershed that drains into the fish sanctuary are preferred.
	Closure / Post-Closure	The TSF will remain following Project closure in a closed-out state. Due to tailings geochemistry, the TSF will be closed out to prevent potential ARD and ML. However, water will contact the TSF in the post closure stage and will depart the site as surface runoff or seepage. Alternatives where runoff and seepage have less potential to result in environmental effects to sensitive receivers, or allow for greater flexibility with water management in the post closure stage, are preferred.	Potential for Seepage to Report to Thunder Lake	Thunder Lake is a deep cold water lake that supports cold water aquatic species, such as Lake Trout. In the post-closure phase the pit lake will fill, the drawdown cone from mine dewatering will cease and groundwater flow patterns will be reestablished. Seepage from the alternatives will have the potential to migrate towards Thunder Lake.
			Surface Water Discharges	It is advantageous for Treasury Metals to have a single discharge location from the operations area as it allows for more control of water quality and quantity leaving the site. Alternatives with 1 discharge location are preferred.
Technical	Design Factors	Design factors include some of the key factors that contribute to technical complexity of the TSF and MWP alternatives. Alternatives that are less technically challenging are generally preferred.	TSF Location Suitability	One of the primary criteria considered in the design of a TSF is the location suitability from an efficiency perspective. For filtered stack TSFs, efficient facilities are located near the processing plant as tailings need to be hauled or conveyed to the TSF. For conventional slurry TSFs, a good storage volume to dam volume ratio is a primary consideration.
			MWP Location Suitability	One of the primary criteria considered in the design of a MWP is the location suitability from an efficiency perspective. The most suitable location for a MWP is typically one with a good storage volume to dam volume ratio.
			Foundation Suitability	TSF alternatives are ideally situated on hard rock for foundational stability, and when located over overburden, free draining material is preferred to reduce potential for excess pore pressure buildup within the dam foundations. Alternatives positioned over more stable or free draining ground are preferred from a technical design perspective.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Technical (cont'd)	Safety Factors	Safety is a primary concern when designing the TSF and MWP and each alternative can be constructed to the necessary factor of safety. However, some technical factors have the potential to increase the risk or consequence of failure and should therefore be avoided.	TSF Hazard Potential	The TSF, regardless of alternative, would be constructed to meet appropriate factors of safety. However, some TSF locations are located where a failure could have the potential to damage infrastructure such as transmission lines, roads and local residences. Alternatives located remote from local infrastructure and residences are preferred from a consequence of failure perspective.
			MWP Hazard Potential	The MWP, regardless of alternative, would be constructed to meet appropriate factors of safety. However, some MWP locations are located where a failure could have the potential to damage infrastructure such as transmission lines, roads and local residences. Alternatives located remote from local infrastructure and residences are preferred from a consequence of failure perspective.
			Maximum TSF Dam Height	There is generally a proportional increase in potential consequence of dam failure with an increase in TSF height. In the unlikely event of failure, taller facilities have greater potential energy to move materials. Shorter dam heights are therefore considered to incur less risk and are the preferred alternative.
			Maximum MWP Dam Height	There is generally a proportional increase in potential consequence of dam failure with an increase in MWP height. In the unlikely event of failure, taller facilities have greater potential energy to move materials. Shorter dam heights are therefore considered to incur less risk and are the preferred alternative.
			Worker Health	The TSF alternatives have the potential to increase risk to worker health, such as exposure to dust. Alternatives with less risk to worker health are preferred.
	Water Management	Water management is a primary consideration when designing both the TSF and MWP. Reclaim water is an integral part of processing and there needs to be sufficient stores or water on site at all times. However, excess water on site will require treatment prior to discharge to ensure environmental protection.	Seepage During Operations	Each of the alternative TSFs and MWPs would be equipped with seepage collection systems for compliance with the MMER. Additionally, alternatives that are located within the mine dewatering drawdown zone of the Project will have the extra benefit of having seepage that bypasses the seepage collection systems captured within the drawdown zone, collected by the mine dewatering pumps and directed to the MWP. Alternatives that are located within the drawdown zone are preferred.
			Runoff Management	All alternatives would be equipped with a runoff collection system, which would likely include a perimeter ditch as well as collection ponds in low-lying areas. The water captured as runoff will be pumped back into the TSF or pumped to either the process plant for recycle or to the treatment plant for discharge.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Technical (cont'd)	Water Management (cont'd)	See rationale on previous page	Watercourse Realignments	Alternatives that overprint watercourses or that have large upstream catchment areas will require realignments or diversions around the structures. Diversions could be technically challenging if constructed through higher ground and bedrock.
			Excess Water Management	A conceptual water balance of the Project site has determined that water will accumulate in the site inventory and will require treatment prior to discharge to the environment. Alternatives with tailings dewatering processes or larger catchment areas will result in additional water requiring treatment and management. The currently envisioned water treatment plant may not meet the needs of some of the alternatives and additional water management infrastructure could be required such as a larger treatment plant or industrial evaporators. Alternatives with increased quantities of water requiring treatment should be avoided.
			Flexibility of Water Management	The majority of water to be used in the process plant will be reclaim water from the TSF, water from the MWP or water from the surface collection ponds. Pumping infrastructure will be constructed between these facilities as needed. However; in the event of a scenario not foreseen during Project design, such as an unexpected buildup of water in the TSF or MWP, it could be technically advantageous to located the TSF and MWP adjacent to each other to allow for water transfers.
	Expansion Capacity	Although Treasury Metals cannot speculate on future reserves / resources, it is conceivable that with ongoing mineral exploration in the area a new mineral reserve could be discovered or existing reserves expanded. The mining of additional ore would increase the quantity of tailings requiring storage. Alternatives that allow for future TSF expansion increase the feasibility of and technical flexibility of potential mine expansions.	Expansion Capacity	In the event that additional ore reserves are identified, it may be advantageous from a technical perspective to expand the TSF as opposed to constructing a new cell. Alternatives that allow for greater expansion capacity are preferred.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Technical (cont'd)	Compliance with Environmental Approvals	The chosen alternative would need to complete provincial regulatory processes prior to use, and would need to comply with all environmental approvals. Alternatives with environmental approvals that are expected to be technically challenging to comply with could result in Treasury Metals being in non-compliance.	Dust Management	Alternatives have the potential to result in fugitive dust and particulate matter emissions when tailings are mechanically disturbed by air currents, or by ground disturbance during hauling of materials, or construction activities. As particulate matter from tailings filtered stack may contain metals in the dust, Provincial approvals may include the requirement for air quality to meet specified criteria at the property boundary. Air quality could exceed thresholds specified in environmental approvals should mitigation measures be insufficient. Alternatives that are more likely to generate air emissions, or create air emissions near the property boundary will reduce the probability of Project compliance with environmental approvals and should be avoided.
Project Economics	Capital Costs	Capital costs required for the TSF and MWP are a key consideration when designing these structures. TSFs often require extensive dam construction, and earth works or costly dewatering plants. Other capital costs include infrastructure for water management and treatment, roads and pipelines.	Clearing / Site Preparation	The location of the TSF and MWP will be cleared of trees prior to construction. Alternatives that are located on previously cleared areas are preferred.
			TSF Dam Construction	TSF embankment dams are large, costly, structures. Alternatives with large dams will have high capital costs.
			Tailings Dewatering Infrastructure	The infrastructure required to dewater tailings to an unsaturated state has a significant capital cost. Additionally, water collected during the dewatering process will require treatment and discharge to the environment in either an expanded water treatment plant, or through industrial evaporators; both of which have large capital costs. Alternatives that do not require extensive dewatering and filtration have reduced capital costs.
			MWP Construction	Alternatives with smaller MWP dams, or alternatives that share perimeter dams with other structures will have lower MWP dam construction costs.
			Roads	Haul roads are required for construction of both the TSF and MWP. Alternatives located near the processing plant that avoid watercourse crossings will have lower road construction costs.
			Pumping Infrastructure	Pumping infrastructure (pipelines, pump houses and associated electrical infrastructure) is required for the management of water with all alternatives. Alternatives located near the processing plant or that have less water management requirements will have reduced pumping infrastructure requirements.
			Seepage Collection Infrastructure	Alternatives that promote a compact site footprint and that are located adjacent to other project infrastructure will require less seepage collection infrastructure such as perimeter ditching.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Project Economics (cont'd)	Operating Costs	Operational costs directly affect Project economics as these expenses occur at regular intervals throughout the life of the mine.	Tailings Deposition	Operational costs for tailings deposition include pumping the tailings slurry and moving the end of pipe in accordance with a deposition plan, or in the case of a dry stack, dewatering, hauling the tailings and constructing a stockpile.
			TSF Water Management	TSF water management costs including pumping water for seepage collection, recycling water to the process plant, and treatment and discharge of excess water.
			MWP Pumping	MWP pumping costs include pumping minewater from the open pit and underground to the MWP, and from pumping from the MWP to the process plant or treatment plant.
	Closure Costs	The closure costs associated with the MWP and TSF include the cost of decommissioning and rehabilitating the site to a stable and more ecologically productive state, in accordance with the Ontario Mine Rehabilitation Code. Extensive closure costs will increase the requirement for closure bonding and will ultimately affect overall project financial performance.	TSF Cover	TSF cover at closure includes the cost of isolating tailings from oxygen to prevent ARD / ML and promote long term stability of stockpiled tailings.
			MWP Reclamation	At closure, the water within the MWP will be treated and used to help fill the open pit. The MWP dams will be reclaimed and the dam material will be used in for grading the site. Overburden may be added as needed. The site will be contoured to promote drainage and revegetated for stability. Reclamation costs will be dominated by the earthworks and seeding.
			Road Reclamation	At closure, the haul roads will be removed following the reclamation of both the TSF and the MWP. Alternatives with a more compact footprint and shorter haul roads are preferred.
	Post-Closure Costs	Post-closure costs generally include long term dam / stockpile monitoring and maintenance or water treatment if needed.	Inspection / Maintenance / Monitoring	Alternatives with longer dams, a dispersed site footprint, or larger perimeter stockpiles will generally require more effort to inspect and perform repairs, if needed.
			Risk of Additional Treatment Facilities	During the closure phase of the Project, the site will be graded to drain all water captured within the operations area to the open pit allowing for one discharge location into post-closure. The water in the open pit will be monitored and will undergo treatment if required before it is discharge into Blackwater Creek. Alternatives that are downgradient of the open pit, or are unable to be graded towards the open pit, may require additional treatment facilities to be built in order for discharge to meet PWQO, should the TSF cover not perform as expected. The construction and operation of an additional treatment facility would significantly impact the Project economics into post-closure.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Project Economics (cont'd)	Ancillary Costs	Some of the alternatives will result in ancillary costs that will impact project economics. Alternatives with less ancillary costs are preferred.	Fish Habitat Compensation	Alternatives that overprint watercourses frequented by fish will require fish habitat compensation as required by the *Fisheries Act* and the MMER. Habitat compensation is generally proportional to the amount of habitat overprinted.
			SAR Compensation	SAR have been identified within in the vicinity of the Project. Habitat compensation for these species may be required through the ESA and will likely be proportional to the amount of habitat overprinted.
			Road Realignment	Alternatives that overprint municipal and forestry roads will require road realignment around the structure at Treasury Metals' expense. Road realignments may also have additional environmental permitting related expenses.
			Haul Distances for Overburden Stockpiles	Alternatives that displace overburden stockpiles will require overburden to be hauled a greater distance from the open pit. Alternatives that do not displace the overburden stockpiles are preferred.
	Risk	Some of the alternatives bring inherent risk to Project economics, could result in schedule delays and risk overall Project viability.	Risk of EA or Environmental Approval Delays or Rejection	There is the possibility that some alternatives could result in the delay or rejection of environmental approvals, ultimately delaying Project construction and operations. This would have a significant cost to Treasury Metals and would impact the overall feasibility of the Project.
			Risk Arising from TSF Costs	Some of the TSF alternatives will have greater costs and will increase the overall production costs for the Project. While the Project is economic at the predicted market price for gold, higher overall production costs will increase the likelihood that fluctuations in the price of gold are substantial enough to force the Project into care and maintenance, or early closure. Alternatives that are more likely to remain economically viable over the predicted life of mine are preferred.
			Delays from Displacing Local Residents	There is the possibility that some alternatives could result in the displacement of permanent residents around the Project site due to inability to meet regulatory emissions criteria at the current property boundary. This could result in delaying Project construction and operations as these properties would have to be purchased by Treasury Metals. The delay in the commencement of the Project would have significant cost to Treasury Metals and would impact the overall feasibility of the Project. More residences potentially being displaced and relocated will increase the risk of Project delays.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Socio-Economic	Aboriginal Land Use and Heritage Value	Treasury Metals understands the importance of traditional land use and heritage values to Aboriginal peoples in the vicinity of the Project, and have taken the necessary steps through engagement to better understand what these values are and how to effectively mitigate negative Project effects.	Access Effected Areas	During the operations phase of the Project, access within the Treasury Metals property boundary for traditional pursuits will be limited to areas that are accessible without crossing active work areas for safety and security reasons. Access may also be limited in areas with air quality above health based guidelines. Alternatives that avoid roads and trails will allow greater access to the land for traditional pursuits and are therefore preferred.
			Wildlife Abundance	Overprinted habitat and noise from the Project have the potential to displace wildlife harvested by Aboriginal peoples. Alternatives with a compact site footprint will affect less wildlife area and are therefore preferred.
			Loss of Undisturbed Habitat	Areas of undisturbed habitat such as older forests and wetlands are assumed to be of greater value to Aboriginal peoples land use and traditional heritage values, compared to areas recently disturbed by logging and other industrial activities. Alternatives that overprint less undisturbed habitat are preferred.
			Avoidance of Thunder Lake Watershed	Thunder Lake has been identified as a cold water lake that contains cold water species such as Lake Trout. It has been identified by Aboriginal communities that Thunder Lake is an important travel route and concern have been raised about the potential effects the Project may have on the lake, and traditional pursuits at the Lake. Alternatives that avoid any potential seepage into the Thunder Lake watershed are preferred.
	Land Use	The Project is situated in a relatively populated area, with nearby First Nations communities, cottages, towns and parks. Minimizing or avoiding potential effects to local peoples values is an integral part of Project development, along with balancing these values with the need for regional economic development.	Loss of Tree Stands	During the site preparation and construction phase of the Project, the merchantable timber from the Project area will be removed by local forestry companies, with oversight by the Dryden Forest Management Company Ltd. Following closure and reclamation, the area overprinted by the TSF will be unavailable for forestry. Alternatives with a smaller TSF will have less effects to long term forestry in the Project vicinity.
			Access Along Transmission Line	There is the potential that local residents utilize the cleared area of the transmission lines running through the Project site for recreation, including ATVing and snowmobiling. Alternatives less likely to restrict or alter access along recreational trails are preferred.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Socio-Economic (cont'd)	Land Use (cont'd)	See rationale on previous page	Area with Air Quality Above Health Based Guidelines	As a result of the TSF, there may be areas where air emissions (such as PM_{10}) exceed criteria for the protection of health. Treasury Metals would discourage land use in areas where these criteria could be exceeded. Alternatives anticipated to result in less area where human health guidelines are exceeded, or alternatives that are less likely to exceeded relevant guidelines are preferred.
	Operational Impact (Air, Noise and Aesthetics)	The Project is situated in a relatively populated area, with nearby First Nations communities, cottages, towns and parks. As a result of the TSF and MWP, there could be effects to these local people including dust, noise emissions, and aesthetics that could affect their enjoyment of the area.	Village of Wabigoon	The Village of Wabigoon is located approximately 4 km south of the Project. Alternatives that could affect this area (e.g. ambient light, noise, fugitive dust, aesthetics) should be avoided.
			Residents and Cottagers around Thunder Lake	There are a number of residents and cottages on the southeast edge of Thunder Lake. Some local residents have expressed concerns regarding effects the Project may have on their enjoyment of the area. Alternatives further away from these residents and cottages are preferred.
			Nearby Rural Residents	Rural residences are located along Tree Nursery Road and Anderson Road and operational effects from some of the alternatives have the potential to affect these residences. Alternatives located further from the rural residences are preferred.
			Aaron Provincial Park	Aaron Provincial Park is located approximately 2 km west of the Project and provides camping opportunities and a boat launch onto Thunder Lake. Alternatives that could negatively affect the use and enjoyment of Aaron Provincial Park should be avoided.
			Fugitive Dust	Alternatives have the potential to result in fugitive dust emissions when tailings are mechanically disturbed by air currents, or by ground disturbance during hauling of materials, or construction activities. Fugitive dust will negatively affect air quality near the Project, and could be a nuisance to nearby residents. Alternatives with predicted higher levels of fugitive dust should be avoided.
			TSF Elevation	Alternatives that have a higher overall elevation have a greater potential to be seen from off site. The Wabigoon Lake Ojibway Nation has identified that views of Thunder Lake have cultural importance to the elders. Therefore, alternatives with a lower overall elevation are preferred to reduce effects to local aesthetics.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Socio-Economic (cont'd)	Operational Impact (Air, Noise and Aesthetics) (cont'd)	See rationale on previous page	Frequency and Duration of Construction	Construction of the TSF and the MWP will result in operational effects such as noise, light, and reduced air quality. Construction requirements for the alternatives vary, with some alternatives requiring longer or continuous construction, and others requiring shorter, seasonal construction. Alternatives with greater construction requirements should be avoided.
	Local Infrastructure	The Project is located just south of the former MNRF Tree Nursery, along the Tree Nursery Road. This is a public road around which Treasury Metals has surface rights to the land.	Access Along Tree Nursery Road	For safety and security reasons, Treasury Metals will restrict access to the operations area, which may include the installation of a gate on Tree Nursery Road. Alternatives that would not cross Tree Nursery Road, or would still allow access along Tree Nursery Road are preferred.
	Drinking Water Quality	Wabigoon Lake and Thunder Lake are both used as drinking water sources for local communities. It is therefore important that the alternatives do no reduce drinking water quality in these water sources.	Potential for Seepage to Affect Drinking Water Wells	The alternatives are expected to vary with potential for seepage migrating off site. Metal concentrations in groundwater typically are reduced the further they migrate from the source due to a combination of dilution and metals becoming bound in the rock. Alternatives located near, and up-gradient of water wells are more likely to affect drinking water quality at the well.
	Public Safety	Alternatives that have a higher hazard potential will have a greater consequence of failure, which could affect public safety.	Hazard Potential of TSF	The TSF, regardless of alternative, would be constructed to meet appropriate factors of safety. However, some TSF locations are located where a failure could have the potential to affect areas frequented by people, as well as permanent dwellings. Alternatives located remote from trails, roads and residences are preferred from a consequence of failure perspective.
			Hazard Potential of MWP	The MWP, regardless of alternative, would be constructed to meet appropriate factors of safety. However, some MWP locations are located where a failure could have the potential to affect areas frequented by people, as well as permanent dwellings. Alternatives located remote from trails, roads and residences are preferred from a consequence of failure perspective.
	Local Employment / Business	The Project has the potential to be a major contributor to the local economy. Alternatives with very tight economic margins are more prone to volatility in gold prices and the Canadian dollar, which could result in suspension of operations and entering a care and maintenance phase. This would negatively affect local employment and business opportunities.	Risk to Local Economy	The Project has the potential to be a major contributor to the local economy. Alternatives with very tight economic margins are more prone to volatility in gold prices and the Canadian dollar, which could result in suspension of operations and entering a care and maintenance phase. This would negatively affect local employment and business opportunities.

Account	Sub-Account	Sub-Account Rationale	Indicator	Indicator Rationale
Socio-Economic (cont'd)	Displacement of Residents	There is the possibility that some alternatives could result in the displacement of permanent residents around the Project site due to an inability to meet regulatory emissions requirements at the current property boundary. If anticipated Provincial criteria cannot be met at the property boundary, Treasury Metals would need to purchase these resident's properties to expand the property boundary. Alternatives that displace local residents should be avoided.	Potential for Displacing Local Residents	There is the possibility that some alternatives could result in the displacement of permanent residents around the Project site due to an inability to meet regulatory emissions requirements at the current property boundary. If anticipated Provincial criteria cannot be met at the property boundary, Treasury Metals would need to purchase these resident's properties to expand the property boundary. Alternatives that displace local residents should be avoided.

Table 8-2: Multiple Accounts Analysis Valuating Criteria

Account	Sub-Account	Indicator	Parameter	Unit	Indicator Value					
					6 (Highest)	5	4	3	2	1 (Lowest)
Environmental	Surface and Groundwater Quantity and Quality	Flow Loss	Qualitative scale	—	Excellent – flow reductions are restricted to a single watershed with <5% flow reduction	Very Good – flow reductions in multiple watersheds with <5% flow reductions	Good – flow reductions are restricted to a single watershed with between 5 to 10% flow reduction	Fair - flow reductions in multiple watersheds with between 5 to 10% flow reduction in the most affected watershed	Poor - flow reductions are restricted to a single watershed with >10% flow reduction	Very Poor - flow reductions in multiple watersheds with >10% flow reduction in the most affected watershed
		Flow Reductions Outside Blackwater Creek	Area outside Blackwater Creek watershed	ha	≤15	16 to 33	34 to 51	52 to 69	70 to 87	>87
		Seepage Capture During Operations	Area located outside of the 2 m drawdown zone	ha	≤5	6-25	26-45	46-65	66-85	>85
	Aquatic Resources	Tributary Fish Habitat Losses	Length of watercourse overprinted	m	0	1 to 550	556 to 1100	1101 to 1650	1651 to 2200	>2200
		Main stem Watercourse Fish Habitat Losses	Length of watercourses overprinted	m	0	1 to 100	101 to 200	201 to 300	301 to 400	>400
		Watercourse Crossings	Number of haul road crossings	#	0	1	2	3	4	≥5
	Terrestrial Resources	Forest Loss	Area of forest loss	ha	≤40	41 to 58	59 to 76	77 to 94	95 to 112	>112
		Wetland Loss	Area of wetland loss	ha	≤2.0	2.1 to 4.5	4.6 to 7.0	7.1 to 9.5	9.6 to 12.0	>12.0
		Use of Recently Disturbed Land	Area of forest disturbed	ha	>10.3	10.3 to 7.8	7.7 to 5.2	5.1 to 2.6	2.5 to 0.1	0
	SAR	Common Nighthawk	Combined area of disturbed or partially disturbed sites	ha	0	0.1 to 2.5	2.6 to 5.1	5.2 to 7.7	7.8 to 10.3	>10.3
		Barn Swallow	Total haul distance	km	≤200,000	200,001 to 400,000	400,001 to 600,000	600,001 to 800,000	800,001 to 1,000,000	>1,000,000
		Bats	Qualitative scale	—	Excellent – area assessed with bat surveys with no identified areas which could potentially support bat maternity roosts	Very Good - area assessed with bat surveys with 1 to 5 ha of habitat which could potentially support bat maternity roosts	Good – area assessed with bat surveys with >5 ha of habitat which could potentially support bat maternity roosts	Fair – area has not been fully assessed with bat surveys, and there are no assessed areas which could potentially support bat maternity roosts	Poor - area has not been fully assessed with bat surveys, with 1 to 5 ha of habitat which could potentially support bat maternity roosts	Very Poor - area has not been fully assessed with bat surveys, with >5 ha of habitat which could potentially support bat maternity roosts
	Atmospheric Emissions	Fugitive Dust	Qualitative scale	—	Excellent – tailings deposited as a conventional slurry in a saturated state / TSF centroid <2 km from open pit centroid	Very Good - tailings deposited as a conventional slurry in a saturated state / TSF centroid >2 km from open pit centroid	Good - tailings thickened (partially dewatered) / deposited <2 km from open pit centroid	Fair - tailings thickened (partially dewatered) / deposited >2 km from open pit centroid	Poor – tailings dewatered and stacked in an unsaturated stockpile <2 km from open pit centroid	Very Poor - tailings dewatered and stacked in an unsaturated stockpile >2 km from open pit centroid

Account	Sub-Account	Indicator	Parameter	Unit	Indicator Value					
					6 (Highest)	5	4	3	2	1 (Lowest)
Environmental (cont'd)	Atmospheric Emissions (cont'd)	Noise Emissions	Qualitative scale	—	Excellent – seasonal construction that is generally constrained to daytime hours, with a buffer area of <10 ha	Very Good – seasonal construction that is generally constrained to daytime hours, with a buffer area between 11 ha and 20 ha	Good - seasonal construction that is generally constrained to daytime hours, with a buffer area of >20 ha	Fair - continuous construction with a buffer area <10 ha	Poor - continuous construction with a buffer area between 11 ha and 20 ha	Very Poor - continuous construction with a buffer area >20 ha
		Greenhouse Gas (GHG) Emissions	Total Haul Distance	km	≤200,000	200,001-400,000	400,001 to 600,000	600,001 to 800,000	800,001-1,000,000	>1,000,000
		Light Trespass	Qualitative scale	—	Excellent - seasonal construction that is generally constrained to daytime hours, <1 km from open pit centroid	Very Good - seasonal construction that is generally constrained to daytime hours, 1 to 2 km from open pit centroid	Good - seasonal construction that is generally constrained to daytime hours, >2 km from open pit centroid	Fair - continuous construction, <1 km from open pit centroid	Poor - continuous construction, 1 to 2 km from open pit centroid	Very Poor - continuous construction, >2 km from open pit centroid
	Protected Areas	Distance to Nature Reserve	Distance	m	>3500	3500 to 2949	2950 to 2399	2400 to 1849	1850 to 1299	≤1300
		Distance to Provincial Park	Distance	m	>4700	4700 to 4049	4050 to 3399	3400 to 2749	2750 to 2099	≤2100
		Provincial Fish Sanctuary	Qualitative scale	—	Excellent – not located in Nugget Creek / Hughes Creek watershed	Very Good – TSF is located partially or entirely in the Nugget Creek / Hughes Creek watershed; seepage during operations captured in the mine dewatering drawdown cone	Good – TSF is located partially or entirely in the Nugget Creek / Hughes Creek watershed; seepage during operations that bypasses collection systems may daylight in or upstream of Provincial Fish Sanctuary	Fair – TSF placement may affect fish movement or fish health in the unprotected reaches of Nugget Creek / Hughes Creek	Poor – TSF placement may affect fish movement or fish health within the Provincial Fish Sanctuary	Very Poor – will result in the permanent loss of the Provincial Fish Sanctuary
	Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	Distance from TSF to Thunder Lake	km	>3.4	3.4 to 3.0	2.9 to 2.5	2.4 to 2.1	2.0 to 1.7	≤1.6
		Surface Water Discharges	Qualitative scale	—	Excellent – no surface water discharges from TSF in post-closure phase (tailings stored as underground backfill or encapsulated in open pit)	Very Good – all surface runoff can be directed to the open pit at closure	Good – a portion of surface runoff can be directed to the open pit at closure; remaining runoff to Blackwater Creek watershed	Fair – surface runoff is entirely to Blackwater Creek	Poor – A portion of surface runoff is to Blackwater Creek and a portion is to either the Thunder Lake Watershed or to Nugget Creek / Hughes Creek	Very Poor – surface runoff drains to the Thunder Lake watershed or to Nugget Creek / Hughes Creek watershed
Technical	Design Factors	TSF Location Suitability	Qualitative scale	—	Excellent – conventional slurry with a storage volume to dam volume ratio of > 4.0 / filtered stack located ≤0.5 km from process plant	Very Good - conventional slurry with a storage volume to dam volume ratio of 3.6 to 4.0 / filtered stack located 0.6 to 1.0 km from process plant	Good - conventional slurry with a storage volume to dam volume ratio of 3.1 to 3.5 / filtered stack located 1.0 to 1.5 km from process plant	Fair - conventional slurry with a storage volume to dam volume ratio of 2.6 to 3.0 / filtered stack located 1.6 to 2.0 km from process plant	Poor - conventional slurry with a storage volume to dam volume ratio of 2.1 to 2.5 / filtered stack located 2.1 to 2.5 km from process plant	Very Poor - conventional slurry with a storage volume to dam volume ratio of ≤2.0 / filtered stack located >2.5 km from process plant
		MWP Location Suitability	Storage to Dam Volume Ratio	Ratio	>5.0	5.0 to 4.6	4.5 to 4.1	4.0 to 3.6	3.5 to 3.1	≤3.0
		Foundation Suitability	Qualitative scale	—	Excellent – foundation comprised of Bedrock	Very Good - conditions providing free draining material with high foundation shear strength	Good - conditions providing free draining material with good foundation shear strength	Fair – conditions providing moderately free draining material with moderate foundation shear strength	Poor - conditions providing low permeability material with fair foundation shear strength	Very Poor - conditions providing very low permeability material with low foundation shear strength
	Safety Factors	TSF Hazard Potential	Qualitative scale	—	Excellent – no potential for residents or infrastructure to be affected	Very Good – failure unlikely to affect residents or infrastructure	Good - failure unlikely to affect residents but will likely affect infrastructure	Fair - failure affects infrastructure that is occasionally used by local residents	Poor – failure affects infrastructure that is occasionally used by local residents, and is adjacent to the property boundary such that there is no dissipation of flows prior to travelling offsite	Very Poor - failure has potential to affect an occupied residence

Account	Sub-Account	Indicator	Parameter	Unit	Indicator Value					
					6 (Highest)	5	4	3	2	1 (Lowest)
Technical (cont'd)	Safety Factors (cont'd)	MWP Hazard Potential	Qualitative scale	—	Excellent – no potential for residents or infrastructure to be affected	Very Good – failure unlikely to affect residents or infrastructure	Good - failure unlikely to affect residents but will likely affect infrastructure	Fair - failure affects infrastructure that is occasionally used by local residents	Poor – failure affects infrastructure that is occasionally used by local residents, and is adjacent to the property boundary such that there is no dissipation of flows prior to travelling offsite	Very Poor - failure has potential to affect an occupied residence
		Maximum TSF Dam Height	Height	m	N/A	≤24	25 to 26	27 to 28	29 to 30	>30
		Maximum MWP Dam Height	Height	m	≤8.2	8.3 to 9.2	9.3 to 10.2	10.3 to 11.2	11.3 to 12.2	>12.2
		Worker Health	Qualitative scale	—	Excellent – conventional slurry TSF located remote from mine workings	Very Good - conventional slurry TSF located near workings	Good – thickened tailings TSF located remote from mine workings	Fair - thickened tailings TSF located remote near mine workings	Poor – filtered stack TSF located remote from mine workings	Very Poor – filtered stack TSF located near mine workings
	Water Management	Seepage During Operations	Percent of TSF located in the 2 m drawdown zone	%	100	99.9 to 80	79.9 to 60.0	59.9 to 40.0	39.9 to 20.0	<20.0
		Runoff Management	Length of ditching	km	≤4.2	4.3 to 4.6	4.7 to 5.0	5.1 to 5.4	5.5 to 5.8	>5.8
		Watercourse Realignments	Qualitative scale	—	Excellent - TSF and MWP facilities requiring no watercourse realignments	Very Good - TSF and MWP facilities requiring minimal watercourse realignments	Good - TSF and MWP facilities requiring potential watercourse realignments	Fair - TSF and MWP facilities requiring one watercourse realignment	Poor - TSF and MWP facilities requiring two watercourse realignments	Very Poor - TSF and MWP facilities requiring more than two watercourse realignments
		Excess Water Management	Qualitative scale	—	Excellent – in-pit or sub-aqueous disposal of tailings (reclaim not required)	Very Good – conventional slurry tailings (no dewatering requirements)	Good - nominally thickened tailings (minimal dewatering)	Fair – thickened tailings with partial dewatering (moderate dewatering)	Poor – paste tailings (high dewatering	Very Poor – filtered tailings (maximum dewatering)
		Flexibility of Water Management	Qualitative scale	—	Excellent – site layout has excellent flexibility for water management	Very Good – site layout has good flexibility for water management	Good – site layout has moderate flexibility for water management	Fair - site layout has some flexibility for water management	Poor – site layout has minimal flexibility for water management	Very Poor – site layout has no flexibility for water management
	Expansion Capacity	Expansion Capacity	Qualitative scale	—	Excellent – large expansion capabilities with good economics	Very Good - large expansion capabilities with poor economics	Good - moderate expansion capabilities with good economics	Fair -moderate expansion capabilities with poor economics	Poor – minimal expansion capabilities	Very Poor – no expansion capabilities
	Compliance with Environmental Approvals	Dust Management	Qualitative scale	—	Excellent – TSF has a lower potential to generate dust emissions and is located away from the property boundary	Very Good – TSF has a lower potential to generate dust emissions and is located a moderate distance from the property boundary	Good - TSF has a lower potential to generate dust emissions and is located near the property boundary	Fair - TSF has a higher potential to generate dust emissions and is located away from the property boundary	Poor - TSF has a higher potential to generate dust emissions and is located a moderate distance from the property boundary	Very Poor - TSF has a higher potential to generate dust emissions and is located near the property boundary
Project Economics	Capital Costs	Clearing / Site Preparation	Cost (millions)	$	≤1.6	1.7 to 2.4	2.5 to 3.2	3.3 to 4.0	4.1 to 4.8	>4.8
		TSF Dam Construction	Volume	m³	N/A	≤2,400,000	2,400,001 to 2,590,000	2,590,001 to 2,780,000	2,780,001 to 2,970,000	>2,970,000
		Tailings Dewatering Infrastructure	Qualitative Scale	—	Excellent – conventional slurry TSF tailings requiring no dewatering	Very Good – thickened tailings TSF requiring minor dewatering	Good – thickened tailings TSF requiring moderate dewatering	Fair – paste tailings TSF requiring moderate dewatering	Poor – filtered stack TSF requiring high dewatering	Very Poor - filtered stack TSF requiring maximum dewatering
		MWP Construction	Dam volume	m³	≤205,000	205,001 to 250,000	250,001 to 295,000	295,001 to 340,000	340,001 to 385,000	>385,000
		Roads	Length of haul roads	km	≤0.5	0.6 to 0.9	1.0 to 1.3	1.4 to 1.7	1.8 to 2.1	>2.1
		Pumping Infrastructure	Length of pipelines	km	≤5.0	5.1 to 6.5	6.6 to 8.0	8.1 to 9.5	9.6 to 11.0	>11.0
		Seepage Collection Infrastructure	Length of ditching	km	≤4.2	4.3 to 4.6	4.7 to 5.0	5.1 to 5.4	5.5 to 5.8	>5.8

Account	Sub-Account	Indicator	Parameter	Unit	Indicator Value					
					6 (Highest)	5	4	3	2	1 (Lowest)
Project Economics (cont'd)	Operating Costs	Tailings Deposition	Qualitative scale	—	Excellent – tailings can be pumped normally, pump distance ≤1 km	Very Good - tailings can be pumped normally, pump distance >1 km and ≤2 km	Good - tailings can be pumped normally, pump distance >2 km	Fair - tailings can be pumped, but require positive displacement pumps	Poor - tailings transportation requires trucks with a hauling distance ≤2 km	Very Poor - tailings transportation requires trucks with a hauling distance >2 km
		TSF Water Management	Qualitative scale	—	Excellent - moderate water treatment and discharge requirements, TSF located near processing plant for easier recycling of supernatant, lower TSF dams reduce costs of pumping seepage back into TSF	Very Good - moderate water treatment and discharge requirements, TSF located near processing plant for easier recycling of supernatant, taller TSF dams increase costs of pumping seepage back into TSF	Good – moderate water treatment and discharge requirements, TSF located away from processing plant increasing reclaim pumping costs, lower TSF dams reduce costs of pumping seepage back into TSF	Fair – moderate water treatment and discharge requirements, TSF located away from processing plant increasing reclaim pumping costs, taller TSF dams increase costs of pumping seepage back into TSF	Poor – high water treatment and discharge requirements	Very Poor – extensive water treatment and discharge requirements
		MWP Pumping	Distance pumped	km	≤2.5	2.6 to 2.9	3.0 to 3.3	3.4 to 3.7	3.8 to 4.1	>4.1
	Closure Costs	TSF Cover	Cost (millions)	$	≤2.4	2.5 to 3.4	3.5 to 4.4	4.5 to 5.4	5.5 to 6.4	>6.4
		MWP Reclamation	Area to be reclaimed	m^2	≤200000	200001 to 219000	219001 to 238000	238001 to 257000	257001 to 276000	>276000
		Road Reclamation	Length of road	km	≤0.5	0,6 to 0.9	1.0 to 1.3	1.4 to 1.7	1.8 to 2.1	>2.1
	Post-Closure Costs	Inspection / Maintenance / Monitoring	Qualitative Scale	—	Excellent – TSF perimeter < 3 km with a height of 21 – 25 m	Very Good – TSF perimeter ≥ 3 km with a height of 21 – 25 m	Good – TSF perimeter < 3 km with a height of 26 – 30 m	Fair - TSF perimeter ≥ 3 km with a height of 26 – 30 m	Poor - TSF perimeter < 3 km with a height of 31 – 35 m	Very Poor - TSF perimeter ≥ 3 km with a height of 31 – 35 m
		Risk of Additional Treatment Facilities	Qualitative scale	—	Excellent - ≥ 50% of surface water runoff from the TSF reports to the open pit	Very Good - < 50% of surface water runoff from the TSF reports to the open pit	Good - ≥ 50% of surface water runoff from the TSF mixes with site runoff prior to discharge	Fair - < 50% of surface water runoff from the TSF mixes with site runoff prior to discharge	Poor - < 50% of surface water runoff from the TSF does not report to Blackwater Creek watershed	Very Poor - ≥ 50% of surface water runoff from the TSF does not report to Blackwater Creek watershed
	Ancillary Costs	Fish Habitat Compensation	Length of watercourse overprinted	km	0	1 to 550	551 to 1100	1101 to 1650	1651 to 2200	>2200
		SAR Compensation	Area of bat habitat overprinted	ha	0	0.1 t0 1.2	1.3 to 2.4	2.5 to 3.6	3.7 to 4.8	>4.8
		Length of Road Realignment	Length of road realignment	m	0	1 to 275	276 to 550	551 to 825	826 to 1100	>1100
		Haul Distances for Overburden Stockpiles	Distance	m	≤156	157 to 159	160 to 162	163 to 165	166 to 168	>168
	Risk	Risk of EA or Environmental Approval Delays or Rejection	Qualitative scale	—	Excellent – alternative is generally consistent with prior consultation, low risk of delays during environmental permitting	Very Good - alternative is generally consistent with prior consultation, moderate risk of delays during environmental permitting	Good – alternative is not consistent with prior consultation, low risk of delays during environmental permitting	Fair - alternative is not consistent with prior consultation, moderate risk of delays during environmental permitting	Poor - alternative is generally consistent with prior consultation, high risk of delays or rejection during environmental permitting	Very Poor - alternative is not consistent with prior consultation, high risk of delays or rejection during environmental permitting
		Risk Arising from TSF Costs	Qualitative scale	—	Excellent – TSF contributes to being a very low cost gold producer, highly resilient to large gold price fluctuations	Very Good – resilient to most gold price fluctuations, TSF is minor component of overall production costs and unlikely to be a primary contributor to temporary closure	Good – TSF is a moderate contributor to production costs, large or prolonged moderate gold price changes could result in temporary care and maintenance until prices improve	Fair – TSF is a moderate contributor to production costs, susceptible to changes in gold price, early care and maintenance is possible during moderate gold price fluctuations	Poor – TSF is a primary contributor to high production costs, project is susceptible to all but very minor changes in gold price, early care and maintenance likely until gold prices improve	Very Poor – TSF is a primary contributor to high cost gold production, very susceptible to minor variability in gold price, forced shutdown and early mine closure likely
		Delays from Displacing Local Residents	Qualitative scale	—	Excellent – no potential for the displacement and relocation of nearby residents	Very Good – may displace and require relocation for a single residence	Good – may displace and require relocation of several residences	Fair – may displace and require the relocation of a cluster of residences	Poor – may displace and require the relocation of a residential neighborhood	Very Poor – may displace and require the relocation of a large community or village

Account	Sub-Account	Indicator	Parameter	Unit	Indicator Value					
					6 (Highest)	5	4	3	2	1 (Lowest)
Socio-Economic	Aboriginal Land Use and Heritage Value	Access Effected Areas	Area with limited access	ha	≤725	726 to 850	851 to 975	976 to 1100	1101 to 1225	>1225
		Wildlife Abundance	Qualitative scale	—	Excellent – does not extend the Project footprint	Very Good – compact site footprint will minimize potential effects to wildlife	Good – contiguous with mine site area, but footprint may extend further from site, potential effects to wildlife abundance limited	Fair – not contiguous with the mine site area, but generally located near the mine site, a new short access corridor may be required	Poor – located a moderate distance away from mine site area, a moderate length access corridor may be required	Very Poor – located distant from mine site area, a longer access corridor may be required
		Loss of Undisturbed Habitat	Area of undisturbed habitat	ha	≤50	51 to 66	67 to 82	83 to 98	99 to 114	>114
		Avoidance of Thunder Lake Watershed	Area located within Thunder Lake watershed	ha	≤5	6 to 13	14 to 21	22 to 29	30 to 37	>37
	Land Use	Loss of Tree Stands	Area	ha	≤30	31 to 44	45 to 58	59 to 72	73 to 86	>86
		Access Along Transmission Line	Qualitative scale	—	Excellent – No loss of access along nearby snowmobiling / ATV trails	Very Good – temporary loss of access along an unofficial snowmobiling / ATV trail, reasonable length realignment available	Good - temporary loss of access along an unofficial snowmobiling / ATV trail, onerous realignment required	Fair – temporary loss of access along a designated snowmobiling / ATV trail, reasonable length realignment available	Poor - temporary loss of access along a designated snowmobiling / ATV trail, onerous realignment required	Very Poor – permanent loss of access along any snowmobiling / ATV trail or loss of access along a regional snowmobiling / ATV corridor
		Area with Air Quality Above Health Based Guidelines	Area	ha	≤250	251 to 265	266 to 280	281 to 295	296 to 310	>310
	Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	Distance	km	>4.2	4.2 to 4.0	3.9 to 3.8	3.7 to 3.6	3.5 to 3.4	≤3.4
		Residents and Cottagers Around Thunder Lake	Distance	km	>2.4	2.3 to 2.0	1.9 to 1.6	1.5 to 1.2	1.1 to 0.8	≤0.8
		Nearby Rural Residents	Distance	km	>1.40	1.40 to 1.21	1.20 to 1.01	1.00 to 0.81	0.80 to 0.61	≤0.6
		Aaron Provincial Park	Distance	km	>3.2	3.2 to 2.7	2.6 to 2.2	2.1 to 1.7	1.6 to 1.2	≤1.2
		Fugitive Dust	Qualitative scale	—	Excellent – tailings deposited as a conventional slurry in a saturated state / TSF centroid <2 km from open pit centroid	Very Good - tailings deposited as a conventional slurry in a saturated state / TSF centroid >2 km from open pit centroid	Good - tailings thickened (partially dewatered) / deposited <2 km from open pit centroid	Fair - tailings thickened (partially dewatered) / deposited >2 km from open pit centroid	Poor – tailings dewatered and stacked in an unsaturated stockpile <2 km from open pit centroid	Very Poor - tailings dewatered and stacked in an unsaturated stockpile >2 km from open pit centroid
		TSF Elevation	Elevation	masl	≤405	406 to 408	409 to 411	412 to 414	415 to 417	>417
		Frequency and Duration of Construction	Qualitative scale	—	Excellent – no construction requirements	Very Good - construction window is limited (<6 months) occurs infrequently, generally limited to daytime activities	Good - construction window is limited (<6 months), occurs annually, generally limited to daytime activities	Fair - construction window is extended (>6 months), occurs annually, generally limited to daytime activities	Poor - construction is continuous, generally limited to daytime activities	Very Poor - construction is continuous, nighttime construction required
	Local Infrastructure	Access Along Tree Nursery Road	Qualitative scale	—	Excellent – TSF and MWP will not require road closures	Very Good – Tree Nursery Road north of Normans Road will be intermittently unavailable for public use during the Project	Good – Tree Nursery Road north of Normans Road, and Normans Road east of Tree Nursery Road, will be intermittently unavailable for public use during the Project	Fair - Tree Nursery Road north of Normans Road will be unavailable for public use during the Project	Poor - Tree Nursery Road north of Normans Road, and Normans Road east of Tree Nursery Road, will be unavailable for public use during the Project	Very Poor – access along Tree Nursery Road will be removed in perpetuity
	Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	Distance to downgradient water well	m	≤950	951 to 1250	1251 to 1550	1551 to 1850	1851 to 2150	>2150

Account	Sub-Account	Indicator	Parameter	Unit	Indicator Value					
					6 (Highest)	5	4	3	2	1 (Lowest)
Socio-Economic (cont'd)	Public Safety	Hazard Potential of TSF	Qualitative scale	—	Excellent – no potential for residents or infrastructure to be affected	Very Good – failure unlikely to affect residents or infrastructure	Good - failure unlikely to affect residents but will likely affect infrastructure	Fair - failure affects infrastructure that is occasionally used by local residents	Poor – failure affects infrastructure that is occasionally used by local residents, and is adjacent to the property boundary such that there is no dissipation of flows prior to travelling offsite	Very Poor - failure has potential to affect an occupied residence
		Hazard Potential of MWP	Qualitative scale	—	Excellent – no potential for residents or infrastructure to be affected	Very Good – failure unlikely to affect residents or infrastructure	Good - failure unlikely to affect residents but will likely affect infrastructure	Fair - failure affects infrastructure that is occasionally used by local residents	Poor – failure affects infrastructure that is occasionally used by local residents, and is adjacent to the property boundary such that there is no dissipation of flows prior to travelling offsite	Very Poor - failure has potential to affect an occupied residence
	Local Employment / Business	Risk to Local Economy	Qualitative scale	—	Excellent – TSF contributes to being a very low cost gold producer, highly resilient to large gold price fluctuations	Very Good – resilient to most gold price fluctuations, TSF is minor component of overall production costs and unlikely to be a primary contributor to temporary closure	Good – TSF is a moderate contributor to production costs, large or prolonged moderate gold price changes could result in temporary care and maintenance until prices improve	Fair – TSF is a moderate contributor to production costs, susceptible to changes in gold price, early care and maintenance is possible during moderate gold price fluctuations	Poor – TSF is a primary contributor to high production costs, project is susceptible to all but very minor changes in gold price, early care and maintenance likely until gold prices improve	Very Poor – TSF is a primary contributor to high cost gold production, very susceptible to minor variability in gold price, forced shutdown and early mine closure likely
	Displacement of Residents	Potential for Displacing Local Residents	Qualitative scale	—	Excellent – No potential for the displacement and relocation of nearby residents	Very Good – may displace and require relocation for a single residence	Good – may displace and require relocation of several residences	Fair – may displace and require the relocation of a cluster of residences	Poor – may displace and require the relocation of a residential neighborhood	Very Poor – may displace and require the relocation of a large community or village

9.0 VALUE BASED DECISION PROCESS

9.1 Valuating

A multiple accounts ledger was developed for the four alternatives. Based on the alternatives characterization (Table 7-1) and valuation criteria (Table 8-2), values have been determined for all indicators and alternatives, and are provided in Table 9-1.

9.2 Weighting

As part of the MAA, weights need to be applied to each account, sub-account, and indicator to reflect the relative importance of these criteria.

The base case scenario uses weights provided by Environment Canada (2011), which sets the environmental account as twice as important as the technical and socio-economic accounts, which are in turn twice as important as the Project economics account:

- Environmental - 6;
- Technical - 3;
- Socio-Economic - 3; and
- Project Economics - 1.5.

Table 9-2 presents the weights given to the accounts, sub-accounts and indicators. A multi-multidisciplinary team from Treasury Metals and Amec Foster Wheeler assigned weights to each of the sub-accounts and indicators. The weights reflect the relative importance between the criteria. Where possible, the weighting team applied higher weights to areas of concern noted during consultation and information requests on the environmental impact statement. It is acknowledged that weighting is a somewhat subjective process and the rationale for each weight is provided in Table 9-2.

9.3 Quantitative Analysis – Base Case

9.3.1 Indicators

Using the values and weights provided in Table 9-1 and Table 9-2, respectively, the MAA was conducted for the base case scenario. The analysis of Environmental, Technical, Project Economics and Socio-economic indicators, and calculation of sub-account merit ratings is provided in Table 9-3, Table 9-4, Table 9-5 and Table 9-6, respectively.

9.3.2 Sub-Accounts

The analysis of Environmental, Technical, Project Economics and Socio-economic sub-accounts, and calculation of account merit ratings, is provided in Table 9-7, Table 9-8, Table 9-9 and Table 9-10, respectively.

For the Environmental Account, Alternative A and Alternative B received equal account merit ratings of 4.2 out of a maximum of 6.0. Alternative C was next highest and received an account merit rating of 3.9.

For the Technical Account, Alternative A is the preferred alternative with an account merit rating of 4.3. Alternative B was the second most viable alternative from a technical perspective with an account merit rating of 4.1.

For the Project Economics Account, Alternative A is preferred with an account merit rating of 5.2. Alternative B received an account merit rating of 5.0.

For the Socio-economic Account, Alternative A is preferred with an account merit rating of 4.0. Alternative B was next highest with an account merit rating of 3.9.

9.3.3 Base Case Result

Overall results of the MAA base case scenario, and calculation of alternative merit ratings, are provided in Table 9-11.

The MAA found that Alternative A is the preferred alternative an alternative merit rating of 4.3 out of a maximum of 6.0. The runner-up alternative (Alternative B) received an alternative merit rating of 4.2. Alternatives A and B are very similar, differentiated only by mine water pond location, and the closeness of account merit ratings is reflective of their many similarities.

Table 9-1: Multiple Accounts Values

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
Environmental	Surface and Groundwater Quantity and Quality	Flow Loss	3	3	1	5
		Flow Reductions Outside Blackwater Creek	6	5	4	1
		Seepage Capture During Operations	6	6	6	1
	Aquatic Resources	Tributary Fish Habitat Losses	1	2	4	6
		Main stem Watercourse Fish Habitat Losses	6	6	1	6
		Watercourse Crossings	6	6	6	4
	Terrestrial Resources	Forest Loss	3	3	6	1
		Wetland Loss	1	2	3	6
		Use of Recently Disturbed Land	5	4	6	1
	SAR	Common Nighthawk	2	3	1	6
		Barn Swallow	6	6	2	1
		Bats	4	4	6	2
	Atmospheric Emissions	Fugitive Dust	6	6	2	5
		Noise Emissions	6	4	6	2
		Greenhouse Gas (GHG) Emissions	6	6	2	1
		Light Trespass	5	5	3	4
	Protected Areas	Distance to Nature Reserve	1	1	6	3
		Distance to Provincial Park	3	3	1	6
		Provincial Fish Sanctuary	6	6	6	4
	Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	3	3	1	6
		Surface Water Discharges	5	5	3	2
Technical	Design Factors	TSF Location Suitability	5	5	4	3
		MWP Location Suitability	3	1	3	6
		Foundation Suitability	4	4	2	3
	Safety Factors	TSF Hazard Potential	3	3	5	4
		MWP Hazard Potential	3	2	1	3
		Maximum TSF Dam Height	5	5	6	1
		Maximum MWP Dam Height	1	2	5	6
		Worker Health	5	5	1	6

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
Technical (cont'd)	Water Management	Seepage During Operations	5	5	6	1
		Runoff Management	6	2	5	1
		Watercourse Realignment	3	3	2	6
		Excess Water Management	5	5	1	5
		Flexibility for Water Management	5	4	1	2
	Expansion Capacity	Expansion Capacity	4	6	6	5
	Compliance with Environmental Approvals	Dust Management	5	5	1	6
Project Economics	Capital Cost	Clearing / Site Preparation	2	2	6	1
		TSF Dam Construction	5	5	6	1
		Tailings Dewatering Infrastructure	6	6	2	6
		MWP Construction	4	1	3	6
		Roads	6	6	3	1
		Pumping Infrastructure	4	5	6	1
		Seepage Collection Infrastructure	6	2	5	1
	Operational Costs	Tailings Deposition	6	6	2	4
		TSF Water Management	6	6	1	3
		MWP Pumping	2	5	6	1
	Closure Costs	TSF Cover	6	6	1	5
		MWP Reclamation	6	4	2	1
		Road Reclamation	6	6	3	1
	Post Closure Costs	Inspection / Maintenance / Monitoring	5	5	6	1
		Risk of Additional Treatment Facilities	6	6	4	1
	Ancillary Costs	Fish Habitat Compensation	1	2	3	6
		SAR Compensation	1	1	6	3
		Road Realignment	6	3	6	1
		Haul Distances for Overburden Stockpiles	6	6	1	6
	Risk	Risk of EA or Environmental Approval Delays or Rejection	5	5	1	5
		Risk Arising from TSF Costs	4	4	1	3
		Delays from Displacing Local Residents	6	6	4	6

Account	Sub-Account	Indicator	Indicator Value			
			Alternative A	Alternative B	Alternative C	Alternative D
Socio-Economic	Aboriginal Land Use and Heritage Value	Access Effected Areas	5	6	5	1
		Wildlife Abundance	4	4	5	2
	Aboriginal Land Use and Heritage Value (cont'd)	Loss of Undisturbed Habitat	3	2	6	1
		Avoidance of Thunder Lake Watershed	6	4	1	5
	Land Use	Loss of Tree Stands	2	2	6	1
		Access Along Transmission Line	5	5	6	4
		Area with Air Quality Above Health Based Guidelines	6	6	1	6
	Operational	Village of Wabigoon	5	6	1	5
		Residents and Cottagers Around Thunder Lake	6	4	1	6
		Nearby Rural Residents	2	4	1	6
		Aaron Provincial Park	6	5	1	6
		Fugitive Dust	6	6	2	5
		TSF Elevation	1	1	6	1
		Frequency and Duration of Construction	4	4	1	3
	Local Infrastructure	Access Along Tree Nursery Road	3	3	6	2
	Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	2	2	6	1
	Public Safety	Hazard Potential of TSF	3	3	5	4
		Hazard Potential of MWP	3	2	1	3
	Local Employment / Business	Risk to Local Economy	4	4	1	3
	Displacement of Residents	Potential for Displacing Local Residents	6	6	4	6

Table 9-2: Sub-Account and Indicator Weightings and Rationale

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Environmental	6	Surface and Groundwater Quality and Quantity	4	Surface and groundwater quality and quantity are of significant concern when designing a TSF and MWP. Changes to the quality or quantity of watercourses as a result of the Project can have cascading effects to aquatic resources, with differing severity between the four alternatives. However, due to each alternative meeting PWQO for surface water discharges, relatively small flow reductions to watercourses, and seepage capture, a moderate weight of four was assigned.	Flow Loss	2	During TSF and MWP operations, precipitation will be captured into the site water balance and will result in the loss of catchment area to nearby watercourses. However, there would be no extensive flow loss to any of the affected watercourses from the different alternatives. Treated water will be returned to Blackwater Creek at the discharge point, mitigating flow losses. Also, the watercourses around the site are dominantly surface water fed with very little inflow from groundwater and are therefore subject to large flow fluctuations depending on the weather conditions. A low weight of two has been assigned to Flow Loss.
					Flow Reductions Outside Blackwater Creek	3	Treasury Metals has agreed to keep the majority of the Project footprint within the Blackwater Creek watershed, to the extent practicable. This would limit the spatial effects of the Project and improve management of water related effects. Since submission of the original EIS, Treasury Metals has made further refinements to the site layout to locate infrastructure in the Blackwater Creek watershed. A moderate weight of three has been assigned to this indicator
					Seepage Capture During Operations	5	Although the Project will be designed with a seepage collection system around the TSF and the operations area, structures located outside the mine dewatering drawdown zone will have some seepage that will migrate off-site. This seepage quality may have negative effects on the water quality of watercourses that the Project seepage reports to. Due to the inherent difficulty of managing seepage reporting to these watercourses, and a large number of information requests on the original EIS pertaining to seepage capture, a high weight of five has been assigned.
		Aquatic Resources	6	Aquatic resources are protected under the *Fisheries Act* and no net loss of fish habitat will occur as a result of the Project. That stated, natural fish habitat will be disturbed by each of the alternatives at differing severities depending on the number of watercourses disturbed and the length of watercourse disturbed. Because of the importance placed on fish habitat by Federal legislation, the maximum weight of six was assigned.	Tributary Fish Habitat Losses	3	Several tributaries around the Project site are intermittent watercourses and do not have permanent flows supporting fish habitat throughout the year. Additionally, under Schedule 2 of the MMER, overprinted fish habitat would be compensated with new habitat so no net loss of habitat would occur. That stated, due to the length of tributary fish habitat losses for some of the alternatives, a moderate weight of three has been assigned.
					Main stem Watercourse Fish Habitat Losses	4	Several main stem watercourses around the Project site have been classified as permanent watercourse with flow throughout the year. They have also been assessed to be more somewhat productive for fish habitat due to flow throughout the year. Additionally, under Schedule 2 of the MMER, overprinted fish habitat would be compensated with new habitat so no net loss of habitat would occur. Due to the greater productivity of these main stem watercourses, a moderate weight of four has been assigned.
					Watercourse Crossings	2	Haul roads and pipelines that cross watercourses have the potential to affect fish habitat by altering the embankments, channel and substrate characteristics. Vehicle traffic over crossings can further affect the quality of fish habitat during the operations phase of the Project. However, watercourse crossings are considered to have less of an impact on fish habitat than the overprinting of watercourses. Therefore, a low weight of two has been assigned.
		Terrestrial Resources	4	The alternatives will overprint forests and wetlands and displace wildlife that utilize these habitats. However, due to the large abundance of similar habitat surrounding the Project area and the relatively compact site the Project will overprint, a moderate weight of three was assigned.	Forest Loss	3	Forests have a high ecological value due to their importance to the local fauna and flora. However, due to the extensive forestry in the region, most of the forests surrounding the Project have been harvested in the past, and will be harvested in the future. As the forests in the area will be logged in the next few decades, a moderate weight of three has been assigned.
					Wetland Loss	4	Wetlands have a high ecological value due to their productivity and large fauna and flora diversity. A moderate weight of four has been assigned to reflect the ecological importance of protecting wetlands in the area.
					Use of Recently Disturbed Land	2	Recently disturbed lands have a relatively low ecological value compared to other ecosystems and are overrepresented relative to pre-industrial conditions. Alternatives that overprint recently disturbed land are preferred. However, only a small percentage of the total footprint of the alternatives is represented by recently disturbed lands and a low weight has been assigned to this indicator.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Environmental (cont'd)		SAR	5	SAR species have been observed in the LSA around the Project during baseline studies, including both threatened and endangered species. Due to the importance of these species through legislation and from a biodiversity perspective, a high weight of five has been assigned.	Common Nighthawk	2	Common Nighthawk have been observed near the Project site and potentially nest near the Project site. They are listed as Threatened through the Federal SARA and are Provincially listed as Special Concern through the ESA. A low weight of two has been assigned to this indicator to reflect the species being listed as Threatened under SARA, but only listed as Special Concern within Ontario.
					Barn Swallow	3	Barn Swallow have been observed foraging near the Project site. They are designated Threatened by the COSEWIC and Threatened through the Provincial ESA, but are not listed to the Federal SARA. Additionally, Barn Swallows tend to inhabit buildings, which will be kept on site following the closure of the Project so there will be no nesting habitat loss. A weight of three has been assigned to this indicator to reflect the species not being listed under the SARA compared to the other SAR indicators.
					Bats	6	Little Brown Myotis and Northern Myotis have been observed within the Project area. They are listed as Endangered under both the Federal SARA and Provincial ESA. The highest weight of six has been assigned to this indicator to reflect the endangered status of bats both Federally and Provincially.
		Atmospheric Emissions	3	Pollution and other materials that are released into the atmosphere could alter aspects of the physical atmospheric environment, which could sequentially affect flora and fauna. However, these effects to the environment are relatively minor compared to other sub-accounts which consider direct habitat loss. A moderate weight of three has been assigned.	Fugitive Dust	3	Alternatives have the potential to result in fugitive dust emissions when tailings are mechanically disturbed by air currents, or by ground disturbance during hauling of materials or construction activities. Fugitive dust deposition on the surrounding area could degrade aquatic and terrestrial habitats downwind of the TSF. That stated, mitigation measure can be put in place to greatly reduce fugitive dust in most cases. A moderate weight of three has been assigned to this indicator.
					Noise Emissions	4	Activities from the Project will result in noise emissions that increase ambient sound levels. An increase to ambient noise can be disruptive wildlife in the area and can deter wildlife from the area. It is more difficult to mitigate noise emissions to a low enough level to avoid environmental effects. A moderate weight of four has been assigned to reflect the importance of local wildlife as well as the difficulty of mitigating noise emissions.
					Greenhouse Gas (GHG) Emissions	5	Although GHG emissions from the Project will be very small compared to total emissions in Ontario and Canada, Treasury Metals recognizes the importance of GHG reduction to slow climate change effects on a global scale. Due to its global importance and the mentality of Treasury Metals that every bit helps no matter how small, a high weight of five was given to this indicator.
					Light Trespass	1	Light trespass has been shown to act as an attractant to some wildlife, therefore increasing the probability of Project-wildlife interactions. However, with proper avoidance and mitigation measure, light trespass will only effect a very small area. The lowest weight of one has been assigned to this indicator.
		Protected Areas	4	Three areas in close proximity to the Project have been assigned Provincial protection due to their recreational, ecological, or unique geological value. Candidate TSF and MWP locations that had large effects on any of these protected areas were considered to have a fatal flaw and were pre-screened out. Although not substantial, the remaining alternatives may have minor effects to these protected areas. A moderate weight of four has been assigned to reflect the importance of avoiding these protected areas.	Distance to Nature Reserve	5	Lola Lake Provincial Nature Reserve is located northeast of the Project and is designed to protect the unique geology of the area. The park is inaccessible to the public and is a relatively undisturbed habitat comprised of mostly peatland. This area is assumed to be significant habitat for a number of diverse species of flora and fauna. Due to the ecological and geological importance of the Lola Lake Provincial Nature Reserve, a high weight of five has been assigned to this indictor.
					Distance to Provincial Park	2	Aaron Provincial Park is a recreational park located west of the Project site that allows for camping at Thunder Lake / Thunder Creek, and also provides habitat for local flora and fauna. From an environmental perspective, the ecological value of Aaron Provincial Park is reduced by the recreational activities in the park, the Trans-Canada Highway running through the park, and the CPR rail running adjacent to the park. A low weight of two has been assigned to reflect the ecological value of the area compared to the nature reserve and fish sanctuary.
					Provincial Fish Sanctuary	4	The lower reaches of Nugget Creek at Barrett Bay (between Hughes Creek and the CPR crossing at Wabigoon Lake) is designated as a Provincial Fish Sanctuary to protect spawning walleye and is closed from fishing from April 1 to May 31. Due to the importance of fish sanctuaries in the area to keep a health population of walleye in Wabigoon Lake, a moderate weight of four has been assigned.
		Closure / Post-Closure	4	The TSF will remain in a closed-out state following the Project's closure phase. Although the TSF will be isolated from oxidation using a wet or dry cover, surface water runoff and seepage will exit the facility and report to nearby surface waters or ground water. A moderate weight of four has been assigned to reflect the importance of water quality from a long-term environmental perspective.	Potential for Seepage to Report to Thunder Lake	5	In the post-closure phase once the open pit has filled, groundwater flow patterns will reestablish and some seepage from the alternatives will likely report to Thunder Lake. Thunder Lake is a deep cold water lake that supports cold water aquatic species, such as Lake Trout. It is also more of a pristine lake compared to Wabigoon Lake, which has been greatly affected by industry in the area. A high weight of five has been assigned.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Environmental (cont'd)		Closure / Post Closure (cont'd)		See rationale on previous page	Surface Water Discharges	4	Alternatives that allow for a single discharge location into closure are advantageous as they allow more control of water quality leaving the site, particularly in the unlikely event that additional treatment or water management is required. Additionally, a single discharge location will only affect a section of a single creek as opposed to multiple creeks or multiple sections of a single creek. A moderate weight of four has been assigned.
Technical	3	Design Factors	6	Design factors evaluate the technical complexity of the TSF and MWP and assess engineering constraints. The alternatives design and location differ greatly in the engineering complexity, which generally indicate the viability of the alternatives from a technical perspective. Therefore, a maximum weighting of six was given.	TSF Location Suitability	6	Location suitability is one of the primary considerations in designing a TSF with varying criteria between conventional slurry and filtered stack tailings deposition. A primary consideration for conventional slurry impoundment is locating the TSF to have good storage volume to dam ratio and a primary consideration for filtered stack is locating the TSF to have a low haul distance. The TSF location suitability indicator was given a maximum weight of six to reflect the importance of this design consideration.
					MWP Location Suitability	3	Location suitability is one of the primary considerations in the design of a MWP, which most often requires a good storage volume to dam volume ratio as a primary design criterion. Since the MWP is a much smaller structure with more location flexibility, a moderate weight of three was assigned.
					Foundation Suitability	4	TSF foundation suitability is a primary consideration in determining the location of the facility, which is ideally situated on hard rock for foundation stability or free draining overburden to reduce potential for excess pore pressure buildup. However, foundation suitability can be altered to provide a more suitable foundation for the TSF. Therefore, a moderate weight of four was assigned.
		Safety Factors	5	Although each TSF and MWP alternative will be designed to the appropriate standard of safety required for operation, there are alternatives that are inherently more safe due to structure design and location. It is of utmost importance to Treasury Metals to maintain a safe work environment including the prevention of dam failures. The highest weight of six was not assigned due to all the alternatives being able to meet the standard of safety, however a high weight of five was assigned to safety factors to reflect the importance of Project safety.	TSF Hazard Potential	6	The hazard potential of the TSF was determined to be the potential for a TSF dam failure to affect nearby residents or infrastructure. The max weighting was assigned to this indicator due to the importance of project safety.
					MWP Hazard Potential	4	The hazard potential of the MWP was determined to be the potential for a MWP dam failure to affect nearby residents or infrastructure. A lower weight was used for this indicator compared to the TSF hazard potential indicator due to the increase damage potential of the TSF. A moderate weight of four was assigned.
					Maximum TSF Dam Height	2	Alternatives with a higher maximum TSF dam height have a greater potential energy stored in the tailings and pond and have the potential to cause more damage in the unlikely event of a dam break. However, the presence of receptors near the TSF is a more important metric for determining safety and a low weight was assigned.
					Maximum MWP Dam Height	1	Alternatives with a higher maximum MWP dam height have a greater potential energy stored in the pond and have the potential to cause more damage in the unlikely event of a dam break. However, all the alternatives have a relatively similar and short proposed dam heights and a minimum weight was assigned.
					Worker Health	3	Some of the alternatives have the potential to increase risk to worker health, such as through exposure to airborne particulates. Worker safety and health is a primary concern to Treasury Metals and proper mitigation measures and personal protective equipment would be implemented to ensure safety is maintained. Due to the known risks of potential worker exposure from some of the alternatives, proper design and personal protective equipment would be used to mitigate risks. Therefore, a moderate weight of three was assigned.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Technical (cont'd)		Water Management	5	The ease of managing water around the Project site varies greatly between alternatives and is influenced by a number of technical factors. For example, both insufficient water for the process plant as well as excess water on site can lead to significant technical problems for the Project, including additional water takings from the environment or an upgrade in water treatment facilities. Water management was therefore given a weight of five to reflect its importance to potential technical complexity.	Seepage During Operations	5	Although the TSF will be equipped with a perimeter seepage collection system, seepage from within the drawdown zone of the Project will drain to the mine dewatering system during operations until the mine is flooded in post-closure. Alternatives that are located outside this drawdown zone will not have this added seepage collection and seepage would be more likely to report off-site. A moderately high weight of five was assigned to this indicator to reflect the significance of Project seepage.
					Runoff Management	3	A runoff collection system, including collection ditches and sumps around the TSF, will be built prior to the beginning of operations. Based on the structure size and location of the TSF alternatives, length of ditching and number of sumps will vary between alternatives. The technical complexity usually increases proportionally with the length of ditching required. A moderate weight of three was assigned.
					Watercourse Realignments	2	Alternatives that overprint watercourses or that have large upstream catchment areas will require realignments or diversions around the structures. However, after assessing each of the alternatives there would be no technically challenging watercourse realignments and difficult cuts into bedrock are not required. Therefore, this indicator was given a moderately low weight of two.
					Excess Water Management	4	A conceptual water balance of the Project site has determined that water will accumulate in the site inventory and will require treatment prior to discharge to the environment. Alternatives that increase the water quantity on site will increase the technical complexity of water management and may require a larger RO facility to treat excess water prior to discharge. There is also the added risk of having excess water on site during 1000-year flood events or if the RO facility is down. A moderate weight of four was assigned to this indicator.
					Flexibility of Water Management	3	Close proximity of the TSF to the MWP allows for flexibility of water management and ease of pumping between these two structures in the event an unforeseen scenario occurs that requires quick transfer of water. It is therefore technically advantageous to have the TSF and MWP available for easy water transfer. A moderate weight of three has been assigned.
		Expansion Capacity	2	It is conceivable that with ongoing mineral exploration in the area, a new mineral reserve could be discovered or existing reserves expanded. TSF alternatives that allow for greater expansion of tailings capacity would negate the need for the creation of a new TSF with potentially new MMER Schedule 2 considerations. However, a low weighting of two was given to this sub-account as it would be advantageous to Treasury Metals to have a greater expansion capacity, but is not essential to the Project feasibility.	Expansion Capacity	1	There is only one indicator in this sub-account, therefore a weight of one was assigned.
		Compliance with Environmental Approvals	3	There is the potential that some of the alternatives would not be able to meet the regulatory requirements for air quality at the point of impingement. This could delay or require Treasury Metals to increase the Project area in order to receive a Provincial Environmental Compliance Approval. Due to the potential significance of not complying with environmental approvals, a moderate weight of three was given.	Dust Management	1	There is only one indicator in this sub-account, therefore a weight of one was assigned.
Project Economics	1.5	Capital Cost	6	Capital costs are expected to have the greatest cost associated with the Project and will have a major effect on Project economics, a maximum weight of six has been assigned to reflect the significance of these upfront costs.	Clearing / Site Preparation	1	During the site preparation and construction phase of the Project, vegetation will need to be cleared prior to the construction of the TSF and the MWP. This is a relatively low cost compared to other capital costs and the indicator was assigned the lowest weight.
					TSF Dam Construction	6	TSF alternatives with conventional slurry tailings deposition have the highest capital costs due to expensive TSF dams. The highest weight of six was assigned to reflect this large cost.
					Dewatering Infrastructure	3	The infrastructure required to dewater tailings to an unsaturated state has a significant capital cost. Additionally, water collected during the dewatering process will require treatment and discharge to the environment in either an expanded water treatment plant, or through industrial evaporators; both of which have large capital costs. However, compared to TSF dam construction, these costs are moderate and a weight of three has been assigned to this indicator.
					MWP Construction	2	The MWP will be constructed during the site preparation and construction phase of the Project and will be a low relative cost to the TSF dam construction. Therefore, a low weight has been assigned to this indicator to reflect the relative cost.
					Roads	2	Haul roads will need to be built in order to bring material to construct both the TSF and the MWP. Additionally, haul roads would also need to be built from the process plant to the filtered stack TSF for continuous hauling of tailings during the operations of the Project. This is a relatively low capital cost relative to other site preparation costs. Therefore, a low weight has been assigned.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Project Economics (cont'd)		Capital Cost (cont'd)		See rationale on previous page	Pumping Infrastructure	1	Pumping infrastructure will be required to manage water for all of the alternatives. Alternatives that are located in close proximity to the open pit and processing plant will have a lower relative cost. The lowest weight of one was assigned to this indicator to reflect the low cost compared to other capital costs.
					Seepage Collection Infrastructure	1	A seepage collection system will be built around the TSF and the operations area during the site preparation and construction phase. This will be a relatively low cost compared to other capital costs and was assigned the lowest weight of one.
		Operational Costs	5	Operational costs are incurred over the operating life of the Project. Some alternatives will have relatively high operational costs that are comparable to the capital costs, which have a large effect on the Project's net present value. A high weight of five has been assigned to this indicator.	Tailings Deposition	6	During operations, the greatest operations cost will be associated with tailings deposition by means of pumping costs for conventional tailings slurry, and trucking cost in the case of the filtered stack. Other associated costs with the filtered stack include grading the tailings and 24/7 labour costs of stockpile construction. The highest weight of six was assigned to reflect this large cost.
					TSF Water Management	4	During operations, TSF water management costs include pumping water for seepage collection, recycling water to the process plant, and treatment and discharge of excess water. These costs vary between the alternatives based on height of the dams to pump seepage back into the TSF, location from the process plant, and the water content of the tailings. The largest cost associated with TSF water management would be dewatering of the tailings in the case of dry stack which would produce a much larger quantity of water requiring treatment. This would require an upgrade to the water treatment facility to treat the increased quantities of water. A moderate weight of four was assigned to reflect the large variation in costs between the alternatives.
					MWP Pumping	1	MWP pumping includes the cost of pumping water from the open pit and underground mine to the MWP, as well as pumping water from the MWP to the process plant or water treatment facility. This is a relatively low cost in comparison to other operational costs and has been assigned the lowest weight of one.
		Closure Costs	3	Closure costs will require financial security as part of the Closure Plan and are unable to be deferred to later in the mine life. This results in a higher net present value. However, closure costs are expected to be less than capital and operational costs. A moderate weight of three was assigned.	TSF Cover	6	Following operations, a multi-layered low-permeability cover will be used to isolate the tailings from oxygen to prevent ARD / ML and promote long-term stability of stockpiled tailings. In the case of the conventional slurry alternatives, a wet cover of treated water or a vegetated dry cover will be used to cover the TSF. In the case of dry stack, a vegetated dry cover would be the only option. This is expected to be the most significant cost in the closure phase, and has been given the highest weight of six.
					MWP Reclamation	2	Following operations, mine dewatering will cease and the MWP will no longer be required. The materials used to build the dams for the MWP will be graded and vegetated. The cost varies between alternatives based on the overall area of the MWP that will need to be reclaimed. However, this is not expected to be a significant cost relative to other closure costs associated with the Project. A low weight of two has been assigned.
					Road Reclamation	2	Following operations, the haul roads to the TSF and MWP will need to be removed and the area reclaimed. The cost varies between alternatives based on the length of haul road to the TSF and MWP. However, this is not expected to be a significant cost relative to other closure costs associated with the TSF. A low weight of two has been assigned.
		Post-Closure Costs	1	Post-closure costs are expected to be minimal once the closure phase is completed and the TSF is stable. Inspection and maintenance costs of the TSF are expected to be low as well as a low risk of an additional treatment facility. The lowest weight of one has been assigned.	Inspection / Maintenance / Monitoring	2	During post-closure, the site will need to inspected, maintained, and monitored by Treasury Metals until the MNDM has deemed the site reclaimed. There will be a requirement to monitoring and inspect the TSF to ensure its structural stability. The cost varies between alternatives with larger structures taking longer to inspect and are more likely to require maintenance. This is not expected to be a significant cost and a low weight of two has been assigned.
					Risk of Additional Treatment Facilities	4	During closure, the site will be graded to drain all water captured in the operations area to the open pit as it is flooding, where it will be monitored and undergo batch treatment if necessary. Alternatives that are downgradient of the open pit or are unable to be graded to the open pit may require additional perimeter treatment systems in the unlikely event that additional water treatment is required. Some of the alternatives have a greater risk of an additional perimeter treatment system than other, which would be a significant cost into post-closure. A moderate weight of four has been assigned to reflect the potential risk of this post-closure cost.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Project Economics (cont'd)		Ancillary Costs	2	Ancillary costs of the Project are incidental to various alternatives and could affect the Project's net present value. However, these costs are expected to be significantly less than other costs and a low weight of two has been assigned.	Fish Habitat Compensation	3	Alternatives that overprint watercourses frequented by fish will require fish habitat compensation as required by the *Fisheries Act* and the MMER. The amount of fish habitat compensation required is usually proportional to the habitat that has been overprinted. The cost of building this habitat is relatively moderate compared to other Project costs as the amount of fish habitat potentially being overprinted is not extensive. A moderate weight of three has been assigned.
					SAR Compensation	1	SAR species have been identified in the vicinity of the Project. There may be some overprint of these SAR species habitat, which may require habitat compensation through the ESA. Based on the projected area of habitat compensation, this is expected to be a low cost relative to other aspects of the Project. The lowest weight of one has been assigned to this indicator.
					Road Realignment	3	Some of the alternatives will overprint municipal or forestry roads around the vicinity of the Project. These roads will need to be realigned around the Project, and may have an additional environmental permitting cost associated with the work. However, the potential road realignment is not considered a significant cost to the Project and has been assigned a moderate weight of three.
					Haul Distances for Overburden Stockpiles	1	Alternatives that displace overburden stockpiles will require overburden to be hauled a greater distance from the open pit. However, this increased haul distance is not significant enough to drastically increase the cost. The lowest weight of one has been assigned to reflect this small change in cost.
		Risk	3	The alternatives have differing economic risks which could contribute to overall Project costs, or delays to the start of construction affecting the net present value of the Project. However, since these are considered risks and not concrete costs like the other Project Economic sub-accounts, a moderate weight of three has been assigned.	Risk of EA or Environmental Approval Delays or Rejection	5	There is the possibility that some alternatives could result in the delay or rejection of the EIS and environmental approvals, potentially delaying Project construction. There is a significant risk to Project feasibility if delays become extended. A high weight of five has been assigned to reflect the risk in potential delays.
					Risk Arising from TSF Costs	3	The alternatives have differing costs of construction and operations of the TSF, which will contribute to overall production costs of the Project. Alternatives which increase production cost will reduce the margins of the Treasury Metals, ultimately increasing the risk of putting the Project into a temporary care and management phase if gold prices sufficiently decrease. A moderate weight of three has been assigned.
					Delays from Displacing Local Residents	4	Some of the alternatives could result in displacement of permanent residents in the vicinity of the Project due to inability to meet regulatory air emissions criteria at the current property boundary. This could result in delays to Project construction if the residents do not wish to sell their property, which may also incur substantial legal costs. A moderate weight of four has been assigned to reflect the inherent risk of displacing residents.
Socio-Economic	3	Aboriginal Land Use and Heritage Value	6	Treasury Metals understands and respects First Nations Aboriginal and Treaty rights. Aboriginal peoples around the Project area have identified important land uses around the Project through engagement and the Federal environmental assessment process, which Treasury Metals has worked to address. Because of the importance of Aboriginal land use and heritage value to both Treasury Metals and local communities, a maximum weight of six has been assigned.	Access Effected Areas	6	It is important to Treasury Metals that Aboriginal Peoples be able to practice traditional land uses on as much area around the Project as possible, while realizing that some areas will be inaccessible for safety and security reasons. Some alternatives allow for a compact site layout and are therefore preferred, while some have a more dispersed layout which do not allow for access to greater areas. Due to the important of Aboriginal Peoples' ability to practice traditional land use in accordance with Aboriginal and Treaty rights, the highest weight of six has been assigned.
					Wildlife Abundance	3	The alternatives have the potential to displace wildlife harvested by Aboriginal peoples by overprinting habitat, and through operational effects that make habitat less desirable to wildlife. However, the TSF and MWP alternatives are not anticipated to have an impact on regional wildlife populations and wildlife abundance for traditional pursuits should remain unimpacted. A moderate weight of three has been assigned to this indicator.
					Loss of Undisturbed Habitat	3	Areas of undisturbed habitat such as older forests and wetlands are assumed to be of greater value to Aboriginal peoples' land use and traditional heritage values, compared to areas recently disturbed by logging and other industrial activities. Areas that overprint less undisturbed land are therefore preferred. A moderate weight of three was assigned to reflect the inherent value of undisturbed habitat.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Socio-Economic (cont'd)		Aboriginal Land Use and Heritage Value (cont'd)		See rationale on previous page	Avoidance of Thunder Lake Watershed	4	Thunder Lake has been identified by Aboriginal peoples as a historic travel route and the view from Thunder Lake has intrinsic value. The lake is also classified as a cold water lake, which contains cold water species of fish such as lake trout. Alternatives that avoid any potential seepage into Thunder Lake watershed are preferred. Through engagement efforts and through the Federal environmental assessment process, Treasury Metals has heard Thunder Lake has value to Aboriginal peoples and a moderate weight of four has been assigned.
		Land Use	3	Lands around the Project site are used for a variety of pursuits. However, due to the large amounts of similar land nearby, major interruptions of land use are not expected, and a moderate weight of three has been assigned.	Loss of Tree Stands	2	During the site preparation and construction phase of the Project, the merchantable timber from the Project area will be removed by local forestry companies, with oversight by the Dryden Forest Management Company Ltd. Following closure and reclamation, the area overprinted by the TSF will be unavailable for forestry. However, this is a very small area in comparison to the area available to forestry. Therefore, a low weight was assigned to reflect the small change in land use.
					Access Along Transmission Line	2	There is the potential that local residents utilize the area along the transmission lines running through the Project site for recreation, including ATVing and snowmobiling. However, this area is not a designated trail and effects will cease in the closure phase. A low weight has been assigned to this indicator.
					Area Where Human Health Guidelines Could be Exceeded	4	As a result of some TSF alternatives, there may be areas where air emissions (such as PM_{10}) exceed criteria for the protection of health. Treasury Metals may restrict or limit land use activities in these areas for safety reasons. The areas where human health guidelines could be exceeded varies greatly among the alternatives with the filtered stack alternative producing the most PM_{10}. A moderately high weight of four has been assigned to this indicator to reflect the importance of limiting emissions that could exceed guidelines.
		Operational Impact (Air, Noise and Aesthetics)	4	The Project is situated in a relatively populated area, with nearby First Nations communities, rural residents, cottages, towns and parks. Operational impacts from the Project may affect these places and people with differing severities between alternatives. However, Treasury Metals will meet all legal requirements for operational impacts and the effects of the operation on local areas are nuisance and not harmful. Most operational impacts would be limited to near the Project site.	Village of Wabigoon	5	Although all alternatives would meet the legal requirements at the necessary receptors, there may be some noticeable effects to the Village of Wabigoon, which is located approximately four km south of the Project. Alternatives that were considered to have too great an impact on the Village of Wabigoon were considered to have a fatal flaw and were removed from the assessment during the pre-screening phase. That stated, some alternatives may provide noticeable effects to the Village of Wabigoon (nuisance noise, aesthetics). A high weight of five has been assigned to this indicator to reflect the importance of reducing effects to local communities.
					Residents and Cottagers around Thunder Lake	5	Although all alternatives would meet the legal requirements at the necessary receptors, there may be some noticeable effects (nuisance noise, aesthetics) to the residents and cottagers to the east side of Thunder Lake. A moderate high weight of five has been assigned to this indicator to reflect the importance of reducing effects to local communities.
					Nearby Rural Residents	5	There are nearby permanent residents that are located off Tree Nursery Road and Anderson Road. Although all alternatives would meet the legal requirements at the necessary receptors, these residents would be more likely to experience operational effects from the TSF and MWP (nuisance noise, aesthetics). However, due to the relatively small number of residents in the direct vicinity of the Project that would be affected, a high weight of five has been assigned.
					Aaron Provincial Park	3	Although all alternatives would meet the legal requirements at the necessary receptors, there may be some noticeable effects (nuisance noise, aesthetics) of the Project at Aaron Provincial Park, which is located approximately 2 km west of the Project. However, Aaron Provincial Park is currently affected by noise from the CPR rail running adjacent to the park, and dust from the Trans-Canada Highway that runs through the park. Treasury Metals recognizes the importance of protecting this area for people's enjoyment, however it may be difficult to distinguish effects coming from the Project and other sources. For this reason, a moderate weight of three has been assigned to this indicator.
					Fugitive Dust	3	Alternatives have the potential to result in fugitive dust emissions when tailings are mechanically disturbed by air currents, or by ground disturbance during hauling of materials, or construction activities. Fugitive dust will negatively affect air aesthetics near the Project, and could be a nuisance to nearby residents. Due to the large variation in fugitive dust emissions from the different alternatives, a moderate weight of three has been assigned.
					TSF Elevation	1	Alternatives that have a higher overall elevation have a greater potential to be seen from off site. However, there is little difference in elevation between the alternatives and the lowest weighting of one has been assigned to this indicator.

Account	Weight	Sub-Account	Weight	Sub-Account Weight Rationale	Indicator	Weight	Indicator Weight Rationale
Socio-Economic (cont'd)		Operational Impact (Air, Noise and Aesthetics) (cont'd)		See rationale on previous page	Frequency and Duration of Construction	4	Construction frequency and durations at the TSF and MWP will vary between the alternatives and will affect when light, noise and air emissions occur. Alternatives with infrequent construction during daytime hours are preferred and a moderate weight of four was assigned.
		Local Infrastructure	1	The alternatives may require minor realignments to Tree Nursery Road or local forest access roads. However, these roads are infrequently travelled, and disruptions to access will be minimal during construction of the realignments. A minimum weight of one has been assigned.	Access Along Tree Nursery Road	1	There is only one indicator in this sub-account, therefore a weight of one was assigned.
		Drinking Water Quality	6	During local engagement and through the Federal environmental assessment process, Treasury Metals has heard concerns expressed regarding the potential for the TSF to affect drinking water quality in nearby wells. Due to the importance of drinking water quality and amount of related comments received, a maximum weight of six has been assigned.	Potential for Seepage to Affect Drinking Water Quality	1	There is only one indicator in this sub-account, therefore a weight of one was assigned.
		Public Safety	5	Ensuring public safety is not affected by the Project is of major importance, regardless of the probability of incidents. Therefore, a high weight of five was assigned.	Hazard Potential of TSF	6	Although a TSF dam failure is highly unlikely, a TSF failure for some alternatives has the potential to affect public safety. The highest weight of six was assigned to reflect this severity.
					Hazard Potential of MWP	3	Although a MWP dam failure is highly unlikely, a failure for some alternatives has the potential to affect public safety. Since this event would have a smaller impact to public safety compared to a potential TSF failure, a moderate weight of three was assigned.
		Local Employment / Business	2	Alternatives with marginal economics are more susceptible to entering care and maintenance during downturns of gold price and will have a greater risk to the local employment and businesses. However, relative to other sub-accounts, such as public safety, risks to the local economy are less pressing and a low weight of two has been assigned.	Risk to Local Economy	1	There is only one indicator in this sub-account, therefore a weight of one was assigned.
		Displacement of Residents	5	There is the possibility that some alternatives could result in the displacement of permanent residents around the Project site due to an inability to meet regulatory emissions requirements at the current property boundary. This would require Treasury Metals to buy the property from these residents to expand the property boundary. A high weight of five has been assigned to reflect the significance of displacing people from their homes.	Potential for Displacing Local Residents	1	There is only one indicator in this sub-account, therefore a weight of one was assigned.

Table 9-3: Environmental Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Surface and Groundwater Quantity and Quality	Flow Loss	2	3	6	3	6	1	2	5	10
	Flow Reductions Outside Blackwater Creek	3	6	18	5	15	4	12	1	3
	Seepage Capture During Operations	5	6	30	6	30	6	30	1	5
	Sub Account Merit Score		54		51		44		18	
	Sub Account Merit Rating		**5.4**		**5.1**		**4.4**		**1.8**	
Aquatic Resources	Tributary Fish Habitat Losses	3	1	3	2	6	4	12	6	18
	Main stem Watercourse Fish Habitat Losses	4	6	24	6	24	1	4	6	24
	Watercourse Crossings	2	6	12	6	12	6	12	4	8
	Sub Account Merit Score		39		42		28		50	
	Sub Account Merit Rating		**4.3**		**4.7**		**3.1**		**5.6**	
Terrestrial Resources	Forest Loss	3	3	9	3	9	6	18	1	3
	Wetland Loss	4	1	4	2	8	3	12	6	24
	Use of Recently Disturbed Land	2	5	10	4	8	6	12	1	2
	Sub Account Merit Score		23		25		42		29	
	Sub Account Merit Rating		**2.6**		**2.8**		**4.7**		**3.2**	
SAR	Common Nighthawk	2	2	4	3	6	1	2	6	12
	Barn Swallow	3	6	18	6	18	2	6	1	3
	Bats	6	4	24	4	24	6	36	2	12
	Sub Account Merit Score		46		48		44		27	
	Sub Account Merit Rating		**4.2**		**4.4**		**4.0**		**2.5**	
Atmospheric Emissions	Fugitive Dust	3	6	18	6	18	2	6	5	15
	Noise Emissions	4	6	24	4	16	6	24	2	8
	Greenhouse Gas Emissions	5	6	30	6	30	2	10	1	5
	Light Trespass	1	5	5	5	5	3	3	4	4
	Sub Account Merit Score		77		69		43		32	
	Sub Account Merit Rating		**5.9**		**5.3**		**3.3**		**2.5**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Protected Areas	Distance to Nature Reserve	5	1	5	1	5	6	30	3	15
	Distance to Provincial Park	2	3	6	3	6	1	2	6	12
	Provincial Fish Sanctuary	4	6	24	6	24	6	24	4	16
	Sub Account Merit Score		35		35		56		43	
	Sub Account Merit Rating		**3.2**		**3.2**		**5.1**		**3.9**	

Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	5	3	15	3	15	1	5	6	30
	Surface Water Discharge	4	5	20	5	20	3	12	2	8
	Sub Account Merit Score		35		35		17		38	
	Sub Account Merit Rating		**3.9**		**3.9**		**1.9**		**4.2**	

Table 9-4: Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Design Factors	TSF Location Suitability	6	5	30	5	30	4	24	3	18
	MWP Location Suitability	3	3	9	1	3	3	9	6	18
	Foundation Suitability	4	4	16	4	16	2	8	3	12
	Sub Account Merit Score		55		49		41		48	
	Sub Account Merit Rating		**4.2**		**3.8**		**3.2**		**3.7**	
Safety Factors	TSF Hazard Potential	6	3	18	3	18	5	30	4	24
	MWP Hazard Potential	4	3	12	2	8	1	4	3	12
	Maximum TSF Dam Height	2	5	10	5	10	6	12	1	2
	Maximum MWP Dam Height	1	1	1	2	2	5	5	6	6
	Worker Health	3	5	15	5	15	1	3	6	18
	Sub Account Merit Score		56		53		54		62	
	Sub Account Merit Rating		**3.5**		**3.3**		**3.4**		**3.9**	
Water Management	Seepage During Operations	5	5	25	5	25	6	30	1	5
	Runoff Management	3	6	18	2	6	5	15	1	3
	Watercourse Realignment	2	3	6	3	6	2	4	6	12
	Excess Water Management	4	5	20	5	20	1	4	5	20
	Flexibility of Water Management	3	5	15	4	12	1	3	2	6
	Sub Account Merit Score		84		69		56		46	
	Sub Account Merit Rating		**4.9**		**4.1**		**3.3**		**2.7**	
Expansion Capacity	Expansion Capacity	1	4	4	6	6	6	6	5	5
	Sub Account Merit Score		4		6		6		5	
	Sub Account Merit Rating		**4.0**		**6.0**		**6.0**		**5.0**	
Compliance with Environmental Approvals	Dust Management	1	5	5	5	5	1	1	6	6
	Sub Account Merit Score		5		5		1		6	
	Sub Account Merit Rating		**5.0**		**5.0**		**1.0**		**6.0**	

Table 9-5: Project Economics Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Capital Cost	Clearing / Site Preparation	1	2	2	2	2	6	6	1	1
	TSF Dam Construction	6	5	30	5	30	6	36	1	6
	Tailings Dewatering Infrastructure	3	6	18	6	18	2	6	6	18
	MWP Construction	2	4	8	1	2	3	6	6	12
	Roads	2	6	12	6	12	3	6	1	2
	Pumping Infrastructure	1	4	4	5	5	6	6	1	1
	Seepage Collection Infrastructure	1	6	6	2	2	5	5	1	1
	Sub Account Merit Score		80		71		71		41	
	Sub Account Merit Rating		**5.0**		**4.4**		**4.4**		**2.6**	
Operational Costs	Tailings Deposition	6	6	36	6	36	2	12	4	24
	TSF Water Management	4	6	24	6	24	1	4	3	12
	MWP Pumping	1	2	2	5	5	6	6	1	1
	Sub Account Merit Score		62		65		22		37	
	Sub Account Merit Rating		**5.6**		**5.9**		**2.0**		**3.4**	
Closure Costs	TSF Cover	6	6	36	6	36	1	6	5	30
	MWP Reclamation	2	6	12	4	8	2	4	1	2
	Road Reclamation	2	6	12	6	12	3	6	1	2
	Sub Account Merit Score		60		56		16		34	
	Sub Account Merit Rating		**6.0**		**5.6**		**1.6**		**3.4**	
Post-Closure Costs	Inspection / Maintenance / Monitoring	2	5	10	5	10	6	12	1	2
	Risk of Additional Treatment Facilities	4	6	24	6	24	4	16	1	4
	Sub Account Merit Score		34		34		28		6	
	Sub Account Merit Rating		**5.7**		**5.7**		**4.7**		**1.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Ancillary Costs	Fish Habitat Compensation	3	1	3	2	6	3	9	6	18
	SAR Compensation	1	1	1	1	1	6	6	3	3
	Road Realignment	3	6	18	3	9	6	18	1	3
	Haul Distance for Overburden Stockpiles	1	6	6	6	6	1	1	6	6
	Sub Account Merit Score		28		22		34		30	
	Sub Account Merit Rating		**3.5**		**2.8**		**4.3**		**3.8**	

Risk	Risk of EA or Environmental Approval Delays or Rejection	5	5	25	5	25	1	5	3	15
	Risk Arising from TSF Costs	3	4	12	4	12	1	3	3	9
	Delays from Displacing Local Residents	4	6	24	6	24	4	16	6	24
	Sub Account Merit Score		61		61		24		48	
	Sub Account Merit Rating		**5.1**		**5.1**		**2.0**		**4.0**	

Table 9-6: Socio-Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Aboriginal Land Use and Heritage Value	Access Effected Areas	6	5	30	6	36	5	30	1	6
	Wildlife Abundance	3	4	12	4	12	5	15	2	6
	Loss of Undisturbed Habitat	3	3	9	2	6	6	18	1	3
	Avoidance of Thunder Lake Watershed	4	6	24	4	16	1	4	5	20
	Sub Account Merit Score		75		70		67		35	
	Sub Account Merit Rating		**4.7**		**4.4**		**4.2**		**2.2**	
Land Use	Loss of Tree Stands	2	2	4	2	4	6	12	1	2
	Access Along Transmission Line	2	5	10	5	10	6	12	4	8
	Area With Air Quality Above Health Based Guidelines	4	6	24	6	24	1	4	6	24
	Sub Account Merit Score		38		38		28		34	
	Sub Account Merit Rating		**4.8**		**4.8**		**3.5**		**4.3**	
Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	5	5	25	6	30	1	5	5	25
	Residents and Cottagers Around Thunder Lake	5	6	30	4	20	1	5	6	30
	Nearby Rural Residents	5	2	10	4	20	1	5	6	30
	Aaron Provincial Park	3	6	18	5	15	1	3	6	18
	Fugitive Dust	3	6	18	6	18	2	6	5	15
	TSF Elevation	1	1	1	1	1	6	6	1	1
	Frequency and Duration of Construction	4	4	16	4	16	1	4	3	12
	Sub Account Merit Score		118		120		34		131	
	Sub Account Merit Rating		**4.5**		**4.6**		**1.3**		**5.0**	
Location Infrastructure	Access Along Tree Nursery Road	1	3	3	3	3	6	6	2	2
	Sub Account Merit Score		3		3		6		2	
	Sub Account Merit Rating		**3.0**		**3.0**		**6.0**		**2.0**	

Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	1	2	2	2	2	6	6	1	1
	Sub Account Merit Score		2		2		6		1	
	Sub Account Merit Rating		**2.0**		**2.0**		**6.0**		**1.0**	

Public Safety	Hazard Potential of TSF	6	3	18	3	18	5	30	4	24
	Hazard Potential of MWP	3	3	9	2	6	1	3	3	9
	Sub Account Merit Score		27		24		33		33	
	Sub Account Merit Rating		**3.0**		**2.7**		**3.7**		**3.7**	

Local Employment / Business	Risk to Local Economy	1	4	4	4	4	1	1	3	3
	Sub Account Merit Score		4		4		1		3	
	Sub Account Merit Rating		**4.0**		**4.0**		**1.0**		**3.0**	

Displacement of Residents	Potential for Displacing Local Residents	1	6	6	6	6	4	4	6	6
	Sub Account Merit Score		6		6		4		6	
	Sub Account Merit Rating		**6.0**		**6.0**		**4.0**		**6.0**	

Table 9-7: Environmental Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	**Score**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Environment	Surface and Groundwater Quantity and Quality	4	5.4	21.6	5.1	20.4	4.4	17.6	1.8	7.2
	Aquatic Resources	6	4.3	26.0	4.7	28.0	3.1	18.7	5.6	33.3
	Terrestrial Resources	4	2.6	10.2	2.8	11.1	4.7	18.7	3.2	12.9
	SAR	5	4.2	20.9	4.4	21.8	4.0	20.0	2.5	12.3
	Atmospheric Emissions	3	5.9	17.8	5.3	15.9	3.3	9.9	2.5	7.4
	Protected Areas	4	3.2	12.7	3.2	12.7	5.1	20.4	3.9	15.6
	Closure / Post-Closure	4	3.9	15.6	3.9	15.6	1.9	7.6	4.2	16.9
	Account Merit Score		124.8		125.5		112.8		105.6	
	Account Merit Rating		**4.2**		**4.2**		**3.8**		**3.5**	

Table 9-8: Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	**Score**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Technical	Design Factors	6	4.2	25.4	3.8	22.6	3.2	18.9	3.7	22.2
	Safety Factors	5	3.5	17.5	3.3	16.6	3.4	16.9	3.9	19.4
	Water Management	5	4.9	24.7	4.1	20.3	3.3	16.5	2.7	13.5
	Expansion Capacity	2	4.0	8.0	6.0	12.0	6.0	12.0	5.0	10.0
	Compliance with Environmental Approvals	3	5.0	15.0	5.0	15.0	1.0	3.0	6.0	18.0
	Account Merit Score		90.6		86.5		67.3		83.1	
	Account Merit Rating		**4.3**		**4.1**		**3.2**		**4.0**	

Table 9-9: Project Economics Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Economic	Capital Cost	6	5.0	30.0	4.4	26.6	4.4	26.6	2.6	15.4
	Operational Costs	5	5.6	28.2	5.9	29.5	2.0	10.0	3.4	16.8
	Closure Costs	3	6.0	18.0	5.6	16.8	1.6	4.8	3.4	10.2
	Post-Closure Costs	1	5.7	5.7	5.7	5.7	4.7	4.7	1.0	1.0
	Ancillary Costs	2	3.5	7.0	2.8	5.5	4.3	8.5	3.8	7.5
	Risk	3	5.1	15.3	5.1	15.3	2.0	6.0	4.0	12.0
	Account Merit Score		104.1		99.4		60.6		62.9	
	Account Merit Rating		**5.2**		**5.0**		**3.0**		**3.1**	

Table 9-10: Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Socio-Economic	Aboriginal Land Use and Heritage Value	6	4.7	28.1	4.4	26.3	4.2	25.1	2.2	13.1
	Land Use	3	4.8	14.3	4.8	14.3	3.5	10.5	4.3	12.8
	Operational Impacts (Air, Noise and Aesthetics)	4	4.5	18.2	4.6	18.5	1.3	5.2	5.0	20.2
	Location Infrastructure	1	3.0	3.0	3.0	3.0	6.0	6.0	2.0	2.0
	Drinking Water Quality	6	2.0	12.0	2.0	12.0	6.0	36.0	1.0	6.0
	Public Safety	5	3.0	15.0	2.7	13.3	3.7	18.3	3.7	18.3
	Local Employment / Business	2	4.0	8.0	4.0	8.0	1.0	2.0	3.0	6.0
	Displacement of Residents	5	6.0	30.0	6.0	30.0	4.0	20.0	6.0	30.0
	Account Merit Score		128.5		125.3		123.2		108.4	
	Account Merit Rating		**4.0**		**3.9**		**3.8**		**3.4**	

Table 9-11: Multiple Accounts Analysis Base Case Results

		Alternative A		Alternative B		Alternative C		Alternative D	
Account	**Weight**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Environment	6	4.2	25.0	4.2	25.1	3.8	22.6	3.5	21.1
Technical	3	4.3	12.9	4.1	12.4	3.2	9.6	4.0	11.9
Project Economics	1.5	5.2	7.8	5.0	7.5	3.0	4.5	3.1	4.7
Socio Economic	3	4.0	12.0	3.9	11.7	3.8	11.5	3.4	10.2
Alternative Merit Score		57.8		56.7		48.3		47.9	
Alternative Merit Rating		**4.3**		**4.2**		**3.6**		**3.5**	

10.0 SENSITIVITY ANALYSIS

A sensitivity analysis was carried out to evaluate the robustness of the analytical process and to determine the degree to which various options are influenced by the choice of weightings.

Three scenarios were given consideration, in addition to the base case:

- S1: base case;
- S2: all accounts weighted equally;
- S3: all accounts, sub-accounts and indicators weighted equally; and
- S4: prioritize people, environment strongly considered (Socio-economics Account weighted six, Environmental Account weighted four, Technical Account weighted two, Project Economics Account weighted one).

The results of the sensitivity analysis are documented in Table 10-1. MAA tables for the sensitivity analysis are provided in Appendix A. The sensitivity analysis found that the Alternative A remained the preferred alternatives, and Alternative B as the runner up in all scenarios.

As the preferred alternative remained Alternative A in all scenarios, the weightings selected in the MAA do not have an undue influence on the overall results, and the assessment can be considered robust.

Table 10-1: Sensitivity Analysis

Scenario	Alternative Merit Rating			
	Alternative A	Alternative B	Alternative C	Alternative D
S1	**4.3**	4.2	3.6	3.5
S2	**4.4**	4.3	3.5	3.5
S3	**4.3**	4.2	3.5	3.5
S4	**4.2**	4.1	3.7	3.5

Note: Bold designates the preferred alternative in each of the sensitivity analysis scenarios

11.0 CONCLUSIONS

The assessment of alternatives considered five candidate tailings storage methods, nine candidate tailings storage locations and nine candidate MWP locations. Following a pre-screening analysis, two of the tailings storage methods, three tailings storage locations and four MWP locations were retained for further consideration through the MAA. Four alternatives were developed using each of the candidate tailing storage methods and various locations.

The MAA considered the four alternatives (Alternatives A, B, C and D) from four perspectives; environmental, technical, project economics and socio-economics. From an environmental perspective Alternatives A and B were equally preferred. Alternative A was the sole preferred alternative from a technical, project economics and socio-economics perspectives.

The MAA found that Alternative A was the preferred overall alternative with an alternative merit rating of 4.3 out of a maximum of 6.0. The runner-up alternative (Alternative B) was similar with an alternative merit rating of 4.2 Alternatives C and D had alternative merit ratings of 3.6 and 3.5 respectively.

A sensitivity analysis was conducted to test the robustness of the assessment and the following scenarios were considered through the sensitivity analysis:

- Environment Canada and Climate Change base case (prioritize environment, minimize project economics);
- All accounts weighted equally (reduce weighting bias);
- All accounts, sub-accounts and indicators weighted equally (remove weighting bias); and
- Prioritize people, environment strongly considered (Socio-economics account weighted six, environmental account weighted four, technical account weighted two, project economics weighted one).

The sensitivity analysis found that the relative preferences between alternatives did not change to any appreciable extent between the various scenarios, with Alternative A remaining the preferred alternative in all scenarios.

12.0 REFERENCES

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APPENDIX A:

MULTIPLE ACCOUNTS ANALYSIS TABLES FROM SENSITIVITY ANALYSES

A1: S2: All accounts weighted equally

A2: S3: All accounts, sub-accounts and indicators weighted equally

A3: S4: Prioritize people, environment strongly considered

Appendix A1: S2: All Accounts Weighted Equally

S2 Weightings

Account	Weight	Sub-Account	Weight	Indicator	Weight
Environmental	1	Surface and Groundwater Quantity and Quality	4	Flow Loss	2
				Flow Reductions Outside Blackwater Creek	3
				Seepage Capture During Operations	5
		Aquatic Resources	6	Tributary Fish Habitat Losses	3
				Main stem Watercourse Fish Habitat Losses	4
				Watercourse Crossings	2
		Terrestrial Resources	4	Forest Loss	3
				Wetland Loss	4
				Use of Recently Disturbed Land	2
		SAR	5	Common Nighthawk	2
				Barn Swallow	3
				Bats	6
		Atmospheric Emissions	3	Fugitive Dust	3
				Noise Emissions	4
				Greenhouse Gas Emissions	5
				Light Trespass	1
		Protected Areas	4	Distance to Nature Reserve	5
				Distance to Provincial Park	2
				Provincial Fish Sanctuary	4
		Closure / Post-Closure	4	Potential for Seepage to Report to Thunder Lake	5
				Surface Water Discharge	4
Technical	1	Design Factors	6	TSF Location Suitability	6
				MWP Location Suitability	3
				Foundation Suitability	4
		Safety Factors	5	TSF Hazard Potential	6
				MWP Hazard Potential	4
				Maximum TSF Dam Height	2
				Maximum MWP Dam Height	1
				Worker Health	3
		Water Management	5	Seepage During Operations	5
				Runoff Management	3
				Watercourse Realignment	2
				Excess Water Management	4
				Flexibility of Water Management	3
		Expansion Capacity	2	Expansion Capacity	1
		Compliance with Environmental Approvals	3	Dust Management	1

Account	Weight	Sub-Account	Weight	Indicator	Weight
Project Economics	1	Capital Cost	6	Clearing / Site Preparation	1
				TSF Dam Construction	6
				Tailings Dewatering Infrastructure	3
				MWP Construction	2
				Roads	2
				Pumping Infrastructure	1
				Seepage Collection Infrastructure	1
		Operational Costs	5	Tailings Deposition	6
				TSF Water Management	4
				MWP Pumping	1
		Closure Costs	3	TSF Cover	6
				MWP Reclamation	2
				Road Reclamation	2
		Post-Closure Costs	1	Inspection / Maintenance / Monitoring	2
				Risk of Additional Treatment Facilities	4
		Ancillary Costs	2	Fish Habitat Compensation	3
				SAR Compensation	1
				Road Realignment	3
				Haul Distance for Overburden Stockpiles	1
		Risk	3	Risk of EA or Environmental Approval Delays or Rejection	5
				Risk Arising from TSF Costs	3
				Delays from Displacing Local Residents	4
Socio-Economic	1	Aboriginal Land Use and Heritage Value	6	Access Effected Areas	6
				Wildlife Abundance	3
				Loss of Undisturbed Habitat	3
				Avoidance of Thunder Lake Watershed	4
		Land Use	3	Loss of Tree Stands	2
				Access Along Transmission Line	2
				Area With Air Quality Above Health Based Guidelines	4
		Operational Impacts (Air, Noise and Aesthetics)	4	Village of Wabigoon	5
				Residents and Cottagers Around Thunder Lake	5
				Nearby Rural Residents	5
				Aaron Provincial Park	3
				Fugitive Dust	3
				TSF Elevation	1
				Frequency and Duration of Construction	4
		Location Infrastructure	1	Access Along Tree Nursery Road	1
		Drinking Water Quality	6	Potential for Seepage to Affect Drinking Water Wells	1

Account	Weight	Sub-Account	Weight	Indicator	Weight
Socio-Economic (cont'd)		Public Safety	5	Hazard Potential of TSF	6
				Hazard Potential of MWP	3
		Local Employment / Business	2	Risk to Local Economy	1
		Displacement of Residents	5	Potential for Displacing Local Residents	1

S2 Environment Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Surface and Groundwater Quantity and Quality	Flow Loss	2	3	6	3	6	1	2	5	10
	Flow Reductions Outside Blackwater Creek	3	6	18	5	15	4	12	1	3
	Seepage Capture During Operations	5	6	30	6	30	6	30	1	5
	Sub Account Merit Score		54		51		44		18	
	Sub Account Merit Rating		**5.4**		**5.1**		**4.4**		**1.8**	

Sub-Account	Indicator	Weight	Alt A Value	Alt A Score	Alt B Value	Alt B Score	Alt C Value	Alt C Score	Alt D Value	Alt D Score
Aquatic Resources	Tributary Fish Habitat Losses	3	1	3	2	6	4	12	6	18
	Main stem Watercourse Fish Habitat Losses	4	6	24	6	24	1	4	6	24
	Watercourse Crossings	2	6	12	6	12	6	12	4	8
	Sub Account Merit Score		39		42		28		50	
	Sub Account Merit Rating		**4.3**		**4.7**		**3.1**		**5.6**	

Sub-Account	Indicator	Weight	Alt A Value	Alt A Score	Alt B Value	Alt B Score	Alt C Value	Alt C Score	Alt D Value	Alt D Score
Terrestrial Resources	Forest Loss	3	3	9	3	9	6	18	1	3
	Wetland Loss	4	1	4	2	8	3	12	6	24
	Use of Recently Disturbed Land	2	5	10	4	8	6	12	1	2
	Sub Account Merit Score		23		25		42		29	
	Sub Account Merit Rating		**2.6**		**2.8**		**4.7**		**3.2**	

Sub-Account	Indicator	Weight	Alt A Value	Alt A Score	Alt B Value	Alt B Score	Alt C Value	Alt C Score	Alt D Value	Alt D Score
SAR	Common Nighthawk	2	2	4	3	6	1	2	6	12
	Barn Swallow	3	6	18	6	18	2	6	1	3
	Bats	6	4	24	4	24	6	36	2	12
	Sub Account Merit Score		46		48		44		27	
	Sub Account Merit Rating		**4.2**		**4.4**		**4.0**		**2.5**	

Sub-Account	Indicator	Weight	Alt A Value	Alt A Score	Alt B Value	Alt B Score	Alt C Value	Alt C Score	Alt D Value	Alt D Score
Atmospheric Emissions	Fugitive Dust	3	6	18	6	18	2	6	5	15
	Noise Emissions	4	6	24	4	16	6	24	2	8
	Greenhouse Gas Emissions	5	6	30	6	30	2	10	1	5
	Light Trespass	1	5	5	5	5	3	3	4	4
	Sub Account Merit Score		77		69		43		32	
	Sub Account Merit Rating		**5.9**		**5.3**		**3.3**		**2.5**	

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Protected Areas	Distance to Nature Reserve	5	1	5	1	5	6	30	3	15
	Distance to Provincial Park	2	3	6	3	6	1	2	6	12
	Provincial Fish Sanctuary	4	6	24	6	24	6	24	4	16
	Sub Account Merit Score		35		35		56		43	
	Sub Account Merit Rating		**3.2**		**3.2**		**5.1**		**3.9**	

Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	5	3	15	3	15	1	5	6	30
	Surface Water Discharge	4	5	20	5	20	3	12	2	8
	Sub Account Merit Score		35		35		17		38	
	Sub Account Merit Rating		**3.9**		**3.9**		**1.9**		**4.2**	

S2 Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Design Factors	TSF Location Suitability	6	5	30	5	30	4	24	3	18
	MWP Location Suitability	3	3	9	1	3	3	9	6	18
	Foundation Suitability	4	4	16	4	16	2	8	3	12
	Sub Account Merit Score		55		49		41		48	
	Sub Account Merit Rating		**4.2**		**3.8**		**3.2**		**3.7**	
Safety Factors	TSF Hazard Potential	6	3	18	3	18	5	30	4	24
	MWP Hazard Potential	4	3	12	2	8	1	4	3	12
	Maximum TSF Dam Height	2	5	10	5	10	6	12	1	2
	Maximum MWP Dam Height	1	1	1	2	2	5	5	6	6
	Worker Health	3	5	15	5	15	1	3	6	18
	Sub Account Merit Score		56		53		54		62	
	Sub Account Merit Rating		**3.5**		**3.3**		**3.4**		**3.9**	
Water Management	Seepage During Operations	5	5	25	5	25	6	30	1	5
	Runoff Management	3	6	18	2	6	5	15	1	3
	Watercourse Realignment	2	3	6	3	6	2	4	6	12
	Excess Water Management	4	5	20	5	20	1	4	5	20
	Flexibility of Water Management	3	5	15	4	12	1	3	2	6
	Sub Account Merit Score		84		69		56		46	
	Sub Account Merit Rating		**4.9**		**4.1**		**3.3**		**2.7**	
Expansion Capacity	Expansion Capacity	1	4	4	6	6	6	6	5	5
	Sub Account Merit Score		4		6		6		5	
	Sub Account Merit Rating		**4.0**		**6.0**		**6.0**		**5.0**	
Compliance with Environmental Approvals	Dust Management	1	5	5	5	5	1	1	6	6
	Sub Account Merit Score		5		5		1		6	
	Sub Account Merit Rating		**5.0**		**5.0**		**1.0**		**6.0**	

S2 Project Economics Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Capital Cost	Clearing / Site Preparation	1	2	2	2	2	6	6	1	1
	TSF Dam Construction	6	5	30	5	30	6	36	1	6
	Tailings Dewatering Infrastructure	3	6	18	6	18	2	6	6	18
	MWP Construction	2	4	8	1	2	3	6	6	12
	Roads	2	6	12	6	12	3	6	1	2
	Pumping Infrastructure	1	4	4	5	5	6	6	1	1
	Seepage Collection Infrastructure	1	6	6	2	2	5	5	1	1
	Sub Account Merit Score		80		71		71		41	
	Sub Account Merit Rating		**5.0**		**4.4**		**4.4**		**2.6**	

Sub-Account	Indicator	Weight	Value	Score	Value	Score	Value	Score	Value	Score
Operational Costs	Tailings Deposition	6	6	36	6	36	2	12	4	24
	TSF Water Management	4	6	24	6	24	1	4	3	12
	MWP Pumping	1	2	2	5	5	6	6	1	1
	Sub Account Merit Score		62		65		22		37	
	Sub Account Merit Rating		**5.6**		**5.9**		**2.0**		**3.4**	

Sub-Account	Indicator	Weight	Value	Score	Value	Score	Value	Score	Value	Score
Closure Costs	TSF Cover	6	6	36	6	36	1	6	5	30
	MWP Reclamation	2	6	12	4	8	2	4	1	2
	Road Reclamation	2	6	12	6	12	3	6	1	2
	Sub Account Merit Score		60		56		16		34	
	Sub Account Merit Rating		**6.0**		**5.6**		**1.6**		**3.4**	

Sub-Account	Indicator	Weight	Value	Score	Value	Score	Value	Score	Value	Score
Post-Closure Costs	Inspection / Maintenance / Monitoring	2	5	10	5	10	6	12	1	2
	Risk of Additional Treatment Facilities	4	6	24	6	24	4	16	1	4
	Sub Account Merit Score		34		34		28		6	
	Sub Account Merit Rating		**5.7**		**5.7**		**4.7**		**1.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Ancillary Costs	Fish Habitat Compensation	3	1	3	2	6	3	9	6	18
	SAR Compensation	1	1	1	1	1	6	6	3	3
	Road Realignment	3	6	18	3	9	6	18	1	3
	Haul Distance for Overburden Stockpiles	1	6	6	6	6	1	1	6	6
	Sub Account Merit Score		28		22		34		30	
	Sub Account Merit Rating		**3.5**		**2.8**		**4.3**		**3.8**	

Risk	Risk of EA or Environmental Approval Delays or Rejection	5	5	25	5	25	1	5	3	15
	Risk Arising from TSF Costs	3	4	12	4	12	1	3	3	9
	Delays from Displacing Local Residents	4	6	24	6	24	4	16	6	24
	Sub Account Merit Score		61		61		24		48	
	Sub Account Merit Rating		**5.1**		**5.1**		**2.0**		**4.0**	

S2 Socio-Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Aboriginal Land Use and Heritage Value	Access Effected Areas	6	5	30	6	36	5	30	1	6
	Wildlife Abundance	3	4	12	4	12	5	15	2	6
	Loss of Undisturbed Habitat	3	3	9	2	6	6	18	1	3
	Avoidance of Thunder Lake Watershed	4	6	24	4	16	1	4	5	20
	Sub Account Merit Score		75		70		67		35	
	Sub Account Merit Rating		**4.7**		**4.4**		**4.2**		**2.2**	
Land Use	Loss of Tree Stands	2	2	4	2	4	6	12	1	2
	Access Along Transmission Line	2	5	10	5	10	6	12	4	8
	Area With Air Quality Above Health Based Guidelines	4	6	24	6	24	1	4	6	24
	Sub Account Merit Score		38		38		28		34	
	Sub Account Merit Rating		**4.8**		**4.8**		**3.5**		**4.3**	
Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	5	5	25	6	30	1	5	5	25
	Residents and Cottagers Around Thunder Lake	5	6	30	4	20	1	5	6	30
	Nearby Rural Residents	5	2	10	4	20	1	5	6	30
	Aaron Provincial Park	3	6	18	5	15	1	3	6	18
	Fugitive Dust	3	6	18	6	18	2	6	5	15
	TSF Elevation	1	1	1	1	1	6	6	1	1
	Frequency and Duration of Construction	4	4	16	4	16	1	4	3	12
	Sub Account Merit Score		118		120		34		131	
	Sub Account Merit Rating		**4.5**		**4.6**		**1.3**		**5.0**	
Location Infrastructure	Access Along Tree Nursery Road	1	3	3	3	3	6	6	2	2
	Sub Account Merit Score		3		3		6		2	
	Sub Account Merit Rating		**3.0**		**3.0**		**6.0**		**2.0**	

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	1	2	2	2	2	6	6	1	1
	Sub Account Merit Score		2		2		6		1	
	Sub Account Merit Rating		**2.0**		**2.0**		**6.0**		**1.0**	
Public Safety	Hazard Potential of TSF	6	3	18	3	18	5	30	4	24
	Hazard Potential of MWP	3	3	9	2	6	1	3	3	9
	Sub Account Merit Score		27		24		33		33	
	Sub Account Merit Rating		**3.0**		**2.7**		**3.7**		**3.7**	
Local Employment / Business	Risk to Local Economy	1	4	4	4	4	1	1	3	3
	Sub Account Merit Score		4		4		1		3	
	Sub Account Merit Rating		**4.0**		**4.0**		**1.0**		**3.0**	
Displacement of Residents	Potential for Displacing Local Residents	1	6	6	6	6	4	4	6	6
	Sub Account Merit Score		6		6		4		6	
	Sub Account Merit Rating		**6.0**		**6.0**		**4.0**		**6.0**	

S2 Environment Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	Surface and Groundwater Quantity and Quality	4	5.4	21.6	5.1	20.4	4.4	17.6	1.8	7.2
	Aquatic Resources	6	4.3	26.0	4.7	28.0	3.1	18.7	5.6	33.3
	Terrestrial Resources	4	2.6	10.2	2.8	11.1	4.7	18.7	3.2	12.9
	SAR	5	4.2	20.9	4.4	21.8	4.0	20.0	2.5	12.3
	Atmospheric Emissions	3	5.9	17.8	5.3	15.9	3.3	9.9	2.5	7.4
	Protected Areas	4	3.2	12.7	3.2	12.7	5.1	20.4	3.9	15.6
	Closure / Post-Closure	4	3.9	15.6	3.9	15.6	1.9	7.6	4.2	16.9
	Account Merit Score		124.8		125.5		112.8		105.6	
	Account Merit Rating		**4.2**		**4.2**		**3.8**		**3.5**	

S2 Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical	Design Factors	6	4.2	25.4	3.8	22.6	3.2	18.9	3.7	22.2
	Safety Factors	5	3.5	17.5	3.3	16.6	3.4	16.9	3.9	19.4
	Water Management	5	4.9	24.7	4.1	20.3	3.3	16.5	2.7	13.5
	Expansion Capacity	2	4.0	8.0	6.0	12.0	6.0	12.0	5.0	10.0
	Compliance with Environmental Approvals	3	5.0	15.0	5.0	15.0	1.0	3.0	6.0	18.0
	Account Merit Score		90.6		86.5		67.3		83.1	
	Account Merit Rating		**4.3**		**4.1**		**3.2**		**4.0**	

S2 Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Economic	Capital Cost	6	5.0	30.0	4.4	26.6	4.4	26.6	2.6	15.4
	Operational Costs	5	5.6	28.2	5.9	29.5	2.0	10.0	3.4	16.8
	Closure Costs	3	6.0	18.0	5.6	16.8	1.6	4.8	3.4	10.2
	Post-Closure Costs	1	5.7	5.7	5.7	5.7	4.7	4.7	1.0	1.0
	Ancillary Costs	2	3.5	7.0	2.8	5.5	4.3	8.5	3.8	7.5
	Risk	3	5.1	15.3	5.1	15.3	2.0	6.0	4.0	12.0
	Account Merit Score		104.1		99.4		60.6		62.9	
	Account Merit Rating		**5.2**		**5.0**		**3.0**		**3.1**	

S2 Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Socio-Economic	Aboriginal Land Use and Heritage Value	6	4.7	28.1	4.4	26.3	4.2	25.1	2.2	13.1
	Land Use	3	4.8	14.3	4.8	14.3	3.5	10.5	4.3	12.8
	Operational Impacts (Air, Noise and Aesthetics)	4	4.5	18.2	4.6	18.5	1.3	5.2	5.0	20.2
	Location Infrastructure	1	3.0	3.0	3.0	3.0	6.0	6.0	2.0	2.0
	Drinking Water Quality	6	2.0	12.0	2.0	12.0	6.0	36.0	1.0	6.0
	Public Safety	5	3.0	15.0	2.7	13.3	3.7	18.3	3.7	18.3
	Local Employment / Business	2	4.0	8.0	4.0	8.0	1.0	2.0	3.0	6.0
	Displacement of Residents	5	6.0	30.0	6.0	30.0	4.0	20.0	6.0	30.0
	Account Merit Score		128.5		125.3		123.2		108.4	
	Account Merit Rating		**4.0**		**3.9**		**3.8**		**3.4**	

S2 Account Analysis

		Alternative A		Alternative B		Alternative C		Alternative D	
Account	**Weight**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Environment	1	4.2	4.2	4.2	4.2	3.8	3.8	3.5	3.5
Technical	1	4.3	4.3	4.1	4.1	3.2	3.2	4.0	4.0
Project Economics	1	5.2	5.2	5.0	5.0	3.0	3.0	3.1	3.1
Socio Economic	1	4.0	4.0	3.9	3.9	3.8	3.8	3.4	3.4
Alternative Merit Score		17.7		17.2		13.8		14.0	
Alternative Merit Rating		**4.4**		**4.3**		**3.5**		**3.5**	

Appendix A2: S3: All Accounts, Sub-Accounts and Indicators Weighted Equally

S3 Weightings

Account	Weight	Sub-Account	Weight	Indicator	Weight
Environmental	1	Surface and Groundwater Quantity and Quality	1	Flow Loss	1
				Flow Reductions Outside Blackwater Creek	1
				Seepage Capture During Operations	1
		Aquatic Resources	1	Tributary Fish Habitat Losses	1
				Main stem Watercourse Fish Habitat Losses	1
				Watercourse Crossings	1
		Terrestrial Resources	1	Forest Loss	1
				Wetland Loss	1
				Use of Recently Disturbed Land	1
		SAR	1	Common Nighthawk	1
				Barn Swallow	1
				Bats	1
		Atmospheric Emissions	1	Fugitive Dust	1
				Noise Emissions	1
				Greenhouse Gas Emissions	1
				Light Trespass	1
		Protected Areas	1	Distance to Nature Reserve	1
				Distance to Provincial Park	1
				Provincial Fish Sanctuary	1
		Closure / Post-Closure	1	Potential for Seepage to Report to Thunder Lake	1
				Surface Water Discharge	1
Technical	1	Design Factors	1	TSF Location Suitability	1
				MWP Location Suitability	1
				Foundation Suitability	1
		Safety Factors	1	TSF Hazard Potential	1
				MWP Hazard Potential	1
				Maximum TSF Dam Height	1
				Maximum MWP Dam Height	1
				Worker Health	1
		Water Management	1	Seepage During Operations	1
				Runoff Management	1
				Watercourse Realignment	1
				Excess Water Management	1
				Flexibility of Water Management	1
		Expansion Capacity	1	Expansion Capacity	1
		Compliance with Environmental Approvals	1	Dust Management	1
Project Economics	1	Capital Cost	1	Clearing / Site Preparation	1
				TSF Dam Construction	1
				Tailings Dewatering Infrastructure	1
				MWP Construction	1
				Roads	1

Account	Weight	Sub-Account	Weight	Indicator	Weight
Project Economics (Cont'd)		Capital Costs (Cont'd)		Pumping Infrastructure	1
				Seepage Collection Infrastructure	1
		Operational Costs	1	Tailings Deposition	1
				TSF Water Management	1
				MWP Pumping	1
		Closure Costs	1	TSF Cover	1
				MWP Reclamation	1
				Road Reclamation	1
		Post-Closure Costs	1	Inspection / Maintenance / Monitoring	1
				Risk of Additional Treatment Facilities	1
		Ancillary Costs	1	Fish Habitat Compensation	1
				SAR Compensation	1
				Road Realignment	1
				Haul Distance for Overburden Stockpiles	1
		Risk	1	Risk of EA or Environmental Approval Delays or Rejection	1
				Risk Arising from TSF Costs	1
				Delays from Displacing Local Residents	1
Socio-Economic	1	Aboriginal Land Use and Heritage Value	1	Access Effected Areas	1
				Wildlife Abundance	1
				Loss of Undisturbed Habitat	1
				Avoidance of Thunder Lake Watershed	1
		Land Use	1	Loss of Tree Stands	1
				Access Along Transmission Line	1
				Area With Air Quality Above Health Based Guidelines	1
		Operational Impacts (Air, Noise and Aesthetics)	1	Village of Wabigoon	1
				Residents and Cottagers Around Thunder Lake	1
				Nearby Rural Residents	1
				Aaron Provincial Park	1
				Fugitive Dust	1
				TSF Elevation	1
				Frequency and Duration of Construction	1
		Location Infrastructure	1	Access Along Tree Nursery Road	1
		Drinking Water Quality	1	Potential for Seepage to Affect Drinking Water Wells	1
		Public Safety	1	Hazard Potential of TSF	1
				Hazard Potential of MWP	1
		Local Employment / Business	1	Risk to Local Economy	1
		Displacement of Residents	1	Potential for Displacing Local Residents	1

S3 Environment Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Surface and Groundwater Quantity and Quality	Flow Loss	1	3	3	3	3	1	1	5	5
	Flow Reductions Outside Blackwater Creek	1	6	6	5	5	4	4	1	1
	Seepage Capture During Operations	1	6	6	6	6	6	6	1	1
	Sub Account Merit Score		15		14		11		7	
	Sub Account Merit Rating		**5.0**		**4.7**		**3.7**		**2.3**	
Aquatic Resources	Tributary Fish Habitat Losses	1	1	1	2	2	4	4	6	6
	Main stem Watercourse Fish Habitat Losses	1	6	6	6	6	1	1	6	6
	Watercourse Crossings	1	6	6	6	6	6	6	4	4
	Sub Account Merit Score		13		14		11		16	
	Sub Account Merit Rating		**4.3**		**4.7**		**3.7**		**5.3**	
Terrestrial Resources	Forest Loss	1	3	3	3	3	6	6	1	1
	Wetland Loss	1	1	1	2	2	3	3	6	6
	Use of Recently Disturbed Land	1	5	5	4	4	6	6	1	1
	Sub Account Merit Score		9		9		15		8	
	Sub Account Merit Rating		**3.0**		**3.0**		**5.0**		**2.7**	
SAR	Common Nighthawk	1	2	2	3	3	1	1	6	6
	Barn Swallow	1	6	6	6	6	2	2	1	1
	Bats	1	4	4	4	4	6	6	2	2
	Sub Account Merit Score		12		13		9		9	
	Sub Account Merit Rating		**4.0**		**4.3**		**3.0**		**3.0**	
Atmospheric Emissions	Fugitive Dust	1	6	6	6	6	2	2	5	5
	Noise Emissions	1	6	6	4	4	6	6	2	2
	Greenhouse Gas Emissions	1	6	6	6	6	2	2	1	1
	Light Trespass	1	5	5	5	5	3	3	4	4
	Sub Account Merit Score		23		21		13		12	
	Sub Account Merit Rating		**5.8**		**5.3**		**3.3**		**3.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Protected Areas	Distance to Nature Reserve	1	1	1	1	1	6	6	3	3
	Distance to Provincial Park	1	3	3	3	3	1	1	6	6
	Provincial Fish Sanctuary	1	6	6	6	6	6	6	4	4
	Sub Account Merit Score		10		10		13		13	
	Sub Account Merit Rating		**3.3**		**3.3**		**4.3**		**4.3**	

Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	1	3	3	3	3	1	1	6	6
	Surface Water Discharge	1	5	5	5	5	3	3	2	2
	Sub Account Merit Score		8		8		4		8	
	Sub Account Merit Rating		**4.0**		**4.0**		**2.0**		**4.0**	

S3 Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Value	Score	Value	Score	Value	Score	Value	Score
Design Factors	TSF Location Suitability	1	5	5	5	5	4	4	3	3
	MWP Location Suitability	1	3	3	1	1	3	3	6	6
	Foundation Suitability	1	4	4	4	4	2	2	3	3
	Sub Account Merit Score		12		10		9		12	
	Sub Account Merit Rating		**4.0**		**3.3**		**3.0**		**4.0**	
Safety Factors	TSF Hazard Potential	1	3	3	3	3	5	5	4	4
	MWP Hazard Potential	1	3	3	2	2	1	1	3	3
	Maximum TSF Dam Height	1	5	5	5	5	6	6	1	1
	Maximum MWP Dam Height	1	1	1	2	2	5	5	6	6
	Worker Health	1	5	5	5	5	1	1	6	6
	Sub Account Merit Score		17		17		18		20	
	Sub Account Merit Rating		**3.4**		**3.4**		**3.6**		**4.0**	
Water Management	Seepage During Operations	1	5	5	5	5	6	6	1	1
	Runoff Management	1	6	6	2	2	5	5	1	1
	Watercourse Realignment	1	3	3	3	3	2	2	6	6
	Excess Water Management	1	5	5	5	5	1	1	5	5
	Flexibility of Water Management	1	5	5	4	4	1	1	2	2
	Sub Account Merit Score		24		19		15		15	
	Sub Account Merit Rating		**4.8**		**3.8**		**3.0**		**3.0**	
Expansion Capacity	Expansion Capacity	1	4	4	6	6	6	6	5	5
	Sub Account Merit Score		4		6		6		5	
	Sub Account Merit Rating		**4.0**		**6.0**		**6.0**		**5.0**	
Compliance with Environmental Approvals	Dust Management	1	5	5	5	5	1	1	6	6
	Sub Account Merit Score		5		5		1		6	
	Sub Account Merit Rating		**5.0**		**5.0**		**1.0**		**6.0**	

S3 Project Economics Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Capital Cost	Clearing / Site Preparation	1	2	2	2	2	6	6	1	1
	TSF Dam Construction	1	5	5	5	5	6	6	1	1
	Tailings Dewatering Infrastructure	1	6	6	6	6	2	2	6	6
	MWP Construction	1	4	4	1	1	3	3	6	6
	Roads	1	6	6	6	6	3	3	1	1
	Pumping Infrastructure	1	4	4	5	5	6	6	1	1
	Seepage Collection Infrastructure	1	6	6	2	2	5	5	1	1
	Sub Account Merit Score		33		27		31		17	
	Sub Account Merit Rating		**4.7**		**3.9**		**4.4**		**2.4**	

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Operational Costs	Tailings Deposition	1	6	6	6	6	2	2	4	4
	TSF Water Management	1	6	6	6	6	1	1	3	3
	MWP Pumping	1	2	2	5	5	6	6	1	1
	Sub Account Merit Score		14		17		9		8	
	Sub Account Merit Rating		**4.7**		**5.7**		**3.0**		**2.7**	

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Closure Costs	TSF Cover	1	6	6	6	6	1	1	5	5
	MWP Reclamation	1	6	6	4	4	2	2	1	1
	Road Reclamation	1	6	6	6	6	3	3	1	1
	Sub Account Merit Score		18		16		6		7	
	Sub Account Merit Rating		**6.0**		**5.3**		**2.0**		**2.3**	

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Post-Closure Costs	Inspection / Maintenance / Monitoring	1	5	5	5	5	6	6	1	1
	Risk of Additional Treatment Facilities	1	6	6	6	6	4	4	1	1
	Sub Account Merit Score		11		11		10		2	
	Sub Account Merit Rating		**5.5**		**5.5**		**5.0**		**1.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Ancillary Costs	Fish Habitat Compensation	1	1	1	2	2	3	3	6	6
	SAR Compensation	1	1	1	1	1	6	6	3	3
	Road Realignment	1	6	6	3	3	6	6	1	1
	Haul Distance for Overburden Stockpiles	1	6	6	6	6	1	1	6	6
	Sub Account Merit Score		14		12		16		16	
	Sub Account Merit Rating		**3.5**		**3.0**		**4.0**		**4.0**	

Risk	Risk of EA or Environmental Approval Delays or Rejection	1	5	5	5	5	1	1	3	3
	Risk Arising from TSF Costs	1	4	4	4	4	1	1	3	3
	Delays from Displacing Local Residents	1	6	6	6	6	4	4	6	6
	Sub Account Merit Score		15		15		6		12	
	Sub Account Merit Rating		**5.0**		**5.0**		**2.0**		**4.0**	

S3 Socio-Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Aboriginal Land Use and Heritage Value	Access Effected Areas	1	5	5	6	6	5	5	1	1
	Wildlife Abundance	1	4	4	4	4	5	5	2	2
	Loss of Undisturbed Habitat	1	3	3	2	2	6	6	1	1
	Avoidance of Thunder Lake Watershed	1	6	6	4	4	1	1	5	5
	Sub Account Merit Score		18		16		17		9	
	Sub Account Merit Rating		**4.5**		**4.0**		**4.3**		**2.3**	
Land Use	Loss of Tree Stands	1	2	2	2	2	6	6	1	1
	Access Along Transmission Line	1	5	5	5	5	6	6	4	4
	Area With Air Quality Above Health Based Guidelines	1	6	6	6	6	1	1	6	6
	Sub Account Merit Score		13		13		13		11	
	Sub Account Merit Rating		**4.3**		**4.3**		**4.3**		**3.7**	
Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	1	5	5	6	6	1	1	5	5
	Residents and Cottagers Around Thunder Lake	1	6	6	4	4	1	1	6	6
	Nearby Rural Residents	1	2	2	4	4	1	1	6	6
	Aaron Provincial Park	1	6	6	5	5	1	1	6	6
	Fugitive Dust	1	6	6	6	6	2	2	5	5
	TSF Elevation	1	1	1	1	1	6	6	1	1
	Frequency and Duration of Construction	1	4	4	4	4	1	1	3	3
	Sub Account Merit Score		30		30		13		32	
	Sub Account Merit Rating		**4.3**		**4.3**		**1.9**		**4.6**	
Location Infrastructure	Access Along Tree Nursery Road	1	3	3	3	3	6	6	2	2
	Sub Account Merit Score		3		3		6		2	
	Sub Account Merit Rating		**3.0**		**3.0**		**6.0**		**2.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	1	2	2	2	2	6	6	1	1
	Sub Account Merit Score		2		2		6		1	
	Sub Account Merit Rating		**2.0**		**2.0**		**6.0**		**1.0**	
Public Safety	Hazard Potential of TSF	1	3	3	3	3	5	5	4	4
	Hazard Potential of MWP	1	3	3	2	2	1	1	3	3
	Sub Account Merit Score		6		5		6		7	
	Sub Account Merit Rating		**3.0**		**2.5**		**3.0**		**3.5**	
Local Employment / Business	Risk to Local Economy	1	4	4	4	4	1	1	3	3
	Sub Account Merit Score		4		4		1		3	
	Sub Account Merit Rating		**4.0**		**4.0**		**1.0**		**3.0**	
Displacement of Residents	Potential for Displacing Local Residents	1	6	6	6	6	4	4	6	6
	Sub Account Merit Score		6		6		4		6	
	Sub Account Merit Rating		**6.0**		**6.0**		**4.0**		**6.0**	

S3 Environment Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A Rating	Alternative A Score	Alternative B Rating	Alternative B Score	Alternative C Rating	Alternative C Score	Alternative D Rating	Alternative D Score
Environment	Surface and Groundwater Quantity and Quality	1	5.0	5.0	4.7	4.7	3.7	3.7	2.3	2.3
	Aquatic Resources	1	4.3	4.3	4.7	4.7	3.7	3.7	5.3	5.3
	Terrestrial Resources	1	3.0	3.0	3.0	3.0	5.0	5.0	2.7	2.7
	SAR	1	4.0	4.0	4.3	4.3	3.0	3.0	3.0	3.0
	Atmospheric Emissions	1	5.8	5.8	5.3	5.3	3.3	3.3	3.0	3.0
	Protected Areas	1	3.3	3.3	3.3	3.3	4.3	4.3	4.3	4.3
	Closure / Post-Closure	1	4.0	4.0	4.0	4.0	2.0	2.0	4.0	4.0
	Account Merit Score		29.4		29.3		24.9		24.7	
	Account Merit Rating		**4.2**		**4.2**		**3.6**		**3.5**	

S3 Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A Rating	Alternative A Score	Alternative B Rating	Alternative B Score	Alternative C Rating	Alternative C Score	Alternative D Rating	Alternative D Score
Technical	Design Factors	1	4.0	4.0	3.3	3.3	3.0	3.0	4.0	4.0
	Safety Factors	1	3.4	3.4	3.4	3.4	3.6	3.6	4.0	4.0
	Water Management	1	4.8	4.8	3.8	3.8	3.0	3.0	3.0	3.0
	Expansion Capacity	1	4.0	4.0	6.0	6.0	6.0	6.0	5.0	5.0
	Compliance with Environmental Approvals	1	5.0	5.0	5.0	5.0	1.0	1.0	6.0	6.0
	Account Merit Score		21.2		21.5		16.6		22.0	
	Account Merit Rating		**4.2**		**4.3**		**3.3**		**4.4**	

S3 Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Economic	Capital Cost	1	4.7	4.7	3.9	3.9	4.4	4.4	2.4	2.4
	Operational Costs	1	4.7	4.7	5.7	5.7	3.0	3.0	2.7	2.7
	Closure Costs	1	6.0	6.0	5.3	5.3	2.0	2.0	2.3	2.3
	Post-Closure Costs	1	5.5	5.5	5.5	5.5	5.0	5.0	1.0	1.0
	Ancillary Costs	1	3.5	3.5	3.0	3.0	4.0	4.0	4.0	4.0
	Risk	1	5.0	5.0	5.0	5.0	2.0	2.0	4.0	4.0
	Account Merit Score		29.4		28.4		20.4		16.4	
	Account Merit Rating		**4.9**		**4.7**		**3.4**		**2.7**	

S3 Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Socio-Economic	Aboriginal Land Use and Heritage Value	1	4.5	4.5	4.0	4.0	4.3	4.3	2.3	2.3
	Land Use	1	4.3	4.3	4.3	4.3	4.3	4.3	3.7	3.7
	Operational Impacts (Air, Noise and Aesthetics)	1	4.3	4.3	4.3	4.3	1.9	1.9	4.6	4.6
	Location Infrastructure	1	3.0	3.0	3.0	3.0	6.0	6.0	2.0	2.0
	Drinking Water Quality	1	2.0	2.0	2.0	2.0	6.0	6.0	1.0	1.0
	Public Safety	1	3.0	3.0	2.5	2.5	3.0	3.0	3.5	3.5
	Account Merit Score		31.1		30.1		30.4		26.0	
	Account Merit Rating		**3.9**		**3.8**		**3.8**		**3.2**	

S3 Account Analysis

		Alternative A		Alternative B		Alternative C		Alternative D	
Account	**Weight**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Environment	1	4.2	4.2	4.2	4.2	3.6	3.6	3.5	3.5
Technical	1	4.2	4.2	4.3	4.3	3.3	3.3	4.4	4.4
Project Economics	1	4.9	4.9	4.7	4.7	3.4	3.4	2.7	2.7
Socio Economic	1	3.9	3.9	3.8	3.8	3.8	3.8	3.2	3.2
Alternative Merit Score		17.2		17.0		14.1		13.9	
Alternative Merit Rating		**4.3**		**4.2**		**3.5**		**3.5**	

Appendix A3: S4: Prioritize People, Environment Strongly Considered

S4 Weightings

Account	Weight	Sub-Account	Weight	Indicator	Weight
Environmental	4	Surface and Groundwater Quantity and Quality	4	Flow Loss	2
				Flow Reductions Outside Blackwater Creek	3
				Seepage Capture During Operations	5
		Aquatic Resources	6	Tributary Fish Habitat Losses	3
				Main stem Watercourse Fish Habitat Losses	4
				Watercourse Crossings	2
		Terrestrial Resources	4	Forest Loss	3
				Wetland Loss	4
				Use of Recently Disturbed Land	2
		SAR	5	Common Nighthawk	2
				Barn Swallow	3
				Bats	6
		Atmospheric Emissions	3	Fugitive Dust	3
				Noise Emissions	4
				Greenhouse Gas Emissions	5
				Light Trespass	1
		Protected Areas	4	Distance to Nature Reserve	5
				Distance to Provincial Park	2
				Provincial Fish Sanctuary	4
		Closure / Post-Closure	4	Potential for Seepage to Report to Thunder Lake	5
				Surface Water Discharge	4
Technical	2	Design Factors	6	TSF Location Suitability	6
				MWP Location Suitability	3
				Foundation Suitability	4
		Safety Factors	5	TSF Hazard Potential	6
				MWP Hazard Potential	4
				Maximum TSF Dam Height	2
				Maximum MWP Dam Height	1
				Worker Health	3
		Water Management	5	Seepage During Operations	5
				Runoff Management	3
				Watercourse Realignment	2
				Excess Water Management	4
				Flexibility of Water Management	3
		Expansion Capacity	2	Expansion Capacity	1
		Compliance with Environmental Approvals	3	Dust Management	1

Account	Weight	Sub-Account	Weight	Indicator	Weight
Project Economics	1	Capital Cost	6	Clearing / Site Preparation	1
				TSF Dam Construction	6
				Tailings Dewatering Infrastructure	3
				MWP Construction	2
				Roads	2
				Pumping Infrastructure	1
				Seepage Collection Infrastructure	1
		Operational Costs	5	Tailings Deposition	6
				TSF Water Management	4
				MWP Pumping	1
		Closure Costs	3	TSF Cover	6
				MWP Reclamation	2
				Road Reclamation	2
		Post-Closure Costs	1	Inspection / Maintenance / Monitoring	2
				Risk of Additional Treatment Facilities	4
		Ancillary Costs	2	Fish Habitat Compensation	3
				SAR Compensation	1
				Road Realignment	3
				Haul Distance for Overburden Stockpiles	1
		Risk	3	Risk of EA or Environmental Approval Delays or Rejection	5
				Risk Arising from TSF Costs	3
				Delays from Displacing Local Residents	4
Socio-Economic	6	Aboriginal Land Use and Heritage Value	6	Access Effected Areas	6
				Wildlife Abundance	3
				Loss of Undisturbed Habitat	3
				Avoidance of Thunder Lake Watershed	4
		Land Use	3	Loss of Tree Stands	2
				Access Along Transmission Line	2
				Area With Air Quality Above Health Based Guidelines	4
		Operational Impacts (Air, Noise and Aesthetics)	4	Village of Wabigoon	5
				Residents and Cottagers Around Thunder Lake	5
				Nearby Rural Residents	5
				Aaron Provincial Park	3
				Fugitive Dust	3
				TSF Elevation	1
				Frequency and Duration of Construction	4
		Location Infrastructure	1	Access Along Tree Nursery Road	1
		Drinking Water Quality	6	Potential for Seepage to Affect Drinking Water Wells	1
		Public Safety	5	Hazard Potential of TSF	6

Account	Weight	Sub-Account	Weight	Indicator	Weight
Socio-Economic (Cont'd)		Public Safety (cont'd)		Hazard Potential of MWP	3
		Local Employment / Business	2	Risk to Local Economy	1
		Displacement of Residents	5	Potential for Displacing Local Residents	1

S4 Environment Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Surface and Groundwater Quantity and Quality	Flow Loss	2	3	6	3	6	1	2	5	10
	Flow Reductions Outside Blackwater Creek	3	6	18	5	15	4	12	1	3
	Seepage Capture During Operations	5	6	30	6	30	6	30	1	5
	Sub Account Merit Score		54		51		44		18	
	Sub Account Merit Rating		**5.4**		**5.1**		**4.4**		**1.8**	
Aquatic Resources	Tributary Fish Habitat Losses	3	1	3	2	6	4	12	6	18
	Main stem Watercourse Fish Habitat Losses	4	6	24	6	24	1	4	6	24
	Watercourse Crossings	2	6	12	6	12	6	12	4	8
	Sub Account Merit Score		39		42		28		50	
	Sub Account Merit Rating		**4.3**		**4.7**		**3.1**		**5.6**	
Terrestrial Resources	Forest Loss	3	3	9	3	9	6	18	1	3
	Wetland Loss	4	1	4	2	8	3	12	6	24
	Use of Recently Disturbed Land	2	5	10	4	8	6	12	1	2
	Sub Account Merit Score		23		25		42		29	
	Sub Account Merit Rating		**2.6**		**2.8**		**4.7**		**3.2**	
SAR	Common Nighthawk	2	2	4	3	6	1	2	6	12
	Barn Swallow	3	6	18	6	18	2	6	1	3
	Bats	6	4	24	4	24	6	36	2	12
	Sub Account Merit Score		46		48		44		27	
	Sub Account Merit Rating		**4.2**		**4.4**		**4.0**		**2.5**	
Atmospheric Emissions	Fugitive Dust	3	6	18	6	18	2	6	5	15
	Noise Emissions	4	6	24	4	16	6	24	2	8
	Greenhouse Gas Emissions	5	6	30	6	30	2	10	1	5
	Light Trespass	1	5	5	5	5	3	3	4	4
	Sub Account Merit Score		77		69		43		32	
	Sub Account Merit Rating		**5.9**		**5.3**		**3.3**		**2.5**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Protected Areas	Distance to Nature Reserve	5	1	5	1	5	6	30	3	15
	Distance to Provincial Park	2	3	6	3	6	1	2	6	12
	Provincial Fish Sanctuary	4	6	24	6	24	6	24	4	16
	Sub Account Merit Score		35		35		56		43	
	Sub Account Merit Rating		**3.2**		**3.2**		**5.1**		**3.9**	

Closure / Post-Closure	Potential for Seepage to Report to Thunder Lake	5	3	15	3	15	1	5	6	30
	Surface Water Discharge	4	5	20	5	20	3	12	2	8
	Sub Account Merit Score		35		35		17		38	
	Sub Account Merit Rating		**3.9**		**3.9**		**1.9**		**4.2**	

S4 Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Design Factors	TSF Location Suitability	6	5	30	5	30	4	24	3	18
	MWP Location Suitability	3	3	9	1	3	3	9	6	18
	Foundation Suitability	4	4	16	4	16	2	8	3	12
	Sub Account Merit Score		55		49		41		48	
	Sub Account Merit Rating		**4.2**		**3.8**		**3.2**		**3.7**	
Safety Factors	TSF Hazard Potential	6	3	18	3	18	5	30	4	24
	MWP Hazard Potential	4	3	12	2	8	1	4	3	12
	Maximum TSF Dam Height	2	5	10	5	10	6	12	1	2
	Maximum MWP Dam Height	1	1	1	2	2	5	5	6	6
	Worker Health	3	5	15	5	15	1	3	6	18
	Sub Account Merit Score		56		53		54		62	
	Sub Account Merit Rating		**3.5**		**3.3**		**3.4**		**3.9**	
Water Management	Seepage During Operations	5	5	25	5	25	6	30	1	5
	Runoff Management	3	6	18	2	6	5	15	1	3
	Watercourse Realignment	2	3	6	3	6	2	4	6	12
	Excess Water Management	4	5	20	5	20	1	4	5	20
	Flexibility of Water Management	3	5	15	4	12	1	3	2	6
	Sub Account Merit Score		84		69		56		46	
	Sub Account Merit Rating		**4.9**		**4.1**		**3.3**		**2.7**	
Expansion Capacity	Expansion Capacity	1	4	4	6	6	6	6	5	5
	Sub Account Merit Score		4		6		6		5	
	Sub Account Merit Rating		**4.0**		**6.0**		**6.0**		**5.0**	
Compliance with Environmental Approvals	Dust Management	1	5	5	5	5	1	1	6	6
	Sub Account Merit Score		5		5		1		6	
	Sub Account Merit Rating		**5.0**		**5.0**		**1.0**		**6.0**	

S4 Project Economics Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Capital Cost	Clearing / Site Preparation	1	2	2	2	2	6	6	1	1
	TSF Dam Construction	6	5	30	5	30	6	36	1	6
	Tailings Dewatering Infrastructure	3	6	18	6	18	2	6	6	18
	MWP Construction	2	4	8	1	2	3	6	6	12
	Roads	2	6	12	6	12	3	6	1	2
	Pumping Infrastructure	1	4	4	5	5	6	6	1	1
	Seepage Collection Infrastructure	1	6	6	2	2	5	5	1	1
	Sub Account Merit Score		80		71		71		41	
	Sub Account Merit Rating		**5.0**		**4.4**		**4.4**		**2.6**	

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Operational Costs	Tailings Deposition	6	6	36	6	36	2	12	4	24
	TSF Water Management	4	6	24	6	24	1	4	3	12
	MWP Pumping	1	2	2	5	5	6	6	1	1
	Sub Account Merit Score		62		65		22		37	
	Sub Account Merit Rating		**5.6**		**5.9**		**2.0**		**3.4**	

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Closure Costs	TSF Cover	6	6	36	6	36	1	6	5	30
	MWP Reclamation	2	6	12	4	8	2	4	1	2
	Road Reclamation	2	6	12	6	12	3	6	1	2
	Sub Account Merit Score		60		56		16		34	
	Sub Account Merit Rating		**6.0**		**5.6**		**1.6**		**3.4**	

Sub-Account	Indicator	Weight	Alternative A Value	Alternative A Score	Alternative B Value	Alternative B Score	Alternative C Value	Alternative C Score	Alternative D Value	Alternative D Score
Post-Closure Costs	Inspection / Maintenance / Monitoring	2	5	10	5	10	6	12	1	2
	Risk of Additional Treatment Facilities	4	6	24	6	24	4	16	1	4
	Sub Account Merit Score		34		34		28		6	
	Sub Account Merit Rating		**5.7**		**5.7**		**4.7**		**1.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Ancillary Costs	Fish Habitat Compensation	3	1	3	2	6	3	9	6	18
	SAR Compensation	1	1	1	1	1	6	6	3	3
	Road Realignment	3	6	18	3	9	6	18	1	3
	Haul Distance for Overburden Stockpiles	1	6	6	6	6	1	1	6	6
	Sub Account Merit Score		28		22		34		30	
	Sub Account Merit Rating		**3.5**		**2.8**		**4.3**		**3.8**	

Risk	Risk of EA or Environmental Approval Delays or Rejection	5	5	25	5	25	1	5	3	15
	Risk Arising from TSF Costs	3	4	12	4	12	1	3	3	9
	Delays from Displacing Local Residents	4	6	24	6	24	4	16	6	24
	Sub Account Merit Score		61		61		24		48	
	Sub Account Merit Rating		**5.1**		**5.1**		**2.0**		**4.0**	

S4 Socio-Economic Indicator Analysis

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Aboriginal Land Use and Heritage Value	Access Effected Areas	6	5	30	6	36	5	30	1	6
	Wildlife Abundance	3	4	12	4	12	5	15	2	6
	Loss of Undisturbed Habitat	3	3	9	2	6	6	18	1	3
	Avoidance of Thunder Lake Watershed	4	6	24	4	16	1	4	5	20
	Sub Account Merit Score		75		70		67		35	
	Sub Account Merit Rating		**4.7**		**4.4**		**4.2**		**2.2**	
Land Use	Loss of Tree Stands	2	2	4	2	4	6	12	1	2
	Access Along Transmission Line	2	5	10	5	10	6	12	4	8
	Area With Air Quality Above Health Based Guidelines	4	6	24	6	24	1	4	6	24
	Sub Account Merit Score		38		38		28		34	
	Sub Account Merit Rating		**4.8**		**4.8**		**3.5**		**4.3**	
Operational Impacts (Air, Noise and Aesthetics)	Village of Wabigoon	5	5	25	6	30	1	5	5	25
	Residents and Cottagers Around Thunder Lake	5	6	30	4	20	1	5	6	30
	Nearby Rural Residents	5	2	10	4	20	1	5	6	30
	Aaron Provincial Park	3	6	18	5	15	1	3	6	18
	Fugitive Dust	3	6	18	6	18	2	6	5	15
	TSF Elevation	1	1	1	1	1	6	6	1	1
	Frequency and Duration of Construction	4	4	16	4	16	1	4	3	12
	Sub Account Merit Score		118		120		34		131	
	Sub Account Merit Rating		**4.5**		**4.6**		**1.3**		**5.0**	
Location Infrastructure	Access Along Tree Nursery Road	1	3	3	3	3	6	6	2	2
	Sub Account Merit Score		3		3		6		2	
	Sub Account Merit Rating		**3.0**		**3.0**		**6.0**		**2.0**	

			Alternative A		Alternative B		Alternative C		Alternative D	
Sub-Account	**Indicator**	**Weight**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Drinking Water Quality	Potential for Seepage to Affect Drinking Water Wells	1	2	2	2	2	6	6	1	1
	Sub Account Merit Score		2		2		6		1	
	Sub Account Merit Rating		**2.0**		**2.0**		**6.0**		**1.0**	

Public Safety	Hazard Potential of TSF	6	3	18	3	18	5	30	4	24
	Hazard Potential of MWP	3	3	9	2	6	1	3	3	9
	Sub Account Merit Score		27		24		33		33	
	Sub Account Merit Rating		**3.0**		**2.7**		**3.7**		**3.7**	

Local Employment / Business	Risk to Local Economy	1	4	4	4	4	1	1	3	3
	Sub Account Merit Score		4		4		1		3	
	Sub Account Merit Rating		**4.0**		**4.0**		**1.0**		**3.0**	

Displacement of Residents	Potential for Displacing Local Residents	1	6	6	6	6	4	4	6	6
	Sub Account Merit Score		6		6		4		6	
	Sub Account Merit Rating		**6.0**		**6.0**		**4.0**		**6.0**	

S4 Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	Surface and Groundwater Quantity and Quality	4	5.4	21.6	5.1	20.4	4.4	17.6	1.8	7.2
	Aquatic Resources	6	4.3	26.0	4.7	28.0	3.1	18.7	5.6	33.3
	Terrestrial Resources	4	2.6	10.2	2.8	11.1	4.7	18.7	3.2	12.9
	SAR	5	4.2	20.9	4.4	21.8	4.0	20.0	2.5	12.3
	Atmospheric Emissions	3	5.9	17.8	5.3	15.9	3.3	9.9	2.5	7.4
	Protected Areas	4	3.2	12.7	3.2	12.7	5.1	20.4	3.9	15.6
	Closure / Post-Closure	4	3.9	15.6	3.9	15.6	1.9	7.6	4.2	16.9
	Account Merit Score		124.8		125.5		112.8		105.6	
	Account Merit Rating		**4.2**		**4.2**		**3.8**		**3.5**	

S4 Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical	Design Factors	6	4.2	25.4	3.8	22.6	3.2	18.9	3.7	22.2
	Safety Factors	5	3.5	17.5	3.3	16.6	3.4	16.9	3.9	19.4
	Water Management	5	4.9	24.7	4.1	20.3	3.3	16.5	2.7	13.5
	Expansion Capacity	2	4.0	8.0	6.0	12.0	6.0	12.0	5.0	10.0
	Compliance with Environmental Approvals	3	5.0	15.0	5.0	15.0	1.0	3.0	6.0	18.0
	Account Merit Score		90.6		86.5		67.3		83.1	
	Account Merit Rating		**4.3**		**4.1**		**3.2**		**4.0**	

S4 Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A Rating	Alternative A Score	Alternative B Rating	Alternative B Score	Alternative C Rating	Alternative C Score	Alternative D Rating	Alternative D Score
Economic	Capital Cost	6	5.0	30.0	4.4	26.6	4.4	26.6	2.6	15.4
	Operational Costs	5	5.6	28.2	5.9	29.5	2.0	10.0	3.4	16.8
	Closure Costs	3	6.0	18.0	5.6	16.8	1.6	4.8	3.4	10.2
	Post-Closure Costs	1	5.7	5.7	5.7	5.7	4.7	4.7	1.0	1.0
	Ancillary Costs	2	3.5	7.0	2.8	5.5	4.3	8.5	3.8	7.5
	Risk	3	5.1	15.3	5.1	15.3	2.0	6.0	4.0	12.0
	Account Merit Score		104.1		99.4		60.6		62.9	
	Account Merit Rating		**5.2**		**5.0**		**3.0**		**3.1**	

S4 Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A Rating	Alternative A Score	Alternative B Rating	Alternative B Score	Alternative C Rating	Alternative C Score	Alternative D Rating	Alternative D Score
Socio-Economic	Aboriginal Land Use and Heritage Value	6	4.7	28.1	4.4	26.3	4.2	25.1	2.2	13.1
	Land Use	3	4.8	14.3	4.8	14.3	3.5	10.5	4.3	12.8
	Operational Impacts (Air, Noise and Aesthetics)	4	4.5	18.2	4.6	18.5	1.3	5.2	5.0	20.2
	Location Infrastructure	1	3.0	3.0	3.0	3.0	6.0	6.0	2.0	2.0
	Drinking Water Quality	6	2.0	12.0	2.0	12.0	6.0	36.0	1.0	6.0
	Public Safety	5	3.0	15.0	2.7	13.3	3.7	18.3	3.7	18.3
	Account Merit Score		128.5		125.3		123.2		108.4	
	Account Merit Rating		**4.0**		**3.9**		**3.8**		**3.4**	

S4 Account Analysis

		Alternative A		Alternative B		Alternative C		Alternative D	
Account	**Weight**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**	**Rating**	**Score**
Environment	4	4.2	16.6	4.2	16.7	3.8	15.0	3.5	14.1
Technical	2	4.3	8.6	4.1	8.2	3.2	6.4	4.0	7.9
Project Economics	1	5.2	5.2	5.0	5.0	3.0	3.0	3.1	3.1
Socio Economic	6	4.0	24.1	3.9	23.5	3.8	23.1	3.4	20.3
Alternative Merit Score		54.6		53.4		47.6		45.5	
Alternative Merit Rating		**4.2**		**4.1**		**3.7**		**3.5**	