



APPENDIX F WATER MANAGEMENT PLAN



TREASURY METALS INC.

GOLIATH GOLD PROJECT

PRE-FEASIBILITY WATER MANAGEMENT STRATEGY



Lycopodium

5027-REP-002

September 2014

| REV NO. | DATE | DESCRIPTION OF REVISION | BY | DESIGN APPROVED | PROJECT APPROVED |
|---------|----------|-------------------------|----|-----------------|------------------|
| E | 25/09/14 | RE-ISSUED FOR STUDY | | AC | |
| D | 05/09/14 | RE-ISSUED FOR STUDY | | AC | |

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DISCLAIMER

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TABLE OF TERMS AND ACRONYMS

| | |
|-------------------|--|
| µm | micron (10 ⁻⁶ m) |
| Ag | silver |
| ARD | Acid Rock Drainage |
| As | Arsenic |
| Au | gold |
| CCME | Canadian Council of Ministers of the Environment – Provide Water Quality Guidelines for the Protection of Aquatic Life |
| Cdn\$ | Canadian dollars |
| CIL | Carbon-in-Leach |
| CN | Cyanide |
| CN _{WAD} | Weak Dissociable Acid Cyanide |
| CNO ⁻ | Cyanate Ion |
| Co | Cobalt |
| COPC | Contaminants of Potential Concern |
| EIS | Environmental Impact Statement |
| g/t | grams per tonne |
| ICP | Inductively Coupled Plasma (trace metal analysis technique) |
| IL | Intensive Leach |
| ILR | Intensive Leach Reactor |
| km | kilometres |
| kWh | kilowatt-hours |
| LOM | Life of Mine |
| m | metres |
| MMER | Metal Mining Effluent Regulations |
| MTO | Material Take Off |
| NaCN | sodium cyanide |
| NAG | Non Acid Generating |
| NG | Natural Gas |
| Ni | Nickel |
| Owner | Treasury Metals Inc. |
| PAG | Potentially Acid Generating |
| Pb | Lead |
| PDC | Process Design Criteria |
| PEA | Preliminary Economic Assessment |
| ppm | parts per million |
| PWQO | Provincial Water Quality Objectives |
| ROM | Run of Mine |
| SAG | Semi-Autogenous Grinding |
| SG | Specific Gravity |
| SMBS | sodium metabisulphite |
| SO ₂ | sulphur dioxide |
| t | tonnes |
| t/a | tonnes per annum (year) |
| t/d | tonnes per day |
| TOC | Total Organic Carbon |
| TSF | Tailings Storage Facility |
| WRSF | Waste Rock Storage Facility |
| WSP | WSP Canada Inc., Engineering consultant for TSF |
| Zn | Zinc |

1.0 EXECUTIVE SUMMARY

1.1 Introduction and Background

Treasury Metals Inc. ("Treasury") plans to develop the Goliath Gold Project, located near the community of Wabigoon and approximately 20 km east of Dryden in northern Ontario, into an operating mine and gold processing facility.

A detailed Project Description (dated 26 November 2012) has been previously prepared, and Treasury is currently working to prepare a detailed Environmental Impact Statement (EIS) for submission in the third quarter of 2014. In the second quarter of 2014, Lycopodium Minerals Canada prepared an assessment of three alternative processing routes that recommended a conventional gravity / CIL circuit with elution and cyanide destruction to produce doré bar.

The purposes of this study are to:

- Develop an overall site water balance;
- Select a cyanide destruction process and estimate operating parameters;
- Predict the final effluent characteristics and determine treatment requirements;
- Provide conceptual design and estimate the cost of the following final effluent discharge point routing options:
 - Blackwater Creek;
 - Wabigoon Lake in the area of Keplyn's Bay;
 - Tree nursery pond(s);
 - Thunder Lake;
 - Hartman Lake.

1.2 Study Approach

In May 2014, Treasury retained Lycopodium Minerals Canada Ltd ("Lycopodium") to prepare this pre-feasibility water management study for the proposed Goliath gold project site. The aim of this study is to use the best available information to predict the final effluent and determine treatment requirements. The information used includes previously performed testwork and previously issued project reports including hydrology, and hydrogeology studies.

This water management strategy was developed with the following primary objectives:

- Meet or exceed effluent regulatory requirements;
- Maintain competitive project economics;
- Minimize the amount of water requiring treatment by maximizing the diversion of surface water around the site;
- Minimize the amount of fresh water taken by recycling and re-using process water;
- Minimize risks to the environment including wildlife and aquatic species;
- Provide one final effluent discharge point for all potentially contaminated water.

1.3 Site Water Balance

A preliminary overall yearly average site water balance has been prepared using available information supplied by WSP, P&E Mining Consultants, Tetrattech, and Lycopodium's own study information based on testwork performed by G&T Metallurgical Services Ltd., Gekko System Pty., Ecometrix Inc., and generally accepted industry practice. The overall site water balance is positive, and there will be a requirement to discharge effluent. The water balance is based on yearly average values and does not take into account seasonal variations in water flows.

1.4 Cyanide Management Plan

Goliath ore will be leached with cyanide in agitated leach reactors. The project will be designed to operate in compliance with the International Cyanide Code as well as federal and provincial regulations and guidelines. Cyanide consumption will be decreased using a recovery thickener to recycle cyanide, and cyanide concentrations of the leach tails will be reduced to acceptable discharge limits using the SO₂-Air cyanide destruction process prior to discharge to the tailings facility. Effluent from the tailings storage facility will be further treated in an effluent treatment plant prior to discharge to the environment. The proposed Goliath process flowsheet minimizes cyanide consumption, minimizes the risk of inadvertent releases of cyanide into the environment, and ensures the protection of wildlife, including waterfowl and aquatic life.

1.5 Water Treatment and Discharge Facilities

Contaminated water will be treated in the cyanide destruction circuit with subsequent attenuation in the tailings storage facility followed by secondary treatment of tailings decant in the effluent treatment plant. The worst case yearly average predicted quantity and quality of the Goliath TSF decant is presented in Table 4.3 Predicted Tailings Storage Facility Supernatant Concentrations Based on Preliminary Data and Worst Case Assumptions.

The preliminary predicted constituent concentrations for tailings storage facility supernatant comply

with applicable effluent regulatory requirements namely MMER (current to May 2014). An effluent treatment plant will render the TSF supernatant suitable for direct discharge to Blackwater Creek (a receiver with minimal assimilative capacity) in compliance with the Provincial Water Quality Objectives (PWQO).

1.6 Effluent Discharge Point Selection

Five alternate final effluent discharge points have been proposed for the Goliath project. Capital costs for routing the final effluent to each of the discharge points have been estimated given that the tailings dam is located to the north-east of the open pit, on the east side of Nursery Road (Option 1):

- Blackwater Creek;
- Wabigoon Lake in the area of Keplyn's Bay;
- Tree nursery pond(s);
- Thunder Lake;
- Hartman Lake.

Blackwater Creek has been selected as the preferred effluent receiver. The effluent discharge facilities will include pumps, overland piping, an outfall or spillway, a weir or flow meter device suitable for measuring the effluent flow rate, access for inspection and sampling of the effluent, and potentially an automatic sampling device.

A drawing depicting the five effluent receiver options is included in Appendix A.

1.7 Evaluation of Alternatives for Water Management for the Goliath Project

The assessment of alternative methods for carrying out the various water management aspects was conducted based on the following performance objectives:

- Economics;
- Technical applicability and capability;
- General environmental effects;
- Suitability to project objectives and processes.

In each case the preferred method was selected and used to develop the final effluent chemistry prediction.

2.0 SITE WATER BALANCE

Goliath is a free-milling gold deposit located near Dryden Ontario. The deposit will be mined using both open pit and underground methods. The ore will be crushed and milled at a rate of 2700 tpd, with gold and silver being recovered by conventional cyanide leaching processes to produce doré bar. Metallurgical assays of the Goliath deposit indicate a relatively clean ore with low levels of substances deleterious to both gold recovery and the environment. Some metals were below the limits of detection of the testing method used, for example mercury. Additional testing has been requested at the lowest limit of detection possible to determine any potential impact of mercury. For the purposes of this study, the following conditions are understood:

Table 2.1 Water Balance Design Basis

| | | |
|---|---------------|-------------------|
| Processing Plant Throughput | 2,700 | t/d |
| Surface Area of TSF | 760,000 | m ² |
| Average Annual Precipitation | 725 | mm |
| Average Annual Lake Evaporation | 500 | mm |
| Waste Rock Storage Catchment Area | 556,748 | m ² |
| Low Grade Stock Pile Catchment Area | 89,760 | m ² |
| Processing Plant Site Surface Area | 65,000 | m ² |
| Ore Moisture | 5 | % |
| Open Pit & Underground Mine Dewater (excluding rainfall) | 1,210 – 1,600 | m ³ /d |
| Open Pit Rainfall Area (maximum pit size) | 350,000 | m ² |
| Overburden Pile | 0 | m ³ /d |
| Plant Fresh Water Requirement | 600 | m ³ /d |

Using the basis of design presented in Table 2.1, and a preliminary steady state simulation of the processing circuit and tailings facility, the overall site water balance and TSF supernatant composition was predicted. No probabilistic modelling or estimating was conducted and probable maximum precipitation events were not considered. With the exception of potentially high values of total suspended solids, high rainfall events should not negatively influence the effluent water quality. This preliminary water and chemical balance does not take into account seasonal variations in water flow.

Sources and destinations of water at the Goliath site have been examined and the overall net water balance is presented in Figure 2-2.

2.1 Water Sources

The following sources contribute water (either contaminated or not) to the overall site water balance: Normal precipitation recorded at the Dryden Airport No. 6032117 station from 1971-2000 is 725 mm of which 80% is rainfall. All precipitation is considered as water in the average overall site water balance. Lake evaporation is considered to be 500 mm per year. Figure 2-1 provides a relative comparison of water balance contributors.

2.1.1 Ore Moisture

Ore from the open pit and underground mine will be fed to the process plant at a rate of 2,700 dry tpd. It is assumed that the ore will have a moisture content of 5% at the point of introduction to the processing facility. The water contribution of ore is calculated to be:

$$2,700 \text{ t/d} \div 0.95 - 2,700 \text{ t/d} \times 1 \text{ m}^3/\text{t} = 142 \text{ m}^3/\text{d}$$

2.1.2 Waste Rock Dump and Low Grade Ore Stockpile Water

No groundwater infiltration is assumed, and surface water is assumed to be diverted around waste dump. Net precipitation is calculated based on surface area with 250 mm of annual evaporation considered. No seepage or other phenomenon such as transpiration are considered. The waste rock dump pile will contain the full variety of rock types present in the deposit and will have a higher degree of reactivity that in situ rock due to increased surface area and exposure to air and water. As reported by EcoMetrix¹, testwork has confirmed the potential for ARD. Therefore, it is realistic to expect that at least some the seepage and runoff from the waste rock dump pile will be acidic and metal enriched. It is assumed that the waste rock dump will not be covered progressively during operations. However, during the later years of mine operation, waste rock will be disposed of in the open pit thereby making it possible to cover and close the waste rock dump pile while ARD water treatment is readily available. Segregation and/or selective placement of waste rock with respect to acid generation potential could minimize the generation of ARD. It may also be possible to backfill the pit with the segregated potentially acid generating (PAG) rock towards the end of the mine life. The waste rock dump and ore pile water contribution is calculated using the final end of life surface area as:

$$0.475 \text{ m net precipitation} \times (556,748 \text{ m}^2 + 89,760 \text{ m}^2) / 365 = 841 \text{ m}^3/\text{d}$$

¹ Geochemical Evaluation of the Goliath Gold Project September 2013 – Report 12-1938

2.1.3 Open Pit Dewatering and Underground Dewatering

Mine dewatering requirements have been estimated by AMEC¹ to be 1320 m³/d (base case scenario). No surface water inflows or precipitation were included in this number. It is assumed that all surface water will be diverted around the open pit and away from the underground portal. Net precipitation is calculated considering an annual evaporation of 250 mm over the end of life open pit surface area, and is estimated to be:

$$0.475 \text{ m net precipitation} \times 350,000 \text{ m}^2 / 365 = 455 \text{ m}^3/\text{d}$$

Therefore, total mine water is calculated as:

$$455 \text{ m}^3/\text{d} + 1,320 \text{ m}^3/\text{d} = 1775 \text{ m}^3/\text{d}$$

2.1.4 Tailings Storage Facility

An above grade tailings impoundment is envisioned that will contain all of the mill tailings in a subaqueous setting. Subaqueous deposition will provide a permanent water cover to remove the possibility of acid generation resulting from oxidation of the tailings. During the initial period of operation, the tailings storage facility will contain all incoming flows and no effluent will be discharged. When the tailings storage facility reaches the design overflow point, it will overflow and discharge effluent. This overflow elevation will increase in stages with dam height raises. The initial period of zero effluent discharge will allow operations to start-up and optimize cyanide addition to the leach circuit as well as the operation of the cyanide destruction circuit without additional risk to the environment.

Net precipitation in the tailings facility is calculated using 725 mm of precipitation and 500 mm lake evaporation. The surface area of the tailings facility will not change over the life of mine.

$$0.725 \text{ m} - 0.5 \text{ m} \times 760,000 \text{ m}^2 / 365 = 468 \text{ m}^3/\text{d}$$

Seepage from the dam will be collected and returned to the tailings storage facility.

2.1.5 Fresh Water

Fresh water will be required in the processing plant for consumption as potable water, pump gland water, reagent makeup, carbon elution, fire fighting water reserve, first fill requirements during start-up, etc. The total fresh water requirement of the process plant is estimated to be 600 m³/d. This demand will be met using 450 m³/d of recycled effluent that has been treated and 150 m³/d of fresh water make-up. The fresh water make-up demand will be met by surface water drawn from the former tree nursery irrigation ponds.

The fresh water make-up requirement is expected to be 150 m³/d.

¹ Hydrogeological Pre-Feasibility/EA Support Study Goliath Project May 2014 – Report TB124004

2.1.6 Process Plant Site

Surface water runoff from the processing plant site is not expected to require treatment. In the future, provision could be made for containment and pumping of the contaminated surface water to the tailings storage facility using a portable pump. However, this water is not expected to be contaminated. By design, plant site surface water will drain into the surrounding terrain and ultimately to Blackwater Creek. It is envisioned that all processing plant equipment will be inside containment bunds and all containment bunds will be under cover and not collect rainfall.

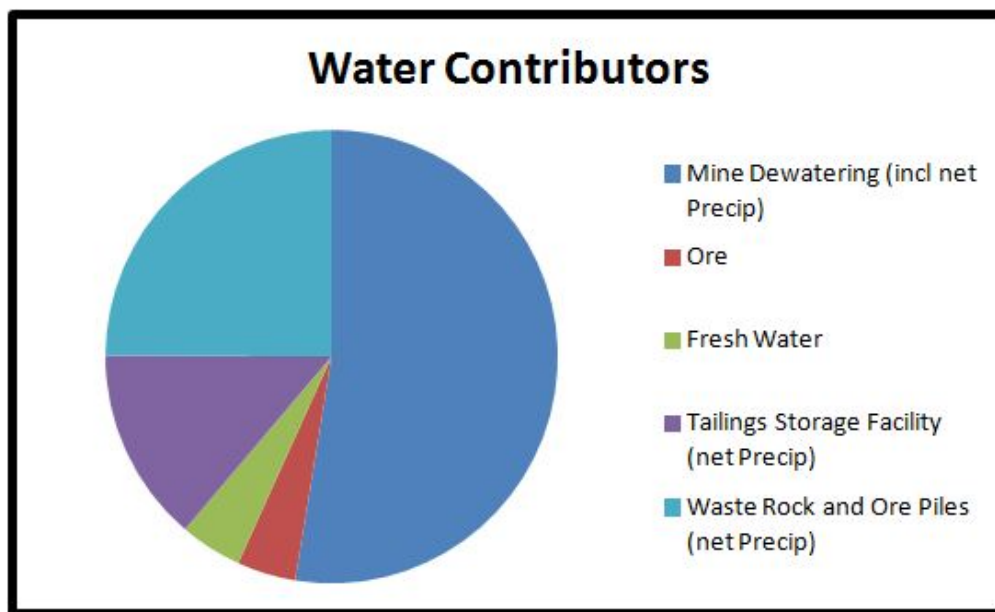
2.1.7 Total Water Sources

The total water contributions are:

$$142 \text{ m}^3/\text{d} + 841 \text{ m}^3/\text{d} + 1775 \text{ m}^3/\text{d} + 468 \text{ m}^3/\text{d} + 150 \text{ m}^3/\text{d} = 3,376 \text{ m}^3/\text{d}$$

Figure 2-1 depicts the distribution of the contributors to the water balance.

Figure 2-1 Distribution of Water Contributors



2.2 Water Destinations

2.2.1 Tailings Storage Facility Sediment

As the tailings slurry settles in the tailings storage facility it will come to a final solids content over time. The percent solids by weight of the consolidated tailings is assumed to be 65%. Water retained in consolidated tails in the tailings facility is calculated as:

$$2,700 \text{ tpd} \div 0.65 - 2,700 \text{ tpd} \times 1 \text{ m}^3/\text{t} = 1,454 \text{ m}^3/\text{d}$$

2.2.2 Process Plant Consumption

Water evaporation will occur predominantly in the air sparged CIL and cyanide destruction tanks, electrowinning cells, carbon reactivation kiln, and off gas scrubbers; and to a lesser extent in the grinding circuit, screen sprays, and cyanide recovery thickener.

Evaporative losses in the processing plant are estimated to 5 m³/d.

2.2.3 Tailings Storage Facility Effluent

All remaining water in the water balance will collect in and be pumped from the tailings facility to the effluent treatment plant. From the effluent treatment plant, a portion of the treated water will be recycled back to the process plant, and the remainder will be discharged to the raw water reservoir and ultimately to Blackwater Creek. The tailings storage facility water balance is positive and the yearly average is expected to be:

$$3,376 \text{ m}^3/\text{d} - 1,454 \text{ m}^3/\text{d} - 5 \text{ m}^3/\text{d} = 1917 \text{ m}^3/\text{d}$$

2.2.4 Effluent Treatment Plant

The effluent treatment plant will treat TSF effluent to comply with PWQO guidelines and return a portion to the process plant with the remainder being discharged to Blackwater Creek. The final effluent quantity is calculated as:

$$1917 \text{ m}^3/\text{d} - 450 \text{ m}^3/\text{d} = 1467 \text{ m}^3/\text{d}$$

This amount represents the yearly average cubic meters per day of effluent that will be discharged from the Goliath project site. Effluent flow rates are expected to be larger in the summer months and lower in the winter months.

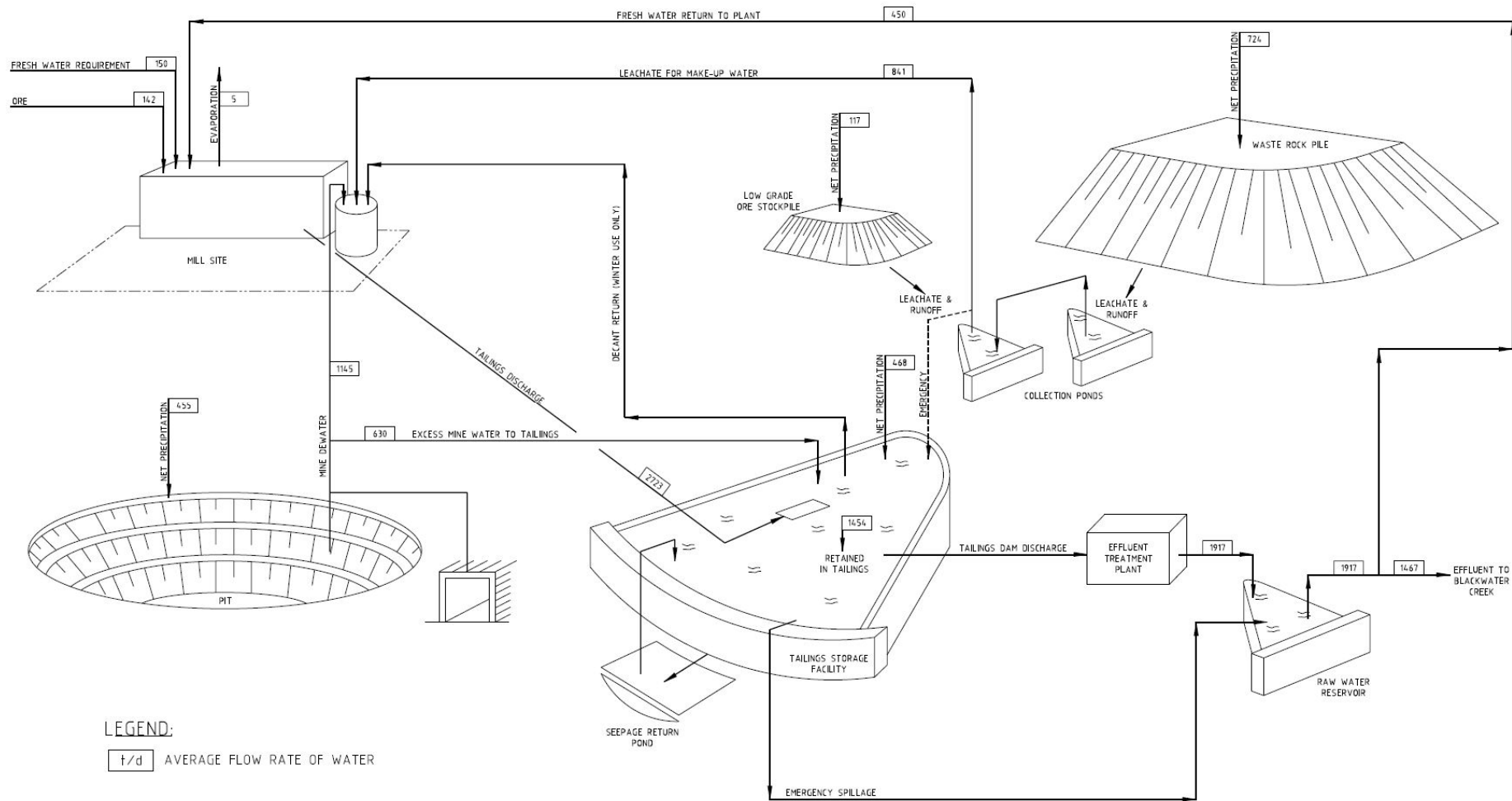
2.3 Overall Water Balance

The overall yearly average water balance is represented pictorially in Figure 2.2.

During seasonal variations, the effluent discharge rate will change considerably. During winter months,

minimal run-off will be recovered from the rock piles, resulting in a requirement for tailings water to be reclaimed to the process plant to meet demand. This will reduce the quantity of effluent discharged to the environment. Conversely, during spring thaw, effluent discharge rates are expected to be higher than the yearly average rates. The concentration of contaminants in the effluent stream will also vary with flow rate and by season. Further study will be required in subsequent stages of the project to define seasonal and storm event variations.

Figure 2-2 Overall Site Water Balance



3.0 CYANIDE MANAGEMENT PLAN

Cyanide solution management is an important component of the overall water management strategy. The proposed Goliath flow sheet ensures that wildlife, including waterfowl and aquatic life, are protected, that cyanide consumption is minimized, and contingency is in place to prevent the inadvertent release of cyanide into the environment.

Two aspects will be key to the management of cyanide with respect to the water balance at Goliath.

3.1 Reduce and Re-use

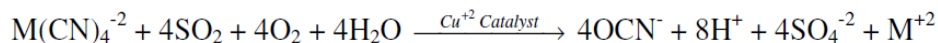
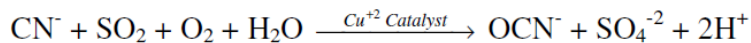
Firstly, cyanide addition will be minimized through continuous monitoring of cyanide levels in the leaching circuit. This permits optimum leaching efficiency while preventing over dosing. Over the life of the mine, operations will continually optimize cyanide addition rates to minimize cost. Secondly, a cyanide recovery thickener is included in the flow sheet prior to the cyanide destruction circuit to recover up to 40% of the cyanide. The recovered cyanide solution will be returned to the milling circuit. In addition to reducing cyanide addition, lime requirements will also be reduced. The process plant water balance, showing recovery of cyanide to the grinding circuit, is depicted in Figure 3-1.

3.2 Treatment

After a portion of the cyanide is recovered through the cyanide recovery thickener, the leached slurry is treated to destroy cyanide to levels that comply with the effluent discharge regulations (1 mg/L CN_{TOTAL}). By destroying cyanide prior to discharging the tailings to the storage facility, potential cyanide contamination situations such as dam seepage or facility overflow during extreme storm events are eliminated. By design, the cyanide treatment circuit will destroy cyanide to a level acceptable for direct discharge to the environment thereby reducing the technical and compliance requirements placed on the TSF.

The SO₂-air destruction process acting on the cyanide recovery thickener underflow has been chosen as the preferred method for cyanide destruction. The SO₂-air process is efficient at removing cyanide from slurry solutions. The cyanide recovery thickener discharge provides the most concentrated slurry stream such that reagent consumption is minimized and higher destruction efficiencies are achieved.

Free and WAD cyanides will be converted to cyanate using SO₂ and air in the presence of copper catalyst at a pH of 9. Free and weakly complexed metal cyanides are oxidized to cyanate by the following reactions:



Iron complexed cyanides will be reduced to the ferrous state and precipitated as insoluble copper-iron-cyanide complexes. Residual metals released from the WAD cyanide complexes will be precipitated

as hydroxides.

3.2.1 Cyanide Destruction Circuit

The cyanide detoxification circuit will consist of two stirred reactors with air sparging as well as copper sulphate, sodium metabisulphite (or liquid SO₂), and lime addition. Lime and ferric chloride can be added to the second reactor to maximize metals precipitation if required. The amount of copper in the feed slurry solution is expected to be approximately 25% of the concentration required for reaction catalysis and therefore copper reagent addition will be required. Piping arrangements will allow one reactor to continue reduced operation in the event that the other reactor is offline. The detoxification circuit will receive washed and thickened CIL tails and discharge treated slurry to the tailings hopper for subsequent disposal in the TSF. Movement of slurry through the detoxification circuit will be by gravity. The cyanide detoxification circuit will be designed to destroy cyanide to 1 mg/L total cyanide, which is the current MMER limit for maximum authorized monthly mean concentration. Table 3.1 presents the key preliminary design parameters of the cyanide destruction circuit depicted in Figure 3-2.

Table 3.1 Pre-Feasibility Cyanide Destruction Circuit Key Design Parameters*

| | | |
|---|------|--------------------------------------|
| Design Incoming Cyanide Concentration | 200 | CN ⁻ _{Total} |
| Slurry Feedrate | 170 | m ³ /h |
| Slurry % Solids | 50 | %wt |
| Circuit Residence Time | 2 | h |
| Cyanide Destruction Discharge pH | 9 | pH |
| Cyanide Destruction Discharge Cyanide Concentration | <1.5 | ppm CN ⁻ _{total} |
| Cu ²⁺ Target Concentration | 50 | mg/L |
| Copper Sulphate Addition | 20 | g Cu ²⁺ /t _{ore} |
| Sodium Metabisulphite Addition | 8 | kg/kg CN ⁻ |
| Lime Addition | 5 | kg/kg CN ⁻ |
| Air Sparging | 1.5 | Nm ³ /h/m ³ |

* Based on industry values and not upon testwork.

Although the cyanide destruction circuit is designed to meet MMER discharge limits at the point of discharge to the tailings storage facility, this is not a requirement and it may be possible to reduce the

reagent consumption during operation and allow for slightly higher discharge limits into the TSF (eg. 5 ppm). It is well established that cyanide naturally attenuates in tailings environments, primarily by means of volatilization of hydrogen cyanide. Once the degree of natural attenuation has been determined, it may be possible to reduce the aggressive cyanide destruction design target of 1 ppm CN_{TOTAL} discharge, particularly during open water months. The cyanide destruction circuit is conservatively designed to meet effluent regulations under a variety of operating conditions.

3.2.2 Cyanide Destruction Reagents

The following reagents will be consumed in the cyanide destruction process:

Sodium Metabisulphite (SBMS)

Sodium metabisulphite is used as the source of SO_2 required for the cyanide destruction reaction and it is purchased as a dry reagent and added to water in an agitated mixing tank. The purchase of liquid sulphur dioxide as a reagent in 1 tonne cylinders should be considered as an alternative to SBMS. It would be added into the sparged air stream.

Lime

Lime addition is required to maintain pH and neutralize the acid generated in the cyanide oxidation reaction. Lime will be slaked at the lime silo and delivered as lime slurry to the cyanide destruction circuit in a ring main.

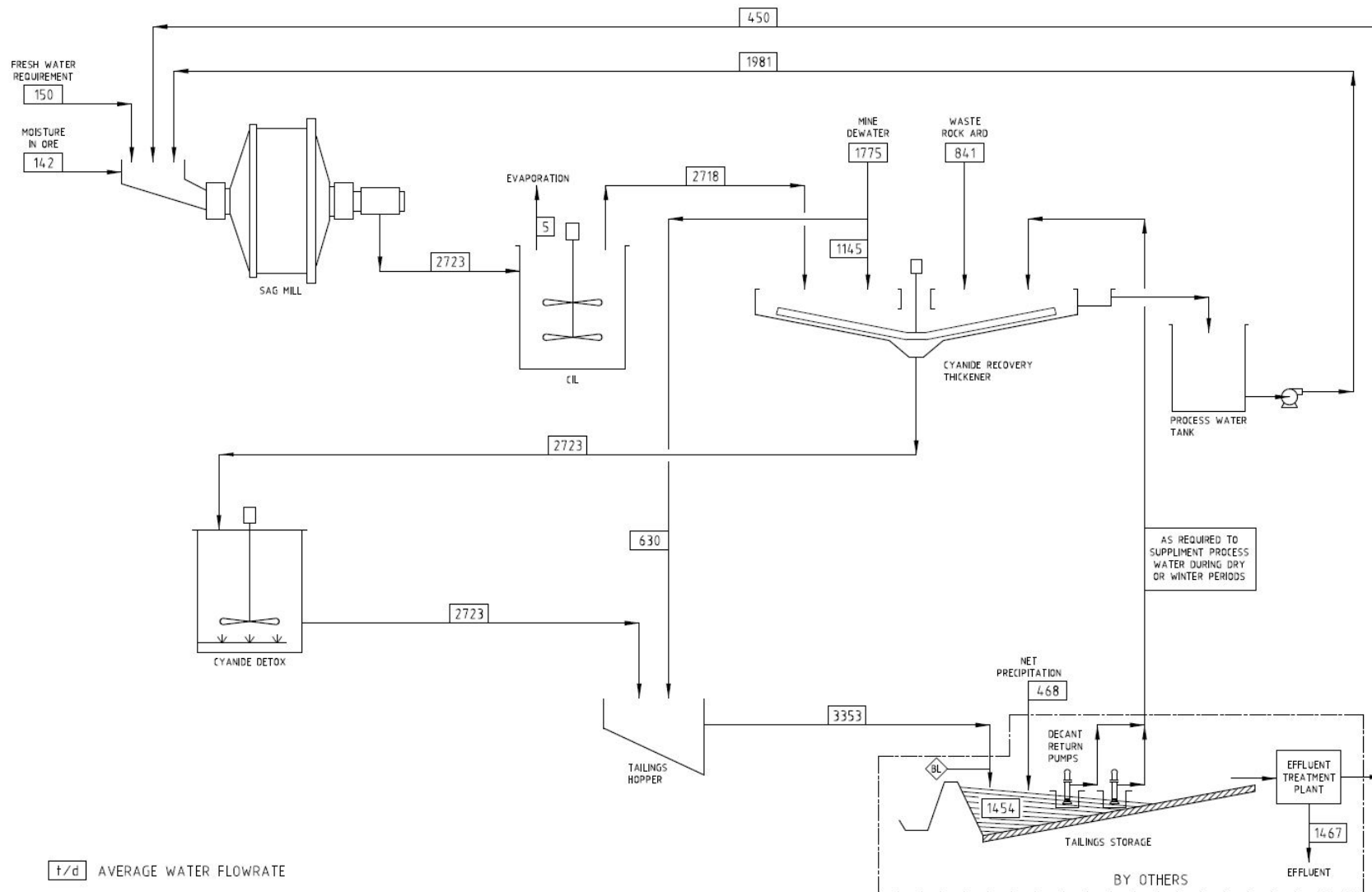
Copper Sulphate

Copper sulphate is purchased as dry granular copper sulphate pentahydrate and will be dissolved in water in an agitated mix tank for dosing to the cyanide destruction reactor(s). Copper in solution is required as a catalyst to increase the rate of reaction. Although the solution naturally contains copper in solution, additional copper will be required. Copper reagent addition will be minimized to reduce cost and prevent copper contamination of the effluent.

Ferric Chloride

Ferric chloride is purchased as ferric chloride hexahydrate which will be mixed with water in an agitated mix tank and added to the second cyanide destruction reactor if required. Ferric chloride assists in the precipitation of metals in solution such as the copper catalyst, arsenic, zinc, and others.

Figure 3-1 Process Plant Water Balance Showing Cyanide Recovery Thickener



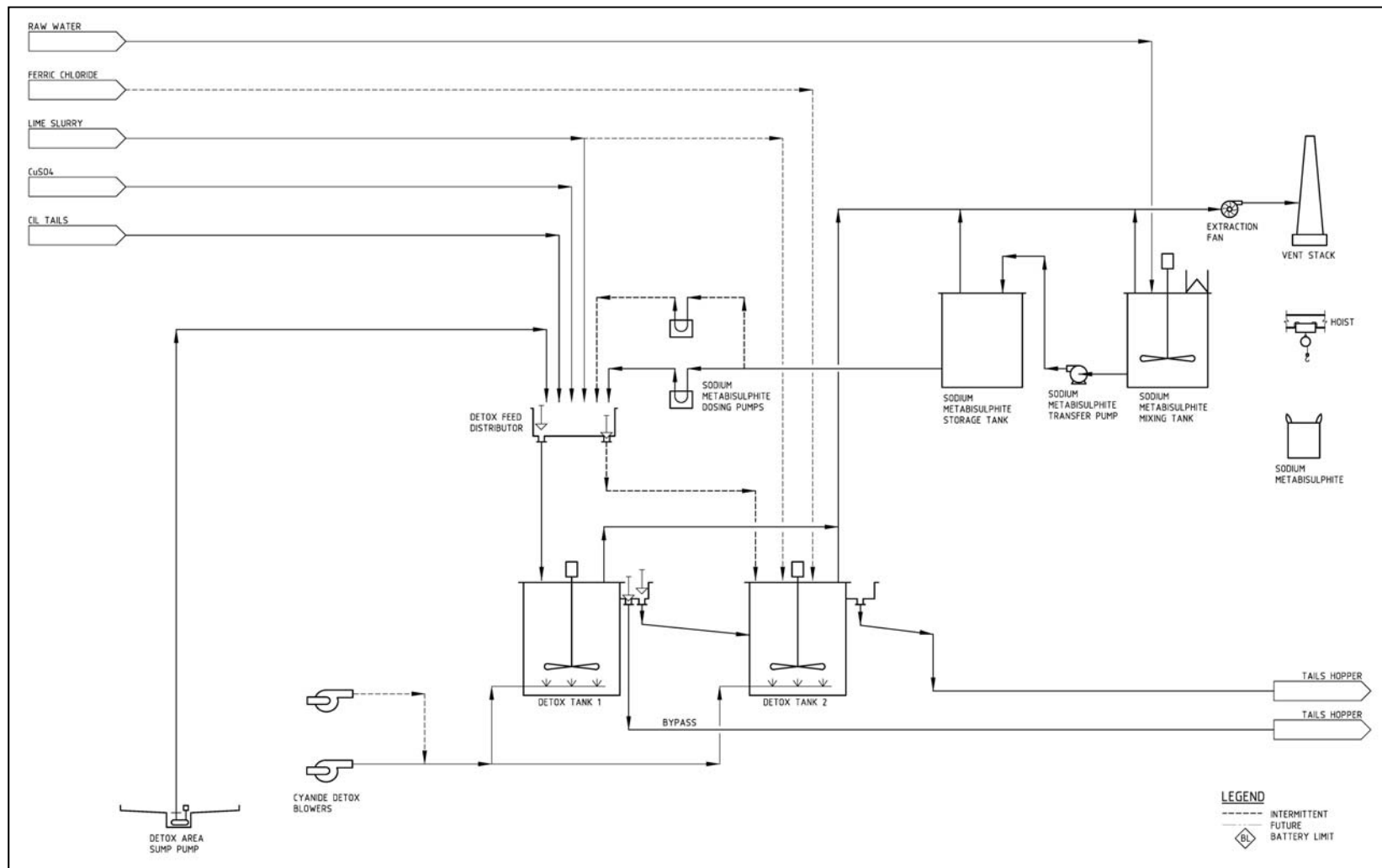


Figure 3-2 Cyanide Destruction Circuit Flowsheet

4.0 WATER TREATMENT AND DISCHARGE FACILITIES

Contaminated water requiring treatment will be generated by both the gold leaching process and the process of mine rock oxidation. Water from both sources will contain dissolved metals, and the leach solution will also contain cyanide. Water from both sources will be treated in the cyanide destruction circuit to the extent possible. During the wet season, there will be too much mine rock contact water to process through the cyanide destruction circuit, and the excess mine dewater will report directly to the tailings storage facility. The tailings storage facility will reduce the metals content of the directly reporting contact water through the processes of neutralization, precipitation, natural attenuation, and entrainment. The tailings facility will also receive direct precipitation, which will dilute the concentrations of contaminants. Precipitation falling on the beached portion of the tailings (assumed worst-case scenario) could also contribute contaminated water which will receive also receive passive treatment (natural attenuation) in the TSF. Supernatant from the tailings storage facility will be treated in the effluent treatment plant prior to discharge to the environment such that the effluent will meet or exceed PWQO guidelines.

4.1 Sources of Contaminated Water

4.1.1 Rock Contact Water

The pre-feasibility testwork program performed by G&T Metallurgical Services reported that the Goliath ore composite sample contained about 2.1% of the mass as sulphide minerals. Small amounts of calcite and other neutralizing materials were also reported. Subsequent geochemical test work performed by Ecometrix reported that the ore was potentially acid generating.

Based on the geochemistry test work, it is assumed that all runoff water from the Goliath site will potentially be acidic and contain at least trace amounts of dissolved metals. As such, all non event run-off will ultimately be discharged through the tailings facility either directly or indirectly. Embankments and diversions will be designed to limit the amount of water being exposed to the ore and thus reduce the amount of water requiring treatment. In later years of operation, waste rock will be stored in the open pit potentially allowing for capping and decommissioning of the WRSF during operations while any ARD can be treated in the processing plant. During operations, it may be possible to segregate the waste rock into non-acid generating (NAG) and PAG areas to minimize the amount of potentially contaminated water using two collection ponds. The contaminated water would report to the processing plant while the non-contaminated water would report directly to the tailings facility for removal of suspended solids. This approach could also simplify monitoring during closure.

Refer to Appendix B for site layout including rock piles and run-off collection ponds.

Open pit walls and underground workings are potential sites for ARD generation due to continuous exposure of the fresh rock faces to air and water. Rock piles, ore and waste rock, are also potential ARD generation sites due to increased exposure to oxidative conditions. Compositions for mine dewater and waste rock run-off water have been estimated by Tetra Tech based on loading rate information for contaminants of potential concern as reported in the Ecometrix Geochemical Evaluation Report. Mine water contaminants such as ammonia and other contaminants from the rock blasting

process are not included in this review. The contact water compositions have been conservatively estimated based on yearly average rainfall and maximum sizes of the WRSF, low grade ore stockpile, and open pit. Details of the estimated compositions, including assumptions, can be found in Appendix C Treasury EIS Water Quality Model.

4.1.2 Beached Tailings

In the event that tailings are deposited above the intended water cover, or the water level in the tailings storage facility drops to the point that tailings solids become exposed to air, oxidation of sulphide minerals in the solids will occur and given sufficient time ARD conditions are likely to develop. While beached tailings are not a planned occurrence, they do have a tendency to occur in late stages of the project life as sites push production beyond the original design capacity of the TSF. For the purposes of the EIS water quality estimate, beached tailings have been conservatively estimated to be 10% of the footprint of the TSF. Rain falling onto the oxidized beached tailings will become contaminated with leached metals and will directly result in increased concentrations of contaminants in the effluent.

4.1.3 Cyanide Leach Solution

In the metallurgical testwork performed by Gekko and ALS, the natural pH of ground whole ore slurry averaged ~8 pH prior to lime addition, while the gravity concentrate slurry (containing concentrated sulphides) averaged a natural pH of ~6.8 pH. Gekko performed ICP analysis on a number of leach solutions representing both the CIL conditions [0.05 %wt/v NaCN (500ppm)] and the intensive leach conditions [2 %wt/v NaCN]. These results have been compiled and adjusted average concentrations of contaminants have been determined. The predicted concentrations and testwork results are presented in Table 4.2. The free and weak acid dissociable cyanide concentration of CIL tails entering the cyanide destruction circuit is reduced significantly by the cyanide recovery thickener which recovers ~40% of the cyanide.

4.1.4 Surface Water

All existing surface drainage ways coinciding with site infrastructure will be diverted around the infrastructure to prevent potential contamination of fresh water and to minimize the quantity of water being processed through the site. Site infrastructure (ore pad, waste rock storage, and processing plant) will be located on sites that are contoured such that surface run-off can be captured independently of surrounding surface water and processed through the mill or be sent directly to the TSF if non-ARD. Any contaminated surface water will be collected in a minimum number of collection ponds and be pumped to mill via a lift station. Surface water runoff from the processing plant site is not expected to require treatment. In the future, provision could be made for containment and pumping of the contaminated surface water to the tailings storage facility using a portable pump. However, this water is not expected to be contaminated. It is envisioned that all processing plant equipment will be inside containment bunds and all containment bunds will be under cover and not collect rainfall. By design, plant site surface water will drain into the surrounding terrain and ultimately into Blackwater Creek, which will also receive the plant effluent and will therefore will be monitored and reported on an ongoing basis.

4.1.5 Sanitary Wastewater

Sanitary wastewater will be processed off-site during the construction and early operational phases of the project. On-site treatment may be pursued in later years with treated wastewater being discharged to the tailings storage facility. Sanitary water is not considered in the water quality predictions.

4.1 Goliath Cyanide Leach Solution Assays (mg/L)

| Goliath Leach Assays (Geikko Analysis) | Whole Ore Leach | Intensive Leach GRG Conc | Intensive Leach CGR Conc | Intensive Leach CGR + Float Conc | GRG Tails | Whole Ore Leach | GRG Tails | Intensive Leach GRG Conc | Average or Assumed Values for CIL at 40% wt | Average or Assumed Values for Intensive Leach | Average or Assumed Values for CIL Adjusted to 45% wt mgpl |
|--|--------------------------|--------------------------|--------------------------|----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---|---|---|
| | LGOL (01) Final Solution | LGOL (02) Final Solution | LGOL (03) Final Solution | LGOL (04) Final Solution | LGOL (05) Final Solution | LGOL (06) Final Solution | LGOL (07) Final Solution | LGOL (08) Final Solution | Average | Average | Average |
| Au | 4.28 | 81.18 | 18.02 | 11.95 | 0.82 | 1.93 | 0.51 | 75.16 | 3.105 | 58.12 | 3.81 |
| Ag | 5.25 | 47.2 | 20.7 | 18.1 | 4.33 | 5.6 | 10.9 | 45.6 | 5.425 | 37.83 | 6.66 |
| Al | 10.7 | <0.1 | 5.5 | 1.9 | 7.2 | 7 | 6 | | 8.85 | 2.8 | 10.86 |
| As | 0.1 | 0.8 | <0.1 | 0.1 | <0.1 | <1 | 2 | | 0.1 | 0.45 | 0.12 |
| B | 2 | 2 | 1 | <1 | 1 | <10 | 10 | | 2 | 1.5 | 2.45 |
| Ba | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | <1 | <1 | | 0.1 | 0.1 | 0.12 |
| Be | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <1 | <1 | | 0.1 | <0.1 | 0.12 |
| Bi | <2 | <2 | <2 | <2 | <2 | <20 | <20 | | 2 | <2 | 2.45 |
| Ca | 6 | 19 | 14 | 13 | 13 | 90 | 100 | | 48 | 16.5 | 58.90 |
| Cd | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 | <1 | <1 | | 0.1 | <0.1 | 0.12 |
| Co | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 | 1 | 1 | | 0.1 | 0.15 | 0.12 |
| Cr | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 | <1 | <1 | | 0.1 | <0.1 | 0.12 |
| Cu | 3.6 | 5.6 | 7.7 | 27.6 | 3.9 | 28 | 19 | | 15.8 | 6.65 | 19.39 |
| Fe | 6.8 | 6.6 | 42.6 | 43.7 | <0.1 | 11 | 10 | | 8.9 | 24.6 | 10.92 |
| Hg | <0.2 | 0.3 | 0.3 | 0.3 | <0.2 | <2 | <2 | | 1 | 0.3 | 1.23 |
| K | 58 | 17 | 14 | 22 | 15 | 250 | 210 | | 154 | 15.5 | 188.96 |
| Mg | 3 | 2 | 3 | <1 | 3 | 370 | 380 | | 186.5 | 2.5 | 228.83 |
| Mn | <0.1 | 0.5 | 0.8 | 0.7 | <0.1 | <1 | <1 | | 0.5 | 0.65 | 0.61 |
| Mo | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 1 | 1 | | 0.1 | <0.1 | 0.12 |
| Na | 340 | 8370 | 7940 | 7960 | 351 | 720 | 760 | | 530 | 8155 | 650.31 |
| Ni | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 2 | <1 | | 0.1 | <0.1 | 0.12 |
| P | <5 | <5 | <5 | <5 | <5 | <50 | <50 | | 4 | <5 | 4.91 |
| Pb | 0.2 | 14.4 | 8.4 | 0.4 | 0.3 | 5 | 5 | | 2.6 | 11.4 | 3.19 |
| S | 77 | 91 | 148 | 96 | 43 | 50 | 50 | | 63.5 | 119.5 | 77.91 |
| Sb | 1.4 | <0.4 | 4 | 6.4 | 1.1 | <4 | <4 | | 2 | 2.2 | 2.45 |
| Si | 25 | 5 | <1 | <1 | 27 | 380 | 390 | | 202.5 | 3 | 248.47 |
| Sn | <1 | <1 | <1 | <1 | <1 | <10 | <10 | | 1 | <1 | 1.23 |
| Sr | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | <1 | <1 | | 0.1 | <0.1 | 0.12 |
| Ti | 0.3 | 0.1 | 0.3 | 0.1 | 0.2 | <1 | <1 | | 0.1 | 0.2 | 0.12 |
| Tl | <1 | <1 | <1 | <1 | <1 | <10 | <10 | | 0.5 | <1 | 0.61 |
| U | <2 | <2 | <2 | <2 | <2 | <20 | <20 | | 1.5 | <2 | 1.84 |
| V | 0.1 | 0.1 | <0.1 | <0.1 | 0.1 | <1 | <1 | | 0.1 | 0.1 | 0.12 |
| W | <5 | <5 | <5 | <5 | <5 | <50 | <50 | | 4 | <5 | 4.91 |
| Zn | 4.5 | 3.4 | 7.6 | 17.6 | 9.5 | 10 | 14 | | 7.25 | 5.5 | 8.90 |
| Zr | <1 | <1 | <1 | <1 | <1 | <10 | <10 | | 0.5 | <1 | 0.61 |

4.2 Water Treatment

Contaminated water from the various sources will ultimately be treated within the process or by the effluent treatment plant. Contact water from the rock piles and pit and underground dewatering will report to the tailings storage facility either directly or indirectly. The amount reporting to the process plant as make-up water will always be maximised. The gold plant requires a continuous supply of process water to replace solution discharged in the tailings. This water will be supplied first by mine dewatering and waste rock storage facility (WRSF) run-off water, secondly by tailings pond reclaim, and lastly by fresh water if required. The contact water will be added directly to the cyanide recovery thickener where the neutralization reaction product precipitates can settle with the tailings solids. During winter months, WRSF runoff will be minimal and the pit dewatering flow may be reduced. Tailings storage facility supernatant reclaim will be required for process make-up water during the winter months. The tailings storage facility supernatant will be pumped from a barge using vertical turbine pumps. The barge will be equipped to maintain open water surrounding the immediate vicinity of the barge during the winter months.

By utilizing contact water to meet water make-up requirements in the process plant, water treatment can be affected through no additional measures. The proposed CIL circuit will be operated at a pH of ~10 and the cyanide destruction circuit will be operated at a pH of 9, resulting in a tailings discharge to the TSF at pH ~9. During wet months, it will not be possible to process all of the contact water through the plant. During these times, excess contact water will report directly to the tailings facility for treatment.

Both contact water and gold leaching slurry will be processed through the cyanide destruction circuit. In addition to destroying cyanide, the cyanide destruction process also precipitates metals from solution, routinely achieving ≥98% removal. The cyanide destruction process generates cyanate as a product, which is much less toxic than cyanide and does not remain in the environment for long periods of time. Cyanate oxidizes to ammonia and then ammonia removal proceeds through the biological nitrification process.

Ammonia will enter the water from two sources. Ammonia is a product of the breakdown of cyanide arising from the hydrolysis of cyanate. This hydrolysis of cyanate will take place in both the cyanide destruction circuit and in the tailings storage facility. Ammonia could also report to the tailings facility through mine dewatering as a result of unreacted ammonium nitrate used in blasting. Ammonia oxidizes to form nitrate NO_3^- which is a relatively non-toxic compound. Nitrate is, however, a biological nutrient which in some cases can lead to abnormal algae growth in waters which in turn reduces the dissolved oxygen presenting a potential hazard to fish.

Subsequent to cyanide destruction, the treated slurry (containing treated contact water and gold leach solution) will report to the tailings storage facility. Excess contact water that cannot be processed by the cyanide destruction circuit will also report directly to the TSF.

The Goliath tailings storage facility will be an above grade impoundment with dams constructed around the full perimeter. The tailings facility will be constructed with a suitable low permeability liner (e.g. clay) where required, and any dam seepage being returned to the impoundment. All of the potentially

contaminated site water will ultimately pass through the tailings facility.

The tailings are classified as potentially acid generating and as such will be deposited subaqueous to prevent oxidation. A water cover of at least 1.2m will be maintained. The tailings storage facility is expected to be 76 hectares in area and the dams are expected to be constructed in at least two phases with an initial construction and subsequent dam raise.

While beached tailings are not a planned occurrence, they do have a tendency to occur in late stages of the project life at mine sites that push production beyond the original design capacity of the TSF. Predicted long term post operation effluent concentrations (if 10% beached tailings are left exposed and ARD conditions are reached) indicate that lead (Pb) will exceed MMER requirements (TetraTech, 2014).

By design, cyanide will be contained within the processing plant and will be prevented from entering the tailings storage facility in any appreciable quantity. This will ensure that wildlife cannot access cyanide containing solutions. Furthermore, unforeseen storm events will cause the release of cyanide to the environment in the event of TSF overflow. The tailings facility will not be fenced as it is not expected to contain water that would be harmful to wildlife coming in contact.

During winter months the tailings storage facility will be under ice cover, a portion of tailings supernatant will be returned to the process plant, and there will be no dilution as result of precipitation. Under these conditions, the water balance may be such that the tailings facility will not discharge decant.

During the commissioning and initial production period, the tailings storage facility will not discharge effluent. This will allow for optimization of the process with respect to cyanide addition, cyanide destruction circuit operation, and effluent treatment plant operation without immediate concern for effluent water quality.

The tailings storage facility will provide natural attenuation of dissolved metals, cyanide, and cyanide breakdown by products. The extent of this attenuation has been assumed to be zero for the purposes of determining the predicted effluent composition. Tailings attenuation test work has not been performed using Goliath material.

4.2.1 Effluent Treatment Plant

Tailings storage facility decant will be pumped to the effluent treatment plant for treatment prior to discharge to the raw water reservoir and ultimately Blackwater Creek.

In the effluent treatment plant, tailings pond decant water will be treated in three distinct process steps including an advanced oxidation process for residual cyanide destruction, multimedia filtration, and reverse osmosis membrane filtration.

TSF decant water will be pumped from a transfer tank to a three chamber multimedia filtration system, operating in parallel, via three multimedia filter feed pumps. The transfer tank may also be used to

capture any out-of-compliance reverse osmosis permeate water which can be diverted from discharge. In addition, this tank could be utilised as a temporary short term storage volume for the diversion of reverse osmosis reject water in order to continue operation of the reverse osmosis system while other areas of the facility are shut-down for routine repair or maintenance. Both sulphuric acid and sodium bisulphite will be dosed into the water stream prior to the multimedia filtration step. Sulphuric acid will be used to lower pH and sodium bisulphite is required to consume any excess oxidant. A polymer or coagulant addition will also be included as a flocculation agent. In the intermediate step of the treatment process, particle filtration will include depth filtration down to a nominal 1.0 micron range. Filtration media will consist of a combination of anthracite, silica sand, and garnet.

In the next step, filtrate from the multimedia filter will be dosed with sulphuric acid, if required for pH adjustment, as well as an anti-scalant to protect the following Reverse Osmosis membranes and reduce the requirement frequency for clean-in-place of the membranes. As a safety precaution, filtrate will be passed through cartridge filters prior to the reverse osmosis system to remove any residual solids and prevent membrane damage.

The resulting impact of these pre-treatment steps is to enable the RO to operate at recoveries as high as 90 percent. Scaling calculations will indicate the upper limits on recovery and efficiency. High pressure pumps will then boost the pressure of the feed water to the reverse osmosis system from a minimum of 25 psig up to 250 psig. This feed pressure overcomes the natural osmotic pressure allowing for the rejection to waste of greater than 98% of all contaminants including: in-organics, organics [greater than 200 NMWL], bacteria and suspended solids as small as 0.003 microns depending upon their shape and strength. The pre-treated feed water will be split into three streams: product, reject and recycle. The recycle stream enables higher recovery by reducing the effects of concentration polarization and creating better cross flow to reduce system cleaning frequency. Depending on testwork results, multiple pass reverse osmosis may be required.

Reverse Osmosis permeate is stored in the permeate storage tank, from where it is returned to the process or discharged to the environment via the raw water reservoir. If permeate quality is out of specification it can be diverted to the transfer tank for retreatment. The Reverse Osmosis reject will report to the residual cyanide destruction process tanks. Hydrogen peroxide (oxidant) and copper sulphate (catalyst) will be dosed in-line prior to a static mixer. Dosed wastewater will flow by cascading gravity sequentially through the cyanide destruct reactors, where cyanide will be eliminated and complexed dissolved heavy metals will be precipitated. The treated reject stream will then return to the TSF.

The effluent treatment plant will ensure that water discharged meets (or exceeds) the provincial water quality objectives.

4.3 Effluent Requirements

Effluent discharged from the Goliath project will need to comply with the Metal Mine Effluent Regulations, and the Provincial Water Quality Objectives. The following excerpt was taken from the Metal Mining Effluent Regulations SOR/2002-22:

Table 4.2 MMER Regulations

SCHEDULE 4
(Section 3, paragraph 4(1)(a), subsections 12(1) and (3), section 13, subsections 15(1), 19.1(1) and 20(1), paragraphs 21(2)(b) and (f), 24(1)(a) and 34(1)(b), subsection 34(3), paragraphs 34(4)(a) and (5)(a) and (b), 35(2)(b), 36(d) and 37(1)(a) and Schedules 5 and 7)

AUTHORIZED LIMITS OF DELETERIOUS SUBSTANCES

| | Column 1 | Column 2 | Column 3 | Column 4 |
|------|------------------------|---|--|---|
| Item | Deleterious Substance | Maximum Authorized Monthly Mean Concentration | Maximum Authorized Concentration in a Composite Sample | Maximum Authorized Concentration in a Grab Sample |
| 1. | Arsenic | 0.50 mg/L | 0.75 mg/L | 1.00 mg/L |
| 2. | Copper | 0.30 mg/L | 0.45 mg/L | 0.60 mg/L |
| 3. | Cyanide | 1.00 mg/L | 1.50 mg/L | 2.00 mg/L |
| 4. | Lead | 0.20 mg/L | 0.30 mg/L | 0.40 mg/L |
| 5. | Nickel | 0.50 mg/L | 0.75 mg/L | 1.00 mg/L |
| 6. | Zinc | 0.50 mg/L | 0.75 mg/L | 1.00 mg/L |
| 7. | Total Suspended Solids | 15.00 mg/L | 22.50 mg/L | 30.00 mg/L |
| 8. | Radium 226 | 0.37 Bq/L | 0.74 Bq/L | 1.11 Bq/L |

NOTE: All concentrations are total values.

SOR/2006-239, s. 25.

The solution contained in the TSF is predicted to comply with the MMER.

Due to the minimal assimilative capacity of Blackwater Creek, all effluent discharged from the Goliath site will be required to meet the PWQO at the point of discharge prior to diffusion. The proposed effluent treatment plant will ensure that the effluent meets stringent Provincial Water Quality Objectives.

4.4 Predicted Tailings Storage Facility Solution Chemistry

Using a PHREEQCI model, Tetra Tech has predicted preliminary and conservative concentrations for contaminants in the TSF solution (TetraTech, 2014). The model is based on the previously discussed yearly average water balance and geochemical test work performed by Ecometrix. Neither cyanide destruction nor tailings attenuation test work have been performed to date and therefore assumptions have been made based on industry standards. A complete list of assumptions made and predicted concentrations are included in the Tetra Tech report included in Appendix C.

The predicted TSF concentrations are based on the intermediate contaminate loading rates reported in the field cell - total metals test work. These are the most representative of the worst-case TSF concentrations. These concentrations, along with corresponding MMER and PWQO guidelines, are presented in Table 4.3 Predicted Tailings Storage Facility Supernatant Concentrations Based on Preliminary Data and Worst Case Assumptions.

4.5 Predicted Effluent Chemistry

All effluent discharged from the Goliath project will be treated by the effluent treatment plant and will meet or exceed the PWQO.

Table 4.3 Predicted Tailings Storage Facility Supernatant Concentrations Based on Preliminary Data and Worst Case Assumptions

| Parameter | Predicted Tailings Supernatant (mgpl) | MMER Max Monthly Mean (mgpl) |
|--|--|-------------------------------------|
| Average Solution Hourly Flow m ³ /h | 61.1 | |
| Aluminum | 0.199 | |
| Ammonia (as N) | 6* | |
| Antimony | 0.002 | |
| Arsenic | 0.018 | 0.50 |
| Barium | 0.012 | |
| Beryllium | 0.0005 | |
| Bismuth | 0.0005 | |
| Boron | 0.02 | |
| Cadmium | 0.002 | |
| Calcium | 7.15 | |
| Carbonate | 15.88 | |
| Chromium | 0.001 | |
| Chloride | 0.78 | |
| Cobalt | 0.004 | |
| Copper | 0.018 | 0.30 |
| Cyanide _{TOTAL} | 0.04 | 1.00 |
| Iron | 0.358 | |
| Lead | 0.082 | 0.20 |
| Lithium | 0.024 | |
| Magnesium | 1.44 | |
| Manganese | 0.063 | |
| Mercury | 0.0018 | |
| Molybdenum | 0.001 | |
| Nickel | 0.021 | 0.50 |
| Nitrate(as N) | 7.07 | |
| pH | 6.16 | |
| Phosphorus | 0.06 | |
| Potassium | 1.78 | |
| Selenium | 0.0005 | |
| Silicon | 0.099 | |
| Silver | 0.00005 | |
| Sodium | 1.16 | |
| Strontium | 0.032 | |
| Sulphates | 68.67 | |
| Sulphur | 22.94 | |
| Thallium | 0.642 | |
| Tin | 0.0005 | |
| Titanium | 0.003 | |
| Uranium | 0.005 | |
| Vanadium | 0.004 | |
| Zinc | 0.04 | 0.50 |

5.0 COST ESTIMATE OF ALTERNATIVE DISCHARGE POINTS

5.1 Effluent discharge Routing options

Routing to five final effluent receivers was considered:

- Direct Discharge into Blackwater Creek Tributary #2 just south of Normans road and East of Tree Nursery Road (total length 1.4 km)
- Direct Discharge into the Tree Nursery Ponds (total length 2.4 km)
- Direct Discharge into Wabigoon lake in the Keplyn's Bay area (total length 6.5 km)
- Direct Discharge into Thunder Lake (total length 4.9 km)
- Direct Discharge into Hartman Lake (total length 14.4 km)

The proposed Routing for the five options is provided in Appendix A.

The table below summarises the main technical parameters for each effluent discharge option.

Table 5.1 Summary Of Technical Parameters

| No | Description | Tree Nursery Pond | Thunder Lake | Blackwater Creek | Wabigoon Lake | Hartman Lake |
|----|-------------------------------|-------------------|--------------|------------------|---------------|--------------|
| 1 | Length of Pipes (m) | 2400 | 4920 | 1440 | 6480 | 14400 |
| 2 | Submersible Pumps | 2 | 2 | 2 | 2 | 2 |
| 3 | Pipe Dia (Inches) | 8 | 8 | 8 | 8 | 6 |
| 4 | Butterfly Valves | 6 | 10 | 8 | 12 | 20 |
| 5 | Creek Crossings | 0 | 1 | 0 | 4 | 3 |
| 6 | Road Crossings | 3 | 2 | 2 | 4 | 4 |
| 7 | Trans Canada Highway Crossing | 0 | 0 | 0 | 1 | 0 |
| 8 | Railway Crossing | 0 | 0 | 0 | 1 | 0 |
| 9 | Length of Access Rd (m) | 0 | 4000 | 0 | 5200 | 11500 |
| 10 | Outfall Structure / Diffuser | 1 | 1 | 1 | 1 | 1 |
| 11 | Automatic Sampling Devices | 2 | 2 | 2 | 2 | 2 |
| 12 | Weir / Flow Meter Device | 2 | 2 | 2 | 2 | 2 |

5.2 Pipelines, Pumping, and Crossings Details

Effluent water will be pumped to the selected location in Blackwater Creek via a pipeline. The quantity of effluent used for pipeline sizing is based on the 1981 – 2010 Environment Canada station 6032117 highest monthly precipitation (July) of 127.6 mm. This amount of precipitation was applied to the catchment area of the tailings storage facility, mine rock piles, and open pit. No evaporation was considered, and a suitable flow rate of effluent was determined to be 158 m³/hr; to which a 20% equipment design margin was applied. The 20% equipment design margin also accounts for net precipitation in the raw water reservoir. Additional effluent capacity requirements are assumed to be held in inventory in the tailings storage facility freeboard for subsequent discharge at the design flow rate.

All discharge systems will be designed for 190 m³/h flow rate with varying TDH. Discharge point elevations have been obtained through Google maps and may not be entirely accurate. The contour elevations of the routes are not available, so the topography is assumed to be relatively flat. Taking the linear distance into consideration, it is assumed that all discharge systems will require pumping. Hartman Lake, the longest discharge system, will have a TDH of 42 m. This will require a heavy duty submersible pump. The remainder of the systems have a TDH of 20-25 m and will require regular duty submersible pumps.

Each of the final effluent discharge options will include appropriate discharge infrastructure namely an outfall for discharge to Blackwater Creek, and a diffuser for each of the underwater lake discharge destinations. Each pipeline alternative will be equipped with flow meter, where applicable, or weir type measurement system to provide quantitative effluent measurement on a daily or continuous basis.

The effluent discharge pipeline material of construction will be HDPE with appropriate drain valves and vacuum breakers to accommodate the terrain. The pipeline will not be insulated, however, the low point drain valves will be protected from freezing. It is recognized that the draining media is polished water suitable for direct discharge into the environment in the event of an emergency. Two butterfly valves will be located at each drain point. The valves will be supported by concrete sleepers. The HDPE pipeline will be laid on the ground and does not require additional supports.

Pipeline lengths are based on linear routing distances from the raw water reservoir to the respective discharge point as shown on the layout in Appendix A. A 10% allowance in length has been added for “snaking” HDPE pipe for cold weather contraction plus a 10% contingency for a total of an additional 20% design factor. Pipe size is NPS 8 for each of the destinations. The HDPE pipe will be butt fused throughout the entire length of each system.

An access corridor will be constructed along the pipeline as required for laying and maintenance of the pipeline. A maintenance road will run alongside the pipeline route. The road will be four meters wide to accommodate single light vehicle access. The pipeline will be above ground and leak detection will be by visual inspection. Yearly snowfall averaged 1.38m at the 6032117 weather station. The pipeline will be laid on grade and the possibility of detecting a leak will be reduced during winter months.

At road crossings, the effluent pipeline will be installed in 12” CSP culverts to allow for the maintenance

of the pipeline.

At creek and stream crossings, the pipeline will be installed in 12” carbon steel pipes or will be laid alongside the access/ maintenance road. Horizontal directional drilling (HDD) will be used for the Trans Canada Highway and Railway crossings.

5.3 Capital Cost Estimate Summary

Detailed Capital Cost Estimates for the five effluent discharge options are summarized in Table 5.2.

Table 5.2: Capital Cost Summary for Effluent Discharge Options (±35% CAD\$)

| Description | Blackwater Creek(\$1000s) | Wabigoon Lake(\$1000s) | Tree Nursery Ponds (\$1000s) | Thunder Lake(\$1000s) | Hartman Lake(\$1000s) |
|--------------------------------------|---------------------------|------------------------|------------------------------|-----------------------|-----------------------|
| Pipe Lines | 72 | 324 | 120 | 246 | 900 |
| Pumps | 55 | 55 | 55 | 55 | 385 |
| Maintenance Access Roads | 0 | 234 | 0 | 180 | 517 |
| Outfall / Diffuser | 20 | 30 | 16 | 30 | 30 |
| Miscellaneous (Creek/Road Crossings) | 38 | 348 | 52 | 73 | 139 |
| Effluent Treatment Plant | 2,500 | - | 2,500 | - | - |
| Total Cost | 2,685 | 991 | 2,743 | 584 | 1,971 |

6.0 CLOSURE WATER BALANCE

Progressive reclamation will commence as soon as mine components such as the WRSA are no longer required. Final closure of the Goliath Project site will commence during the final months of operation.

Following completion of open pit mining, the pit will be allowed to fill to a designed level. During the flooding period, water accumulating in the pit will not be treated. Treated effluent discharge may be directed into the open pit to increase the rate of flooding as required to maintain water quality in the pit and increase the rate of flooding. It is expected to take approximately two years to flood the open pit. Once the mine dewatering has ceased to allow flooding, the process plant will be able to maintain operation by utilizing TSF decant return, as would be used during normal winter operations. When the open pit has been flooded to the designed level, dewatering will once again take place to maintain the water level and prevent overtopping of potentially contaminated water. Dewatering will consist of pumping excess water to the process plant and TSF for treatment and subsequent discharge to Blackwater Creek as per the operating treated effluent discharge route. This process will continue until the pit water quality has stabilized and no longer presents a source of contaminants. The period of stabilization is expected to be less than 5 years. Once the open pit water is determined to have stabilized and it no longer presents environmental risk, the pit dewatering for level control and subsequent water treatment will cease and the pit will be allowed to flood to ground water level for the post closure phase.

When the low-grade ore stockpile has been completely processed and reclaimed, plant operations will cease and closure of the TSF will commence. During the ramp down period of mill operation, the tailings storage facility will be gradually dewatered by increasing the rate of decant withdrawal such that the water cover is removed and the tailings are further consolidated. If the open pit water quality has stabilized and treatment is not required, the rate of decant reclaim to the process plant could be increased to compensate for the lack of mine water and the full capacity of the effluent treatment plant would be available to process TSF decant water. Given progressive reclamation of the site, there will be sufficient water treatment capacity to allow for timely dewatering of the TSF without exceeding effluent quality requirements. Strategically placed dewatering wells or wick drains (prefabricated vertical drains) may also be utilised to further reduce the tailings water content and improve consolidation of the tailings as required. When the TSF has been sufficiently dewatered, it will be capped with an engineered cover sufficient to prevent unacceptable water infiltration and oxidation of the tailings. The effluent treatment plant will be decommissioned once the WRSF, open pit, and TSF have stabilized on no longer present potential for contamination of the environment.

7.0 EVALUATION OF ALTERNATIVES FOR COMPONENTS OF THE WATER MANAGEMENT STRATEGY

Alternative methods were identified and evaluated for the following aspects of the Goliath water management strategy:

-
- Mine water management;
 - Fresh water supply;
 - Site water management;
 - Process plant discharge treatment and recycling;
 - Sanitary waste;
 - Effluent receivers.

The alternative methods were assessed by Lycopodium based on the following equally weighted performance objectives:

- Economics – ability to provide acceptable capital, operating, and closure expenses that will allow the project to be competitive, and to provide acceptable financial risk;
- Technical applicability and demonstrated capability – the technology or method has been proven in similar applications;
- General environmental effects – the method will allow for uncomplicated compliance with environmental regulations, will minimize risk and environmental impacts. Impacts include overall footprint, unsightliness, air quality, noise emissions, effluent quality, minimization of solids waste requiring landfill, and minimization of impact to wildlife, etc. Additional evaluation of alternative methods will be required by the project with respect to environmental impacts which are outside of Lycopodium's normal practice;
- Suitability of the method to the project's objectives – the method aligns with the other preferred methods selected for the project in terms of reagent availability, equipment availability, technical risk, chemical compatibility, etc, and aligns with the ore body and metallurgy of the deposit.

The methods considered were scored against each these objectives using a scale of 1 to 4.

| Score | Definition |
|-------|--|
| 1 | Does not meet objective |
| 2 | Somewhat meets objective but not easily - not a preferred method for meeting the objective |
| 3 | Meets objective sufficiently to be considered an acceptable method but a better method has been identified |
| 4 | The preferred method for achieving the objective |

The scoring results of each of the alternative methods considered are presented at the end of this section in Table 7.2 Scoring of Alternative Methods.

7.1 Methods of Mine Water Management

Mine water encompasses contact water associated with the open pit, underground, waste rock pile, and low grade ore pile. This water is collected in three ponds for transfer to the processing plant: one mine water pond, one low-grade ore stockpile pond, and one main waste rock pond. Depending on layout and surface grading, multiple collection ponds or ditches may be required around the waste rock pile. All of the secondary waste rock contact water collection ponds and ditches would report to the main waste rock pond for transfer to the processing plant.

The mine water ponds would be installed in the early portion of the construction phase, prior to mine development to allow for mine dewatering activities. During the mine development stage, mine water would report to the tailings storage facility, which would have sufficient capacity to hold all of the mine water received until the processing plant was operational - at which point the water would be reclaimed for treatment if required. By storing the mine water in the TSF during construction, a water cover suitable to prevent oxidation of the tailings can be established prior to plant operation.

Following successful closure of the mining operations and waste rock pile, the collection ponds would be decommissioned and remediated.

7.1.1 Direct Discharge to Environment

As a portion of the mine rock is classified as potentially acid generating, contacted mine water must be treated prior to discharge. Direct discharge is not a viable method during the construction and operational phases of the project.

7.1.2 Dedicated Treatment Plant

A dedicated mine water treatment plant could be built to treat only the mine water. This plant would consist of agitated reaction tanks where lime and possibly other chemicals would be added to precipitate metals from solution and sedimentation or filtration techniques would be used to remove solids. Effluent water would then be discharged directly to the environment.

Because of the nature of the main processing plant, namely the high operating pH resulting from lime addition and the ability of the tailings storage facility to remove solids, a dedicated treatment plant is unnecessary and provides no apparent benefit to the project.

7.1.3 Integrated Treatment of Mine Water

By utilizing contacted mine water to meet process water requirements in the plant, treatment can be affected through no additional measures. The proposed CIL circuit will be operated at a pH of ~10 and the cyanide destruction circuit will be operated at a pH of 9. The processing circuit will be capable of neutralizing any contact water and ARD and precipitate metals from solution in addition to destroying cyanide. During wet periods, it will not be possible to process all of the contact water through the plant. During these periods, excess mine water will report directly to the tailings facility via the tailings pipeline. During operation of the plant, the tailings storage facility is expected to operate with an alkaline pH of ~9 and natural attenuation will reduce the metals concentrations. During periods of low precipitation, the tailings supernatant will be reclaimed to the process plant providing additional treatment for any contact water that was diverted directly to the TSF.

The integrated treatment of mine water is the preferred method of mine water treatment in terms of each of the performance objectives.

7.2 Methods of Fresh Water Supply

The processing plant will consume an estimated average 600 m³/d of fresh water during operation. This fresh water will be used for makeup of select reagents, various spray nozzles, carbon elution, plant wash down and cleanup, and potable water. Potable water will be produced to provincial standards by clarifying, removing harmful constituents, and disinfecting the raw fresh water as required by the source.

During construction activities, the fresh water supply requirement is expected to be similar to or less during operations depending on the stage of construction. During closure, fresh water consumption will taper to nil. During the start-up of the plant an initial first fill quantity of water will be required, however, this water does not need to be fresh water and as such will be supplied by the mine dewatering activities and taken from the contact water sediment ponds as required. The only fresh water required at plant start-up is the first fill of the raw water tank (includes firewater), potable water tank, and select reagent tanks. This demand is insufficient to warrant additional consideration.

The following alternative water taking sources were considered: nearby creeks, groundwater, nearby lakes and ponds. The ability of the source to supply uninterrupted water sufficient to meet the project requirements is critical. Scoring of the sources of fresh water is presented in Table 7.2 Scoring of Alternative Methods.

7.2.1 Nearby Creeks

Based on spot flow gauging of creeks within the project area (AMEC, 2014) including Blackwater Creek, Hughes Creek, Little Creek, Thunder Lake Tributary #3 and #2, and Hoffstrom's Bay Tributary, insufficient water flow is available throughout the year in most of these creeks to support the plant's fresh water requirements. The results of the flow gauging studies conducted are presented in Table 7.1 Minimum Gauged Flows and Corresponding Maximum Allowable Water Take of Creeks Near the Goliath Project, along with the maximum allowable water take, which is calculated as 10% of the flow of the creek. Sourcing from multiple creeks is also impractical; particularly since all creeks have reduced flow rate during the same time periods.

Table 7.1 Minimum Gauged Flows and Corresponding Maximum Allowable Water Take of Creeks Near the Goliath Project

| | TL1a Blackwater Creek | JCTa Blackwater Creek | HS3 Blackwater Creek | HS6 Little Creek | HS4 Thunder Lake Trib. #3 | HS5 Hoffstrom's Bay Trib. | HS7 Thunder Lake Trib. #2 |
|--|-----------------------------|-----------------------------|----------------------------|------------------------|---------------------------------|---------------------------------|------------------------------------|
| Minimum Measured 2012 Flow (m ³ /s) | 0.0001 | | 0.0027 | 0.0092 | 0.0131 | 0.0004 | 0.0197 |
| Minimum Measured 2013 Flow (m ³ /s) | .00096 | 0.0016 | 0.0020 | 0.0001 | 0.0265 | 0.0000 | 0.0152 |
| Minimum Measured Flow (m ³ /d) | 8.6 | 138.2 | 172.8 | 8.6 | 2290 | 0 | 1313 |
| Maximum Water Take @ 10% (m ³ /d) | 0.86 | 13.8 | 17.3 | .86 | 229 | 0 | 131.3 |

There are two ponds on the proposed project site, referred to as the tree nursery ponds. These dug ponds were used for irrigation during the historical operation of a tree nursery. These ponds are situated on the creek referred to as Thunder Lake Tributary 3 in the hydrology report (AMEC, 2014). This creek was gauged and the results reported for measurements taken during 2013 indicate sufficient flow to meet the process plant requirements. To meet the processing plant requirements, taking 26% of the flow of Thunder Lake Tributary #3 would be required. If the appropriate permits can be obtained, the tree nursery ponds are the preferred fresh water source.

7.2.2 Groundwater

Per the project hydrology report (AMEC, 2014), groundwater levels measured were consistently within 7m of ground surface and on average within 3m of ground surface. Groundwater level fluctuations were typically on the order of 1 to 2 m.

Each of the nine ground water stations was sampled six times for water quality with assaying including major ions and anions as well as dissolved metals. All of the ground water monitoring stations produced water suitable for fresh water consumption. With respect to drinking water, some manganese and iron assays were above provincial standards, however, these elements would be removed during the potable water treatment process.

The ability of wells to supply freshwater has yet to be assessed. However, as the total seepage into the proposed open pit and underground mine workings is predicted to be only 1,320 m³/d, the production of water by a reasonable number of ground wells is assumed to be inadequate. Work completed to date suggests that the overburden characteristics north of the former tree nursery may yield wells with sufficient capacity, however, this is yet to be determined.

Because of the technical uncertainty of capacity, groundwater supply is not considered viable at this time.

7.2.3 Nearby Lakes

The three significantly sized bodies of water closest to the proposed Goliath plant site in order of distance are: Thunder Lake (approx 4.9 km), Wabigoon Lake (approx 6.5 km), and Hartman Lake (approx 14.4km). These distances are estimated pipeline lengths, as opposed to straight-line distances. Each of these lakes is of sufficient capacity to supply the fresh water demands of the project, and the most desirable source is the one with the shortest pipeline, and hence lowest cost – Thunder Lake. However, the cost of building a pipeline to Thunder Lake discounts this option relative to the tree nursery ponds. The tree nursery ponds are the preferred source of fresh water, with Thunder Lake being the second preferred source.

7.3 Methods of Managing Cyanide Containing Process Effluent

Cyanide will be used to leach gold and silver from the Goliath ore. This is one of the standard processes used worldwide for the production of gold. Other processes include flotation and gravity separation. The processing option study conducted by Lycopodium, and reported separately, has selected Carbon-In-Leach (CIL) as the preferred method for the recovery of gold and silver for the Goliath project.

In the CIL process, cyanide is added ground ore slurry (approximately 45% solids) to leach gold and silver. In addition to gold and silver, other metals are also leached. The leached metals, including gold and silver, are removed from the slurry by activated carbon.

The resulting leach residue contains the now barren ore along with solution containing free cyanide and cyanide complexed with metals at an alkaline pH. This cyanide containing process waste stream must be treated appropriately.

The primary objectives of effective cyanide management at the Goliath project are:

- The protection of wildlife including waterfowl and aquatic life
- Minimal cyanide and reagent consumption, and therefore cost
- Minimal risk

All of the methods considered for managing the cyanide containing CIL waste stream include a cyanide recovery process to allow the reuse of cyanide and reduction of discharge cyanide concentrations.

Alternative methods considered for the treatment of the leach waste stream include:

- Wash the leach tails slurry through CCD (Counter Current Decantation) thickeners to reduce the cyanide concentration below 50 ppm and discharge it to the tailings storage facility for natural degradation of remaining cyanide and removal of metals. A cyanide concentration of 50 ppm cyanide is the maximum permissible for tailings storage under the International Cyanide Management Code. Washing the stream through the CCD thickeners recovers a portion of the cyanide back to the process.
- Wash the leach tails slurry through cyanide recovery thickener(s) to recover a portion of the cyanide and destroy the remaining cyanide in the plant prior to discharge of the stream to the tailings facility. Metals are also reduced in the cyanide destruction circuit. In the TSF, additional natural cyanide degradation will occur.
- A combination of the above whereby cyanide is partially recovered in CCD thickeners, the slurry is discharged to the tailings storage facility with cyanide <50 ppm, and an effluent treatment plant is constructed to destroy cyanide and remove metals contained in the tailings storage facility effluent (final effluent).
- Wash the leach tails slurry through cyanide recovery thickener(s) to recover a portion of the cyanide and destroy the remaining cyanide in the plant prior to discharge of the stream to the tailings facility. Metals are also reduced in the cyanide destruction circuit. In the TSF, additional natural cyanide degradation will occur. Further treat the tailings storage facility supernatant in an effluent treatment plant prior to discharge to the environment.

Scoring of the methods considered is presented in Table 7.2 Scoring of Alternative Methods.

7.3.1 Natural Cyanide Degradation in the Tailings Storage Facility

Removal of cyanide and cyanide metal complexes by natural means has been practiced successfully in the mining industry for many years and is a widely accepted practice. A variety of mechanisms are responsible for the natural degradation process over time including volatilization, oxidation, adsorption onto solids, hydrolysis, biodegradation, and precipitation. Although these processes are effective for reducing cyanide, they can require approximately a year to produce acceptable effluent levels and they are difficult to predict.

One issue is that arsenic is not sufficiently removed by natural degradation and thus requires additional chemical treatment. Examples of Canadian plants that have employed natural degradation include the Lupin mine and the Holt Mine.

Inherent in the natural degradation method is the discharge of cyanide containing slurry from the processing plant into the environment, albeit into a controlled environment. This presents risk to the project in terms of both approval and perception. The tailings storage facility would need to be sized for the residence time required for effective treatment such that high purity water effluent water can be produced, and therefore the footprint and associated environmental impact would be drastically increased as would the cost of constructing and closing the tailings storage facility. The complexity of the tailings storage facility with respect to seepage, fencing for wildlife, and methods of bird entry prevention would also be increased due to the presence of elevated cyanide concentrations. In addition, due to the unpredictability of the processes involved, effluent treatment may still be required in the future.

For these reasons, this method somewhat meets the objectives of the project but is not a preferred method.

7.3.2 In-Plant Cyanide Destruction Followed by Natural Degradation

By maximizing the recycle of cyanide and destroying cyanide prior to discharging the tailings to the storage facility, potential cyanide contamination situations such as dam seepage or tailings facility overflow during extreme storm events late in the project life are eliminated. By design, the cyanide treatment circuit will destroy cyanide to a level acceptable for MMER compliance and reduce the environmental safety requirements placed on the TSF.

This method ensures that wildlife, including waterfowl and aquatic life are protected, that cyanide consumption is minimized, and that contingency is in place to prevent the inadvertent release of cyanide into the environment. However, to meet PWQO standards at the point of discharge, the tailings storage facility would need to be sized for the residence time required for effective passive treatment such that high purity water effluent water could be produced. As result, the TSF footprint and associated environmental impact would be drastically increased as would the cost of constructing and closing the tailings storage facility.

For these reasons, this method somewhat meets the objectives of the project but is not a preferred method.

The Inco SO₂-Air process has been selected as the preferred method for in plant cyanide destruction. This method is detailed in the discussion of alternative cyanide destruction methods.

7.3.3 Natural Degradation Followed by Effluent Treatment

This method utilizes natural degradation processes to partially remove cyanide and metals from the effluent prior to final treatment using a chemical process suitable for treating effluent such as hydrogen peroxide oxidation or reverse osmosis. By removing only a portion of the cyanide, the tailings storage facility residence time can be reduced thereby reducing the size and cost of the tailings impoundment. The intent is to take advantage of whatever natural degradation occurs in the tailings facility (that has not been increased in size to allow for degradation), thereby saving effluent treatment reagent costs. This option has similar environmental and project impacts to the natural degradation only method, as well as the added cost of a chemical treatment plant. Albeit, the cost of operating the chemical treatment plant will be lower than the cost of operating the in plant cyanide destruction circuit.

As a result, this method meets the objectives of the project but is preferable only to the natural degradation only method. The tailings storage facility would contain higher levels of cyanide and as such, pose increased risk to the environment.

7.3.4 In-Plant Cyanide Destruction Followed by Natural Degradation Followed by Effluent Treatment

By maximizing the recycle of cyanide and destroying cyanide prior to discharging the tailings to the storage facility, potential cyanide contamination situations such as dam seepage or tailings facility overflow during extreme storm events late in the project life are eliminated. By design, the cyanide treatment circuit will destroy cyanide in the leach tails to a level acceptable for MMER compliance and reduce the environmental safety requirements placed on the TSF.

This method ensures that wildlife, including waterfowl and aquatic life are protected, that cyanide consumption is minimized, and that contingency is in place to prevent the inadvertent release of cyanide into the environment.

To meet PWQO standards at the point of discharge while maintaining a reasonably sized tailings storage facility, an effluent treatment plant would be used to treat the tailings pond water discharge prior to release into the environment. The effluent treatment plant would rely on reverse osmosis technology to obtain high purity water for discharge.

For these reasons, this method is the preferred method.

The Inco SO₂-Air process has been selected as the preferred method for in plant cyanide destruction. this method is detailed in the discussion of alternative cyanide destruction methods.

7.4 Methods of In-Plant Chemical Cyanide Destruction

A number of proven and effective methods are available for treating cyanide. The selection of a particular process is based on the characteristics of the stream containing cyanide, the capabilities and costs of the process, and the applicable environmental regulations and guidelines. The most common cyanide removal processes in use in Canada today are the Inco SO₂-air process, natural degradation, hydrogen peroxide and alkaline chlorination. As Carbon-in-Leach (CIL) has been selected as the preferred process for the proposed Goliath plant, the discharge stream will be a slurry containing cyanide. A cyanide recovery thickener will recycle a portion of the cyanide back to the process and reduce the quantity of cyanide to be destroyed. The selected cyanide destruction process must be capable of treating the amount of cyanide present, and it must be capable of efficiently treating the slurry stream. Scoring of the methods considered is presented in Table 7.2 Scoring of Alternative Methods.

7.4.1 Alkaline Chlorination

Alkaline chlorination is a chemical treatment process involving the oxidation of free and WAD forms of cyanide under alkaline conditions. This process has been used widely for many years and is perhaps the most common cyanide destruction process. Although this process is used widely in other applications such as metal plating and industrial wastewater treatment, few mining operations still use the alkaline chlorination process and other oxidation processes have become dominant.

The alkaline chlorination process is best applied on clear solutions where WAD cyanide, thiocyanate and/or ammonia removal is required. The process typically uses chlorine gas that requires special handling and environmental and safety considerations. In addition, iron and sulphides present in the Goliath ore may increase reagents consumption and decrease the efficiency of the this method. The residual end products of this method include free chlorine and chloramines which must be removed. Additional treatment may be required to remove iron complexed cyanide and metals. Alkaline chlorination is not a preferred method for treatment of the cyanide bearing waste stream.

7.4.2 Hydrogen Peroxide

Hydrogen peroxide is widely used to oxidize free and WAD cyanide in effluent. The process is not economically applied to slurries because of the high consumption of H₂O₂ from reaction with solids and the greatly increased residence time required. Utilization of the hydrogen peroxide process for the Goliath project would best be applied through the use of a separate effluent treatment plant downstream of the tailings facility. Hydrogen peroxide could be considered an appropriate method if used in conjunction with natural degradation, however, the Inco SO₂-Air process has been determined to be the preferred method of cyanide destruction for the Goliath project.

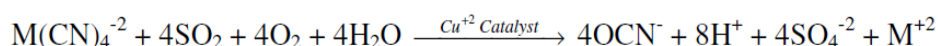
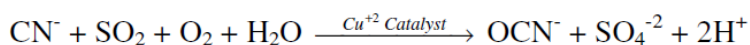
7.4.3 Natural Degradation

Removal of cyanide and cyanide metal complexes by natural means has been practiced successfully in the mining industry for many years and is a widely accepted practice. A variety of mechanisms are responsible for the natural degradation process over time including volatilization, oxidation, adsorption onto solids, hydrolysis, biodegradation, and precipitation. Although these processes are effective for reducing cyanide, they can require approximately a year to produce acceptable effluent levels and they are difficult to predict. In addition, arsenic is not sufficiently removed by natural degradation and thus requires additional chemical treatment. Examples of Canadian plants that have employed natural degradation include the Lupin mine and the Holt Mine. Natural degradation has not been selected as a preferred method for the Goliath project due to the additional requirements placed on the tailings facility and the relative unpredictability of the process.

7.4.4 Inco SO₂-Air

SO₂-Air destruction acting on the cyanide recovery thickener underflow has been chosen as the preferred method for cyanide destruction. The SO₂-air process is efficient at removing cyanide from slurry solutions, and the cyanide recovery thickener discharge provides the most concentrated slurry stream such that reagent consumption is minimized and higher destruction efficiencies are achieved.

In the SO₂-Air process, free and metal complexed cyanides (WAD cyanide) are oxidized to cyanate using SO₂ and air in the presence of copper catalyst in solution, at a pH of ~9. Free and weakly complexed metal cyanides are oxidized to cyanate by the following reactions:



Iron complexed cyanides are reduced to the ferrous state and precipitated as insoluble copper-iron-cyanide complexes. Residual metals released from the WAD cyanide complexes are precipitated as metal hydroxides. Thiocyanate is oxidized slowly and, under typical operating conditions, only 10-20% of thiocyanate is removed. While the SO₂-Air process effectively treats cyanide, it has poor removal efficiency for ammonia, cyanate and thiocyanate (products of the process) and additional treatment may be required. Over time, the constituents will degrade in the tailings storage facility. Ongoing cyanide destruction and tailings aging test work will confirm if final effluent treatment is required.

7.5 Methods of Cyanide Recovery

A crucial aspect of responsible cyanide management is minimizing the consumption of cyanide. This is achieved by optimizing the reagent addition to achieve adequate leaching with minimal reagent addition, and by recycling cyanide within the operating plant.

By far the most widely used method for cyanide recovery is tailings washing with recycling of the wash solution. Tailings washing via a single thickener is the preferred cyanide recovery method for the Goliath project.

In this process, contact water from the mine and rock piles, or tailings reclaim water, will be introduced into the cyanide recovery thickener as wash water which will dilute the concentration of cyanide retained in the tails stream reporting to the cyanide destruction circuit. The wash water, containing increased cyanide concentrations, will be recycled to the grinding circuit.

Other technologies include AVR (Acidify- Volatilize-Neutralize), resin extraction, and SART (Sulphidize-Acidify-Recycle-Thicken). These much less common technologies are significantly more costly and less proven than washing, and they do not meet the performance objectives of the Goliath project.

7.6 Methods of Treating Sanitary Waste

During operations, the Goliath processing plant is expected to support the sanitary requirements of approximately 50 persons during the day shift. During construction, the requirement expands to around 400 persons. Due to the immediate proximity of the city of Dryden, neither a long-term construction camp nor permanent residences will be constructed by the project. Given the large discrepancy in waste treatment demand for the construction versus operating phases, it is proposed that all sanitary waste generated during the construction phase be handled by an approved third party contractor and processed offsite. Offsite treatment is also the preferred method of handling sanitary waste at this early stage in the project development. Scoring of the methods considered is presented in Table 7.2 Scoring of Alternative Methods.

During the operating phase of the project, the following methods of treatment were reviewed and will be considered further in later stages of the project:

- Sewage treatment plant
- Septic system(s)
- Offsite treatment

7.6.1 Onsite Sewage Treatment Plant

An onsite sewage treatment plant would consist of a pre-engineered and package supplied module that would treat the sanitary waste and produce an effluent suitable for direct release to the environment or the tailings storage facility. Several types of plants exist however, all plants produce an effluent stream and a solids or sludge stream which can either be disposed of in the tailings storage facility or in approved landfill. An onsite sewage treatment plant has the primary drawback of higher initial capital expense. This method will be considered further in later stages of the project development as an alternative to offsite treatment. This method meets the performance objectives for the project.

7.6.2 Septic System(s)

A septic system typically consists of a tank with two compartments and a network of permeable drain

pipes buried underground. Sanitary waste enters the first chamber of the tank where solids settle.

The settled solids are anaerobically digested, reducing the volume of solids. The liquid component flows through the dividing wall into the second chamber, where further settlement takes place, with the excess liquid then draining, in a relatively clear condition, from the outlet into the drain field or seepage field. The size of the drain field depends on the percolation characteristics of the local soil. The impurities remaining in the liquid are trapped and eliminated in the soil, with the excess water being eliminated through percolation into the soil, through evaporation, and by uptake through the root system of plants and eventual transpiration or entering groundwater or surface water. The system often operates by gravity. Potential drawbacks of using this method at Goliath include additional soil testing required for the design of septic bed and potential cost of fill material if the soil is inadequate; the possibility of contaminating watercourses and ground water; and potentially unpredictable long term effectiveness. This method presents additional risk and is not preferred.

7.6.3 Offsite Treatment

Offsite treatment requires all sanitary waste to be stored onsite in receiving/holding tanks. The contents of the holding tanks are removed by truck and are delivered to an offsite sewage treatment plant. The drawbacks of this method of treatment include extra handling of raw sewage, increased truck activity, higher ongoing treatment costs, and relatively large holding tanks. However, this method of treatment can be scaled up and down quickly and it present low initial capital investment. This is the preferred method of sanitary waste treatment for the construction and early operating phases of the project, with future consideration of onsite treatment.

7.7 Assessment of Effluent Receivers

There are several lakes and creeks capable of receiving the effluent from the Goliath project.

The three significantly sized bodies of water closest to the proposed Goliath plant site in order of distance are: Thunder Lake (approx 4.9 km), Wabigoon Lake (approx 6.5 km), and Hartman Lake (approx 14.4km). These distances are estimated pipeline lengths, as opposed to straight-line distances. Each of these lakes is of sufficient capacity to assimilate the effluent from the project, and the most desirable destination is the one with the shortest pipeline, and hence lowest cost. Two creeks are also capable of receiving the effluent: Blackwater Creek and Tributary #3 to Thunder Lake which flows through the tree nursery ponds. Based on preliminary data, neither creek has sufficient assimilative capacity to accommodate untreated TSF decant. Therefore, secondary effluent treatment will be required prior to discharge to either creek. Blackwater Creek is the preferred creek as it ultimately flows to Wabigoon Lake. Scoring of the effluent receivers considered is presented in Table 7.2 Scoring of Alternative Methods.

7.7.1 Wabigoon Lake

Wabigoon lake is the second farthest receiver with an estimated 6.5km long pipeline. To reach Wabigoon lake, the effluent pipeline must cross multiple creeks and roads including the TransCanada highway and the railway. As Wabigoon lake is the source of drinking water for the City of Dryden, discharge of mining effluent into the lake via an underwater diffuser could present social acceptance issues.

7.7.2 Thunder Lake

Thunder lake is a highly valued fishing lake with the local community. The lake is perceived as naturally beautiful and there are a number of cottages located on the lake. Because of the close proximity of Thunder Lake and its assimilative capacity, it is the preferred effluent receiving lake out of Wabigoon, Thunder and Hartman lakes. In the interest of preserving the perceived value of Thunder Lake, other effluent receivers will be sought.

7.7.3 Hartman Lake

Is the farthest lake identified as a possible effluent receiver with an estimated pipeline distance of 14.4 km. To reach Hartman Lake, multiple creek and road crossing are required in addition to the relatively lengthy access road required for maintenance of the pipeline. Due to the length of the pipeline, the area of land impacted is significantly larger than the alternatives and the cost to the project is significantly increased. While Hartman Lake is likely to be the most socially acceptable lake for effluent discharge, it is the highest capital cost alternative and is not a preferred alternative. With increasing distance comes a larger number of piping low points that will require drainage during winter stoppages to prevent freezing increasing the complexity of operation.

7.7.4 Tree Nursery Ponds (Thunder Lake Tributary)

Discharge into the tree nursery ponds will require secondary water treatment because of the lack of assimilative capacity of the ponds and creek. This creek is a tributary to Thunder Lake and may present the same social issues as discharging to Thunder Lake directly. In addition, this creek has been selected as the preferred fresh water source for the project, although this does not negate the possibility of discharging effluent downstream of the freshwater intake. Due to the aforementioned complications, effluent discharge to the tree nursery ponds is not the preferred option.

7.7.5 Blackwater Creek

Discharge into Blackwater Creek will require secondary water treatment due to the lack of assimilative capacity. Using this waterway will present an ongoing operating cost to the project but will also allow the project to minimize its environmental impact. Consideration will need to be given to the physical flow rate receiving capacity of Blackwater Creek throughout the seasons with the possible regulation of flows and temporary storage of effluent in the tailings storage facility. Blackwater creek intersects the TransCanada highway and railway, and the flow capacity of these crossings will need to be determined and taken into

consideration when determining the maximum effluent discharge flow rate. Due to its proximity to the processing plant, tailings storage facility, and eventual destination in Wabigoon Lake versus Thunder Lake, Blackwater Creek is the preferred final effluent receiver of TSF effluent that has received secondary treatment.

Table 7.2 Scoring of Alternative Methods

| Scoring (1-4) | Economics | Technical | Suitability | Environmental |
|---|-----------|-----------|-------------|---------------|
| Mine Water Management | | | | |
| Direct Discharge | 4 | 4 | 1 | 1 |
| Dedicated Treatment Plant | 3 | 4 | 4 | 4 |
| <i>Integrated Treatment Plant</i> | 4 | 4 | 4 | 4 |
| Fresh Water Sources | | | | |
| <i>Nearby Creeks</i> | 4 | 4 | 4 | 3 |
| Nearby Lakes | 2 | 4 | 3 | 4 |
| Groundwater | 3 | 4 | 1 | 3 |
| Cyanide Effluent Management | | | | |
| Cyanide Recovery by Thickener and Natural Degradation | 1 | 2 | 2 | 2 |
| Cyanide Recovery by Thickener and In-Plant Cyanide Destruction with Natural Degradation | 2 | 3 | 3 | 3 |
| Cyanide Recovery by Thickener, Partial Natural Degradation with Effluent Treatment Plant | 3 | 4 | 4 | 3 |
| <i>Cyanide Recovery by Thickener, In-Plant Cyanide Destruction, Natural Degradation with Effluent Treatment Plant</i> | 3 | 4 | 4 | 4 |
| Cyanide Destruction | | | | |
| Alkaline Chlorination | 3 | 2 | 2 | 3 |
| Hydrogen Peroxide | 3 | 3 | 2 | 3 |
| Natural Degradation | 3 | 2 | 2 | 2 |
| <i>Inco SO₂-Air</i> | 3 | 4 | 4 | 4 |
| Sanitary Waste Treatment | | | | |
| On-site Sewage Treatment Plant | 3 | 4 | 4 | 4 |
| Septic System(s) | 4 | 3 | 3 | 4 |
| <i>Off-site Treatment</i> | 4 | 4 | 4 | 4 |
| Effluent Receiver | | | | |
| Wabigoon Lake | 3 | 3 | 3 | 3 |
| Thunder Lake | 4 | 3 | 3 | 2 |
| Hartman Lake | 2 | 3 | 3 | 3 |
| Tree Nursery Ponds (Thunder Lake Tributary #3) (with Effluent Treatment Plant) | 1 | 4 | 4 | 3 |
| <i>Black Water Creek (with Effluent Treatment Plant)</i> | 1 | 4 | 4 | 4 |

7.0 Recommendations

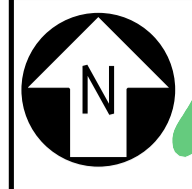
The following items are recommended for follow-up in subsequent phases of the project:

- Cyanide destruction test work needs to be performed to determine the extent of metals and cyanide removal as well as design and operating cost parameters.
- Tailings attenuation and aging test work should be performed to determine the treatment capability tailings storage facility.
- Thorough estimations of mine water quality and rock pile leachate water quality given seasonal variations are required.
- Review of the above recommendations in light of life of mine, closure, and seasonal variations.
- Determination of seasonal or monthly effluent characteristics and site water balance over the life of mine.
- Testing of effluent treatment plant processes using Goliath materials.

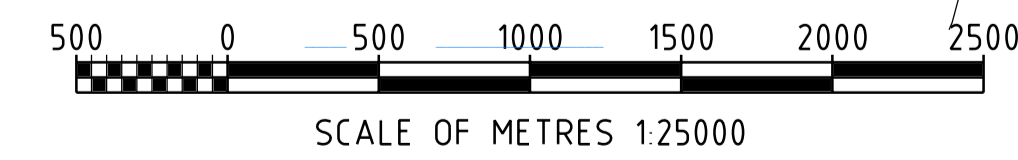
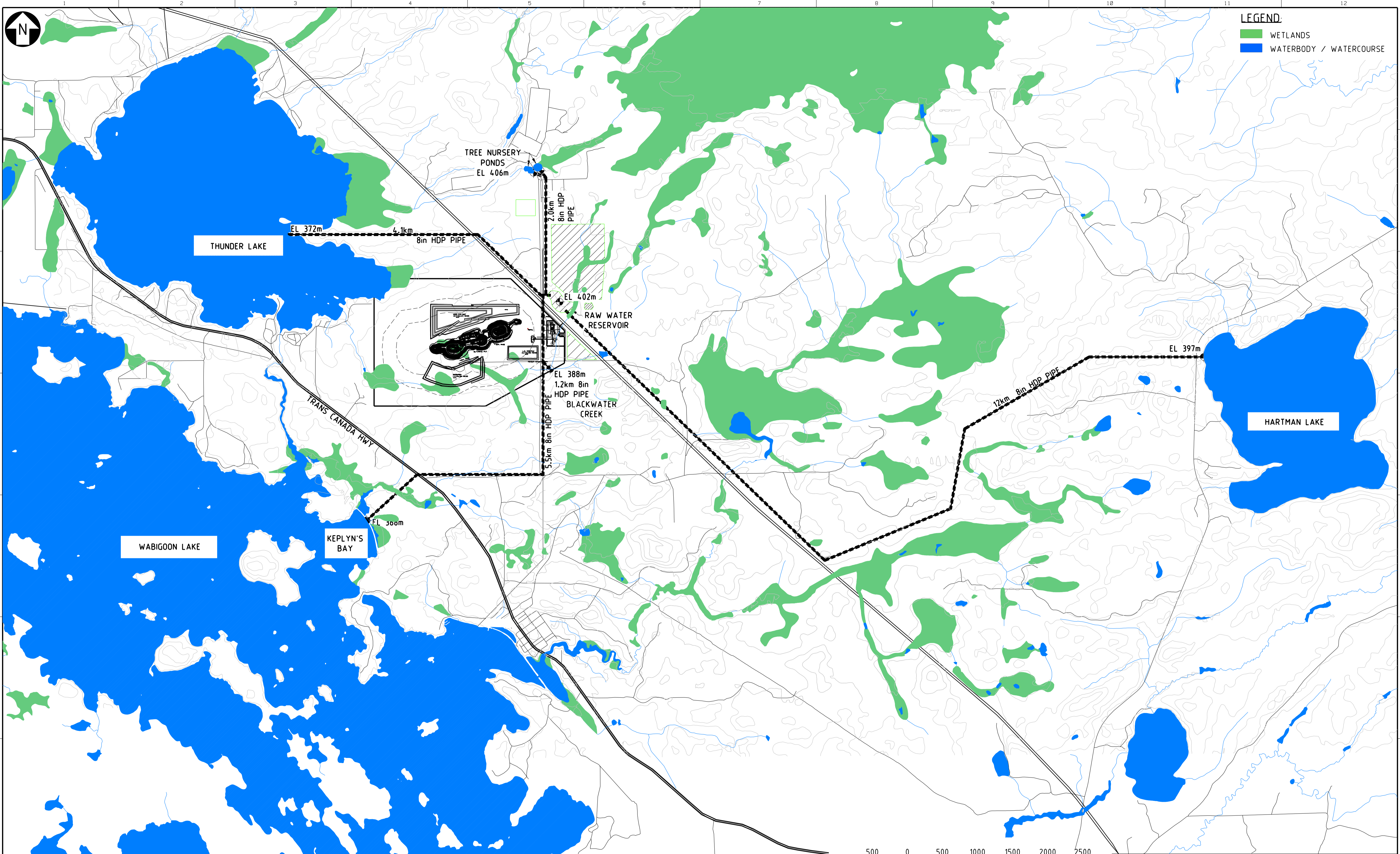
Appendix A - Effluent Pipeline Routings

Appendix B - Project Site Arrangement

Appendix C - Tetra Tech EIS Water Quality Report



LEGEND:
■ WETLANDS
■ WATERBODY / WATERCOURSE



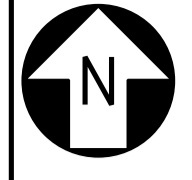
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|--------|--------------------|----|------|-----------|-----|-------|--------|--------------|------------|--------------|
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CLIENT: TREASURY METALS INC.
 PROJECT: GOLIATH GOLD

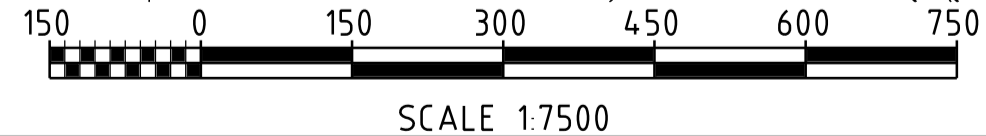
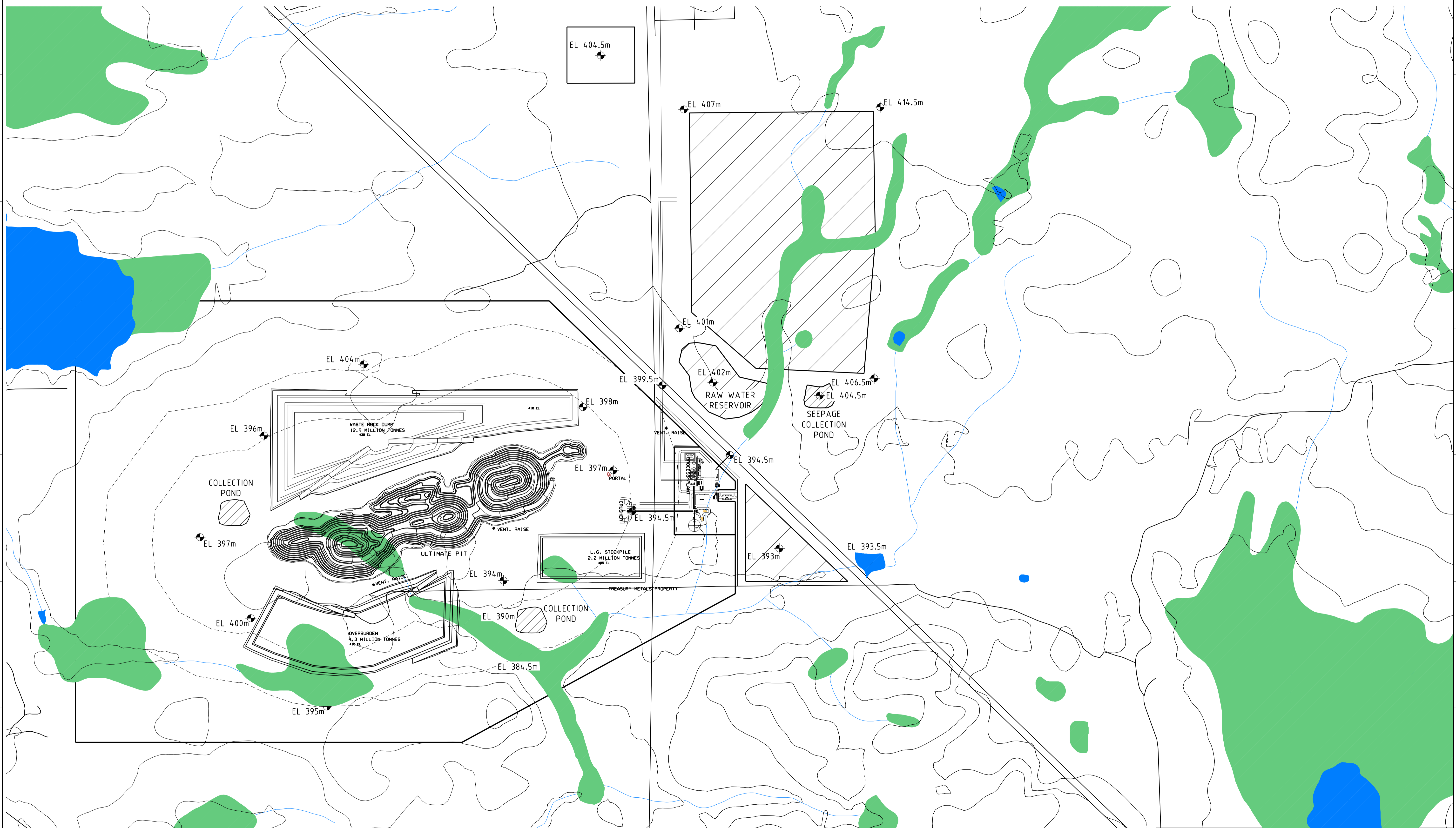
Lycopodium
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| DRAWING TITLE | | | | | | | |
| AREA MINE SITE | | | | | | | |
| PROCESS WATER BALANCE | | | | | | | |
| GENERAL SITE LAYOUT - PLAN | | | | | | | |
| SCALE | 125000 | JOB NO. | 5027 | DWG NO. | 110-C-001 | REV. | A |
| DRAWN | SgM | DATE | 02 JUN 14 | | | | |



LEGEND:
■ WETLANDS
■ WATERBODY / WATERCOURSE



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| DRAWING TITLE | | | SCALE | JOB NO. | DWG NO. | REV. |
| AREA MINE SITE PROCESS WATER BALANCE SITE LAYOUT - PLAN | | | 1:7500 | 5027 | 110-C-002 | A |
| DRAWN | DATE | | | | | |
| SdM | 02 JUN 14 | | | | | |

Treasury Metals Goliath Project

Preliminary Water Quality Model

704-V15103069-02
August 19, 2014

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ACRONYMS/ABBREVIATIONS

| Acronyms/Abbreviations | Definition |
|------------------------|---|
| ARD | Acid rock drainage |
| CEEA | Canadian Environmental Association Agency |
| CCME | Canadian Council for Ministers of the Environment |
| EIS | Environmental Impact Statement |
| HTC | Humidity test cell |
| LGO | Low-grade ore |
| mg/L | Milligrams per liter |
| ML | Metal leaching |
| MMER | Metal Mining Effluent Regulations |
| TSF | Tailings Storage Facility |
| USGS | United States Geologic Survey |
| WRSF | Waste rock storage facility |

1.0 INTRODUCTION

As part of the Baseline Conditions characterization for the Goliath Gold Project Environmental Impact Statement (EIS), acid rock drainage (ARD) and metal leaching (ML) behaviour must be assessed. Per the EIS Guidelines for the Goliath Gold Project prepared by the Canadian Environmental Assessment Agency (CEEA, 2013), the following information must be provided:

- Pit water chemistry during operation and post-closure, and pit closure management measures (e.g. flooding). This shall include geochemical modeling of pit water quality in the post-closure period;
- Surface and seepage water quality from the waste rock storage facilities (WRSF), tailings/waste rock impoundment facility, stockpiles and other infrastructure during operation and post-closure;
- Quantity and quality of leachate from samples of tailings, waste rock, and ore; and
- Quantity and quality of effluent to be released from the site into the receiving waters.

Although a finalized mine plan and site-wide water balance are not available at this time, a preliminary predictive geochemical model has been constructed to begin to address these needs for the purpose of the EIS. The model is intended to provide guidance towards the development of ARD/ML mitigation and closure planning, which is addressed in various sections of EIS. As a more detailed mine plan and site water balance become available the geochemical model may be refined to reflect those changes.

Tetra Tech WEI Inc. (operating as Tetra Tech) has conducted a preliminary geochemical model for the Goliath Project site water quality using the PHREEQC geochemical modeling computer code. The scope of this effort includes:

- Review of existing data and generation of source terms.
- Construction of a preliminary geochemical model for assessment of surface water quality during mine operations, as well as the proposed pit lake water quality at closure.
- Generation of a summary report of findings to be included in the EIS.

The following is a summary status report for the Preliminary Water Quality Model for the Goliath Gold Project, Manitoba. Changes to the mine plan or water balance will necessitate revisions of this model.

2.0 BACKGROUND INFORMATION

The model is based upon and should be read in conjunction with the following project-related reports and data:

- Project Description (Treasury Metals, 2012)
- Goliath Gold Project Pre-Feasibility Water Management Strategy (Lycopodium, June 2014)
- DRAFT Geochemical Characterization of the Goliath Gold Project (Ecometrix, September 2013).
- Baseline Study (Klohn Crippen Berger, 2012)

This work was completed as part of the EIS level study of the project.

In addition, raw data in the form of lab certificates and analysis spreadsheets were provided for:

- 11 Humidity cells (Treasury_WR_HCT_Data_0715014.xls, provided by Ecometrix)–
 - Three cells of each of the following waste rock types BMS, BS, MS
 - Two cells of MSED waste rock

- Two cells of representative tailings material (produced by metallurgical bench scale testing)
- # Field cells (Field Cell Summary_071614.xlsx, provided by Ecometrix)
 - One field cell for each of the four waste rock types
- Ratio of rock types in waste rock piles (email from M. Wheeler, Treasury Gold).

Multiple data gaps were identified while reviewing the available data. In an effort to address those gaps, a series of assumptions were made. Assumptions and the accompanying rationale has been included in Table 1 – Assumptions.

3.0 SOURCE TERM DERIVATION

The accuracy and usefulness of a water quality model is dependent upon the quality of the data inputs, generally referred to as source terms. Source terms for the Goliath Gold Project have been generated based upon the available geochemical characterization data, in accordance with the assumptions listed in Table 1. The source terms describe the water quality parameters of the run-off/leachate from the various waste rock types, low-grade ore (LGO), and tailings materials identified on the project. The water quality of pure rain or snow fall was calculated by allowing atmospheric levels of carbon dioxide and oxygen to equilibrate with water at a pH of 5.6. The source terms used in the model have been included in Table 2.

Initial leachate/run-off water quality was approximated from the average water quality of the leachate from the three operating HTC's of each rock type or tailings from weeks 0 through 5. The intermediate water quality representing the quasi-steady state established prior to the onset of acid generating conditions was estimated using the average of the three humidity cells from weeks 20-40. After week 63, operations of two of the three HTC's of each rock type was discontinued. Beyond week 63, only a single HTC of each rock type remained in operation.

Regression analysis of cumulative elemental concentrations for each element and humidity cell sample was attempted in order to assess rates of element (ie metal and sulphur) release after closure. However, as of April 1, 2014, the humidity cells in operation show evidence of the onset of acid generating conditions and significant decreases in the leachate pH with coincident increases in dissolved metal concentrations. Because the pH and metal concentrations have not yet attained a steady-state, the curves fitted to the data suggest an exponential dependence of pH or elemental concentration on time. This over-estimates the projected long term water quality. Therefore, the average of the data collected from weeks 60 through 80 were used to represent long-term water quality.

Source term calculation included the application of scaling factors applied to the laboratory data to generate leachate solutions which are representative of conditions in the field based on site-specific conditions. The scaling factors were selected based on applicability to site conditions at the Goliath Gold Project and were calibrated against the data collected from field cells in operation since November 2012. The details of the scaling factors applied to each source term are presented in Table 1.

Additionally, the water quality of the leachate collected from the field cells were included as source terms for model iterations described below. The field cell water quality was not scaled in any way and was used as a direct measure of the runoff from the WRSF, Pit Walls, and Underground seepage.

Note that the source terms as provided here are specific to the mine plan and water balance provided in the background documents.

4.0 GEOCHEMICAL MODELING METHODOLOGY

Using the derived source terms, a preliminary geochemical model for assessment of surface water quality during mine operations was conducted using the computer code PHREEQCi Version 2.17.4799 (Parkhurst and Appelo, 1999), supplied by the U.S. Geological Survey (USGS). For this project, the WATEQ4F database (Ball and Nordstrom, 1991) was updated using the PHREEQC database published with the computer code (Parkhurst and Appelo, 1999). The combination of the two databases provided the broad range of parameters needed to accurately model the ARD at the Goliath property.

PHREEQCI is a flexible model platform that can be used to meet a range of modeling needs, from simple mass balance models to complex multiple geochemical equilibria and mixing reactions, to produce a final prediction of chemical composition at the point of site water treatment or discharge. At this time, a mass balance model approach with considerations for pH, alkalinity, and charge balance was used. This produces a conservative estimate of water quality because it assumes that all constituents remain in solution, regardless of mixing, dilution, saturation indices, etc. This approach is most appropriate at preliminary phases of project development and provides accurate assessments of general water quality behaviours in a worst-case scenario. Model outputs were qualitatively evaluated to determine if the calculated water qualities are chemically “reasonable”. This model can later be revised to include simulations of precipitation and oxidation reactions to more accurately simulate actual conditions at the project site as additional data (i.e. mine plan and water management plan) becomes available.

Geochemical modeling for the prediction of the annual water qualities at various points on the mine site was performed, including:

- Pit wall run-off and underground seepage water quality;
- Surface and seepage water quality from the WRSF and LGO stockpile;
- Water quality of the Tailings Management Facility (TMF), which is equivalent to the site-wide surface water effluent; and,
- Final pit lake water quality at closure.

The conceptual geochemical model combines the physical and chemical components that are the basis of the geochemical computer modeling. The material composition of the waste rock and pit walls is assumed to remain constant over time. However, this is not likely the case and may be updated in future modeling efforts. Relative proportions of each inflow to the collection pond or TSF were calculated as a percentage of the total annual input volume based upon the water balance model .

The potential generation of acidic conditions required additional model simulations. Three separate geochemical model scenarios were built based on the mine plan, as follows:

1. Neutral waste rock drainage, pit wall/underground dewater, low-grade ore stockpile, and tailings run-off, based on kinetic testing data collected from weeks 1-5. This scenario represents initial flushing of newly exposed materials in the WRSF, LGO stockpile, pit wall, or underground stopes.
2. Mildly acidic waste rock drainage, pit wall/underground dewater, low-grade ore stockpile, and tailings run-off, based on kinetic testing data collected from weeks 20-40. This scenario represents the quasi-steady state water quality generated from exposed materials in the WRSF, LGO stockpile, pit wall, or underground stopes prior to the onset of acid generating conditions and is representative of water quality during the majority of mine operations.
3. Acidic waste rock drainage, pit wall/underground dewater, low-grade ore stockpile, and tailings run-off, based on kinetic testing data collected from weeks 60-80. This scenario represents the long-term water quality generated from exposed materials in the WRSF, LGO stockpile, pit wall, or

underground stopes after the onset of acid generating conditions and is representative of leachate from older areas of the mine (i.e. pit walls and stope walls exposed early in the mine life) or post-closure.

Each of these scenarios were modeled using variations of the geochemical characterization data as follows:

- a) Scaled Humidity Test Cell (HTC) data for dissolved metal concentrations
- b) Field cell test data for dissolved metal concentrations
- c) Field cell test data for total metal concentrations

Application of the various source data aids in the sensitivity analysis of the model outputs and represents the range of concentrations which may ultimately be observed at the site.

At this time, closure planning includes the following:

- Capping of the WRSF with stockpiled overburden, and subsequent revegetation
- Backfilling of the West and Central Pit areas with waste rock, capping, and revegetation
- Filling of the East Pit to form a lake for sub-aqueous pit wall at closure

Accordingly, the following assumptions were made for the purposes of the model:

- Run-off from covered areas will have water quality similar to background water quality from the surface water monitoring point TL2.
- Backfilled pits and capped materials are effectively isolated from water and oxygen, thus prevented from undergoing further ARD reactions or generating leachate.
- Because passive filling (i.e. collection of precipitation only) of the East Pit will take approximately 125 years, active filling using underground seepage water has been assumed, resulting in an abbreviated filling time of 3 years.

5.0 MODEL RESULTS AND CONCLUSIONS

The results of the modeling scenarios have been provided in Table 3. The Canadian Council of Ministers of the Environment (CCME) for the protection of freshwater aquatic life and the Metal Mining Effluent Regulations (MMER) water quality values are also presented in each table for comparison. The parameter concentrations in bold indicate an exceedance of the CCME guideline concentrations. The highlighted parameter concentrations indicate an exceedance of the MMER guideline concentrations. Exceedances have been summarized in Table 4, where an "X" represents an exceedance of the CCME guideline value, and a highlighted cell with an "X" represents an exceedance of the MMER guideline value.

Note that because anions were not included in the HTC leachate analysis, the model cannot attain charge balance and concentrations of anions (including nutrients such as nitrate and nitrite) are not addressed here.

5.1 WASTE ROCK STORAGE FACILITY (WRSF)

5.1.1 HTC Source Data, Dissolved Metals

Initial flushing of the WRSF indicates that concentrations of the following analytes exceed their respective CCME guidelines; aluminum, arsenic, cadmium, copper, lead, nickel, phosphorous, selenium, silver, and zinc. Prior to the onset of ARD-generating conditions, concentrations of most analytes decrease slightly, but remain above CCME guidelines. Arsenic concentrations decrease below the CCME guideline, however cadmium and lead concentrations increase over time. Sulphate concentrations decrease after the initial flushing of readily soluble material to a local minima prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

After the onset of sulfide oxidation, the pH of the leachate/run-off of the WRSF decreases to approximately 5.8. Note that, to date, none of the HTCs have yet attained long-term steady state conditions; meaning that the pH of the leachate can be expected to decrease further. Under the mildly acidic conditions observed in all of the HTCs, concentrations of alkaline-soluble metals continue to decrease while the concentrations of acid-soluble metals increase. Concentrations of cadmium, copper, lead, nickel, phosphorous, selenium, silver, and zinc remain above the CCME guidelines. HTC data indicates that these metal concentrations, as well as sulphate, will continue to rise as pH decreases.

5.1.2 Field Cell Source Data, Dissolved Metals

Model scenarios based on the dissolved metal concentrations in the field cell leachate were notably different from the HTC leachate-derived scenarios. Initial flushing of the WRSF indicates that concentrations of the following analytes exceed their respective CCME guidelines; cadmium, copper, lead, nickel, phosphorous, and zinc. Prior to the onset of ARD-generating conditions, concentrations of the majority of analytes decrease slightly, but remain above CCME guidelines. Lead concentrations decrease below the CCME guideline of 0.001 mg/L. Sulphate concentrations decrease after the initial flushing of readily soluble material to 16.23 mg/L prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

Although the field cells have operated for approximately the same length of time as the HTCs, differences in particle size, flushing volumes, and temperature-dependant reaction rates results in a delay in the onset of acid-generating conditions. As such, the field tests were not yet acid generating at the time of this modelling effort.

5.1.3 Field Cell Source Data, Total Metals

Because CCME guidelines are reflective of total metal concentrations, an additional set of scenarios were constructed which use the field cell total metal concentrations as source data. Initial flushing of the WRSF indicates that concentrations of the following analytes exceed their respective CCME guidelines; aluminum, cadmium, copper, lead, nickel, phosphorous, and zinc. Prior to the onset of ARD-generating conditions, concentrations of the majority of analytes decrease slightly, but remain above CCME guidelines. Cadmium and zinc concentrations decrease below their respective CCME guidelines. Iron, selenium, silver, and thallium concentrations increase to above the respective CCME guidelines. Sulphate concentrations decrease after the initial flushing of readily soluble material to 16.23 mg/L prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

Although the field cells have operated for approximately the same length of time as the HTCs, differences in particle size, flushing volumes, and temperature-dependant reaction rates results in a delay in the onset of acid-generating conditions. As such, the field tests were not yet acid generating at the time of this modelling effort.

5.2 LOW-GRADE ORE STOCKPILE

5.2.1 HTC Source Data, Dissolved Metals

Initial flushing of the LGO stockpile indicates that concentrations of the following analytes exceed their respective CCME guidelines; aluminum, arsenic, cadmium, copper, lead, nickel, phosphorous, silver, selenium, and zinc. Prior to the onset of ARD-generating conditions, concentrations of most analytes decrease slightly, but remain above CCME guidelines. Aluminum, arsenic and nickel concentrations decrease below the CCME guideline, however cadmium and lead concentrations increase over time. Sulphate concentrations decrease after the initial flushing of readily soluble material to a local minima prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.5).

After the onset of sulfide oxidation, the pH of the leachate/run-off from the LGO stockpile decreases to approximately 5.7. Note that, to date, the HTCs have not yet attained long-term steady state conditions; meaning that the pH of the leachate can be expected to decrease further. Under the mildly acidic conditions observed in the HTC, concentrations of alkaline-soluble metals continue to decrease while the concentrations of acid-soluble metals increase. Concentrations of cadmium, copper, lead, phosphorous, silver, and zinc remain above the CCME guidelines. HTC data indicates that these metal concentrations, as well as sulphate, will continue to rise as pH decreases.

5.2.2 Field Cell Source Data, Dissolved Metals

Model scenarios based on the dissolved metal concentrations in the field cell leachate were notably different from the HTC leachate-derived scenarios. Initial flushing of the LGO stockpile indicates that concentrations of the following analytes exceed their respective CCME guidelines; cadmium, copper, lead, nickel, phosphorous, and zinc. Prior to the onset of ARD-generating conditions, concentrations of the majority of analytes fluctuate but remain above CCME guidelines. Sulphate concentrations decrease after the initial flushing of readily soluble material to 7.12 mg/L prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

Although the field cells have operated for approximately the same length of time as the HTCs, differences in particle size, flushing volumes, and temperature-dependant reaction rates results in a delay in the onset of acid-generating conditions. As such, the field tests were not yet acid generating at the time of this modelling effort.

5.2.3 Field Cell Source Data, Total Metals

Because CCME guidelines are reflective of total metal concentrations, an additional set of scenarios were constructed which use the field cell total metal concentrations as source data. Initial flushing of the LGO stockpile indicates that concentrations of the following analytes exceed their respective CCME guidelines; cadmium, copper, lead, nickel, phosphorous, and zinc. Prior to the onset of ARD-generating conditions, concentrations of the majority of analytes decrease slightly, but remain above CCME guidelines. Nickel concentrations decrease below the CCME guideline of 0.25 mg/L. Aluminum, selenium, silver, and thallium concentrations increase to above the respective CCME guidelines. Sulphate concentrations

decrease after the initial flushing of readily soluble material to 7.12 mg/L prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

Although the field cells have operated for approximately the same length of time as the HTCs, differences in particle size, flushing volumes, and temperature-dependant reaction rates results in a delay in the onset of acid-generating conditions. As such, the field tests were not yet acid generating at the time of this modelling effort.

5.3 COLLECTION PONDS

The inputs to the collection pond are primarily composed of leachate/run-off from the WRSF, with minor contributions from the LGO stockpile. Therefore, the water quality trends in the collection pond are the same as those observed in the WRSF (discussed above in Section 5.2).

According to the water balance, water from the collection ponds will be processed through the cyanide destruction treatment plant before ultimately being discharged into the TSF.

5.4 PIT WALL RUN-OFF AND UNDERGROUND DEWATER

Quality of the water collected during dewatering of the pit was generated using the assumptions outlined in Table 1. Because the same ARD-reactions are also occurring within the underground stopes as a reaction of the exposed rock face with the groundwater seepage, the quality of the water collected during underground dewatering is assumed to be the same as the water collected from the pit. The following discussion applies to all water generated during dewatering operations.

The blend of rock types expressed in the WRSF is assumed to be the same as the blend expressed in the pit walls and stopes, resulting in very similar water qualities of the WRSF run-off and the mine dewater. The only notable difference is that the concentration of selenium and silver in the HTC dissolved metal source data scenarios decreases to less than the respective CCME guidelines after the onset of acid-generating conditions.

5.5 PIT LAKE

Quality of the water used to fill the pit was generated using the assumptions outlined in Table 1. For the purposes of this model, active filling using underground seepage water has been assumed, resulting in an abbreviated filling time of 3 years.

The quality of the water from the dewatering activities in the underground stopes used to fill the pit is assumed to be the same as Pit run-off water. Additional leaching or dissolution from the pit walls is assumed to cease once the pit wall is submersed. Therefore, the water quality within the pit lake is equivalent to the long term water quality of the underground seepage, which is very similar to the long term WRSF run-off. Without the inclusion of secondary reactions, it follows that the water quality within the pit lake will remain constant over time and after closure, and will be roughly equivalent to the long term water quality of the waste rock run-off.

5.6 TAILINGS STORAGE FACILITY / SITE EFFLUENT

Inputs to the TSF include cyanide-treated tailings slurry from the mill, excess mine dewater, precipitation, and run-off from tailings beach areas. Assumptions regarding each input are outlined in Table 1.

The water quality of the TSF will be unaltered as it is discharged to the receiving waters via the polishing pond. As such, the water quality of the TSF is equivalent to the water quality of the site effluent.

5.6.1 HTC Source Data, Dissolved Metals

Initial inputs to the TSF based on initial flushing of exposed site material (pit walls and tailings) indicates that concentrations of the following analytes exceed their respective CCME guidelines; cyanide, aluminum, arsenic, cadmium, copper, iron, lead, mercury, nickel, phosphorous, selenium, silver, thallium, and zinc. Prior to the onset of ARD-generating conditions, concentrations of aluminum, arsenic, copper, nickel, silver, and thallium decrease slightly, but remain above CCME guidelines. Iron and selenium concentrations decrease below the CCME guideline. However cadmium, lead, and zinc concentrations increase over time. Sulphate concentrations decrease after the initial flushing of readily soluble material to a local minima prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.5).

After the onset of sulfide oxidation, the pH of TSF decreases to approximately 4.8. Note that, to date, the HTCs have not yet attained long-term steady state conditions; meaning that the pH of the leachate can be expected to decrease further. Under the mildly acidic conditions observed in the HTC, concentrations of alkaline-soluble metals continue to decrease while the concentrations of acid-soluble metals increase. Concentrations of cyanide, aluminum, arsenic, cadmium, copper, lead, mercury, nickel, phosphorous, and zinc remain above the CCME guidelines. Parameters of concern remain below the MMER limits, with the exception of lead which increases to roughly 6-times the limit of 0.2 mg/L after acid generating conditions are established. HTC data indicates that these metal concentrations, as well as sulphate, will continue to rise as pH decreases.

5.6.2 Field Cell Source Data, Dissolved Metals

Model scenarios based on the dissolved metal concentrations in the field cell leachate were notably different from the HTC leachate-derived scenarios. Initial inputs to the TSF based on initial flushing of exposed site material (pit walls and tailings) indicates that concentrations of the following analytes exceed their respective CCME guidelines; cyanide, arsenic, cadmium, copper, lead, mercury, nickel, phosphorous, thallium, and zinc. Concentrations remain above the CCME guideline for the three time horizons considered. In addition, the concentration of dissolved aluminum increases to above the CCME guideline of 0.1 mg/L after long-term operation. Parameters remain below the MMER limits, with the exception of lead which increases to roughly 6-times the limit of 0.2 mg/L after acid generating conditions are established in the tailings material. Sulphate concentrations decrease after the initial flushing of readily soluble material to a local minima prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

Although the field cells have operated for approximately the same length of time as the HTCs, differences in particle size, flushing volumes, and temperature-dependant reaction rates results in a delay in the onset of acid-generating conditions. As such, the field tests were not yet acid generating at the time of this modelling effort.

5.6.3 Field Cell Source Data, Total Metals

Because CCME guidelines are reflective of total metal concentrations, an additional set of scenarios were constructed which use the field cell total metal concentrations as source data. Initial inputs to the TSF based on initial flushing of exposed site material (pit walls and tailings) indicates that concentrations of the following analytes exceed their respective CCME guidelines; cyanide, aluminum, arsenic, cadmium, copper, iron, lead, mercury, nickel, phosphorous, thallium, and zinc. Concentrations of most analytes remain above the CCME guideline for the three time horizons considered, with the exception of nickel and

zinc which decrease to below their respective CCME guidelines. In addition, selenium and silver concentrations increase to above their respective CCME guidelines one ARD-generating conditions are established in the tailings. Parameters remain below the MMER limits, with the exception of lead which increases to roughly 6-times the limit of 0.2 mg/L after acid generating conditions are established in the tailings material. Sulphate concentrations decrease after the initial flushing of readily soluble material to a local minima prior to the onset of ARD-generating conditions. pH during the majority of mine operations will remain circumneutral (>6.0).

Although the field cells have operated for approximately the same length of time as the HTC's, differences in particle size, flushing volumes, and temperature-dependant reaction rates results in a delay in the onset of acid-generating conditions. As such, the field tests were not yet acid generating at the time of this modelling effort.

5.7 CLOSURE CONSIDERATIONS

At this time, preliminary closure plans indicate that the East and Central pits will be filled with waste rock. Subsequently, the filled pits and WRSF will be capped and revegetated. Closure run-off water quality from these former impoundments will be similar to the baseline water quality in the local tributaries.

The LGO stockpile will be processed through the mill prior to the cessation of mill operations and will no longer exist on the site post-closure.

The water quality of the lake which will result from the filling of the West pit is discussed above in Section 5.5. The pit lake water quality model will be revised as additional closure planning is available.

6.0 CONCLUSIONS AND LIMITATIONS

Although the water quality of the run-off/leachate generated on-site exceeds multiple CCME concentration guidelines under all model scenarios considered, only the TSF effluent, after acid generating conditions become established, has a concentration exceeding the MMER guidelines (for lead). Future site planning should evaluate the efficiency of primary water treatment and the necessity for secondary water treatment to address concentration exceedances above the MMER guideline values prior to discharge into the receiving waters.

The accuracy of the geochemical model and its ability to predict leachate chemistry is limited by the quality and availability of data used to create the model. The mass-balance approach used in this model does not take into consideration the formation of secondary mineral phases which may serve to reduce the solution concentrations of multiple potential contaminants of concern. A cursory evaluation of the saturation indices of a suite of common mineral phases indicates that several iron and aluminum minerals are supersaturated under these conditions. Future modeling efforts should consider the formation of these mineral phases as a sink for various aqueous species.

This geochemical model and report are to be considered as preliminary, and will be living documents to be refined at later phases of the project as additional information becomes available, including the mine plan and closure plan.

7.0 REFERENCES

- Ball, J. W., and Nordstrom, D. K., 1991, User's manual for WATEQ4F with revised data base: U.S. Geological Survey Open-File Report 91-183, 189 p.
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- Lycopodium. Goliath Gold Project Pre-Feasibility Water Management Strategy. June 2014.
- Parkhurst, D.L., and Appelo, C.A.J., 1999. User's guide to PHREEQC (Version 2.17.4799) — A computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations: U.S. Geological Survey Water-Resources Investigations Report 99-4259.
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Assumptions

| Source Data Set | Assumptions |
|-------------------------|---|
| All | This PHREEQCI model is based upon the water balance titled "Goliath Gold Project Pre-Feasibility Water Management Strategy", (Lycopodium, June 2014) and the geochemical characterization work titled "DRAFT Geochemical Characterization of the Goliath Gold Project" (Ecometrix, September 2013). |
| | All facilities were modeled annually based on average annual precipitation less the average annual evaporation (as provided in the Water Management Strategy). Additional detail for monthly water management requires a site water balance to be presented on a monthly basis, which has not yet been developed. |
| | For analytes with reported concentrations less than the analytical detection limit (<DL), a numerical value of 1/2 of the analytical detection limit was used for calculations of average concentrations/loadings and all subsequent model inputs. |
| | Anion concentrations in the humidity cells were not reported by Ecometrix, but are needed to provide a charge balance for the solutions. All source solutions in PHREEQCI and the model are not charge balanced with the other solution constituents. Because a mass-balance approach is applied here, a charge balanced solution is not required to proceed with the model simulations. |
| | All mixing was performed within PHREEQCI, and common secondary mineral phases were allowed to precipitate if the solution became saturated. |
| | For the purposes of this preliminary water quality model, all run-off and seepage waters are considered to be collected and diverted to the TSF. |
| Mine Dewater | Water quality of groundwater seepage into the pit and the underground workings is taken from Hydrogeological Pre-Feasibility/EA Support Study Appendix E, AMEC 2014. However, because ARD reactions can occur at GW seeps into the underground workings, all groundwater pumped from the underground is estimated to have the same water quality as the pit wall run-off. |
| | Median results of Overburden SFE tests from appropriate area samples were used to represent overburden runoff from cover materials impaced upon the closed WRSF and pits (Table 6.9, KCB 2012). Concentrations were scaled based on the final area of each impoundment (as needed), assuming that the final area of the impoundment will be fully covered with overburden and a 0.5 m active depth into the surface of the overburden. The Overburden SFE test results were scaled to 50% of the SFE concentration to better approximate the long-term leachate profile, such as would be present in a humidity cell test (HTC) sample after steady state conditions have been established.* Background surface water quality was also used as a comparison using monitoring point TL2 median concentrations (Table 4.2, KCB 2012). |
| WRSF and Pit | All water contacting the waste rock was conservatively considered as seepage, assuming no kinetic limitations for water interaction with the rock surfaces. |
| | The ratio of the different rock types in the WRSFs and open pits were assumed to be constant through the life of mine and were based on the following percentages: 70% BMS, 20% MSSED, 15% MSS, and 5% BS. (e-mail communication from Mark Wheeler via Lara Reggin) |
| | For each rock type, the geometric average of the three columns were averaged over the given time interval to generate a loading for the initial period (<5 weeks), an intermediate steady state (20-40 weeks). After week 63, two of the three HTCs for each rock type were discontinued. For the long-term steady state (60-80 weeks), only a single column from each rock type remained in operation. (Treasury_HC Test Summary_29Apr14.xls, provided by EcoMetrix). |
| | All loading values were scaled to correct for surface area in the HTC vs. field conditions (0.10) and for rinsing efficiency (0.3) for a total scaling factor of 0.03. Calculated run-off concentrations were compared to measured values to calibrate the scaling assumptions, and were within a factor of 2 of the measured values. |
| | Because the oxidation of sulphur is exothermic, weathering reactions will generate an unknown quantity of heat which will affect the kinetics of the weathering reactions. At this time, temperature corrections to the reaction rates have not been considered and the laboratory-derived rates represent a conservative estimate of reaction times in the field. |
| | For the WRSFs, the quality of the leachate was scaled based on the total surface area, an assumed active depth of 3 meters, and total monthly precipitation. |
| | Pit wall runoff was assumed to be equal to the area of exposed pit wall, with an assumed active depth of 2.0 meters and a scaling factor of 0.03. |
| | During flooding, the pit lake will be formed by the accumulation of pit wall run-off and the collected groundwater seepage into the underground stopes with a total fill time of 3 years. |
| | An average density for waste rock of 2.7 tonnes/m ³ was used for all placed rock (WRSF and LGO stockpiles). |
| | Blasting residues, such as ammonia and nitrate, have not been considered in the water quality of the runoff from the pit or WRSF at this time. The water quality derived from the field test leachate was not scaled and is considered to be directly representative of the run-off water quality. |
| Ore Stockpile | Geochemical characterization of the low grade ore has not yet been completed. The water quality of the MSS host rock has been used as a surrogate for the low grade ore as a preliminary approximation. The water quality of the runoff from the ore stockpile was calculated based on the surface area and assumed an active depth of 3.0 meters. |
| | For MSS host rock surrogate data, the geometric average of the three columns were averaged over the given time interval to generate a loading for the initial period (<5 weeks), an intermediate steady state (20-40 weeks). After week 63, two of the three HTCs for each rock type were discontinued. For the long-term steady state (60-80 weeks), only a single column from each rock type remained in operation. (Treasury_HC Test Summary_29Apr14.xls, provided by EcoMetrix). |
| | All loading values were scaled to correct for surface area in the HTC vs. field conditions (0.10) and for rinsing efficiency (0.3) for a total scaling factor of 0.03. Calculated run-off concentrations were compared to measured values to calibrate the scaling assumptions, and were within a factor of 2 of the measured values. |
| | Because the oxidation of sulphur is exothermic, weathering reactions will generate an unknown quantity of heat which will affect the kinetics of the weathering reactions. At this time, temperature corrections to the reaction rates have not been considered and the laboratory-derived rates represent a conservative estimate of reaction times in the field. |
| | The quality of the leachate was scaled based on the total surface area, an assumed active depth of 3 meters, and total annual precipitation. |
| Collection Ponds | Collection ponds will have no carry-over volume from year-to-year and are considered temporary storage only. |
| | Tailings HTC data was originally reported in the "DRAFT Geochemical Evaluation of the Goliath Gold Project" (Ecometrix, 2013). |
| TSF | In accordance with the water management strategy (Lycopodium, 2014), all tailings material shall be deposited sub-aqueously. However, a maximum exposed tailings area of 10% of the TSF footprint has been assumed to provide a conservative estimate of TSF water quality. As such, the water quality of mill outflows are presented in Table 1 of the "Goliath Gold Project Pre-Feasibility Water Management Strategy" (Lycopodium June 2014) will be blended with tails and other site runoff and precipitation to determine the water quality of the TSF and subsequently the Polishing Pond. |
| | Because Tailings HTC material is identical to material ultimately deposited in the TSF, the HTC loading data did not require scaling to represent field conditions as was done for waste rock, LGO, and pit walls. |
| | Any and all water discharged from the TSF will be contained within Polishing Pond, which will contain no other inflows. |
| Treated Effluent | Water quality of treated effluent (inputs into the Polishing Pond) are presented in Table 1 of the "Goliath Gold Project Pre-Feasibility Water Management Strategy", Lycopodium June 2014. For concentrations reported as less than the analytical detection limit, the numerical value of the analytical detection limit was used in lieu of the 1/2 detection limit value typically employed. This approach will provide a more conservative estimate of site effluent water quality. |

*SFE tests are static, short-term tests which involve saturating and then agitating a sample for 24 hours, thus mobilizing all soluble constituents and maximizing their concentrations in the solution. These tests, therefore, do not represent site conditions and the results cannot be used to directly represent seepage or runoff from the rock. In contrast, humidity cell tests (HCTs) are longer-term, kinetic tests which run for at least 40 weeks and leached using a water:rock ratio that is more analogous to weathering that would occur on site. Therefore, results of HCTs are often used to directly represent leachates that will be derived under field conditions. Since no HCTs were conducted on overburden, there is no data available to represent overburden runoff. To develop appropriate overburden source terms, we examined the relationship between leachate concentrations derived from SFEs and HCTs from waste rock and determined that, in general, steady-state HCTs concentrations are half of those from SFEs. Therefore, we decreased the overburden SFE concentrations by 50% to obtain source terms.

Source Terms

Source terms are defined as unique water qualities derived from measurements or calculations and are not developed from modeling. The references for each term is provided in Assumptions and Refs. All other terms are modeled from these values.

| Source Group | Notes | Description | pH | Sulphate | Al | Sb | As | Ba | Be | Bi | B | Cd | Co | Cr | Cu | Fe | Pb | Li | Mg | Mn | Mo | |
|--------------------------------|---------------------------------|---------------------------------|-------|----------|---------|---------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------|
| | | | | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | |
| CCME (Max Monthly Mean) | | | 6.5 | 0.1 | 0.005 | 0.005 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 1.5 | 0.00009 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.073 | |
| MMER (Max Monthly Mean) | | | | | | | | | | | | | | | | | | | | | | |
| Background waters | Calculated | Precipitation | 5.62 | 0.00 | 0.00000 | 0.00000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.00 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | |
| Background waters | Field Data | Groundwater | 22.04 | 0.2109 | 0.00054 | 0.00235 | 0.00463 | 0.0015 | 0.0022 | 0.007 | 0.000027 | 57.86 | 0.00195 | 0.00021 | 0.000995 | 0.654 | 0.00171 | 0.07293 | 14.26 | 0.2630 | 0.00655 | |
| Background waters | Field Data | Surface Water Quality - T12 | 7.30 | 1.30 | 0.5901 | 0.00000 | 0.00110 | 0.021001 | 0.000000 | 0.000000 | 0.000000 | 0.000045 | 21.00 | 0.00140 | 0.00210 | 0.00130 | 3.000 | 0.000490 | 0.00000 | 6.30 | 0.7901 | |
| Treated Effluent Source | See Assumptions | Treated Effluent | 8.80 | 1270 | 1.6020 | 0.00000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.00 | 0.0102 | 0.03605 | 0.000000 | 3.74 | 0.000000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | |
| Overburden Source | Site data | Overburden Run-off | 6.60 | 0.00 | 40.046 | 0.00026 | 3.840461 | 0.0002 | 0.0083 | 2.43 | 0.015474 | 327.67 | 0.2026 | 0.10487 | 0.28871 | 50.059 | 0.25038 | 0.00000 | 86.14 | 0.0086 | 0.00825 | |
| Tailings Source | HTC data, Dissolved Metals Only | Tailings Run-off - Initial | 6.512 | 2.79 | 0.1476 | 0.00022 | 0.11370 | 0.783756 | 0.0165 | 0.0506 | 1.07 | 0.020468 | 412.61 | 0.01098 | 0.06995 | 0.02318 | 1.441 | 1.20029 | 0.29688 | 130.25 | 6.957 | 0.27282 |
| Tailings Source | | Tailings Run-off - Intermediate | 6.44 | 2526 | 0.2123 | 0.33591 | 0.01033 | 0.1065190 | 0.0102 | 0.0512 | 1.03 | 0.033496 | 492.06 | 0.01025 | 0.05502 | 0.15032 | 0.960 | 1.505304 | 0.05310 | 69.07 | 14.096 | 0.05123 |
| Tailings Source | | Tailings Run-off - Final | 4.42 | 18982 | 0.57394 | 0.08778 | 0.34459 | 1.652335 | 0.183 | 0.0572 | 1.14 | 1.652313 | 242.91 | 0.0114 | 1.82734 | 13.38979 | 103.649 | 0.378 | 621.680 | 0.1321 | 73.98 | 44.0707 |
| Waste Rock Source | BMS - Initial | Waste Rock | 7.54 | 63.09 | 0.01868 | 0.01837 | 0.013168 | 0.010 | 0.0050 | 0.14 | 0.000199 | 68.29 | 0.0124 | 0.01478 | 0.01354 | 0.338 | 0.00450 | 0.00010 | 12.34 | 0.3380 | 0.01769 | |
| Waste Rock Source | BMS - Intermediate | Waste Rock | 7.50 | 40.60 | 0.00899 | 0.00899 | 0.00944 | 0.011 | 0.0050 | 0.12 | 0.000161 | 58.82 | 0.0124 | 0.00620 | 0.01260 | 0.179 | 0.01749 | 0.00000 | 7.86 | 0.2618 | 0.00453 | |
| Waste Rock Source | BS - Initial | Waste Rock | 7.70 | 52.40 | 0.08675 | 0.08411 | 0.02869 | 0.039322 | 0.0010 | 0.0050 | 0.13 | 0.000245 | 67.86 | 0.0113 | 0.01385 | 0.00002 | 0.218 | 0.009582 | 0.00698 | 9.48 | 0.1799 | 0.03078 |
| Waste Rock Source | BMS - Initial | Waste Rock | 7.84 | 91.85 | 0.01639 | 0.01672 | 0.026164 | 0.010 | 0.0050 | 0.11 | 0.000178 | 107.05 | 0.0127 | 0.00917 | 0.00939 | 0.454 | 0.00139 | 0.00000 | 17.07 | 17.04 | 0.9623 | 0.13487 |
| Waste Rock Source | BMS - Intermediate | Waste Rock | 6.47 | 19.75 | 0.0078 | 0.0078 | 0.00806 | 0.010 | 0.0050 | 0.12 | 0.000537 | 26.49 | 0.0101 | 0.00731 | 0.00787 | 0.147 | 0.00258 | 0.00593 | 1.88 | 0.1750 | 0.00503 | |
| Waste Rock Source | BMS - Intermediate | Waste Rock | 6.58 | 13.60 | 0.00895 | 0.00952 | 0.010410 | 0.005 | 0.0050 | 0.12 | 0.000909 | 24.96 | 0.0114 | 0.01196 | 0.00967 | 0.109 | 0.002320 | 0.00593 | 1.58 | 0.2248 | 0.00503 | |
| Waste Rock Source | BS - Intermediate | Waste Rock | 6.61 | 20.05 | 0.0098 | 0.00750 | 0.00500 | 0.002352 | 0.010 | 0.0050 | 0.12 | 0.000308 | 28.19 | 0.0101 | 0.01379 | 0.00887 | 0.107 | 0.003300 | 0.00503 | 1.55 | 0.1422 | 0.00503 |
| Waste Rock Source | BMS - Intermediate | Waste Rock | 6.68 | 22.03 | 0.0132 | 0.01207 | 0.00450 | 0.002195 | 0.010 | 0.0050 | 0.12 | 0.000152 | 44.57 | 0.0113 | 0.00323 | 0.00769 | 0.183 | 0.003220 | 0.00593 | 2.47 | 0.4623 | 0.01053 |
| Waste Rock Source | BMS - Long Term | Waste Rock | 31.22 | 0.0671 | 0.00101 | 0.00378 | 0.023746 | 0.010 | 0.0050 | 0.12 | 0.001648 | 32.36 | 0.00281 | 0.00507 | 0.01057 | 0.101 | 0.000727 | 0.00593 | 1.47 | 0.3136 | 0.00503 | |
| Waste Rock Source | BMS - Long Term | Waste Rock | 5.69 | 14.50 | 0.0057 | 0.00342 | 0.00374 | 0.018805 | 0.010 | 0.0050 | 0.12 | 0.002521 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | 0.00593 | 1.17 | 0.2629 | 0.00503 |
| Waste Rock Source | BS - Long Term | Waste Rock | 5.79 | 31.50 | 0.0736 | 0.00225 | 0.00241 | 0.001442 | 0.010 | 0.0050 | 0.13 | 0.000366 | 29.31 | 0.0101 | 0.00663 | 0.01230 | 0.101 | 0.008676 | 0.00615 | 1.83 | 0.1396 | 0.00503 |
| Waste Rock Source | BMS - Long Term | Waste Rock | 6.30 | 27.52 | 0.0142 | 0.01411 | 0.02025 | 0.02252 | 0.010 | 0.0050 | 0.13 | 0.000922 | 46.76 | 0.0101 | 0.00358 | 0.01214 | 0.101 | 0.007784 | 0.00593 | 2.15 | 0.0690 | 0.00503 |
| Waste Rock and Pit Wall Source | BMS - Initial | Waste Rock | 5.87 | 15.87 | 0.0500 | 0.01668 | 0.01621 | 0.011619 | 0.009 | 0.0044 | 0.11 | 0.000172 | 60.26 | 0.0101 | 0.01304 | 0.01294 | 0.299 | 0.009718 | 0.00593 | 10.89 | 0.2983 | 0.00593 |
| Pit Wall Source | BMS - Initial | Waste Rock | 7.50 | 35.30 | 0.7358 | 0.07940 | 0.04111 | 0.008324 | 0.009 | 0.0044 | 0.11 | 0.000318 | 49.25 | 0.0109 | 0.00547 | 0.01129 | 0.158 | 0.01511 | 0.00444 | 6.93 | 0.2310 | 0.03762 |
| Pit Wall Source | BS - Initial | Waste Rock | 7.70 | 46.24 | 0.07421 | 0.02531 | 0.034694 | 0.009 | 0.0044 | 0.12 | 0.000216 | 58.88 | 0.0117 | 0.01222 | 0.00768 | 0.192 | 0.008454 | 0.00616 | 3.86 | 0.1535 | 0.00371 | |
| Pit Wall Source | BMS - Initial | Waste Rock | 7.84 | 81.04 | 0.0192 | 0.02023 | 0.01475 | 0.023085 | 0.009 | 0.0044 | 0.10 | 0.000517 | 94.46 | 0.0112 | 0.00809 | 0.00887 | 0.403 | 0.001270 | 0.0024 | 15.04 | 0.8472 | 0.01190 |
| Pit Wall Source | BMS - Intermediate | Waste Rock | 7.43 | 17.43 | 0.0161 | 0.0161 | 0.0161 | 0.0161 | 0.009 | 0.0044 | 0.10 | 0.000974 | 23.17 | 0.0101 | 0.00947 | 0.123 | 0.00174 | 0.0024 | 1.66 | 0.154 | 0.00443 | |
| Pit Wall Source | BMS - Intermediate | Waste Rock | 6.59 | 12.00 | 0.00878 | 0.00796 | 0.009185 | 0.009 | 0.0044 | 0.10 | 0.000537 | 24.23 | 0.0101 | 0.01408 | 0.00587 | 0.109 | 0.007317 | 0.00444 | 1.39 | 0.1844 | 0.00461 | |
| Pit Wall Source | BS - Intermediate | Waste Rock | 6.61 | 17.69 | 0.0081 | 0.00662 | 0.00490 | 0.020816 | 0.009 | 0.0044 | 0.10 | 0.000272 | 24.87 | 0.0089 | 0.01129 | 0.00606 | 0.095 | 0.002912 | 0.00444 | 1.37 | 0.1254 | 0.00443 |
| Pit Wall Source | BMS - Intermediate | Waste Rock | 6.68 | 19.44 | 0.02783 | 0.01055 | 0.00387 | 0.018877 | 0.009 | 0.0044 | 0.10 | 0.000134 | 39.33 | 0.0101 | 0.00205 | 0.00679 | 0.162 | 0.002841 | 0.00444 | 2.18 | 0.3902 | 0.00429 |
| Pit Wall Source | BMS - Long Term | Waste Rock | 5.69 | 12.54 | 0.0057 | 0.00342 | 0.00374 | 0.018805 | 0.010 | 0.0050 | 0.12 | 0.000152 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | 0.00593 | 1.17 | 0.2629 | 0.00503 |
| Pit Wall Source | BMS - Long Term | Waste Rock | 5.69 | 12.80 | 0.0844 | 0.00302 | 0.00330 | 0.016592 | 0.009 | 0.0044 | 0.11 | 0.002224 | 13.88 | 0.0089 | 0.00455 | 0.00242 | 0.114 | 0.012388 | 0.00444 | 1.01 | 0.2302 | 0.00443 |
| Pit Wall Source | BS - Long Term | Waste Rock | 5.79 | 27.79 | 0.0049 | 0.00199 | 0.00248 | 0.012478 | 0.012 | 0.0044 | 0.11 | 0.000233 | 25.86 | 0.0089 | 0.00585 | 0.00285 | 0.089 | 0.007655 | 0.00543 | 1.61 | 0.1232 | 0.00443 |
| Pit Wall Source | BMS - Long Term | Waste Rock | 6.30 | 24.28 | 0.01096 | 0.01245 | 0.01181 | 0.019899 | 0.009 | 0.0044 | 0.11 | 0.000284 | 41.25 | 0.0089 | 0.01316 | 0.00713 | 0.089 | 0.008888 | 0.00444 | 1.90 | 0.9943 | 0.00443 |
| Low Grade Ore Source | HTC, Dissolved Metals Only | Low Grade Ore | 6.50 | 40.00 | 0.0896 | 0.0896 | 0.0896 | 0.0896 | 0.010 | 0.0050 | 0.12 | 0.000161 | 58.82 | 0.0124 | 0.00620 | 0.01260 | 0.179 | 0.01749 | 0.00000 | 7.86 | 0.2618 | 0.00453 |
| Low Grade Ore Source | HTC, Dissolved Metals Only | Low Grade Ore | 6.59 | 13.60 | 0.00895 | 0.00995 | 0.010410 | 0.005 | 0.0050 | 0.12 | 0.000909 | 24.96 | 0.0114 | 0.01196 | 0.00967 | 0.109 | 0.002320 | 0.00593 | 1.58 | 0.2248 | 0.00503 | |
| Low Grade Ore Source | HTC, Dissolved Metals Only | Low Grade Ore | 6.61 | 14.50 | 0.00987 | 0.00811 | 0.00500 | 0.002352 | 0.010 | 0.0050 | 0.12 | 0.000308 | 28.19 | 0.0101 | 0.01379 | 0.00887 | 0.107 | 0.003300 | 0.00593 | 1.55 | 0.1422 | 0.00503 |
| Low Grade Ore Source | HTC, Dissolved Metals Only | Low Grade Ore | 6.68 | 15.87 | 0.0132 | 0.01207 | 0.00450 | 0.002195 | 0.010 | 0.0050 | 0.12 | 0.000152 | 44.57 | 0.0113 | 0.00323 | 0.00769 | 0.183 | 0.003220 | 0.00593 | 2.47 | 0.4623 | 0.01053 |
| Low Grade Ore Source | HTC, Dissolved Metals Only | Low Grade Ore | 31.22 | 0.0671 | 0.00101 | 0.00378 | 0.023746 | 0.010 | 0.0050 | 0.12 | 0.001648 | 32.36 | 0.00281 | 0.00507 | 0.01057 | 0.101 | 0.000727 | 0.00593 | 1.47 | 0.3136 | 0.00503 | |
| Low Grade Ore Source | HTC, Dissolved Metals Only | Low Grade Ore | 5.69 | 14.50 | 0.0057 | 0.00342 | 0.00374 | 0.018805 | 0.010 | 0.0050 | 0.12 | 0.000152 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | 0.00593 | 1.17 | 0.2629 | 0.00503 |
| Waste Rock and Pit Wall Source | BMS - Initial | Waste Rock | 6.92 | 26.88 | 0.00587 | 0.00295 | 0.00350 | 0.005000 | 0.005 | 0.005 | 0.03 | 0.000251 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | 0.00593 | 1.17 | 0.2629 | 0.00503 |
| Waste Rock and Pit Wall Source | BMS - Initial | Waste Rock | 6.96 | 30.28 | 0.00587 | 0.00295 | 0.00350 | 0.005000 | 0.005 | 0.005 | 0.03 | 0.000251 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | 0.00593 | 1.17 | 0.2629 | 0.00503 |
| Waste Rock and Pit Wall Source | BMS - Initial | Waste Rock | 6.98 | 32.88 | 0.00587 | 0.00295 | 0.00350 | 0.005000 | 0.005 | 0.005 | 0.03 | 0.000251 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | 0.00593 | 1.17 | 0.2629 | 0.00503 |
| Waste Rock and Pit Wall Source | BMS - Initial | Waste Rock | 6.98 | 32.88 | 0.00587 | 0.00295 | 0.00350 | 0.005000 | 0.005 | 0.005 | 0.03 | 0.000251 | 15.73 | 0.0101 | 0.00165 | 0.00768 | 0.129 | 0.004327 | | | | |

Model Outputs

| Source Group | Notes | Description | pH | Hardness | Sulphate | Al | Sb | As | Ba | Be | Bi | B | Cd | Ca | Cr | Co | Cu | Fe | Pb | Li | Mg | Mn | Mo | Hg |
|-------------------------|---------------------------------|---|------|--------------|----------|---------------|---------|----------------|----------|--------|--------|--------|-----------------|--------|---------|---------|----------------|--------------|-----------------|---------|--------|--------|----------|-----------------|
| | | | | (mg/L CaCO3) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| CCME | | | 6.5 | | | 0.1 | | 0.005 | | | | 1.5 | 0.00009 | | | | 0.002 | 0.3 | 0.001 | | | | 0.073 | 0.000026 |
| MMER (Max Monthly Mean) | | | | | | | | 0.5 | | | | | | | | | 0.3 | | 0.2 | | | | | |
| Contact Water | | WRSF Run-off - Initial | 7.58 | 215.84 | 58.74 | 0.7758 | 0.04137 | 0.02484 | 0.016646 | 0.0010 | 0.0050 | 0.14 | 0.000231 | 67.73 | 0.00125 | 0.01284 | 0.01224 | 0.298 | 0.007359 | 0.06007 | 11.35 | 0.3301 | 0.006762 | 0.000000 |
| Contact Water | | WRSF Run-off - Intermediate | 6.52 | 75.17 | 18.78 | 0.1090 | 0.00479 | 0.00445 | 0.011235 | 0.0010 | 0.0050 | 0.12 | 0.000501 | 27.10 | 0.00104 | 0.00941 | 0.00724 | 0.136 | 0.010995 | 0.00503 | 1.81 | 0.1917 | 0.000531 | 0.000000 |
| Contact Water | | WRSF Run-off - Long Term | 5.80 | 80.39 | 28.05 | 0.0758 | 0.00221 | 0.00356 | 0.021484 | 0.0011 | 0.0050 | 0.13 | 0.001572 | 29.70 | 0.00216 | 0.00459 | 0.01024 | 0.106 | 0.093681 | 0.00518 | 1.49 | 0.2964 | 0.000503 | 0.000000 |
| Collection Pond | | WRSF/LGO Run-off - Initial | 7.58 | 215.78 | 58.72 | 0.7759 | 0.04144 | 0.02487 | 0.016636 | 0.0010 | 0.0050 | 0.14 | 0.000232 | 67.71 | 0.00125 | 0.01283 | 0.01224 | 0.298 | 0.007373 | 0.06007 | 11.34 | 0.3300 | 0.006758 | 0.000000 |
| Collection Pond | | WRSF/LGO Run-off - Intermediate | 6.51 | 75.16 | 18.77 | 0.1089 | 0.00480 | 0.00446 | 0.011233 | 0.0010 | 0.0050 | 0.12 | 0.000501 | 27.10 | 0.00104 | 0.00941 | 0.00723 | 0.136 | 0.011041 | 0.00503 | 1.81 | 0.1918 | 0.000531 | 0.000000 |
| Collection Pond | | WRSF/LGO Run-off - Long Term | 5.79 | 80.34 | 28.03 | 0.0758 | 0.00221 | 0.00356 | 0.021480 | 0.0011 | 0.0050 | 0.13 | 0.001573 | 29.68 | 0.00215 | 0.00459 | 0.01024 | 0.106 | 0.094077 | 0.00518 | 1.49 | 0.2964 | 0.000503 | 0.000000 |
| Contact Water | HTC Data, Dissolved Metals Only | Mine Dewater WQ - Initial | 7.58 | 190.43 | 51.83 | 0.6845 | 0.03650 | 0.02191 | 0.014687 | 0.0009 | 0.0044 | 0.12 | 0.000704 | 59.76 | 0.00111 | 0.01133 | 0.01080 | 0.263 | 0.066493 | 0.00536 | 10.01 | 0.2912 | 0.002966 | 0.000000 |
| Contact Water | | Mine Dewater WQ - Initial | 6.52 | 66.33 | 16.57 | 0.0961 | 0.00423 | 0.00393 | 0.009913 | 0.0009 | 0.0044 | 0.10 | 0.000442 | 23.91 | 0.00091 | 0.00830 | 0.00638 | 0.120 | 0.009702 | 0.00444 | 1.60 | 0.1692 | 0.000469 | 0.000000 |
| Contact Water | | Mine Dewater WQ - Initial | 5.79 | 70.93 | 24.75 | 0.0669 | 0.00195 | 0.00195 | 0.018956 | 0.0009 | 0.0044 | 0.11 | 0.001387 | 26.21 | 0.00190 | 0.00405 | 0.00904 | 0.093 | 0.082658 | 0.00457 | 1.32 | 0.2616 | 0.000443 | 0.000000 |
| TSF | | TSF - Initial | 7.50 | 189.44 | 101.38 | 0.7201 | 0.03848 | 0.03575 | 0.014538 | 0.0009 | 0.0043 | 0.12 | 0.000321 | 59.74 | 0.00148 | 0.01222 | 0.02074 | 0.303 | 0.009569 | 0.00528 | 9.78 | 0.2828 | 0.005847 | 0.016116 |
| TSF | | TSF - Intermediate | 6.50 | 64.92 | 65.12 | 0.1521 | 0.00426 | 0.01849 | 0.015940 | 0.0009 | 0.0043 | 0.10 | 0.002485 | 23.16 | 0.00129 | 0.00945 | 0.01661 | 0.166 | 0.079950 | 0.00427 | 1.71 | 0.1739 | 0.000451 | 0.016116 |
| TSF | | TSF - Long Term | 4.83 | 68.94 | 83.51 | 0.1793 | 0.00192 | 0.01796 | 0.019175 | 0.0009 | 0.0043 | 0.11 | 0.003785 | 25.20 | 0.00224 | 0.00640 | 0.03151 | 0.206 | 1.195170 | 0.00445 | 1.45 | 0.2782 | 0.000427 | 0.016116 |
| Contact Water | | WRSF Run-off and Mine Dewater- Initial | 6.73 | 43.82 | 28.14 | 0.1736 | 0.00445 | 0.00197 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000118 | 13.50 | 0.00050 | 0.00508 | 0.01255 | 0.296 | 0.006346 | 0.02501 | 2.46 | 0.1109 | 0.001180 | 0.000005 |
| Contact Water | | WRSF Run-off and Mine Dewater- Intermediate | 6.33 | 23.20 | 15.44 | 0.1397 | 0.00230 | 0.00192 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000056 | 7.16 | 0.00050 | 0.00210 | 0.00657 | 0.318 | 0.005130 | 0.02501 | 1.30 | 0.0520 | 0.000695 | 0.000005 |
| Contact Water | | WRSF Run-off and Mine Dewater- Final | 6.33 | 23.20 | 15.44 | 0.1397 | 0.00230 | 0.00192 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000056 | 7.16 | 0.00050 | 0.00210 | 0.00657 | 0.318 | 0.005130 | 0.02501 | 1.30 | 0.0520 | 0.000695 | 0.000005 |
| Collection Pond | | WRSF/LGO Run-off - Initial | 6.72 | 43.82 | 28.15 | 0.1734 | 0.00447 | 0.00197 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000119 | 13.50 | 0.00050 | 0.00507 | 0.01257 | 0.296 | 0.006361 | 0.02501 | 2.45 | 0.1109 | 0.001181 | 0.000005 |
| Collection Pond | | WRSF/LGO Run-off - Intermediate | 6.33 | 23.19 | 15.43 | 0.1397 | 0.00231 | 0.00192 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000056 | 7.15 | 0.00050 | 0.00210 | 0.00657 | 0.317 | 0.005143 | 0.02501 | 1.29 | 0.0519 | 0.000696 | 0.000005 |
| Collection Pond | | WRSF/LGO Run-off - Long Term | 6.33 | 23.19 | 15.43 | 0.1397 | 0.00231 | 0.00192 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000056 | 7.15 | 0.00050 | 0.00210 | 0.00657 | 0.317 | 0.005143 | 0.02501 | 1.29 | 0.0519 | 0.000695 | 0.000000 |
| TSF | | TSF - Initial | 6.70 | 49.87 | 83.56 | 0.2375 | 0.00818 | 0.01809 | 0.005308 | 0.0005 | 0.0005 | 0.02 | 0.000251 | 15.74 | 0.00094 | 0.00636 | 0.02336 | 0.338 | 0.009722 | 0.02397 | 2.57 | 0.1104 | 0.001283 | 0.001775 |
| TSF | | TSF - Intermediate | 6.16 | 23.77 | 68.67 | 0.1989 | 0.00243 | 0.01796 | 0.011840 | 0.0005 | 0.0005 | 0.02 | 0.002311 | 7.15 | 0.00094 | 0.00366 | 0.01776 | 0.358 | 0.082283 | 0.02383 | 1.44 | 0.0629 | 0.000665 | 0.001775 |
| TSF | | TSF - Long Term | 6.08 | 23.34 | 80.25 | 0.2592 | 0.00225 | 0.01820 | 0.005919 | 0.0005 | 0.0005 | 0.02 | 0.002747 | 6.98 | 0.00094 | 0.00477 | 0.03130 | 0.430 | 1.227826 | 0.02388 | 1.44 | 0.0805 | 0.000009 | 0.001770 |
| Contact Water | | WRSF Run-off and Mine Dewater- Initial | 6.66 | 41.77 | 30.26 | 0.0669 | 0.00432 | 0.00101 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000111 | 12.91 | 0.00050 | 0.00392 | 0.00978 | 0.012 | 0.002090 | 0.02501 | 2.32 | 0.0799 | 0.000800 | 0.000005 |
| Contact Water | | WRSF Run-off and Mine Dewater- Intermediate | 6.33 | 24.87 | 15.44 | 0.0345 | 0.00238 | 0.00162 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000044 | 7.77 | 0.00050 | 0.00234 | 0.00473 | 0.087 | 0.001660 | 0.02501 | 1.33 | 0.0162 | 0.000590 | 0.000005 |
| Contact Water | | WRSF Run-off and Mine Dewater- Final | 6.33 | 24.87 | 15.44 | 0.0345 | 0.00238 | 0.00162 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000300 | 23.05 | 0.00050 | 0.01766 | 0.00468 | 0.010 | 0.005760 | 0.02501 | 3.44 | 0.3163 | 0.000590 | 0.000005 |
| Collection Pond | | WRSF/LGO Run-off - Initial | 6.66 | 41.77 | 30.26 | 0.0669 | 0.00434 | 0.00101 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000112 | 12.91 | 0.00050 | 0.00392 | 0.00980 | 0.012 | 0.002105 | 0.02501 | 2.32 | 0.0799 | 0.000801 | 0.000005 |
| Collection Pond | | WRSF/LGO Run-off - Intermediate | 6.33 | 24.85 | 15.43 | 0.0345 | 0.00239 | 0.00162 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000044 | 7.76 | 0.00050 | 0.00234 | 0.00473 | 0.087 | 0.001667 | 0.02501 | 1.33 | 0.0162 | 0.000590 | 0.000005 |
| Collection Pond | | WRSF/LGO Run-off - Long Term | 6.32 | 24.85 | 15.43 | 0.0345 | 0.00239 | 0.00162 | 0.005000 | 0.0005 | 0.0005 | 0.03 | 0.000301 | 23.04 | 0.00050 | 0.01764 | 0.00468 | 0.010 | 0.005742 | 0.02501 | 3.44 | 0.3160 | 0.000590 | 0.000005 |
| TSF | | TSF - Initial | 6.65 | 47.92 | 85.57 | 0.0789 | 0.00805 | 0.01718 | 0.005308 | 0.0005 | 0.0005 | 0.02 | 0.000244 | 15.17 | 0.00094 | 0.00526 | 0.02072 | 0.068 | 0.005674 | 0.02397 | 2.44 | 0.0809 | 0.000921 | 0.001775 |
| TSF | | TSF - Intermediate | 6.16 | 25.35 | 68.67 | 0.0798 | 0.00250 | 0.01768 | 0.011840 | 0.0005 | 0.0005 | 0.02 | 0.002300 | 7.74 | 0.00094 | 0.00198 | 0.01601 | 0.138 | 0.078983 | 0.02383 | 1.47 | 0.0288 | 0.000565 | 0.001775 |
| TSF | | TSF - Long Term | 6.08 | 69.50 | 80.25 | 0.1324 | 0.00089 | 0.001695 | 0.005919 | 0.0005 | 0.0005 | 0.02 | 0.002980 | 22.10 | 0.00094 | 0.01957 | 0.02950 | 0.138 | 1.223661 | 0.02388 | 3.48 | 0.3319 | 0.000565 | 0.001775 |

| Source Group | Notes | Description | Ni | P | K | Se | Si | Ag | Na | Sr | S | Ti | Sn | Tl | U | V | Zn | Nitrate | Ammonia | Carbonate | Cyanide | Cl |
|-------------------------|-------|---------------------------------|---------------|-------------|--------|---------------|--------|-----------------|--------|--------|--------|----------|---------|--------|----------|--------|---------------|---------|---------|-----------|---------|--------|
| | | | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |
| CCME | | | 0.025 | 0.004 | | 0.001 | | 0.001 | | | | 0.0008 | | | 0.015 | | 0.03 | 13 | 15.3 | | 0.005 | 120 |
| MMER (Max Monthly Mean) | | | 0.5 | | | | | | | | | | | | | | 0.5 | | | | 1 | |
| Contact Water | | WRSF Run-off - Initial | 0.1149 | 3.02 | 43.22 | 0.0014 | 3.232 | 0.029015 | 17.38 | 0.2601 | 19.62 | 0.000130 | 0.00101 | 0.101 | 0.010328 | 0.0101 | 0.0703 | 0.00 | 0.00 | 121.42 | 0.00 | 0.00 |
| Contact Water | | WRSF Run-off - Intermediate | 0.0360 | 3.02 | 9.38 | 0.0010 | 1.340 | 0.000974 | 3.97 | 0.0712 | 6.27 | 0.000121 | 0.00101 | 0.100 | 0.001693 | 0.0101 | 0.1494 | 0.00 | 0.00 | 226.75 | 0.00 | 0.00 |
| Contact Water | | WRSF Run-off - Long Term | 0.0806 | 3.02 | 8.86 | 0.0010 | 9.716 | 0.000101 | 7.89 | 0.0686 | 9.37 | 0.000101 | 0.00101 | 0.100 | 0.001862 | 0.0101 | 0.5111 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Collection Pond | | WRSF/LGO Run-off - Initial | 0.1148 | 3.02 | 43.19 | 0.0014 | 3.232 | 0.028977 | 17.37 | 0.2600 | 19.61 | 0.000130 | 0.00101 | 0.101 | 0.010322 | 0.0101 | 0.0703 | 0.00 | 0.00 | 121.42 | 0.00 | 0.00 |
| Collection Pond | | WRSF/LGO Run-off - Intermediate | 0.03 | | | | | | | | | | | | | | | | | | | |