



**FIRST MINING
GOLD**



APPENDIX K

GEOCHEMISTRY TECHNICAL SUPPORT DOCUMENTS

- K-1.1 Static Testing Baseline Report 2021
- K-1.2 Tailings ML/ARD Assessment – Static Testing Results
- K-1.3 Kinetic Geochemistry Report 2023
- K-1.4 Static Geochemical Characterization of Overburden and the Fish Habitat Development Area
- K-1.5 Static Geochemical Characterization of Springpole Lake Sediment Samples
- K-1.6 Preliminary Geochemical Assessment of CDF Quarry
- K-2 Mine Site Water Quality Modelling Report**



Mine Site Water Quality Modelling Report

Springpole Gold Project
First Mining Gold Corp.

ONS2104

Prepared by:
WSP Canada Inc.

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Mine Site Water Quality Modelling Report Springpole Gold Project

Red Lake District, Northwest Ontario
Project #ONS2104

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EXECUTIVE SUMMARY

First Mining Gold Corp. proposes to develop an open pit gold and silver mine with supporting facilities known as the Springpole Gold Project (Project). The Project is located in a remote area of northwestern Ontario, approximately 110 kilometres (km) northeast of the Municipality of Red Lake and 145 km north of the Municipality of Sioux Lookout.

An environmental assessment pursuant to the *Canadian Environmental Assessment Act, 2012* (SC 2012, c. 19, s. 52) and the Ontario *Environmental Assessment Act* (RSO 1990, c. E.18) is required to be completed for the Project. This report is one of a series of Technical Support Documents prepared by WSP Canada Inc. on behalf of First Mining Gold Corp. to support the predicted environmental effects of the Project.

This report presents the water quality estimates prepared for the Project to support the Environmental Impact Statement / Environmental Assessment. The results of the water quality estimates represent contact water quality for the mine site. These results are used as an input to the Surface Water Quality Model (Appendix N-2, WSP 2024a) and Effects Assessment, which ultimately informs water management and mitigation measures to protect the receiving environment.

The water quality estimates were developed for the operations and closure phases using a mass balance approach modelled in GoldSim (version 14.0). As part of the water quality estimate, geochemical modelling was conducted in PHREEQC (version 3.4.0) to incorporate non-conservative geochemical processes (e.g., solubility, adsorptive controls) at selected model nodes. The model included an assessment of on site water quality for key mine features: a) the maximum Project extent (year 10 of operations); b) year 1 of active closure conditions; and c) long-term steady state closure conditions (i.e., post-closure). Water quality estimates for operations include the co-disposal facility (CDF) contact water (representing drainage captured in the ditch and fugitive seepage), seepage from the low-grade ore stockpile, and the influent to the effluent treatment plant. For the mine closure estimates, CDF contact water and fugitive seepage, as well as water quality for rehabilitated catchments, including the former ore stockpile, plant site, and surficial soil stockpile areas were included. Water quality estimates for the refilled open pit basin are provided in the Predictive Modeling of Open Pit Basin Water Quality (Lorax 2024).

The mine site water quality estimates were prepared using the average annual monthly water balance (WSP 2024b), along with mine planning information and geochemical data (Wood 2021, 2022; WSP 2024c,d). Model parameters included aluminum, arsenic, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, sulphate, thallium, uranium, vanadium and zinc. Water quality estimates included an Expected Case scenario and a Conservative Case scenario. Model source terms for mine rock and tailings were varied between the two scenarios based on currently available geochemical test results.

The active closure model results had elevated concentrations of sulphate and metals due to mass load accumulation within the CDF-process plant circuit, because the CDF drainage is being used as reclaim water at the process plant. It was therefore assumed that some form of water treatment would be used to manage concentrations of sulphate and metals in the tailings discharge, reducing the potential for load accumulation to occur. Water treatment of the tailings discharge was incorporated into the model by the addition of calcium and iron as part of geochemical modelling in PHREEQC, to enhance natural solubility controls and manage concentrations of sulphate and metals respectively. Water treatment of the tailings discharge water will require further assessment in the next stage of Project engineering. Overall, process water deposited with the tailings in the CDF represents the predominant source of mass load to the CDF contact water.

The water quality estimates show that during operations, minewater reporting to the effluent treatment plant had an acidic pH and would require management before discharge to the environment. Key sources of mass load to the effluent treatment plant include process water reclaimed from the CDF and mine water pumped from the open pit during operations. This contact water will be managed at the ETP during operations.

Post-closure water quality, representing long-term steady state conditions, was estimated for fugitive seepage from the CDF and contact water collected in the drainage ditch. The water quality estimate results were assessed in the Surface Water Quality Model (Appendix N-2, WSP 2024a) and Effects Assessment, which indicated that fugitive seepage and drainage from the CDF is not expected to affect water quality in receiving waterbodies. Monitoring and contingency measures, if required, will further ensure that receiving waterbodies are protected in the long-term.

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LIST OF ACRONYMS AND ABBREVIATIONS

ARD	acid rock drainage
CDF	co-disposal facility
CWSP	central water storage pond
EIS/EA	Environmental Impact Statement / Environmental Assessment
ETP	effluent treatment plant
FMG	First Mining Gold
ha	hectares
ML	metal leaching
m ² /t	square metres per tonne
m ³	cubic metres
Mm ²	million square metres
Mm ³	million cubic metres
Mt	million tonnes
NAG	non-potentially acid generating
NP	neutralization potential
PAG	potentially acid generating
Project	Springpole Gold Project
SFE	Shake Flask Extraction
t/m ³	tonnes per cubic metres
WSP	Water storage pond

1.0 INTRODUCTION

First Mining Gold Corp. (FMG) proposes to develop, operate, and eventually decommission / close an open pit gold and silver mine and ore process plant with supporting facilities known as the Springpole Gold Project (Project). The Project is in a remote area of northwestern Ontario, approximately 110 kilometres (km) northeast of the Municipality of Red Lake and 145 km north of the Municipality of Sioux Lookout.

An environmental assessment (EA) pursuant to the *Canadian Environmental Assessment Act, 2012* and the *Ontario Environmental Assessment Act* is required to be completed for the Project. This report is one of a series of Technical Support Documents prepared by WSP Canada Inc. (WSP) on behalf of FMG to support the predicted environmental effects of the Project

Water quality estimates were supported by the Project water balance (WSP 2024b), along with currently available mine planning information and geochemical data (Wood 2021, 2022; WSP 2024c,d,e). Water quality estimates were prepared for the mine site for operations and closure as follows:

- Operations: the mine site was represented by the maximum extent configuration of mine features for the operational phase of the Project.
- Closure: two stages of mine closure were evaluated in the water quality estimates including:
 - o Active closure: the mine site was represented by closure conditions immediately following placement of the co-disposal facility (CDF) closure cover, and rehabilitation of the ore stockpile area and process plant site. At that time, long-term steady state conditions have not yet developed for the CDF and residual process water held within the pore space of the tailings pile continues to be released via seepage. Water quality estimates for the active closure stage represent a snapshot of year 1 following the closure of the site.
 - o Post-closure: the mine site was represented by long term steady state closure conditions. At that time the facility was assumed to have released all residual process water stored within the tailings pile and the ongoing reduced oxidation of covered mine wastes within the CDF represented the only source of load to seepage (i.e., stored load from process water had been fully released due to ongoing infiltration through the tailings pile and tailings consolidation). Preliminary estimates indicate that the long-term steady state condition could be reached within approximately 100 years after the active closure stage.

Water quality results for the refilled open pit basin during closure are included in the Predictive Modeling of Open Pit Basin Water Quality (Lorax 2024). This document provides a summary of the mine site water quality estimates including the model approach, inputs and assumptions, and results. Results are provided for a range of parameters to support the final EIS/EA.

The results of the water quality estimates represent contact water quality for the mine site. These results are used as an input to the Surface Water Quality Model (Appendix N-2, WSP 2024a) and Effects Assessment, which ultimately informs water management and mitigation measures to protect the receiving environment.

2.0 MODEL APPROACH AND CONFIGURATION

The mine site water quality estimates were developed using GoldSim (version 14.0), using a mass balance modelling approach. Additional geochemical modelling was conducted in PHREEQC version 3.4.0 (Parkhurst and Appelo, 2013) to incorporate non-conservative geochemical processes (i.e., solubility and adsorptive controls) for selected milestones, where appropriate.

The model included an assessment of water quality for key mine features at the maximum Project footprint extent during operations (year 10), as well as an assessment of year 1 of active closure conditions and long-term steady state closure conditions. The mine site water quality estimates were modelled using the average annual monthly water balance (WSP 2024b). The mine site water quality estimates included the following:

- For operations: CDF contact water (representing drainage captured in the ditch and fugitive seepage), seepage from the low-grade ore stockpile, and the influent to the effluent treatment plant.
- For closure: CDF contact water and fugitive seepage, as well as water quality for other rehabilitated catchments including the former ore stockpile, plant site, and surficial soil stockpile areas.

Various types of mine waste will be present, including acidic potentially acid generating (PAG) mine rock, non-acidic PAG mine rock, metal leaching non-acid generating (NAG) mine rock, non-metal leaching NAG mine rock, NAG tailings, and PAG tailings. Potentially acid generating mine rock will be placed in the centre of the north cell. Non-acid generating tailings will be hydraulically placed between the perimeter dikes, the dike between the north and south cells and the mine rock. The NAG tailings will function as an oxygen barrier for the PAG and/or metal leaching mine rock. Limiting the influx of oxygen will limit the rate of oxidation and consequently limit metal leaching. The PAG tailings will be placed sub-aqueously in the south cell. The specific geochemical characteristics of these mine wastes were considered in detail for source term development.

Water quality estimates included two model scenarios: an Expected Case scenario; and a Conservative Case scenario. Model source terms for mine rock and tailings were varied between the two scenarios as summarized below and described in Section 3.0. Other mine features were represented by the same source term inputs for both scenarios.

- **Expected Case:** representing the expected metal release rates for mine rock and tailings based on currently available kinetic testing results and geochemical information for the Project. This generally included the use of median release rates from ongoing Project humidity cell tests (Section 3.0).
- **Conservative Case:** representing elevated metal release rates for mine rock and tailings based on currently available kinetic testing results and geochemical information for the Project. This generally included the use of 90th percentile and/ or maximum release rates from ongoing Project humidity cell tests (Section 3.0).

Model parameters were selected to support water treatment design criteria needs and included: aluminum, arsenic, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, sulphate, thallium, uranium, vanadium and zinc. Preliminary estimates of pH were also provided based on geochemical information for the Project.

Results are provided for key model nodes. For operations, this includes contact water (i.e., runoff, captured seepage and fugitive seepage) from the CDF, fugitive seepage from the low grade ore (LGO) stockpile, and the effluent treatment plant (ETP) influent. For mine closure, this included contact water from the CDF (i.e., fugitive seepage and runoff) and rehabilitated areas.

A description of key mine features in the model and the overall model configuration is presented below for operations (Section 2.1) and closure (Section 2.2).

2.1 Mine Site Operations

The mine site is represented by the maximum extent configuration of mine features for the operations phase of the Project. The configuration of key mine features are described below and presented in Figure 2-1.

2.1.1 Co-disposal Facility (CDF)

Tailings and mine rock will be stored in the onsite CDF. Contact water from the CDF will gain load from several sources, including the tailings stored within the facility, as well as the mine rock within the facility and used to construct the perimeter embankments. Within the CDF, there are two distinct containment areas known as the north cell and south cell that will be loading sources for contact water.

- The north cell has an aerial extent of 344.2 hectares (ha) and contains NAG tailings co-mingled with PAG and/or metal leaching mine rock. The base of the cell is unlined and retained within a lined embankment of non-metal leaching NAG mine rock. For the purposes of these estimates, it was assumed that the PAG and/or metal leaching mine rock stored in the facility will be effectively encapsulated in NAG tailings and be placed below the long-term phreatic surface within the tailings pile. As such it was assumed that no rock surfaces are exposed to atmospheric oxygen, and therefore the mine rock will not oxidize and release load. As such, process water, the NAG tailings, and the non-metal leaching NAG mine rock used to construct the perimeter embankment are the only sources of mass load to contact water from the north cell.
- The south cell has an aerial extent of 115 ha and contains PAG tailings slurry (sulphide concentrate tailings). This cell is lined with a low permeability material and is retained within an embankment of non-metal leaching NAG mine rock. During operations, the slurry tailings contained within the cell are stored beneath a water cover such that they are isolated from atmospheric oxygen. For the purposes of the model, it was assumed that tailings management during operations maintained a water cover over the tailings and prevented acidic drainage from developing in the south cell. Therefore, the PAG tailings were assumed to release no load and the only load source within the south cell is process water. Non-metal leaching NAG mine rock used to construct the perimeter embankment will also release load.

Water leaves the CDF via three principal pathways, supported by the water balance (WSP 2024b) and groundwater flow modelling (WSP 2024e) completed for the Project:

- Water contained within the south cell is pumped back to the process plant as make-up water. Water in the south cell originates from process water discharged to the south cell with the tailings and drainage from the north cell.
- Seepage and runoff from the north cell, contact water from the NAG mine rock perimeter embankment, and seepage from south cell is collected in a seepage collection ditch around the CDF. The seepage collection ditch reports to the central water storage pond (CWSP) and is either pumped back to the process plant as make-up water or pumped to the ETP.
- Seepage out of the base of the CDF, that is not captured by the seepage collection ditch (i.e., fugitive seepage), reports to the open pit (where it is handled as minewater), site ponds, and the receiving environment. Sources of load to fugitive seepage include process water, the NAG tailings stored in the north cell, the NAG mine rock used to construct the perimeter embankment around the CDF, and seepage from the south cell that leaves the facility through imperfections in the low permeability liner underlying the south cell tailings.

Make up water at the process plant is primarily (75%) sourced from minewater, with collected drainage from the CDF and minewater from the CWSP representing approximately 60% and 15% of the annual make up water, respectively.

2.1.2 Open Pit

- Water collected in the open pit during operations includes flow and mass load contributions from several sources as outlined below. Water collected in the open pit is pumped to the CWSP. Runoff from the pit walls and disturbed areas within the open pit catchment are collected within the open pit. The pit walls include exposed NAG and PAG mine rock.
- Groundwater seepage from several sources including seepage from the CDF, regional groundwater seepage, and seepage from other areas of the site (e.g., low grade and high/medium grade ore stockpiles) are collected within the open pit.
- Runoff from NAG / non-metal leaching mine rock used to construct the east dike and west dike is collected within the open pit.
- NAG / metal leaching rock is backfilled in the north end of the open pit during operations. Contact water from the backfill collects within the open pit.

2.1.3 Central Water Storage Pond

The CWSP receives flow and mass load from the sources outlined below. The CWSP reports to the process plant, as makeup water, and to the ETP.

- Runoff from the surficial soil stockpile, exposed lake sediment, and disturbed areas around the open pit are collected by ditching and directed to the CWSP.
- Runoff from the ore stockpile areas including PAG and NAG mine rock along with natural and disturbed areas is collected by ditching and directed to the CWSP, including runoff from a portion of the medium/high grade ore stockpile within the CWSP catchment area.
- Open pit dewatering is pumped to the CWSP.
- Runoff from disturbed areas around the plant site is directed to the process plant pond, which reports to the CWSP.

2.1.4 Effluent Treatment Plant

The ETP receives inputs solely from the CWSP.

2.2 Mine Closure

Two phases of mine closure were evaluated in the water quality estimates including active closure and post-closure conditions.

The open pit catchment was not included in the closure water quality estimates as the refilled open pit basin during closure was modelled separately (Lorax 2024). Influent chemistry to the ETP was not included in the closure water quality estimates as the ultimate closure water balance will be dependent upon the open pit basin quality estimate results.

2.2.1 Active Closure

A description of key catchment configurations in the active closure stage are described as follows.

Co-disposal Facility

Following completion of PAG mine rock disposal within the north cell, NAG tailings will be deposited over the entire north cell surface to fully cover the PAG mine rock and limit oxygen ingress. A growth medium cover (dominantly overburden) will be placed on the surface of the north cell NAG tailings and the mine rock embankments of the CDF, for revegetation purposes. Runoff will be directed to the south cell.

Ponded water in the south cell will be drained and pumped to the CWSP and treated at the ETP. A permeable vegetated cover, designed to maintain water saturation of the PAG tailings, will be placed immediately after the cell is drained and prior to acidification of the PAG tailings contained in the south cell.

Toe seepage from the CDF and surface runoff will continue to be collected in ditching around the CDF and treated at the ETP. Seepage out of the base of the CDF, that is not captured by the seepage collection ditch, reports to the open pit basin and the receiving environment as fugitive seepage.

Water quality estimates for active closure of the CDF are based on the site configuration for the first year of closure conditions, following the cessation of operations and placement of the closure cover. Load released from the north cell tailings and mine rock used to construct the embankment was assumed to be reduced by 50% due to placement of the revegetated cover. Seepage water quality was assumed to be the same as the seepage water quality from the end of operations for the active closure estimates.

Ore Stockpile Area Catchment

All ore stockpiled during operations will be processed prior to closure. At closure, the footprint of the former ore stockpiles will be excavated if needed, so that no PAG material is remaining. Thereafter, the ore stockpile areas will be reclaimed (either regraded to promote natural drainage and revegetation or re-developed as part of the fish habitat and compensation activities).

Surficial Soil Stockpile Catchment

At closure, the footprint of the former surficial soil stockpile will be recontoured and revegetated as required.

Process Plant Catchment

The process plant will be decommissioned, and the area will be recontoured, covered with overburden and revegetated.

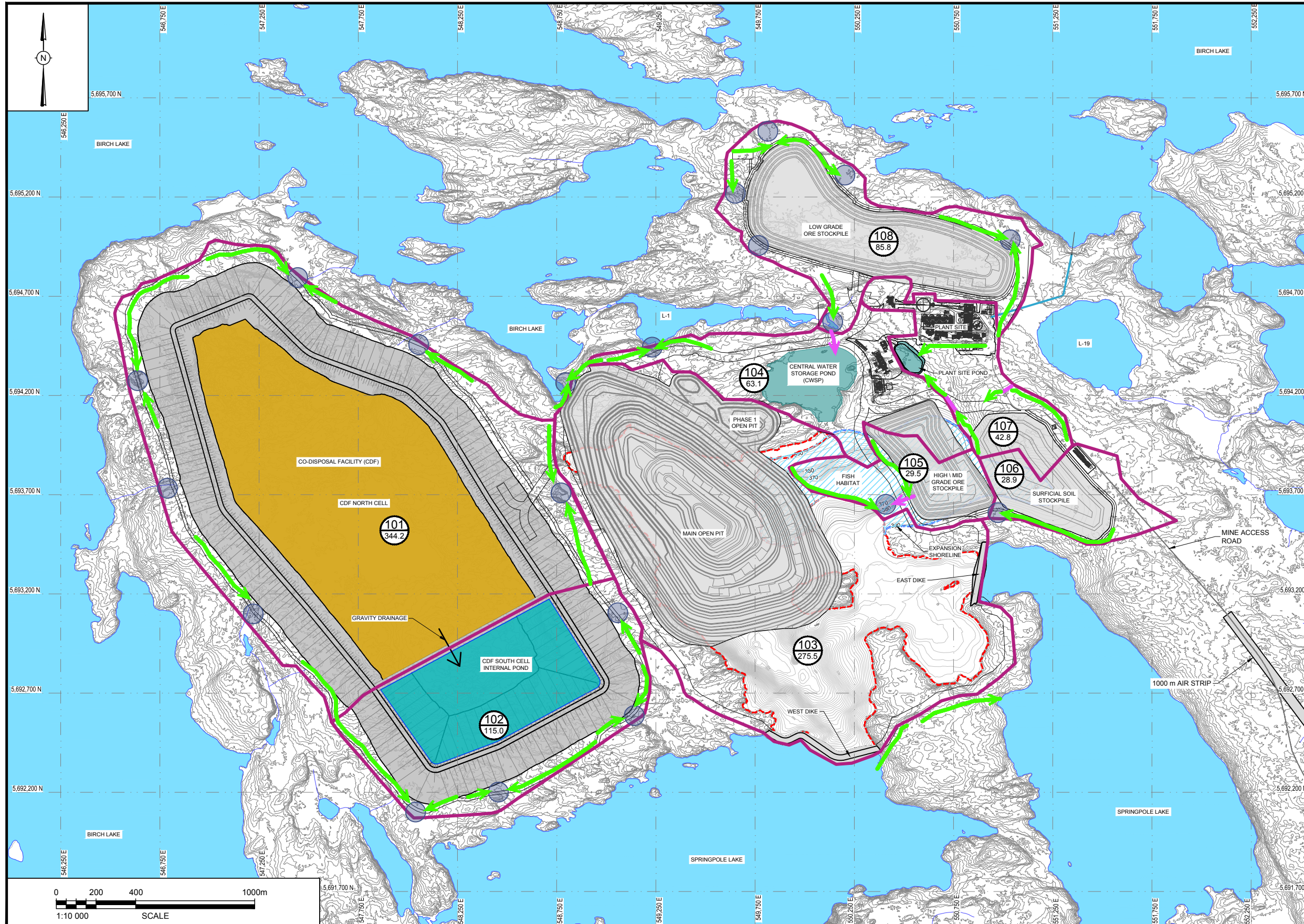
2.2.2 Post-Closure

Post-closure conditions in the model used the same site configuration and assumptions as active closure (Section 2.2.1) with the following exceptions.

Co-disposal Facility (CDF)

Post-closure water quality estimates from the CDF are a snapshot of long-term steady state conditions. Similar to active closure stage, the CDF surface will be covered and revegetated. As such, load released from the north cell tailings and mine rock used to construct the embankment is assumed to be reduced by 50%, due to placement of the revegetated cover.

For the post-closure stage, it was assumed that the facility had reached a steady state geochemical condition (i.e., all residual porewater is assumed to have been flushed out of the tailings pile, and residual process water stored within the tailings does not contribute to the estimated seepage quality). Preliminary estimates indicate that the steady state condition may be reached within approximately 100 years after the active closure stage.



NOTES:

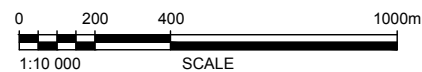
1. ALL DIMENSIONS AND ELEVATIONS ARE IN METERS. GRID COORDINATES ARE IN NAD 1983 UTM ZONE 15N.
2. THE DIGITAL FILES FOR THE BASE MAP WERE PRODUCED FROM DRAWING SP-0000-GX-LYD-0003-1.dwg, PROVIDED BY AUSENCO.

LEGEND:

- CONTOUR (1 m INTERVAL)
- BATHYMETRY CONTOUR (1 m INTERVAL)
- WATERBODY
- SUB-WATERSHED
- WATERSHED ID
- WATERSHED AREA (ha)
- DITCH
- CULVERT
- SUMP/LOCAL COLLECTION POND
- BERM / WATER CONTROL STRUCTURE

WATERSHED AREAS SUMMARY TABLE

CATCHMENT ID	CATCHMENT AREA (ha)
101	344.2
102	115.0
103	275.5
104	63.1
105	29.5
106	28.9
107	42.8
108	85.8
TOTAL:	984.8



CLIENT LOGO



CLIENT:

FIRST MINING GOLD

WSP Canada Inc.

6925 Century Ave., Suite 600
Mississauga, Ontario, Canada, L5N 7K2

DWN BY:

CHK'D BY:

DATUM: UTM NAD 83

PROJECTION: ZONE

SCALE: AS SHOWN

COMPANY LOGO



PROJECT

SPRINGPOLE GOLD PROJECT
MINE SITE WATER BALANCE

TITLE

ULTIMATE OPERATIONS SITE PLAN
WITH CONCEPTUAL WATER MANAGEMENT PLAN

DATE: DECEMBER 2023

PROJECT NO.:

REV. NO.: B

FIGURE No. 2-1

3.0 KEY INPUTS AND ASSUMPTIONS

3.1 Water Balance

The operations phase was modelled based on the average annual monthly water balance for the Project during operations (WSP 2024b). The closure phases were modelled based on the average annual monthly water balance for active and post-closure (WSP 2024b) for the mine site catchments.

The water balance includes estimates of groundwater seepage from various site features, including the north cell and south cell of the CDF, based on results of groundwater flow modelling for the Project (WSP 2024e).

Flow schematics for the water balance for the operations, active closure, and post-closure phases are provided in Figures 3-1, 3-2, and 3-3 respectively.

3.2 Key Rock Types

The Project hosts PAG and NAG mine rock. The PAG and NAG mine rock types have specific geochemical characteristics that results in varying management considerations in the mine plan, as well as specific consideration of these geochemical characteristics in the water quality estimates.

Data from the Project ML/ARD block model was extracted to support interpretation of the specific characteristics of PAG and NAG rock in the material balance. A description of these key rock types (1A, 1B, 1C, 2), their screening criteria, and implications for management are provided in Table 3-1.

These criteria were used in the Project ML/ARD block model to identify the volumes of material that were PAG, NAG, and metal leaching. These rock types are present as follows:

- PAG rock (Types 1A and 1B), along with some of the NAG / metal leaching rock (Type 1C) is comingled with NAG tailings in the CDF north cell.
- NAG / metal leaching rock (Type 1C) is backfilled in the north end of the open pit.
- NAG / non-metal leaching rock (Type 2) is used for construction purposes (i.e. CDF perimeter embankment and east and west dikes).
- All PAG (Type 1A, 1B) and NAG rock types (Type 1C, 2) are present in ore-grade materials and on the pit walls.

Other data from the block model including sulphur content, neutralization potential content, and arsenic content were used to further assess the quality of the rock and support source term development.

3.3 Material Balance

- The volume of mine rock in the CDF perimeter embankment was estimated to be 78 million cubic metres (Mm^3 ; ~ 170 Mt), based on CDF design information. The volume of mine rock in the east and west dikes (reporting to the open pit catchment) was estimated to be approximately 311,000 cubic metres (m^3 ; ~ 0.68 Mt), based on design information. Rock volumes were converted to tonnages based on a conversion factor of 2.2 tonnes per cubic metre (t/m^3), consistent with design information (representing compacted rock in the dike). Tonnages were converted to reactive surface areas based on an assumed mine rock surface area of 50 square metres per tonne (m^2/t). It was assumed that all mine rock used for construction comprised Type 2 mine rock (i.e., NAG / non-metal leaching).

- The volume of NAG / metal leaching (Type 1C) rock backfilled in the north end of the open pit was estimated to be 1,158,800 m³ (~2.5 Mt) based on design information. Rock volumes were converted to tonnages based on a conversion factor of 1.9 t/m³. The tonnages were converted to reactive surface areas based on an assumed mine rock surface area of 50 m²/t.
- The average low grade ore stockpile balance over the life of mine of approximately 10 Mt was used to represent the low-grade ore stockpile balance in the model during operations. Tonnages were converted to reactive surface areas based on an assumed mine rock surface area of 50 m²/t.
- The average medium/high grade ore stockpile balance over the life of mine of approximately 3.2 Mt was used to represent the medium/high grade ore stockpile balance in the model during operations. Tonnages were converted to reactive surface areas based on an assumed mine rock surface area of 50 m²/t.
- An aerial extent of 1.8 Mm² was used to represent the exposed surface of NAG tailings in the north cell of the CDF during operations (WSP 2024b).
- The maximum pit wall surface area exposed during operations was estimated to be approximately 1.9 Mm² based on pit design information. Rock types on the pit wall were defined based on outputs from the ML/ARD block model and Project geochemical criteria (see Section 3.3). All PAG and NAG rock types were exposed on the pit walls, and wall areas were discretized according to a projection of the block model outputs for these rock types onto the pit wall surface. A fracture factor of 50 m² per m² of exposed surface area was applied to pit wall surface areas to estimate reactive rock surface areas.

3.4 Geochemical Assumptions and Source Terms

Key geochemical assumptions and source terms are presented in the following sections.

3.4.1 Acid Rock Drainage Potential and Projected Lag Times to Acid Onset

The proportions of NAG, non-acidic PAG and acidic PAG¹ mine rock and ore were used to apply source terms in the model. The proportion of PAG and NAG rock and projected lag times to acid rock drainage (ARD) were based on currently available geochemical information (Wood 2021, WSP 2024c) and the Project ML/ARD block model (see Section 3.2).

The estimated time to acidification of PAG mine rock was determined based on humidity cell test results for the Project (WSP, 2024c) and consideration of the neutralization potential (NP) content of the PAG rock. Neutralization potential content data was obtained from the Project ML/ARD block model for the PAG mine rock (Type 1A and 1B). For modelling purposes, it was assumed that:

- PAG mine rock with a low NP content (e.g., Type 1A, Table 1) would be net acid generating upon exposure (i.e., Type 1A PAG mine rock is considered immediately net acid generating).
- PAG mine rock with a relatively higher NP content (e.g., Type 1B, Table 1) would become net acid generating within several decades. Acidification of Type 1B PAG mine rock would not occur during the model time frame and no Type 1B rock is exposed within the model domain at that time.

Material balance information for mine rock features is outlined in Table 3–2.

¹ PAG rock is differentiated as acidic PAG and non-acidic PAG for modelling purposes. Acidic PAG rock is PAG rock that is already net-acid generating. Non-acidic PAG rock is PAG rock that is not yet net-acid generating but will become net-acid generating in the future.

The PAG materials are also stored in the CDF, including PAG mine rock comingled with the NAG tailings in the north cell and PAG tailings stored in the south cell. The exposure of PAG materials in the CDF to atmospheric oxygen was assumed to be limited by the proposed disposal methods, including the comingling of PAG mine rock with NAG tailings, as well as the subaqueous storage of PAG tailings during operations and maintenance of tailings saturation during closure. As such, acid onset in these PAG materials was assumed not to occur. No acid onset is predicted to occur from the CDF perimeter embankments, as they will be constructed with NAG / non-metal leaching mine rock (Type 2 mine rock).

3.4.2 Mine Rock

Mine rock source terms were developed to represent the various mine rock types including acidic PAG rock, non-acidic PAG rock, metal leaching NAG rock, and non-metal leaching NAG rock.

Mine rock source terms were developed from currently available humidity cell test results for the Project, including 16 humidity cell tests that have operated for approximately 96 to 197 weeks (WSP 2024c). Source term release rates were surface area normalized based on the estimated surface area of the humidity cell test samples and applied to mine rock surface areas in the model.

Mine rock source terms are presented in Table 3–3 and described below.

- Source terms for acidic PAG mine rock were based on currently available humidity cell test results for acidic leaching humidity cells for the Project. This included use of average steady state release rates for two humidity cell tests that had an acidic pH (pH ~2.5) and had operated for 90 and 197 weeks at the time of source term development. Steady state release rates were based on the last 20 and 10 weeks of testing in each respective humidity cell test. The source term was used to represent both the Expected Case and Conservative Case for assessment purposes.
- Source terms for non-acidic PAG mine rock were based on currently available humidity cell test results for PAG humidity cells that had a neutral pH leaching condition (i.e., had not yet become net-acid generating²). This included the use of average release rates for the last 20 weeks of testing for 13 humidity cell tests. These cells had operated for 96 to 197 weeks at the time of source term development. For most parameters, the Expected Case and Conservative Case source terms were based on the median and maximum release rates for the last 20 weeks of testing, respectively. This approach was considered conservative as most humidity cell test samples generally have notably elevated sulphur and metal contents relative to the overall Project ML/ARD dataset and are inferred to represent less common higher sulphide and metal content material found in some of the mine rock. Source terms for arsenic, however, were based on a regression analysis of humidity cell release rates, due to observed relationships between metal content and release rates in the available data. Arsenic release rates were scaled to the to the median (23 mg/kg) and 90th percentile (102 mg/kg) arsenic content of non-acidic PAG mine rock (represented by Type 1B mine rock) in the Project ML/ARD block model for the Expected Case and Conservative Case, respectively.
- Metal leaching NAG mine rock generally had a higher sulphur and metal content than other NAG rock. Therefore, the metal leaching NAG mine rock was represented by the non-acidic PAG source term for most parameters. Arsenic is a key parameter of interest for metal leaching for the Project. Therefore, source terms for arsenic were based on a regression analysis of humidity cell release rates, due to observed relationships between metal content and release rates in the available data.

² One cell, HC-3, was excluded from source term development for both the non-acidic PAG and metal leaching NAG source terms, as the cell appeared to be progressing toward acidic leaching conditions at the time source terms were developed (but had not yet reached a strongly acidic pH).

Arsenic release rates were scaled to the median (86 mg/kg) and 90th percentile (212 mg/kg) arsenic content of metal leaching NAG mine rock (represented by Type 1C mine rock) in the Project ML/ARD block model for the Expected Case and Conservative Case, respectively.

- NAG / non-metal leaching mine rock generally had a lower sulphur and metal content than other NAG mine rock. Source terms for the non-metal leaching NAG mine rock were based on release rates from four non-acidic mine rock humidity cell tests, selected based on their relatively low sulphide contents³. The cells had operated for 96 to 197 weeks and the average release rates over the last 20 weeks of testing were used to represent most parameters. Source terms for arsenic were based on a regression analysis, similar to the other mine rock source terms. Arsenic release rates were scaled to the median (11 mg/kg) and 90th percentile (38 mg/kg) arsenic content of non-metal leaching NAG mine rock (represented by Type 2 mine rock) in the Project ML/ARD block model for the Expected Case and Conservative Case, respectively.
- Load generated from November to March was reduced by 85% to account for lower rates of sulphide oxidation at reduced temperatures (MEND 2006).
- A flushing factor of 40% was applied to the CDF perimeter embankment, the east and west dikes, the open pit backfill, and the ore stockpiles, to represent the estimated proportion of the total generated load that is released from these features each month. All the load generated by open pit wall surfaces and was assumed to be released each month (i.e., 100% flushing).
- At closure, the load released from the covered mine rock embankments around the CDF was assumed to be reduced by 50% in direct proportion to the reduction in contact water following placement of the cover.

3.4.3 Tailings and Process Water

3.4.3.1 North Cell – NAG Tailings

Tailings source terms were applied to the aerial extent of north cell of the CDF to represent sulphate and metal release from the tailings.

The north cell NAG tailings are expected to have a low sulphur content with no potential for acidic drainage. As summarized in WSP (2024c), tailings humidity cell test data are currently available for three synthetic NAG tailings samples, representing the current mine plan. One humidity cell was initiated in 2021 and has 97 weeks of available data. Two cells were initiated in 2023 and have 25 weeks of available data. All test samples were NAG (NPR>2) with a low sulphur content (0.05 – 0.23 % sulphur).

Tailings source terms are presented in Table 3–4 and described below. Process water source terms are described in Section 3.4.3.3.

- Expected Case source terms were developed using the median release rates from the last 10 weeks of test results from the humidity cell test initiated in 2021. This data was used as the cell had been operating over the long term and obtained relatively steady state release rates.

³ One cell, HC-10, was excluded from source term development for Zn, Cd, and Pb, due to anomalous solid phase concentrations for these parameters in the test sample.

- Since two of the NAG tailings humidity cell tests had been recently initiated, the cells were early in their operation and generally had higher release rates as they had not yet reached a steady state condition. Therefore, Conservative Case source terms were developed based on median release rates from earlier in the humidity cell test period. This included the use of the last five weeks of available data from the two NAG tailings humidity cell tests initiated in 2023 (week 20 – 25). Data from the NAG tailings humidity cell test initiated in 2021 (week 20 – 25) were also included for completeness. In some instances, this approach resulted in release rates that were lower than the Expected Case source term. Where this occurred, the Expected Case source term was increased by a factor of two to represent the Conservative Case.
- Release rates were surface area normalized based on the exposed surface area (footprint) of the humidity cell test sample and applied to the aerial extent of the CDF.
- Load generated from November to March was reduced by 85% to account for lower rates of sulphide oxidation that occur at reduced temperatures (MEND 2006).
- At closure, following placement of the cover, the load released from the covered NAG tailings was assumed to be reduced by 50% in direct proportion to the reduction in contact water following placement of the cover.

3.4.3.2 South Cell – PAG Tailings

The PAG slurry tailings are stored in the south cell, which is lined with a low permeability material during operations, and saturation is assumed to be maintained in closure.

- During operations the slurry tailings are stored in a water saturated condition so they are isolated from atmospheric oxygen. For the purposes of the model, it was assumed that this tailings management prevented acidic drainage from developing in the south cell. Therefore, the PAG tailings solids were assumed to release no load and the only load source within the south cell is from process water contained within the interstices of the tailings solids, and the ponded process water on surface. Process water source terms are presented in Section 3.4.3.3.
- At closure, a vegetated cover will be placed on the tailings surface and tailings saturation will be maintained. For the purposes of the model, it was assumed that the tailings will remain saturated, and acid generation will not occur.

3.4.3.3 Process Water

- Supernatant water quality (post cyanide destruction) from metallurgical testwork tailings, representing the currently planned Project tailings, was used to represent process water in the model. Supernatant water quality of the flotation tailing and sulphide concentrate life of mine samples generated in the 2021 metallurgical program (WSP 2024f)⁴ were used to represent the respective NAG and PAG tailings process water quality.
- Additional sodium metabisulphite was added as part of bench scale testing to improve performance of the cyanide destruction circuit at the lab scale. This increased concentrations of sulphate and sodium in the process water relative to field scale conditions. Sodium metabisulphite will be used at the field scale as the SO₂ source for cyanide destruction, however, less is expected to be used relative to the bench scale testing. Therefore, theoretical usage rate data for SO₂ per gram of

⁴ Supernatant samples from 2023 (WSP 2024f) were not representative of future process water due to reagent overuse as part of optimization testing. Representative samples from 2021 were utilized to support modelling (see text).

cyanide oxidized in the cyanide destruction process (Botz, 2001) was used to scale sulphate and sodium concentrations in the process water. An excess cyanide concentration of 200 mg/L was used to support scaling calculations, as indicated by the metallurgical consultant.

- The scaled sulphate and sodium concentrations were used to represent the Expected Case. The laboratory-measured concentrations of sulphate and sodium were used to represent the Conservative Case. All other parameters were represented by measured concentrations in the supernatant samples for the Expected Case and the Conservative Case.

3.4.4 Groundwater Seepage

- Regional groundwater seepage source terms used in the operations model were based on the median groundwater quality data collected from 2021 to 2023 for monitoring wells screened in shallow bedrock around the Project site (Table 3–5).
- Ore stockpile seepage water quality was calculated internally in the operations model based on loading and flow inputs for the ore stockpiles. Mine rock source terms were used to represent the ore stockpile material, with specific assumptions for the proportion of the ore that was NAG and PAG, as outlined in Section 3.2. The average annual concentration for contact water from the ore stockpiles was used to represent seepage quality in the model. Seepage from both ore stockpiles reports to the open pit, while a proportion of seepage from the low-grade stockpile reports to the environment as fugitive seepage (WSP, 2024e).
- Seepage water quality from the CDF that reports to the open pit, ditches, and other receivers as fugitive seepage was calculated internally in the operations and closure models. This included consideration for mass load from mine rock (Section 3.4.2), the tailings (Section 3.4.3), and process water (Section 3.4.3.3) contributing to the overall CDF seepage water quality.

3.4.5 Runoff

Source terms for runoff for disturbed areas, natural areas, the surficial soil stockpile during operations, and covered and revegetated areas at closure, were represented by a concentration applied to estimated runoff volumes from these areas:

- The surficial soil stockpile runoff source terms were based on available Shake Flask Extraction (SFE) test results for overburden samples (Wood 2022) in the operations model. The median of all SFE test results were used to represent this source term (Table 3–5).
- The exposed lake sediment runoff source terms were based on available SFE test results for lake sediment samples (WSP 2024d) in the operations model. The median of the test results were used to develop the Expected Case source term, and the maximum of the test results were used to develop the Conservative Case source term (Table 3–5).
- Natural area runoff source terms were based on baseline water quality data for ponds, streams and lake surface water proximal to the Project site. Data used in the model were collected in 2021 and the median of data from selected stations was used (Table 3–5). Natural area runoff was used to represent natural areas in the operations and closure models.
- Disturbed area runoff source terms were represented as five times the natural area source terms during operations for assessment purposes (Table 3–5).
- For the purposes of the model, at closure the rehabilitated areas of the Project were represented by natural runoff source terms, to represent their long-term steady state closure condition following rehabilitation, and the placement of overburden and revegetation of these areas.

3.5 Solubility Controls

The site water management approach minimizes freshwater intake to the process plant, which largely relies on recycled water from the CDF internal pond. Seepage from the CDF that reports to the collection ditch is also pumped back to the CDF, where it ultimately reports to the CDF internal pond.

The water management approach causes mass load to accumulate within the CDF-process plant water management circuit. This is a result of mass load being continually added from the process plant (due to ore processing) and from weathering of mine wastes in the CDF. Since water from the CDF is recycled for use at the process plant and there are only minor losses of load to fugitive seepage and via water transfer to the ETP, mass load accumulates within the CDF-process plant water management circuit.

This process of mass load accumulation often occurs for similar water management circuits. Mass load accumulation can cause concentrations to increase over time until solubility limits are reached. Concentrations will stabilize at solubility limits as mass load is removed due to chemical precipitation.

Key constituents in the process plant water, such as sulphate and metals, can be influenced by solubility constraints including the precipitation of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and the precipitation of iron oxyhydroxide minerals (e.g., ferrihydrite, $\text{Fe}(\text{OH})_3$) which adsorb metals. Assessment of the process plant water composition indicated that the concentrations of calcium (to precipitate gypsum and limit sulphate concentrations) and iron (to precipitate iron oxyhydroxide minerals and limit metal concentrations via adsorption) were too low relative to the concentrations of sulphate and metals in the water to naturally remove these parameters via solubility controls. Therefore, in the model, additional calcium was assumed to be added to the tailings stream after the process plant to increase calcium concentrations, such that gypsum precipitated to control sulphate concentrations. Similarly, additional iron was assumed to be added in the same way to precipitate sufficient secondary iron minerals to decrease metal concentrations via adsorption.

These solubility controls were implemented via preliminary geochemical modelling as follows:

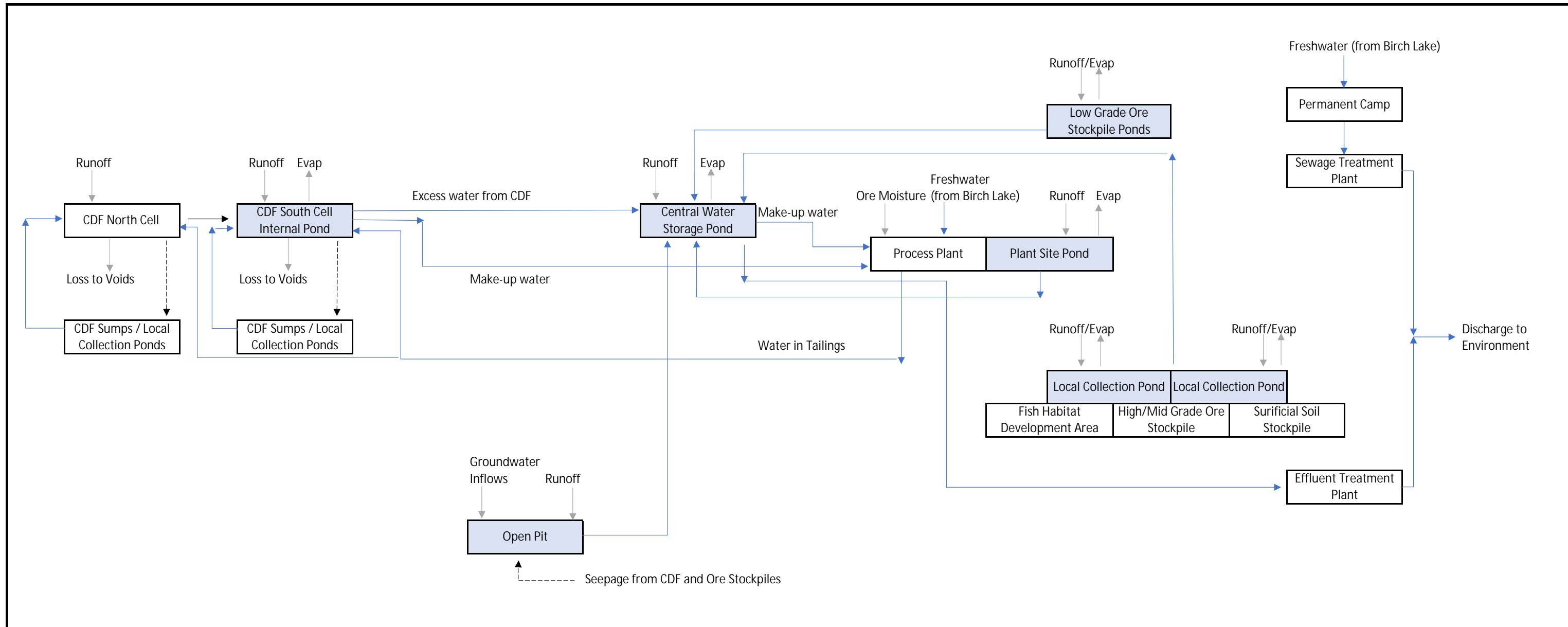
- The geochemical code PHREEQC (version 3.4.0; Parkhurst and Appelo 2013), was used for geochemical modelling. The minteq.v4.dat thermodynamic database (Allison et al. 1991) was used.
- Solutions were equilibrated with atmospheric oxygen and carbon dioxide. Gypsum, amorphous aluminum hydroxide ($\text{Al}(\text{OH})_3$), calcite (CaCO_3), anglesite (PbSO_4), and ferrihydrite were allowed to precipitate if they were oversaturated.
- If ferrihydrite formed, metals were allowed to adsorb to its surfaces. The number of available adsorption sites to ferrihydrite was calculated assuming 0.005 strong bonding sites and 0.2 weak bonding sites per mole of ferrihydrite (Dzombak and Morel 1990). A specific surface area of $600 \text{ m}^2/\text{g}$ was assumed. Due to known limitations on the use of molybdenum adsorption coefficients within PHREEQC, molybdenum adsorption was evaluated in consideration of experimental results presented in Gustaffson (2003). Experimental data for tungsten was also presented in Gustaffson (2003) and used for the model, as tungsten adsorption data was not available in PHREEQC.
- Gypsum and ferrihydrite did not form naturally due to the low concentrations of dissolved calcium and iron in the Springpole tailings slurry, relative to the concentration of sulphate and metals. Therefore, iron and calcium were added as ferric sulphate and lime ($\text{Ca}(\text{OH})_2$), respectively, so chemical precipitation of gypsum and ferrihydrite would occur. The pH was buffered at pH 8 through the addition of hydrochloric acid to support metal removal via adsorption.

The above geochemical modelling was conducted on a monthly timestep for the first year of operations. GoldSim mass balance results for month 1 were input to PHREEQC to implement solubility controls and reduce sulphate and metal concentrations accordingly. The PHREEQC result was input to GoldSim to represent recycled process plant water and start a simulation for month 2. At the end of month 2, the GoldSim mass balance results were input to PHREEQC. This iterative process was continued each month through Year 1 of operations. It was assumed that the addition of calcium and iron would continue throughout operations and be capable of maintaining concentrations at the low levels achieved via this process through the Year 1 simulation. This assessment was conducted for modelling purposes only. Further assessment of water management requirements will be carried out during the next Project engineering stage.

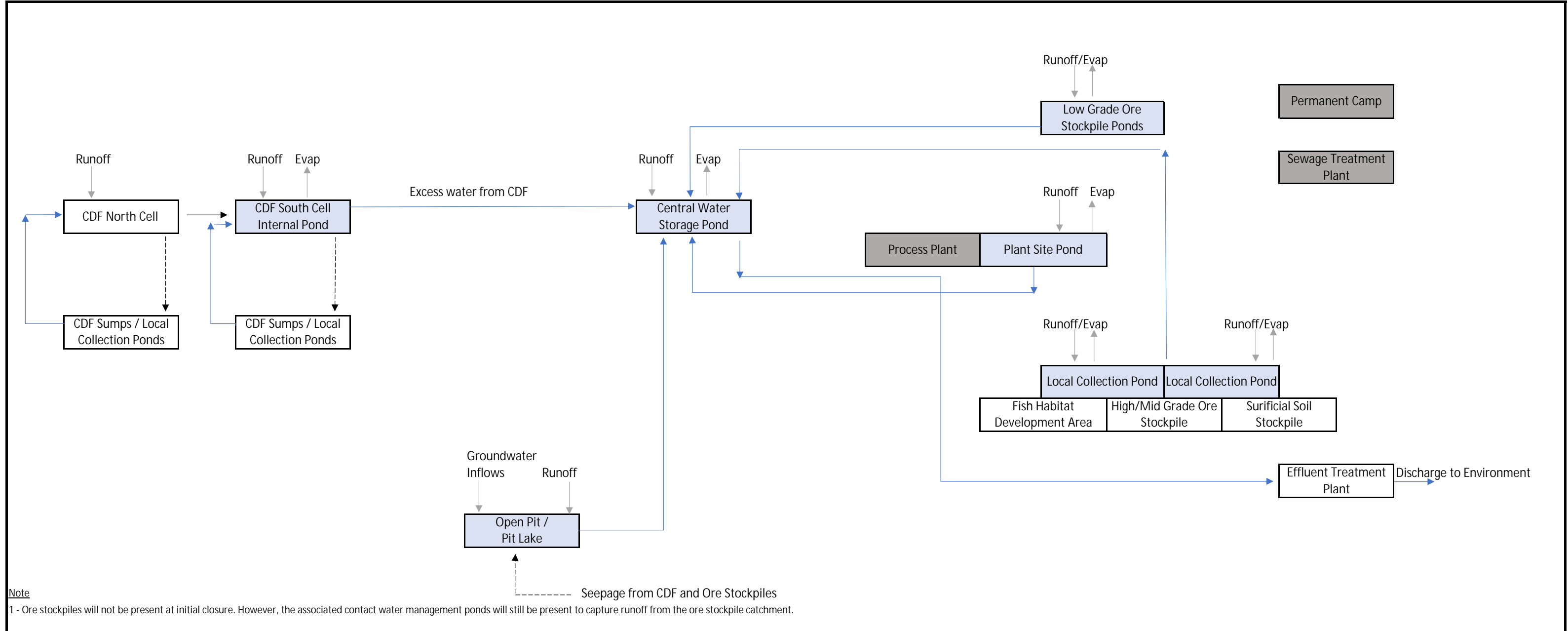
Geochemical modelling was conducted at other key model nodes, using PHREEQC, including seepage from the low-grade ore stockpile and influent to the ETP during operations, as well as fugitive seepage from the CDF during post-closure. Geochemical modelling at these nodes included the natural equilibration of solutions (i.e., without additional iron or calcium added) to estimate water quality following geochemical equilibration. In those instances, solutions were equilibrated with atmospheric oxygen and carbon dioxide, and gypsum, amorphous aluminum hydroxide, calcite, anglesite, and ferrihydrite were allowed to precipitate if they were oversaturated. If secondary iron minerals formed, metals were allowed to adsorb to their surfaces based on the adsorption inputs outlined above.

3.6 Other Assumptions

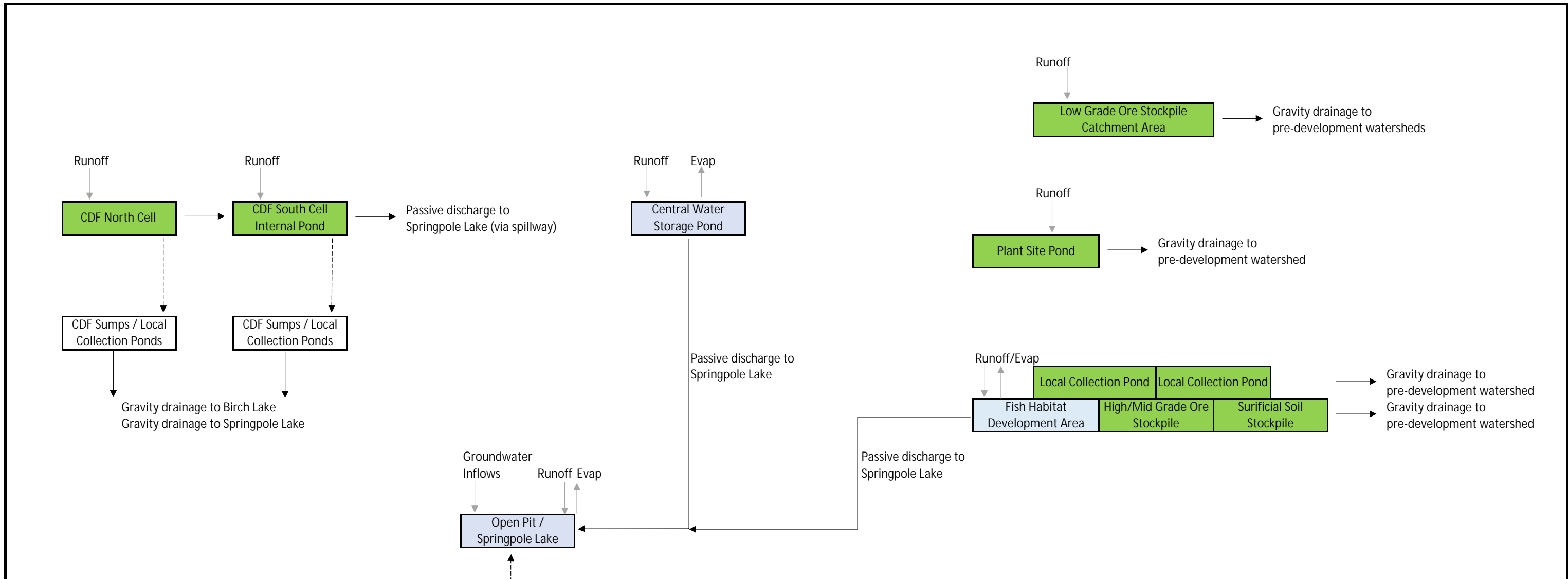
- It is assumed that complete mixing at all modelled ponds occurred.
- Where solubility constraints were applied in PHREEQC, it is assumed that waters at the modelled mine components reach thermodynamic equilibrium (which is the computational basis for PHREEQC).
- Within the CDF (and ore stockpiles) mass load generated in a given month was assumed to instantaneously exit the facility. Mass transport processes and geochemical reactions along groundwater flow paths were not considered in these estimates and cannot be defined with currently available information.



LEGEND: 	CLIENT LOGO: 	CLIENT: FIRST MINING GOLD	COMPANY LOGO: 	PROJECT TITLE: SPRINGPOLE GOLD PROJECT MINE SITE WATER BALANCE	DATE: DECEMBER 2023
		WSP Canada Inc. 6925 Century Avenue, Suite 600 Mississauga, Ontario, Canada, L5N 7K2		DRAWING TITLE: OPERATIONS PHASE FLOW SCHEMATIC	PROJECT NO: ONS2104
					FIGURE NO: 3-1



LEGEND: 	CLIENT LOGO: 	CLIENT: FIRST MINING GOLD	COMPANY LOGO: 	PROJECT TITLE: SPRINGPOLE GOLD PROJECT MINE SITE WATER BALANCE	DATE: DECEMBER 2023
		CLIENT: WSP Canada Inc. 6925 Century Avenue, Suite 600 Mississauga, Ontario, Canada, L5N 7K2		DRAWING TITLE: ACTIVE CLOSURE PHASE FLOW SCHEMATIC	PROJECT NO: ONS2104
					FIGURE NO: 3-2



Note
 1 - Ore stockpiles will not be present at post closure. However, the associated contact water management ponds will still be present to capture runoff from the ore stockpile catchment.
 2 - At post closure, the Springpole Lake dikes will be modified to allow natural flow of water between the reclaimed open pit basin and Springpole Lake.

LEGEND: 	CLIENT LOGO: 	CLIENT: FIRST MINING GOLD	COMPANY LOGO: 	PROJECT TITLE: SPRINGPOLE GOLD PROJECT MINE SITE WATER BALANCE	DATE: DECEMBER 2023
		WSP Canada Inc. 6925 Century Avenue, Suite 600 Mississauga, Ontario, Canada, L5N 7K2		DRAWING TITLE: POST CLOSURE PHASE FLOW SCHEMATIC	PROJECT NO: ONS2104
					FIGURE NO: 3-3

Table 3–1: Project Mine Rock ML/ARD Classification Criteria

ML/ARD Classification		Description	Criteria ^A	Construction Suitability
Type 1 – PAG and/or metal leaching	Type 1A	Reactive PAG	NPR ≤ 2, NP ≤ 20 kg/t	Requires management *
	Type 1B	PAG	NPR ≤ 2, NP > 20 kg/t	
	Type 1C	Metal Leaching (ML)	NPR > 2, As > 50 ppm	
Type 2 C – NAG / non-metal leaching			NPR > 2, As < 50 ppm	Geochemically suitable for use in construction

Notes:

^A Criteria based on industry standard criteria or Project-specific thresholds. Criteria apply to mine rock only.

*Management approaches used for each rock type are described in Section 3.

Table 3–2: Proportion of PAG and NAG in Ore Stockpiles and Exposed on Pit Walls

Mine Feature	Total Material	Rock Types
Low Grade Ore Stockpile	10.2 Mt	<ul style="list-style-type: none"> • 28 % (2.8 Mt) metal leaching NAG • 30 % (3.1 Mt) acidic PAG • 42 % (4.2 Mt) non-acidic PAG
Medium/High Grade Stockpile	3.2 Mt	<ul style="list-style-type: none"> • 15 % (0.48 Mt) metal leaching NAG • 47 % (1.5 Mt) acidic PAG • 38 % (1.2 Mt) non-acidic PAG
Pit Walls (full pit wall exposure at end of mine life, before flooding)	1.9 Mm ²	<ul style="list-style-type: none"> • 15% (0.29 Mm²) metal leaching NAG • 40% (0.76 Mm²) non-metal leaching NAG • 25% (0.48 Mm²) acidic PAG • 20% (0.38 Mm²) non-acidic PAG

PAG rock is differentiated as acidic PAG and non-acidic PAG for modelling purposes. Acidic PAG rock is PAG rock that is already net-acid generating. Non-acidic PAG rock is PAG rock that is not yet net-acid generating but will become net-acid generating in the future.

Table 3-3: Mine Rock Source Terms

Source Term	NAG, Non Metal Leaching Rock		NAG, Metal Leaching Rock		Non-acidic PAG Rock		Acidic PAG Rock
	Expected	Conservative	Expected	Conservative	Expected	Conservative	
Units	mg/m ² /wk*	mg/m ² /wk*	mg/m ² /wk*	mg/m ² /wk*	mg/m ² /wk*	mg/m ² /wk*	mg/m ² /wk*
pH	7.5	7.5	7.5	7.5	7.5	7.5	2.5
Sulphate	0.23	0.98	0.36	1.3	0.36	1.3	112
Aluminum (Al)	0.0048	0.0078	0.0034	0.0090	0.0034	0.0090	0.46
Antimony (Sb)	0.00011	0.00019	0.000055	0.00022	0.000055	0.00022	0.00024
Arsenic (As)	0.00011	0.00019	0.00032	0.00068	0.00014	0.00037	0.037
Beryllium (Be)	0.00000098	0.0000062	0.0000010	0.0000084	0.0000010	0.0000084	0.00013
Boron (B)	0.00023	0.00081	0.00019	0.0010	0.00019	0.0010	0.00058
Cadmium (Cd)	0.00000019	0.000020	0.00000069	0.000025	0.00000069	0.000025	0.00030
Chromium (Cr)	0.000045	0.000050	0.000031	0.000052	0.000031	0.000052	0.00031
Cobalt (Co)	0.0000047	0.00038	0.0000027	0.00054	0.0000027	0.00054	0.024
Copper (Cu)	0.000027	0.000048	0.000024	0.000051	0.000024	0.000051	0.032
Iron (Fe)	0.00026	0.0011	0.00020	0.0034	0.00020	0.0034	34
Lead (Pb)	0.0000047	0.0000051	0.0000047	0.000039	0.0000047	0.000039	0.00037
Phosphorus (P)	0.00098	0.0033	0.0010	0.0042	0.0010	0.0042	0.20
Molybdenum (Mo)	0.000026	0.00059	0.000041	0.00095	0.000041	0.00095	0.0030
Nickel (Ni)	0.000023	0.00019	0.0000097	0.00026	0.0000097	0.00026	0.019
Selenium (Se)	0.0000100	0.000035	0.000028	0.00022	0.000028	0.00022	0.0011
Silver (Ag)	0.00000098	0.0000049	0.0000010	0.0000068	0.0000010	0.0000068	0.00017
Thallium (Tl)	0.0000014	0.0000037	0.0000015	0.0000043	0.0000015	0.0000043	0.000047
Tungsten (W)	0.000020	0.000030	0.000017	0.000081	0.000017	0.000081	0.000048
Uranium (U)	0.000016	0.000020	0.0000047	0.000045	0.0000047	0.000045	0.0029
Vanadium (V)	0.000089	0.00010	0.000076	0.00010	0.000076	0.00010	0.0013
Zinc (Zn)	0.000093	0.00043	0.000082	0.00051	0.000082	0.00051	0.026
Mercury (Hg)	0.0000004	0.00000046	0.00000037	0.00000082	0.00000037	0.00000082	0.00000088
Calcium (Ca)	0.45	0.62	0.37	0.86	0.37	0.86	1.3
Magnesium (Mg)	0.066	0.12	0.086	0.16	0.086	0.16	0.10
Sodium (Na)	0.0058	0.0099	0.0054	0.015	0.0054	0.015	0.012
Potassium (K)	0.049	0.094	0.031	0.10	0.031	0.10	0.085

Notes:

*Release rates were surface area normalized based on the estimated surface areas of mine rock humidity cell samples (see text).

Table 3–4: Tailings and Process Water Source Terms

Source Term	NAG Tailings		NAG Tailings Process Water		PAG Tailings Process Water	
	Expected	Conservative	Expected	Conservative	Expected	Conservative
Units	mg/m ² /wk*	mg/m ² /wk*	mg/L	mg/L	mg/L	mg/L
pH	6.6	6.5	8.2	8.2	8.1	8.1
Sulphate	50	241	1809	3100	1609	2900
Aluminum (Al)	2.9	5.7	0.017	0.017	0.042	0.042
Antimony (Sb)	0.034	0.041	0.100	0.100	0.12	0.12
Arsenic (As)	0.056	0.11	0.026	0.026	0.050	0.050
Beryllium (Be)	0.00014	0.00027	0.00010	0.00010	0.00010	0.00010
Boron (B)	0.038	0.065	0.050	0.050	0.050	0.050
Cadmium (Cd)	0.00015	0.00037	0.000081	0.000081	0.00020	0.00020
Chromium (Cr)	0.0072	0.0074	0.0041	0.0041	0.0053	0.0053
Cobalt (Co)	0.0043	0.0069	0.028	0.028	0.028	0.028
Copper (Cu)	0.082	0.16	0.27	0.27	0.82	0.82
Iron (Fe)	1.3	2.6	0.010	0.010	0.042	0.042
Lead (Pb)	0.013	0.025	0.00020	0.00020	0.0088	0.0088
Phosphorus (P)	0.14	0.26	0.015	0.015	0.029	0.029
Molybdenum (Mo)	0.071	0.35	0.32	0.32	0.30	0.30
Nickel (Ni)	0.0017	0.0042	0.0043	0.0043	0.0089	0.0089
Selenium (Se)	0.0049	0.013	0.0051	0.0051	0.013	0.013
Silver (Ag)	0.00058	0.0012	0.00010	0.00010	0.00010	0.00010
Thallium (Tl)	0.00046	0.00074	0.00088	0.00088	0.00074	0.00074
Tungsten (W)	0.0088	0.018	0.27	0.27	0.31	0.31
Uranium (U)	0.020	0.029	0.019	0.019	0.013	0.013
Vanadium (V)	0.014	0.015	0.0010	0.0010	0.0017	0.0017
Zinc (Zn)	0.019	0.020	0.0040	0.0040	0.047	0.047
Mercury (Hg)	0.000072	0.00014	0.00021	0.00021	0.00019	0.00019
Calcium (Ca)	194	308	470	470	449	449
Magnesium (Mg)	30	73	16	16	10	10
Sodium (Na)	3.6	8.8	960	1270	860	1170
Potassium (K)	22	41	118	118	106	106

Notes:

*Release rates were surface area normalized based on the exposed footprint area of the tailings humidity cells (see text).

Table 3-5: Other Mine Catchment Source Terms

Source Term	Exposed Lake Sediment Runoff		Surficial Soil Stockpile Runoff	Natural Area Runoff / Vegetated Cover Runoff	Disturbed Area Runoff	Regional Groundwater Seepage to Open Pit
	Expected	Conservative				
Case	Expected	Conservative				
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
pH	6.7	6.0	7.0	7.5	7.5	8
Sulphate	25	89	0.50	1.3	6.5	4.4
Aluminum (Al)	0.031	0.12	0.11	0.0050	0.025	0.0048
Antimony (Sb)	0.00047	0.00089	0.000059	0.00010	0.00050	0.000050
Arsenic (As)	0.0020	0.010	0.00080	0.00054	0.0027	0.00052
Beryllium (Be)	0.000010	0.000020	0.000011	0.000020	0.00010	0.000010
Boron (B)	0.017	0.14	0.0050	0.010	0.050	0.010
Cadmium (Cd)	0.000014	0.00018	0.0000066	0.0000050	0.000025	0.0000050
Chromium (Cr)	0.00057	0.00088	0.00041	0.00016	0.00080	0.00025
Cobalt (Co)	0.00025	0.0044	0.00013	0.00010	0.00050	0.00018
Copper (Cu)	0.0046	0.0089	0.0037	0.00063	0.0032	0.00048
Iron (Fe)	0.021	0.086	0.099	0.011	0.055	0.12
Lead (Pb)	0.000064	0.00014	0.000092	0.000050	0.00025	0.000025
Phosphorus (P)	0.067	2.2	0.013	0.050	0.25	0.026
Molybdenum (Mo)	0.0037	0.033	0.00036	0.000089	0.00045	0.0021
Nickel (Ni)	0.0012	0.0052	0.00072	0.00050	0.0025	0.00094
Selenium (Se)	0.00080	0.0054	0.00020	0.000072	0.00036	0.000080
Silver (Ag)	0.000012	0.000069	0.000012	0.000010	0.000050	0.0000050
Thallium (Tl)	0.000030	0.00050	0.0000063	0.000010	0.000050	0.0000050
Tungsten (W)	0.00020	0.00075	0.00020	0.00010	0.00050	0.00056
Uranium (U)	0.000067	0.0028	0.00014	0.000011	0.000055	0.00058
Vanadium (V)	0.0024	0.013	0.0013	0.00050	0.0025	0.00025
Zinc (Zn)	0.0023	0.23	0.0016	0.0011	0.0055	0.0013
Mercury (Hg)	0.000020	0.000022	0.000010	0.0000050	0.000025	0.0000025
Calcium (Ca)	20	42	2.5	11	55	38
Magnesium (Mg)	2.5	4.4	0.55	1.5	7.5	7.4
Sodium (Na)	2.4	4.6	0.64	0.55	2.8	6.7
Potassium (K)	2.9	6.0	0.72	0.71	3.6	2.4

4.0 RESULTS

Mine site water quality modelling results are presented below.

The results of the water quality estimates represent contact water quality for the mine site. These results are used as an input to the Surface Water Quality Model (Appendix N-2, WSP 2024a) and Effects Assessment, which ultimately informs water management and mitigation measures to protect the receiving environment.

4.1 Mine Site Operations

Water quality estimate results for the operation phase are provided for contact water from the CDF, seepage from the low grade ore stockpile, and the influent to the ETP. The CDF contact water estimates represent loading contributions from the north cell tailings, south cell tailings, process water, and mine rock embankments. These estimated water qualities represent all water leaving the CDF, including fugitive seepage to the environment. Results are summarized in Table 4-1 and Table 4-2 represent the maximum extent of operations (i.e., Year 10) for average annual conditions.

During operations, drainage from the CDF is estimated to have a circumneutral to slightly alkaline pH (e.g., pH 7 to 9) based on the characteristics of the north cell tailings and mine waste management approaches in place for PAG mine rock co-disposed in the north cell and PAG tailings deposited in the south cell, as well as the alkalinity of the process water.

Notable mass load accumulation occurred within the CDF-process plant circuit in the model. Calcium and iron were assumed to be added to the tailings stream for water quality management purposes. For assessment purposes, results for the CDF are provided based on mass balance considerations only, as well as geochemical modelling, as shown in Table 4-1. The difference between the mass balance result and the geochemical modelling results with iron and calcium addition suggest that further assessment of site water management practices may be required to address mass load accumulation. This will be further addressed in the next stage of Project engineering. Overall, process water deposited with the tailings in the CDF represents the predominant source of mass load to the CDF contact water.

As shown in Table 4-1, seepage from the low-grade ore stockpile is estimated to have an acidic pH (pH ~3.5). Results incorporate geochemical modelling in PHREEQC and allowed for natural precipitation and adsorption reactions to occur. Potential geochemical reactions that occur along the groundwater flowpath to receivers (including potential neutralization reactions with other media along the flowpath) was not considered.

The ETP influent is estimated to be moderately acidic (pH 4) including consideration of runoff from acidic PAG wall rock and seepage from the ore stockpiles that reports to the ETP. Results presented in Table 4-2 represent median and maximum estimated ETP influent concentrations. Mass balance results are provided along with results that were equilibrated in PHREEQC (natural precipitation and adsorption reactions allowed to occur).

4.2 Active Closure

Active closure water quality estimate results are provided in Table 4-3. This represents a 'snap shot' of initial conditions immediately following the cessation of operations and placement of the closure cover. Results are provided for fugitive seepage from the CDF, as well as contact water collected in the CDF ditch. At this time, CDF seepage comprises mass load from residual pore water and the covered mine wastes. Contact water reporting to the CDF ditch includes runoff from the top of the covered facility and the embankments. For modelling purposes, residual pore water was represented by the CDF drainage (equilibrated result that

includes supplemental calcium and iron addition to the tailings stream) from the operations estimate. As shown in Table 4-3, drainage from the CDF is estimated to have a circumneutral to slightly alkaline pH in active closure.

At closure, it was assumed that water collected in the CDF ditch would be pumped to the ETP. Pumping water from the CDF ditch back to the CDF would add load back into the CDF and would likely prolong the time to establish long term steady state conditions for the facility.

4.3 Post-Closure

Post-closure water quality estimate results are provided in Table 4-4 and Table 4-5. This represents a 'snapshot' of long-term steady state closure conditions. In this condition, all residual process water has been depleted from the CDF and mass load contributions are only from the covered NAG tailings and covered non-metal leaching NAG mine rock used to construct the embankments. The PAG mine wastes within the facility are assumed to remain geochemically inert and isolated within the tailings pile and below the long-term phreatic surface.

Preliminary modelling indicated that long-term steady state conditions could occur within approximately 100 years after the active closure stage. This is largely driven by the time required for all residual process water within the tailings pile to be released with seepage from the facility.

In the post-closure configuration, toe seepage is diluted with runoff from the covered embankment (cover runoff from the top of the facility exits via a spillway to Springpole Lake). Drainage from the CDF and other rehabilitated areas of the site are estimated to have a circumneutral pH based on the previously described mine waste management and closure approaches for the Project.

Table 4-1: Operations Water Quality Estimate Results - Co-Disposal Facility and Low Grade Ore Stockpile

Parameter	Units	CDF Contact Water ¹				Low Grade Ore Seepage ²	
		Mass Balance		Mass Balance Plus Equilibration in PHREEQC with Assumed Addition of Fe and Ca for Water Quality Management		Mass Balance and Equilibration in PHREEQC	
Case:		Expected	Conservative	Expected	Conservative	Expected	Conservative
pH	pH units	~8	~8	~8	~8	~3.5	~3.5
Sulphate	mg/L	216,000	413,000	2200	2200	582	592
Aluminum (Al)	mg/L	19	25	0.6	0.8	2.4	2.5
Antimony (Sb)	mg/L	13	14	0.6	0.6	0.002	0.004
Arsenic (As)	mg/L	4.6	5.3	0.00002	0.00005	0.03	0.03
Beryllium (Be)	mg/L	0.017	0.026	0.00000002	0.00000002	0.0007	0.0008
Boron (B)	mg/L	7.0	8.8	0.3	0.4	0.02	0.03
Cadmium (Cd)	mg/L	0.020	0.046	0.0001	0.0003	0.002	0.002
Chromium (Cr)	mg/L	0.59	0.67	0.004	0.007	0.002	0.002
Cobalt (Co)	mg/L	3.9	4.8	0.06	0.07	0.1	0.1
Copper (Cu)	mg/L	47	52	0.0008	0.0008	0.2	0.2
Iron (Fe)	mg/L	726	806	0.00005	0.00004	59	69
Lead (Pb)	mg/L	0.3	0.3	0.0000004	0.0000005	0.002	0.002
Phosphorus (P)	mg/L	11	20	0.005	0.01	1.1	1.1
Molybdenum (Mo)	mg/L	38	43	0.03*	0.03*	0.02	0.03
Nickel (Ni)	mg/L	1.1	1.4	0.004	0.004	0.1	0.1
Selenium (Se)	mg/L	0.8	1.0	0.04	0.04	0.006	0.008
Silver (Ag)	mg/L	0.018	0.025	0.0005	0.0007	0.0009	0.001
Thallium (Tl)	mg/L	0.11	0.12	0.004	0.005	0.0003	0.0003
Tungsten (W)	mg/L	33	37	0.03*	0.03*	0.0006	0.001
Uranium (U)	mg/L	2.2	2.4	0.09	0.09	0.01	0.02
Vanadium (V)	mg/L	0.3	0.4	0.000003	0.000005	0.008	0.008
Zinc (Zn)	mg/L	2.3	3.4	0.003	0.004	0.1	0.1
Mercury (Hg)	mg/L	0.03	0.03	0.0001	0.0001	0.00001	0.00002
Calcium (Ca)	mg/L	58,000	64,000	627	744	22	28
Magnesium (Mg)	mg/L	2,000	2,400	85	89	3.0	3.9
Sodium (Na)	mg/L	113,000	167,000	500	1206	0.7	0.8
Potassium (K)	mg/L	14,000	16,000	603	613	1.5	2.3

Notes:

1) Equilibrated values influenced by addition of Ca and Fe in CDF-process plant circuit, as described in Section 3.5.

2) Equilibrated values influenced by natural equilibration processes only, as described in Section 3.5.

* - Based on adsorption assumptions per Gustaffson (2003).

Table 4-2: Operations Water Quality Estimate Results - ETP Influent

Parameter	Units	ETP Influent							
		Mass Balance ¹				Mass Balance and Equilibration in PHREEQC ²			
Case:		Expected (median)	Expected (maximum)	Conservative (median)	Conservative (maximum)	Expected (median)	Expected (maximum)	Conservative (median)	Conservative (maximum)
pH	pH units	~4	~4	~4	~4	~4	~4	~4	~4
Sulphate	mg/L	270	317	332	389	264	310	327	383
Aluminum (Al)	mg/L	0.6	0.7	0.7	0.8	0.6	0.7	0.7	0.8
Antimony (Sb)	mg/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Arsenic (As)	mg/L	0.05	0.06	0.05	0.06	0.01	0.02	0.02	0.02
Beryllium (Be)	mg/L	0.0002	0.0002	0.0003	0.0003	0.0002	0.0002	0.0002	0.0003
Boron (B)	mg/L	0.03	0.04	0.06	0.06	0.03	0.04	0.06	0.06
Cadmium (Cd)	mg/L	0.0004	0.0005	0.0005	0.0006	0.0004	0.0005	0.0005	0.0006
Chromium (Cr)	mg/L	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002
Cobalt (Co)	mg/L	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04
Copper (Cu)	mg/L	0.06	0.07	0.06	0.07	0.06	0.07	0.06	0.07
Iron (Fe)	mg/L	44	51	44	51	5.4	6.8	5.5	6.9
Lead (Pb)	mg/L	0.0007	0.0007	0.0008	0.0009	0.0007	0.0007	0.0008	0.0009
Phosphorus (P)	mg/L	0.4	0.4	0.8	0.8	0.03	0.03	0.07	0.07
Molybdenum (Mo)	mg/L	0.02	0.04	0.06	0.08	0.001	0.002	0.003	0.004
Nickel (Ni)	mg/L	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Selenium (Se)	mg/L	0.003	0.003	0.004	0.005	0.003	0.003	0.004	0.005
Silver (Ag)	mg/L	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Thallium (Tl)	mg/L	0.0002	0.0003	0.0003	0.0004	0.0002	0.0003	0.0003	0.0004
Tungsten (W)	mg/L	0.01	0.01	0.02	0.08	0.001	0.001	0.001	0.004
Uranium (U)	mg/L	0.007	0.008	0.007	0.009	0.007	0.008	0.007	0.009
Vanadium (V)	mg/L	0.004	0.004	0.006	0.006	0.004	0.004	0.006	0.006
Zinc (Zn)	mg/L	0.04	0.04	0.08	0.08	0.04	0.04	0.08	0.08
Mercury (Hg)	mg/L	0.00003	0.00003	0.00003	0.00003	0.000005	0.000005	0.000006	0.000006
Calcium (Ca)	mg/L	64	71	73	80	64	71	73	80
Magnesium (Mg)	mg/L	6.9	7.9	7.6	8.7	6.9	7.9	7.6	8.8
Sodium (Na)	mg/L	48	52	77	87	35	40	55	80
Potassium (K)	mg/L	20	27	21	28	20	27	21	28

Notes:

- 1) Results use CDF contact water result that incorporates Fe and Ca addition, and equilibration in PHREEQC, at CDF-process plant circuit.
- 2) Results include an additional natural equilibration step in PHREEQC, as described in Section 3.5.

Table 4-3: Initial Closure Water Quality Estimate Results – CDF Drainage

Parameter	Units	CDF Fugitive Seepage		CDF Contact Water ¹	
		Mass Balance and Equilibration in PHREEQC		Expected	Conservative
Case:		Expected	Conservative	Expected	Conservative
pH	pH units	~8	~8	~8	~8
Sulphate	mg/L	2200	2200	573	573
Aluminum (Al)	mg/L	0.6	0.8	0.2	0.2
Antimony (Sb)	mg/L	0.6	0.6	0.1	0.1
Arsenic (As)	mg/L	0.00002	0.00005	0.0004	0.0004
Beryllium (Be)	mg/L	0.00000002	0.00000002	0.00002	0.00002
Boron (B)	mg/L	0.3	0.4	0.09	0.099
Cadmium (Cd)	mg/L	0.0001	0.0003	0.00003	0.00008
Chromium (Cr)	mg/L	0.004	0.007	0.001	0.002
Cobalt (Co)	mg/L	0.06	0.07	0.02	0.017
Copper (Cu)	mg/L	0.0008	0.0008	0.0007	0.0007
Iron (Fe)	mg/L	0.00005	0.00004	0.008	0.008
Lead (Pb)	mg/L	0.0000004	0.0000005	0.00004	0.00004
Phosphorus (P)	mg/L	0.005	0.01	0.04	0.04
Molybdenum (Mo)	mg/L	0.03*	0.03*	0.009	0.009
Nickel (Ni)	mg/L	0.004	0.004	0.001	0.002
Selenium (Se)	mg/L	0.04	0.04	0.01	0.01
Silver (Ag)	mg/L	0.0005	0.0007	0.0001	0.0002
Thallium (Tl)	mg/L	0.004	0.005	0.001	0.001
Tungsten (W)	mg/L	0.03*	0.03*	0.008	0.008
Uranium (U)	mg/L	0.09	0.1	0.024	0.02
Vanadium (V)	mg/L	0.00000	0.00000	0.0004	0.0004
Zinc (Zn)	mg/L	0.003	0.004	0.002	0.002
Mercury (Hg)	mg/L	0.0001	0.00015	0.00004	0.00004
Calcium (Ca)	mg/L	627	744	171	201
Magnesium (Mg)	mg/L	85	89	23	24
Sodium (Na)	mg/L	500	1206	130	314
Potassium (K)	mg/L	603	613	157	160

Notes:

- 1) CDF Contact Water represents toe seepage mixed with runoff from the covered top surface and embankments of the facility (see text).
- The primary loading source for P was based on source terms at or near method detection limits and this is considered an artefact of the model.
- * - Based on adsorption assumptions per Gustaffson (2003).

Table 4-4: Post-Closure Water Quality Estimate Results – CDF Drainage

Parameter	Units	CDF Fugitive Seepage		CDF Contact Water ²	
		Mass Balance and Equilibration ¹		Expected	Conservative
Case:		Expected	Conservative	Expected	Conservative
pH	pH units	7	7	7	7
Sulphate	mg/L	27	111	11	45
Aluminum (Al)	mg/L	0.6	1.0	0.2	0.4
Antimony (Sb)	mg/L	0.01	0.02	0.005	0.01
Arsenic (As)	mg/L	0.012	0.020	0.005	0.008
Beryllium (Be)	mg/L	0.000008	0.00002	0.00002	0.00002
Boron (B)	mg/L	0.04	0.1	0.02	0.04
Cadmium (Cd)	mg/L	0.00003	0.002	0.00001	0.0008
Chromium (Cr)	mg/L	0.005	0.006	0.002	0.002
Cobalt (Co)	mg/L	0.0007	0.04	0.0003	0.02
Copper (Cu)	mg/L	0.003	0.003	0.001	0.002
Iron (Fe)	mg/L	0.00004	0.00005	0.007	0.00666
Lead (Pb)	mg/L	0.0002	0.0002	0.0001	0.00009
Phosphorus (P)	mg/L	0.2	0.4	0.09	0.2
Molybdenum (Mo)	mg/L	0.005	0.07	0.002	0.03
Nickel (Ni)	mg/L	0.003	0.02	0.001	0.01
Selenium (Se)	mg/L	0.001	0.004	0.0005	0.002
Silver (Ag)	mg/L	0.0001	0.0006	0.00006	0.0002
Thallium (Tl)	mg/L	0.0002	0.0004	0.00007	0.0002
Tungsten (W)	mg/L	0.002	0.004	0.001	0.002
Uranium (U)	mg/L	0.002	0.003	0.0009	0.001
Vanadium (V)	mg/L	0.009	0.01	0.004	0.004
Zinc (Zn)	mg/L	0.01	0.04	0.005	0.02
Mercury (Hg)	mg/L	0.00005	0.00006	0.00002	0.00003
Calcium (Ca)	mg/L	41	61	23	31
Magnesium (Mg)	mg/L	9.2	16	4.5	7
Sodium (Na)	mg/L	1.2	1.8	0.8	1.0
Potassium (K)	mg/L	6.5	12	3.0	3.0

Notes:

- 1) Results include an additional natural equilibration step in PHREEQC, as described in Section 3.5.
- 2) CDF Contact Water represents toe seepage mixed with runoff from the covered embankments of the facility (see text).
- The primary loading source for P was based on source terms at or near method detection limits and this is considered an artefact of the model.

Table 4-5: Post-Closure Water Quality Estimate – Other Mine Site Catchments

Parameter	Units	Rehabilitated Ore Stockpile Catchment	Rehabilitated Process Plant Site Catchment	Rehabilitated Surficial Soil Stockpile Catchment
pH	pH units	~7	~7	~7
Sulphate	mg/L	1	1	1
Aluminum (Al)	mg/L	0.005	0.005	0.005
Antimony (Sb)	mg/L	0.0001	0.0001	0.0001
Arsenic (As)	mg/L	0.0005	0.0005	0.0005
Beryllium (Be)	mg/L	2E-05	2E-05	2E-05
Boron (B)	mg/L	0.01	0.01	0.01
Cadmium (Cd)	mg/L	5E-06	5E-06	5E-06
Chromium (Cr)	mg/L	0.0002	0.0002	0.0002
Cobalt (Co)	mg/L	0.0001	0.0001	0.0001
Copper (Cu)	mg/L	0.0006	0.0006	0.0006
Iron (Fe)	mg/L	0.01	0.01	0.01
Lead (Pb)	mg/L	5E-05	5E-05	5E-05
Phosphorus (P)	mg/L	0.05	0.05	0.05
Molybdenum (Mo)	mg/L	9E-05	9E-05	9E-05
Nickel (Ni)	mg/L	0.0005	0.0005	0.0005
Selenium (Se)	mg/L	7.2E-05	7.2E-05	7.2E-05
Silver (Ag)	mg/L	1E-05	1E-05	1E-05
Thallium (Tl)	mg/L	1E-05	1E-05	1E-05
Tungsten (W)	mg/L	0.0001	0.0001	0.0001
Uranium (U)	mg/L	1E-05	1E-05	1E-05
Vanadium (V)	mg/L	0.0005	0.0005	0.0005
Zinc (Zn)	mg/L	0.001	0.001	0.001
Mercury (Hg)	mg/L	5E-06	5E-06	5E-06
Calcium (Ca)	mg/L	10	10	10
Magnesium (Mg)	mg/L	2	2	2
Sodium (Na)	mg/L	0.5	0.5	0.5
Potassium (K)	mg/L	0.7	0.7	0.7

5.0 CLOSING

This mine site water quality modelling report was prepared for First Mining Gold Corp. by WSP. The quality of information, conclusions and scheduling estimates contained here is consistent with the level of effort involved in WSP's services and based on 1) information available at the time of preparation; 2) data supplied by outside sources; and 3) the assumptions, conditions and qualifications set forth in this report.

Yours sincerely,

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