Stantec

Berry Pit Expansion Project Water Quantity and Water Quality Model Update Report

Final Report

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Executive Summary

Marathon Gold Corporation (Marathon) is currently developing the Valentine Gold Project (the Approved Project), consisting of two gold deposits (Leprechaun and Marathon), waste rock piles, crushing and stockpiling areas, conventional milling, and processing facilities (the mill), a tailings management facility (TMF), personnel accommodations, and supporting infrastructure including roads, on-site power lines, buildings, and water and effluent management facilities. Marathon is proposing to mine a third deposit (Berry), located between the Leprechaun and Marathon deposits; this is referred to as the Berry Pit Expansion Project (Project Expansion). This report incorporates the Project Expansion to update the integrated water quantity and water quality models developed for the Marathon and Leprechaun pits, TMF and mill.

The Project Expansion consists of one open pit comprised of three basins (northern, central, and southern), a waste rock pile, combined overburden and low-grade ore stockpiles with the Marathon stockpiles, a topsoil stockpile, and water management infrastructure. Ore from the Berry open pit will be mined for up to nine years, stockpiled and processed at the mill. Tailings will be deposited in the southern basin of Berry from Mine (i.e., operation) Year 10 to Year 15. Waste rock will be placed in the northern basin beginning in Mine Year 6 of operation and the waste rock pile will be expanded over the top of the pit footprint. The central basin will be filled with waste rock to the surface beginning in Year 9. For the purposes of this report, the southern basin of the Berry open pit is referred to as the Southwest (SW) pit; the central basin is referred to as the Central pit; and the northern basin of the Berry pit is referred to as the Northeast (NE) pit.

The water quantity and water quality model incorporates the relevant water management infrastructure designs to simulate watershed areas, volume capacities, flow diversions and flow paths for major mine components of the Berry, Marathon and Leprechaun pit complexes, mill and TMF. The following main concepts are included in the model:

- Perimeter ditches around the stockpiles will flow into sedimentation ponds and discharge to local Final Discharge Points (FDPs). Progressive rehabilitation and closure activities will include adding a soil cover and vegetating the waste rock pile. When the waste rock pile soil covers have been established, the seepage collection ditches will have passive permeable reactive barriers installed, where required based on a pilot study, to intercept and treat toe and groundwater seepage.
- Mine water from dewatering the Berry open pit will be collected in sumps and pumped to a sedimentation pond (BER-SP-05) prior to discharge to the environment.
- The TMF will receive water from the mill via tailings slurry water (Mine Years 1 to 9), seepage collection pond discharge (intercepting tailings seepage from the tailings pond and pumping back into the pond for reuse) and runoff. In Mine Year 10, tailings deposition will switch to deposition in the Berry SW pit. Outflows/losses from the tailings pond include reclaim water to the mill, water retained in the tailings matrix, deep groundwater seepage, evaporation and excess water (tailings pond overflow). The excess of water in the tailings pond will be treated in a water treatment plant on an eight month to year-round basis when the TMF receives tailings during operation and during the closure phases until the TMF is rehabilitated. From Mine Year 10 to the end of Mine Year 15, tailings

will be deposited in the Berry pit, however, tailings pond water above dead storage will continue to be reclaimed to the processing plant. After Mine Year 15 and until Mine Year 17 excess TMF water will be pumped to the treatment plant. In Mine Year 17 the tailings pond will be drawn down by pumping to the treatment plant, the tailings will be graded and have a vegetated overburden cover placed on top and the emergency spillway will be breached. Seepage recirculation will cease when the tailings pond is drawn down. Post-closure, toe seepage and runoff from the TMF will be allowed to drain downgradient to predevelopment catchments.

- The NE Berry pit spillway elevation is lower than the connection elevation to the SW and Central pits. The SW and Central pits are connected at an elevation of 348 m above sea level (asl) with a spillway elevation of 418 m asl. Reclaim water from the SW pit and/or freshwater from the Victoria Lake Reservoir may be used to provide additional makeup water to the mill from Mine Years 10 to 15 if the tailings pond is not able to meet demand and water levels are at or above 100 m below the SW pit spillway elevation.
- No accelerated filling of the Berry pits is planned (using freshwater from Valentine Lake or the Victoria Lake Reservoir as is planned for the Marathon and Leprechaun pits).

The water quantity and water quality model results indicate that average condition (Climate Normal) average monthly and annual flows from the eight Berry sedimentation ponds are typically highest during the operation phase (Mine Years 1 to 9 when the TMF receives tailings and/or Mine Years 10 to 15 when the Berry SW pit receives tailings). At closure[1], the waste rock pile associated ponds (BER-SP-01A, 01B, 02 and 03) are predicted to have flow rates similar to the operation phase, due to increased runoff from the rehabilitated pile, and diversion of runoff on slopes adjacent to the open pit to drain to BER-SP-05.

The tailings pond is predicted for the average condition (Climate Normal) to have sufficient storage capacity during the construction and operation phases and closure, with no overflow discharge. For the 25-year return period annual wet year there are two years during operation that may require changes to treatment plant operation (e.g., triggering longer treatment duration than the typical eight months per year).

Process water needs for the process plant will be reclaimed from the tailings pond on a year-round basis with freshwater water needs being met by pumping from the Victoria Lake Reservoir during Mine Years 1 to 9. Additional freshwater from the Victoria Lake Reservoir is expected to be required to meet process water demands during TMF transition periods between the Stage 1 and 2 dam lifts when there is reduced storage volume in the TMF available for reclaim. As noted above, when tailings deposition is transferred to the Berry SW pit and the only inflows to the TMF are from precipitation, reclaim flow from the Berry SW pit and/or freshwater from the Victoria Lake Reservoir may be required in Mine Years 11 to 15.

[1] It is anticipated that placement of waste rock on the Berry waste rock pile will be complete at the end of Mine Year 13, and the model simulates commencement of rehabilitation at that time. The outflow rates from the sedimentation ponds associated with the waste rock pile will change during / upon rehabilitation. The topsoil and overburden piles will be scavenged at this time and those areas also rehabilitated.

After in-pit mining ceases at the end of Mine Year 6 in the NE pit, it will be filled with waste rock. Once the waste rock in-filling elevation reaches the existing ground surface, the Berry waste rock pile will be extended over the NE pit area. The NE pit is predicted to fill and discharge to the spillway (404 m asl) between 7.75 and 9.8 years after stopping in-pit mining. The SW pit will be filled with tailings and waste rock will be placed in the Central pit after in-pit mining is stopped at the end of Mine Year 9. The combined SW and Central pits are estimated to discharge via the spillway at 418 m asl elevation between 6.3 and 9.75 years after stopping in-pit mining. From the end of Mine Year 12, the Leprechaun pit will take 10.6 and 11 years to fill (without placement of tailings in it following stopping of in-pit mining and a freshwater filling rate from the Victoria Lake Reservoir of 4 Mm^3/year. The Marathon pit is estimated to take between 8.8 and 9.3 years for the wet and dry scenarios, respectively, to fill and overflow at the spillway elevation of 330 m asl after stopping in-pit mining at the end of Mine Year 13.

The water quantity and water quality model was extended to include a chemical mass balance model by incorporating baseline water quality, source terms, and the mine development schedule for the Project Expansion. The objective of the water quality model is to predict concentrations of potential contaminants in mine facilities and FDPs. Overall predicted water quality results for the major mine facilities (e.g., tailings pond and Berry open pit) and all FDPs in the Project Expansion are consistent with the Approved Project.

Only the *Metal and Diamond Mining Effluent Regulations* (MDMER) limits are directly applicable to the discharges. The Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-FAL) are used for screening purposes to update the parameters of potential concern (POPCs) identified in the ARD/ML report; these guidelines are not applicable to discharges, as they are developed for the receiving environment. The water quantity and water quality model results show that the tailings pond water will exceed the MDMER limits for copper, total cyanide, and un-ionized ammonia during the operation phase of the Project Expansion, consistent with the modelling results for the Approved Project. However, water from the tailings pond is treated at the water treatment plant (WTP) and the SAGR® unit to meet MDMER limits prior to discharging to Victoria Lake Reservoir through the discharge point PP-FDP-01. The SW and Central pit lake waters will exceed MDMER total cyanide and un-ionized ammonia during the operation and closure phases due to the deposition of tailings from Mine Year 10 to the end of Mine Year 15. Dewatering and overflow from the SW and Central pits and the NE pit are collected in the BER-SP-05 pond with site runoff prior to discharge to the Valentine Lake via BER-FDP-05 discharge point. No MDMER exceedances are predicted for the BER-FDP-05 discharge point. Final discharge points BER-FDP-01A, BER-FDP-01B, BER-FDP-02, and BER-FDP-03 receives overflow from sedimentation ponds that collect water from runoff and seepage from the Berry waste rock pile during the operation phase. The water quality model results show that there are no MDMER exceedances predicted at these discharge points. Long-term CWQG-FAL are not applicable to discharges, however, were used to screen POPCs for receivers. Parameters predicted to exceed the respective long-term CWQG-FAL for FDPs (BER-FDP-01A, BER-FDP-01B, BER-FDP-02, and BER-FDP-03) are aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, phosphorus, selenium, silver, uranium, zinc, nitrite, nitrate, ammonia, un-ionized ammonia, and fluoride during operation. These parameters decrease during the closure phase. These discharge points do not discharge water post-closure.

Final discharge point BER-FDP-05 receives overflow from the sedimentation pond that primarily receives dewatering and overflow from the Berry pit. BER-FDP-05 is the only point of discharge that discharges water through all phases for the Project Expansion. The water quality model results show that there are no MDMER exceedances predicted at BER-FDP-05. During operation, arsenic, cadmium, copper, mercury, selenium, silver, uranium, nitrite, total ammonia, un-ionized ammonia, and fluoride are predicted to exceed the respective long-term CWQG-FAL in addition to the parameters exceeded under baseline conditions (aluminium, chromium, iron, manganese, phosphorus, and zinc). Post-closure, arsenic, selenium, silver, uranium, nitrite, total ammonia, un-ionized ammonia, and fluoride will decrease to the levels below the respective long-term CWQG-FAL whereas cadmium, copper, mercury total ammonia, un-ionized ammonia, and fluoride will remain in exceedance of the long-term CWQG-FAL. The parameters exceeding the long-term CWQG-FAL under baseline conditions (aluminium, chromium, iron, manganese, phosphorus, and zinc) are predicted to remain exceeding the long-term CWQG-FAL post-closure.

Marathon will conduct regular site and receiving environment monitoring for flows, water levels, and water quality during all phases of the Approved Project and Project Expansion. The monitoring data will be used to calibrate the water balance and water quality model throughout the life-of-mine. Additional geochemical characterization and environmental monitoring will be completed to assess the actual site conditions, and to refine the water quantity and quality model throughout the life-of-mine, as applicable.

Table of Contents

Limitations and Sign-off ..... **i**

Executive Summary ..... **iii**

1 Introduction **1**
- 1.1 Study Objectives 1
- 1.2 Project Overview 2
  - 1.2.1 Project Facilities 2
  - 1.2.2 Water Management Infrastructure 5
  - 1.2.3 Project Phases 12

2 Modelling Approach **15**

3 Water Quantity Model Update **16**
- 3.1 Conceptual Model 16
- 3.2 Water Quantity Model Approach 25
- 3.3 Model Inputs 26
  - 3.3.1 Climate and Hydrology 26
  - 3.3.2 Waste Rock Piles and Stockpiles 28
  - 3.3.3 Surface Runoff 29
  - 3.3.4 Groundwater Infiltration 30
  - 3.3.5 Open Pit 31
  - 3.3.6 Tailings Management Facility 35

4 Water Quantity Model Results **38**
- 4.1 Sedimentation Ponds 38
- 4.2 Tailings Management Facility 47
- 4.3 Berry Pits 53
  - 4.3.1 Berry Complex 53
  - 4.3.2 Marathon and Leprechaun Pit Complexes 58

5 Water Quality Model Update **61**
- 5.1 Conceptual Model 61
- 5.2 Baseline Water Quality Inputs 62
- 5.3 Model Inputs 63
  - 5.3.1 Waste Rock Pile, Ore Stockpiles, and Rubble in the Open Pit 63
  - 5.3.2 TMF 67
  - 5.3.3 Berry Pit Complex 69
  - 5.3.4 Solubility Controls 70

6 Water Quality Predictions 72
6.1 Model Runs and Outputs 72
6.2 Project Expansion Components 72
6.2.1 Waste Rock Pile 72
6.2.2 Low-Grade Ore Stockpile 75
6.2.3 Tailings Pond 76
6.2.4 Berry Complex Pits 78
6.3 Final Discharge Points 81
6.3.1 BER-FDP-01A 81
6.3.2 BER-FDP-01B 82
6.3.3 BER-FDP-02 82
6.3.4 BER-FDP-03 82
6.3.5 BER-FDP-04 and MA-FDP-01AB 82
6.3.6 BER-FDP-05 83
6.3.7 BER-FDP-06 84

7 Predictions Summary 85
7.1 Water Quantity 85
7.2 Water Quality 86

8 References 1

List of Tables

Table 1.1 Tailings Pond Excess Pump Rates to the Treatment Plant 6
Table 1.2 Sedimentation Ponds, Drainage Areas, Seepage Catchment Areas, and Pond Design Attributes 8
Table 1.3 Description of Project Phases of Development 12
Table 3.1 Stockpile Construction Start Times and Surface Area Buildout Percentage during Construction and Operation at End of Mine Year 18
Table 3.2 Berry Pit Annual Surface Area Expansions during Construction and Operation Phases 19
Table 3.3 Water Quantity Model Climate Inputs with Monthly Distribution 27
Table 3.4 AET, Snowmelt, Runoff and Toe Seepage Adjustment Factors 29
Table 3.5 Runoff Coefficients by Land Use Type for Select Project Facilities and TMF Watershed Areas 30
Table 3.6 Stockpile Groundwater Recharge by Water Managament Receptor 31
Table 3.7 Surface Area of SW, Central and NE Pits during Mining 31
Table 3.8 Stage Elevation, Projected Surface Area and Volume for Individual NE, Central and SW Pits, and Combined Central and SW Pit Complex 33
Table 3.9 Groundwater Inflow Rates to NE, Central and SW Pits 35
Table 3.10 TMF Watershed Areas for Different Operation Stages 35
Table 3.11 TMF Seepage Rates 37
Table 4.1 Monthly Average Condition Outflows from Sedimentation Ponds and Downstream Final Discharge Point for BER-SP-05. 40
Table 4.2 Monthly and Annual Average Berry SW Pit Reclaim Rates to Plant 51
Table 4.3 Average Condition TMF Water Quantity Model Flow Summary for Operation 52
Table 4.4 Monthly Average, 5th Percentile and 95th Percentile NE and SW and Central Pit Complex Dewatering Rates 55

Table 5.1 Percentages and Inputs for Different Lithologies/Materials....................................64
Table 5.2 Ranges and Sources of Scale up Factors 65
Table 5.3 Temperature of Scale Up Factor for TMF (Kempton 2012) 68

List of Figures

Figure 1.1 Project Expansion and Approved Project Site Layout 3
Figure 1.2 Berry Pile Catchment Area Plan...10
Figure 1.3 Berry Pile Seepage Catchment Areas..11
Figure 1.4 Development Project Phases (Mine Year vs. Model Year).....................................14
Figure 3.1 Berry Mine Water Management Conceptual Model – Construction / Operation (Mine Year -2.25 to 6)...17
Figure 3.2 Berry Mine Water Management Conceptual Model - Operation (Mine Year 7 to 9) 20
Figure 3.3 Berry Mine Water Management Conceptual Model - Operation (Mine Year 10 to 12) 21
Figure 3.4 Berry Mine Water Management Conceptual Model - Operation (Mine Year 13 to 15) 22
Figure 3.5 Berry Mine Water Management Conceptual Model - Closure (Mine Year 16 until Pit is Full) 23
Figure 3.6 Berry Mine Water Management Conceptual Model - Post-Closure (Pit is Full) 24
Figure 3.7 Conceptual Stockpile or Waste Rock Pile Flow Pathways.....................................26
Figure 4.1 Average Condition Volume, Inflows and Outflow of Sedimentation Pond BER-SP-03 39
Figure 4.2 Average Condition Volume, Inflows and Outflow of Sedimentation Pond BER-SP-05 39
Figure 4.3 Sedimentation Pond BER-SP-01A Annual Outflow Probabilistic Analysis. 42
Figure 4.4 Sedimentation Pond BER-SP-01B Annual Outflow Probabilistic Analysis. 43
Figure 4.5 Sedimentation Pond BER-SP-02 Annual Outflow Probabilistic Analysis. 43
Figure 4.6 Sedimentation Pond BER-SP-03 Annual Overflow Probabilistic Analysis. 44
Figure 4.7 Sedimentation Pond BER-SP-04 Annual Outflow Probabilistic Analysis. 45
Figure 4.8 Sedimentation Pond MA-SP-01AB Annual Outflow Probabilistic Analysis..............45
Figure 4.9 Final Discharge Point BER-FDP-05 Annual Outflow Probabilistic Analysis. 47
Figure 4.10 Sedimentation Pond BER-SP-06 Annual Outflow Probabilistic Analysis. 47
Figure 4.11 Average Climate Condition Tailings Pond Storage and Outflows 48
Figure 4.12 25-year Return Period Annual Wet Year (95th Percentile) for Tailings IPond Storage and Maximum Storage Below Spillway 49
Figure 4.13 Average Condition Tailings Pond, Freshwater and Berry SW Pit Reclaim Rates to Plant 50
Figure 4.14 Annual Average Flow Rates for the Average Condition for Tailings Pond, Freshwater and Berry SW Reclaim 50
Figure 4.15 Average Scenario for NE Pit Level, Inflows and Dewatering 53
Figure 4.16 Probabilistic Analysis of NE Pit Dewatering Rate 54
Figure 4.17 Probabilistic Analysis of Natural Filling of NE Pit...56
Figure 4.18 Average Scenario for SW and Central Pit Level, Inflows and Dewatering 57
Figure 4.19 Probabilistic Analysis of SW and Central Pit Dewatering Rate 57

Figure 4.20 Probabilistic Analysis of Tailings Deposition and Natural Filling of SW and Central Berry Pit Complex........58
Figure 4.21 Probabilistic Analysis of Accelerated Filling of the Leprechaun Pit Adding Water from Victoria Lake Reservoir 59
Figure 4.22 Probabilistic Analysis of Accelerated Filling of the Marathon Pit Adding Water from Valentine Lake........60
Figure 5.1 Regression Used for Derivation of K_{AGEING} CN_T. CN_T is Total Cyanide (mg/L as Nitrogen); t is time (day); $K_{CNT\ Ageing}$ is the First Order Constant Which is the Slope of the Linear Line. 69
Figure 5.2 Box Plots for Total Al and Fe in Surface Water Stations, LP02 and LP04 (Stantec 2020b) 71
Figure 6.1 Temporal Concentration Trends of Zn and N-NO_2. 74
Figure 6.2 Temporal Concentration Trend of Zn in LGO Seepage 75
Figure 6.3 Temporal Concentration Trend of Total Cyanide in Tailings Pond Water 76
Figure 6.4 Temporal Concentration Trend of Total Ammonia in Tailings Pond Water 77
Figure 6.5 Temporal Concentration Trend of Cu in Tailings Pond Water 78
Figure 6.6 Temporal Concentration Trend of Zinc in the NE Pit Water........79
Figure 6.7 Temporal Concentration Trend of Copper in the SW and Central Pit Water........80
Figure 6.8 Temporal Concentration Trend of Un-ionized Ammonia in the SW and Central Pit Water 81
Figure 6.9 Temporal Concentration Trend of Copper in the Water at BER-FDP-05 Discharge Point 84

List of Appendices

Appendix A Water Quantity Model Results

Appendix B Water Quality Model Inputs

Appendix C Water Quality Model Results

Appendix D Time Series Model Result Figures for Selected Parameter

1 Introduction

Marathon Gold Corporation (Marathon) is presently constructing two open gold mine pit complexes (Leprechaun and Marathon), waste rock piles, crushing and stockpiling areas, conventional milling, and processing facilities (the mill), a tailings management facility (TMF), personnel accommodations, and supporting infrastructure, including roads, on-site power lines, buildings, and water and effluent management facilities for the Valentine Gold Project (the Approved Project).

Stantec Consulting Ltd. (Stantec) is updating the water quantity and water quality modelling in support of the proposed Berry Pit Expansion Project (the Project Expansion). The Valentine Gold Project groundwater (GW), water quantity, and water quality (WQ) models (Stantec 2020a, 2020b, 2020c) were originally built to support the effects assessment for the Valentine Gold Project Environmental Impact Statement (EIS) for the Approved Project (Valentine Gold EIS; Marathon 2020). The Valentine Gold EIS water quantity and WQ models were constructed using GoldSim™ simulation software and are project-based models that do not include a receiving environment water balance. One GoldSim™ model was developed for the Marathon pit complex (Stantec 2020b), and another was developed for the Leprechaun pit complex and TMF (Stantec 2020c). In January 2022, the groundwater flow model was updated in response to Valentine Gold EIS information requests (Stantec 2022). The following report presents the updates to the GoldSim™ water quantity and WQ models to incorporate the Project Expansion.

1.1 Study Objectives

The model considers both the quantity and quality of water under management and is used to support the prediction of potential environmental effects in the Environmental Assessment (EA) Update / Environmental Registration for the Project Expansion.

The objectives of the Berry complex water quantity and WQ model are to:

- Estimate the quantity and quality of surface water runoff associated with the Project Expansion facilities including the open pit, ore stockpile, overburden stockpile, topsoil stockpile, waste rock pile, and TMF operational process flows and discharges during all phases of development
- Predict the quantity and quality of effluent discharge at each final discharge point (FDP) during all phases of development
- Aid in the development of the conceptual closure plan for the Project Expansion

Effects of the Project Expansion on surface water quality of the receiving environment are not simulated in this model. A separate assessment of the assimilative capacity of the receiving waters provides the surface water quality of the effluent discharge once mixed with the receiving waters. The model uses mill water balance inputs and outputs provided in the Feasibility Study (Ausenco 2022) and Valentine Gold Project – Water Balance and Hydraulic Design for Tailings Management Facility (Golder 2022).

1.2 Project Overview

1.2.1 Project Facilities

The Berry complex consists of one open pit, comprised of three basins (southern, central and northern), stockpiles (i.e., waste rock pile, topsoil stockpile, and overburden and low-grade ore [LGO] stockpiles that are shared with the Marathon pit), and sedimentation ponds. Note that for the purposes of this report, the southern basin of the Berry open pit is referred to as the Southwest (SW) pit, the central basin is referred to as the Central pit and the northern basin of the Berry pit is referred to as the Northeast (NE) pit. The processing plant and TMF complex consists of the TMF (i.e., the tailings impoundment and process water management unit [submerged attached growth reactor (SAGR®)], water treatment plant, process plant/mill, truck shop, run-of-mill (ROM) pad, and high-grade ore (HGO) stockpile. A description of the facilities at the TMF and Processing Plant complex and the Berry complex are presented below and in the updated Water Management Plan (Stantec 2023c). The Marathon and Leprechaun complexes had water quantity and WQ models developed for the Valentine Gold EIS and are not part of the Project Expansion, except to reassess the water filling rate for the Leprechaun pit based on Year 10 diversion of tailings deposition to the Berry pit. The location of the Processing Plant and TMF complex and Berry complex facilities are presented on Figure 1.1

Ore Milling and Processing Plant: Processing is proposed in two phases of operation. The initial processing period (Mine Year 1 to 4) has a nominal throughput of 6,859 tonnes per day (t/d) or 2.5 million tonnes per year (Mt/a). As the mill feed grade decreases and plant capacity is required to increase to maintain gold production, the mill will operate at full production rate of 10,960 t/d or 4.0 Mt/a (Mine Year 5 to 15). At full production, flotation equipment will be employed to recover most of the gold to a low mass concentrate stream, and ultra-fine grinding and cyanidation.

Fresh make-up water and elution water will be pumped from Victoria Lake Reservoir to the mill, amounting to approximately 13% of process water for initial processing and 8% of process water for full production. The tailings pond will provide the remainder of the process water for the mill.

In the model, which includes a water linkage to the mill and processing plant, the mill and process plant (the Plant) are represented in the model as water demand elements, reclaiming water from the tailings pond. For the Project Expansion, when tailings are being actively deposited in the Berry SW pit, reclaim demands that are not met by the tailings pond may be supplemented by pumping water from the Berry SW pit. The pumping rate from the Berry SW pit will equal the design meteoric incident precipitation and groundwater seepage rate to the three Berry pits (2,387 m^3/d) when the water elevation within the pit is 100 m below the spillway elevation (318 m asl).

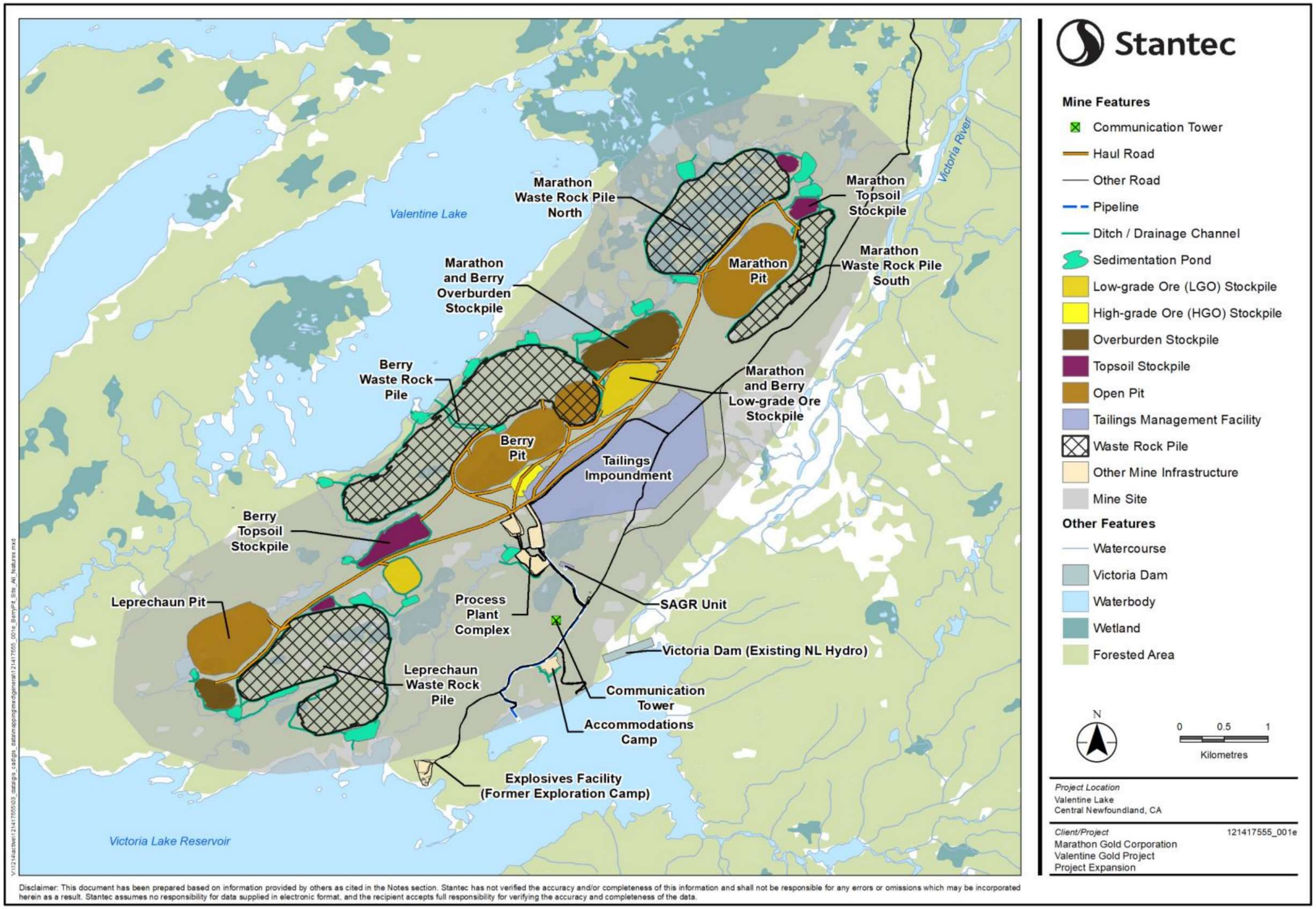


Figure 1.1 Project Expansion and Approved Project Site Layout

Tailings Management Facility: The TMF is located northeast of the plant along a natural topographic ridge. The TMF will receive direct precipitation, as well as the process water discharged with the tailings slurry. Excess water from the open pit dewatering and runoff and collected seepage from stockpiles at the Berry complex are managed separately and do not report to the TMF.

The tailings pond, with an end of mine life maximum storage capacity of 1 million cubic metres (Mm^3), has been sized to store the excess tailings pond water during the winter months period (December to March). Reclaim water will be pumped from a floating barge in the TMF to the processing plant. TMF reclaim water demand is setup as per the Golder water balance TMF and mill model (Golder 2022) with details presented in Section 3.3.6. The process water demand will primarily be supplied with reclaimed water from the TMF to reduce the need for fresh surface water demand.

A continuous downstream raise of the tailings impoundment will be constructed to meet requirements for water and tailings storage. The primary construction material for the TMF is the waste rock from the open pits. Dam runoff and seepage will be captured in the perimeter seepage collection ditches and pumped back to the TMF.

A water treatment plant will treat excess tailings pond water prior to discharge to Victoria Lake Reservoir on an eight month to year-round basis. A polishing pond was previously planned to provide final adjustments of the water quality of the treated effluent from the treatment plant, prior to release to the natural environment (Marathon 2020); however, the polishing pond has been replaced with a submerged attached growth reactor (SAGR®) unit.

Berry Open Pit: The SW, Central and NE pits will be progressively expanded when actively mined. The SW and Central pits will be mined from the beginning Mine Year 1 to the end of Mine Year 9. The NE pit will be actively mined from the beginning of Mine Year 1 to the end of Mine Year 6. The Berry, Marathon and Leprechaun pits will be mined simultaneously with plans for the ore stream to be blended and processed together. Ore extracted from the open pits will be hauled to stockpiles or to the processing plant. Ore grading between 0.33 and 0.50 grams per tonne (g/t) of gold (Au) will be stockpiled in the associated LGO stockpiles, including the combination Berry / Marathon LGO stockpile. Cut-off grade optimization on the mine production schedule will also send ore above 0.50 g/t Au to an HGO stockpile in certain planned periods.

The Berry open pit will be dewatered throughout operation by pumping from sumps at the base of the pits. The collected contact water will be stored in the sump prior to being pumped to a sedimentation pond (BER-SP-05) at the surface. Water from the sedimentation ponds will be discharged to the environment (following treatment to meet discharge quality criteria).

The Berry NE pit lowest elevation is 258 m asl with a spillway elevation of 400 m asl, and a maximum surface area of 0.2 square kilometres (km^2). The Berry combined SW and Central pits have a lowest elevation of 198 m asl (Central) with a spillway elevation of 418 m asl, and a maximum surface area of 0.6 km^2. The SW and Central pit pits meet at an elevation of 348 m asl, and the SW pit has a lowest elevation of 210 m asl.

Waste rock will be placed in the Berry NE pit beginning in Mine Year 7 and reach the ground surface approximately at the start of Mine Year 9. Waste rock will continue to be stockpiled on top of the NE pit area until the end of Mine Year 13 from the Berry SW and Central pits, and the Marathon complex.

After completion of mining in the SW and Central pits, the SW pit will be filled with tailings beginning in Mine Year 10.25 (spring season) to an elevation of 404.5 m asl with a 10% beach slope that extends to where the SW and Central pits meet (348 m asl) at the end of Mine Year 15. The Central pit will be backfilled with waste rock beginning in Mine Year 10 from the Marathon complex up to an elevation of 414 m asl at the end of Mine Year 13.

The SW, Central and NE pits will receive groundwater seepage, direct precipitation and. For the NE pit, waste rock stockpile infiltration and surface water runoff. Once full, the NE pit will spill through a discharge channel to the sedimentation pond BER-SP-05 and then via the waste rock pile rock fill drain to Valentine Lake. The SW and Central pit lake will discharge via its spillway into a drainage channel to BER-SP-05 and then via the waste rock pile rock fill drain to Valentine Lake.

Low-grade ore (LGO) Stockpile, Overburden Stockpile, Topsoil Stockpile and Waste Rock Pile: The Berry waste rock pile is located west of the three open pit limits and built up to a crest elevation of 475 m asl. The waste rock pile footprint extends over the NE pit footprint. Topsoil from the pit will be stored in a topsoil stockpile directly southwest of the pit limits and overburden will be stored in the combined Berry / Marathon overburden stockpile directly northwest of the three pit limits. The LGO stockpile will be located northeast of the three Berry pits. These piles are separated to avoid local natural watercourses. The waste rock pile will be constructed from the existing ground surface and will be sloped and benched as it is developed, creating overall safe slopes for final closure of three horizontal to one vertical (3H:1V). The pile will be progressively rehabilitated during operation and closure by covering slopes and benches with a vegetated soil cover to reduce infiltration and increase evapotranspiration.

Final Discharge Points (FDPs): The FDPs receive the outflows from the sedimentation ponds. Watershed areas upstream of each FDP associated with the Project Expansion water management infrastructure were developed using available public topographic information and LiDAR data collected for the Project Expansion.

1.2.2 Water Management Infrastructure

Water management infrastructure includes the water treatment plant constructed downstream of the tailings impoundment and processing plant, and the sedimentation ponds constructed upstream of each FDP. Water from the tailings pond that is not reclaimed as process water will be treated in the water treatment plant followed by additional treatment in the SAGR® unit prior to discharge to the Victoria Lake Reservoir. At the Berry complex, collection ditches will be installed around the perimeter of Project facilities to intercept surface water and toe seepage and convey it to the sedimentation ponds. Further details regarding water management infrastructure are described in Section 3.3.

A water treatment plant facilitates treatment and discharge of process and tailings effluent to Victoria Lake Reservoir. Treatment of the process and tailings effluent involves the following:

- a cyanide (CN) destruction circuit in the mill circuit
- sedimentation of suspended solids, and supplemental natural cyanide degradation in the tailings pond
- copper and ammonia removal, and pH adjustment in the water treatment plant
- coagulant polymer added at the water treatment plant to facilitate the removal of colloidal sized suspended matter
- a SAGR® unit (added to the treatment train), which uses a biomass to oxidize compounds and reduce ammonia concentrations to non-toxic regulatory levels

Treatment of tailings water will occur on an eight month to year-round basis. The pumping rates of water from the tailings pond are managed by the annual mill production and the percentage of the allowable TMF storage volume that is filled (Table 1.1).

Table 1.1 Tailings Pond Excess Pump Rates to the Treatment Plant

Trigger	Production Phase									
	0 <2.49 Mt/yr		1 <3.0 Mt/yr		2 ≥3.0 Mt/yr, Berry Pit Deposition		3 Berry Pit End of Operations (Mine Year 15 - 16) [C]		4 Closure (Mine Year 17) [D]	
	% Allowable Volume Trigger	m^3/hr	% Allowable Volume Trigger	m^3/hr	% Allowable Volume Trigger	m^3/hr	% Allowable Volume Trigger	m^3/hr	% Allowable Volume Trigger	m^3/hr
1 [A,B]	90	0	10	0	10	0	10	0	10	220
2	95	45	45	120	56	60	30	60	30	220
3	100	60	75	165	75	85	60	85	60	220
4	100	80	100	240	100	220	100	220	100	220

Notes:

[A] If December to March required reclaim volume for that given month is less than the actual tailings pond stored water volume then the treatment plant flow rate is 0 m^3/hr

[B] The SAGR® unit is a biological process that requires continuous flow to maintain the treatment biomass. During the winter months (December to March) when the treatment plant flow rate is 0 m^3/hr, tailings pond water may need to be recirculated through SAGR® unit and back into the tailings pond to support the treatment biomass.

[C] Phase developed to manage tailings pond when seepage collection recirculation occurs during the last year of operation with reduced mill demand to the start of the closure sub-phase (two-year period)

[D] Phase developed to drain the tailings pond in closure to treatment system and installation of vegetated earthen cover over exposed tailings

The sedimentation ponds at the Berry complex are intended to control the sediment contained in contact water discharges from mine facilities. Each sedimentation pond collects runoff, toe seepage, and groundwater infiltration through a series of ditches. The ditches may capture flow from waste rock piles, and LGO, topsoil or overburden stockpiles, or water from pit dewatering. These water management features (ditches and sedimentation ponds) were designed under a decentralized water treatment framework, operating under gravity drainage to reduce the need for pumping when managing flows. Figure 1.2 and Figure 1.3 present the Berry complex water management infrastructure and associated drainage and seepage catchment areas.

Table 1.2 presents a list of the ditches and sedimentation ponds in the Berry complex that capture runoff and toe seepage from each mine facility, as well as pond watershed area, seepage collection area (toe seepage, basal seepage) and volume of the sedimentation ponds.

Table 1.2 Sedimentation Ponds, Drainage Areas, Seepage Catchment Areas, and Pond Design Attributes

Mine Facility	Ditch Name	Sedimentation Pond Name	Sedimentation Pond Watershed Area (m^2)	Pond Seepage Collection area (m^2)	Pond Volume (m^3)	Pond Area (m^2)
Berry / Marathon LGO Stockpile	MA-DR-02	MA-SP-01AB	93,483	93,483	88,500	25,114
Berry / Marathon Overburden Stockpile	MA-DR-01		188,300	188,300		
Berry / Marathon LGO Stockpile	BER-DR-08	BER-SP-04	141,221	141,221	42,600	20,107
Berry / Marathon Overburden Stockpile	BER-DR-07		230,720	230,720		
Berry Waste Rock Pile	BER-DR-01	BER-SP-01A	283,406	362,177	34,600	12,983
	BER-DR-01A		103,769			
	BER-DR-02A	BER-SP-01B	352,609	535,164	51,500	18,507
	BER-DR-02		75,482			
	01B East Runoff Area [A]		85,599			
	Rockfill Drain West Runoff Area	Rockfill Drain	46,591	65,339	-	-
	Rockfill Drain East Runoff Area [A]		30,362			
	BER-DR-03	BER-SP-02	210,554	461,517	45,400	19,543
	BER-DR-04		109,641			
	02 East Runoff Area [A]		124,361			
	BER-DR-05	BER-SP-03	108,598	458,955	63,500	21,486
	BER-DR-06		319,417			
	03 East Runoff Area [A]		96,559			
	NE Pit SP03 Runoff Area		65,687			
	NE Pit Area	NE Pit [B]	124,038	189,725	-	-
	NE Pit Runoff Area		8,936	8,936		
	SW Pit Total Dewatering	BER-SP-05	199,380	-	76,500	6,380
	Central Pit Total Dewatering		294,498	-		
	NE Pit Total Dewatering		339,948	-		

Table 1.2 Sedimentation Ponds, Drainage Areas, Seepage Catchment Areas, and Pond Design Attributes

Mine Facility	Ditch Name	Sedimentation Pond Name	Sedimentation Pond Watershed Area (m^2)	Pond Seepage Collection area (m^2)	Pond Volume (m^3)	Pond Area (m^2)
Topsoil Stockpile	BER-DR-09	BER-SP-06	103,821	237,209	26700	11,844
	BER-DR-10		133,388			

Notes:

[A] Waste rock pile surfaces on the east side during operation and due to grade of existing ground are assumed to have surface runoff and toe seepage drain under the stockpile and be intercepted by the seepage collection ditches for the representative sedimentation pond (e.g., East Runoff Area 01B to BER-SP-01B). During decommissioning, rehabilitation, and closure when the waste rock pile surface is covered, surface runoff will be collected in a drainage ditch at the toe and conveyed to BER-SP-05 (Figure 1-2). Toe seepage during decommissioning, rehabilitation and closure will be conveyed under the waste rock pile and be intercepted by the seepage collection ditch for the representative sedimentation pond.

[B] Surface runoff, toe seepage and basal seepage from the waste rock pile within and over the NE pit is captured within the pit shell and will discharge to BER-SP-05 via a drainage channel from the pit spillway.

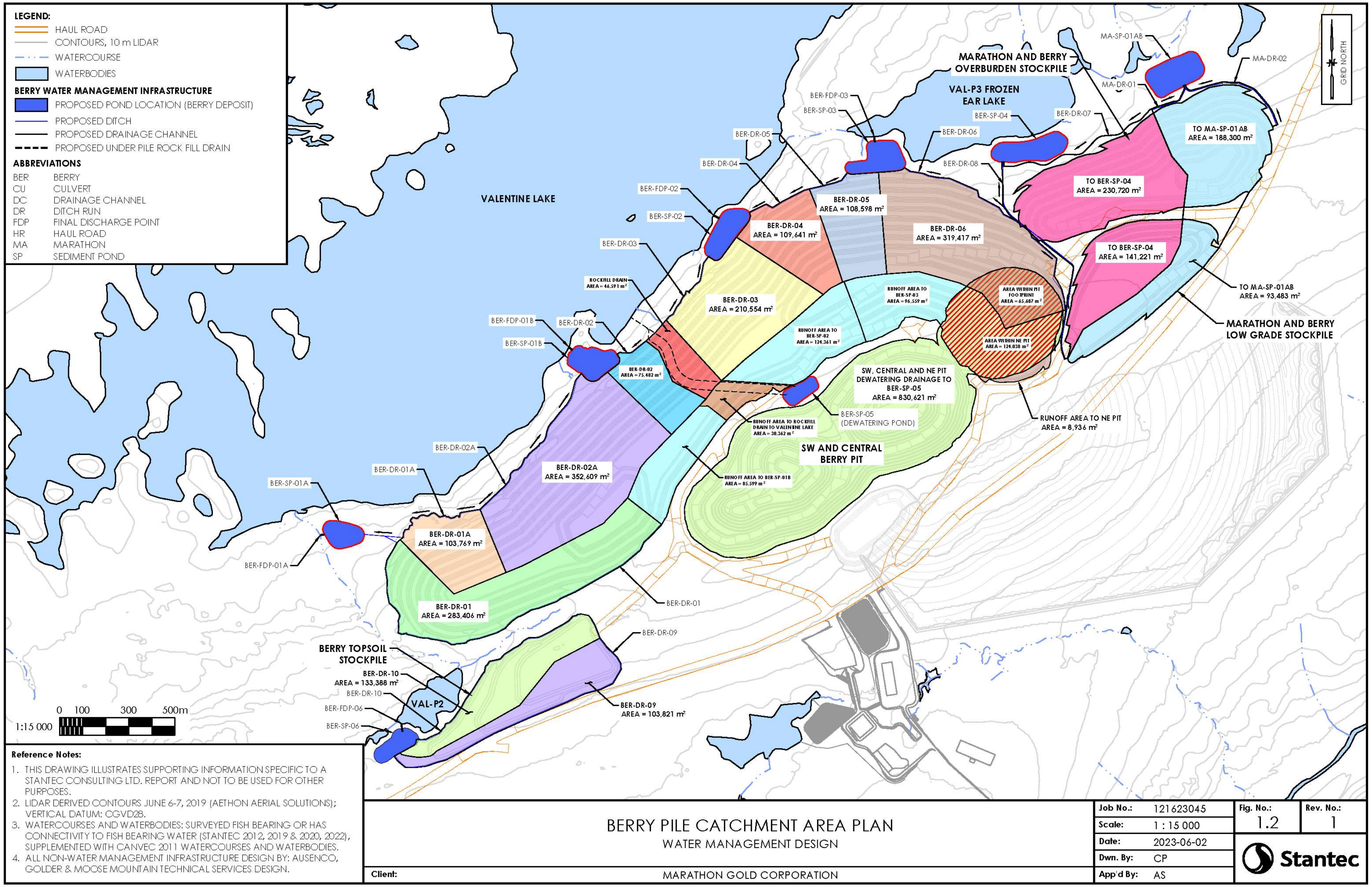


Figure 1.2 Berry Pile Catchment Area Plan

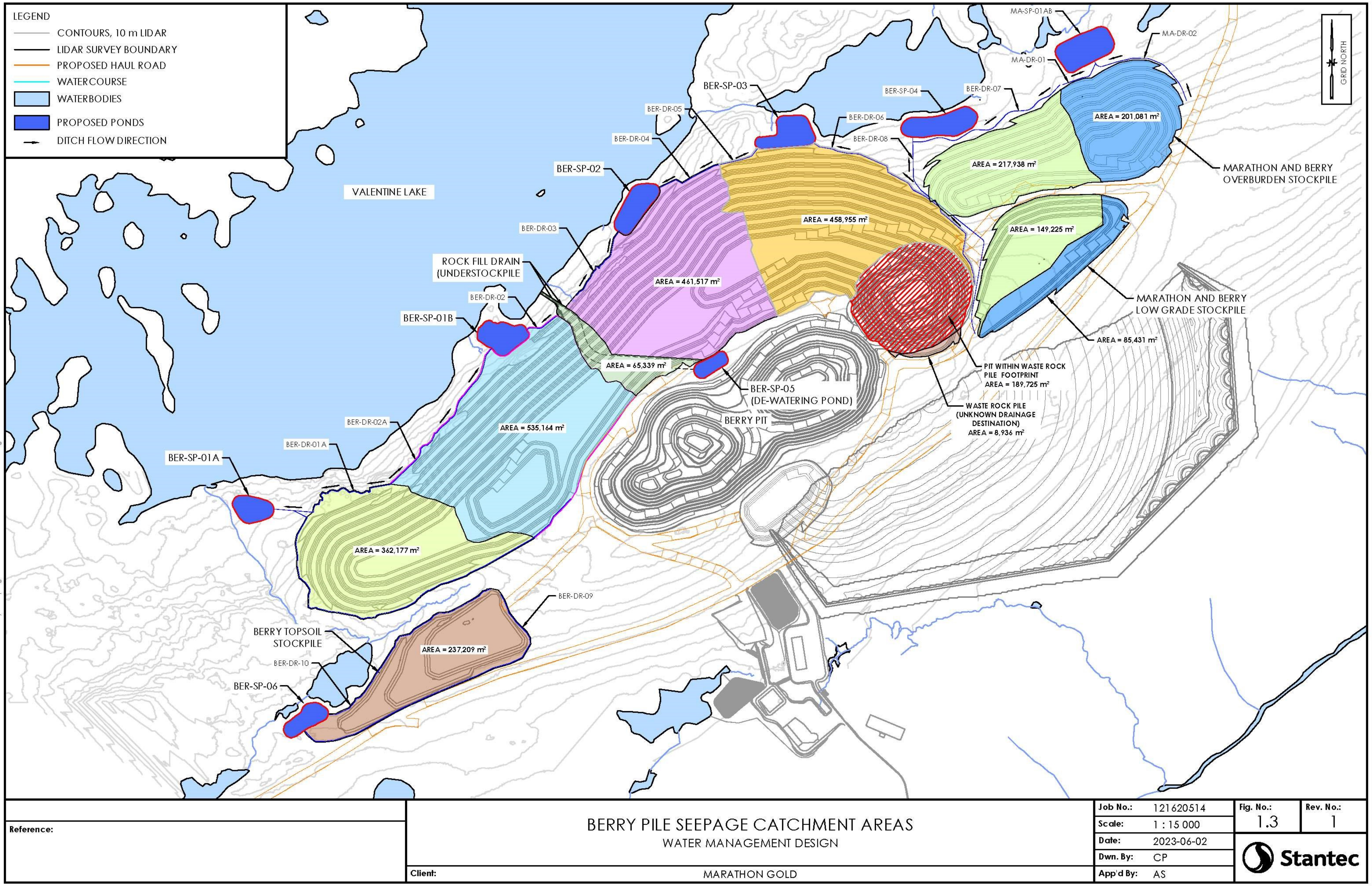


Figure 1.3 Berry Pile Seepage Catchment Areas

1.2.3 Project Phases

The overall Project development schedule will consist of three primary phases: construction, operation, and decommissioning, rehabilitation, and closure. Project activities within these phases are further subdivided for the purposes of this report as presented in Table 1.3. Closure in the model and this report refers to the first five years of the decommissioning, rehabilitation, and closure phases, while post-closure refers to the remainder of the closure phase.

Table 1.3 Description of Project Phases of Development

Project Phase	Mine Year Time Frames Incorporated into the Model	Model Years	Description
Construction	Year -2.25 – Year -1 (2.25 years)	0 – 2.25	• Construction activities will occur over 27 months however are predominantly associated with mine Year -2.25 and 1. • Mining activity has commenced during construction to provide material for TMF and road construction from the Leprechaun and Marathon pit complex areas. • The Berry / Marathon overburden stockpile will be developed during construction, as well as the ground preparation for the Berry waste rock pile footprint areas for the first year of operation.
Operation	Year 1 – Year 6 (6 years)	2.25 – 8.25	• During Years 1 - 6, the three Berry pits (SW, central and NE) will be mined, ground preparation for the waste rock pile footprint areas, waste rock piles will be extended to their full footprint and constructed vertically, ore will be processed, low-grade ore stockpiled, and the mill plant and TMF will be operational. • Mining activities cease at the end of Year 6 in the Berry NE pit.
	Year 7 – Year 9 (3 years)	8.25 – 11.25	• The Berry NE pit will commence filling with waste rock and water during Year 7, as dewatering activities will cease. • Mining activities cease at the end of Year 9 in the Berry SW and Central pits.
	Year 10 – Year 13 (4 years)	11.25 – 15.25	• The Berry SW and Central pits will commence filling with water during Year 10, as dewatering activities will cease. The Berry SW pit will start receiving tailings from the mill during Year 10. The Berry Central pit will start receiving waste rock during Year 10. • Water from the Berry SW pit will be pumped to the mill to supplement reclaim when the demand is not met by the tailings water. Reclaim will start from the SW pit when the water level is above 318 m asl (100 m from spillway elevation) and at the maximum rate. • Waste rock placement ceases at the end of Year 13 in the Berry stockpiles, including NE and Central pits.

Table 1.3 Description of Project Phases of Development

Project Phase	Mine Year Time Frames Incorporated into the Model	Model Years	Description
Operation	Year 14 – Year 15 (2 years)	15.25 – 17.25	• Tailings discharge to the Berry SW pit ceases by the end of Year 15. • Waste rock piles are designed for closure and the slopes and benches will be progressively rehabilitated. • Surface runoff from the waste rock pile east side will be collected in ditches and directed to BER-SP-05 • The model does not account for progressive rehabilitation vegetated soil covering activities that will have begun during operation, representing a moderate estimate of environmental effects during operation. • The overburden and topsoil stockpiles will be used up and the footprint areas stabilized with vegetation, and the waste rock piles will be rehabilitated with vegetated soil covers.
Decommissioning, Rehabilitation and Closure	Closure: Year 16 to Year 20 (5 Years)	17.25 – 21.25	• The LGO stockpile footprint areas will be stabilized with vegetation, and the waste rock piles will be rehabilitated with vegetated soil covers. • Unless otherwise stated in this report, water management infrastructure will remain in place at closure until the vegetated covers have become established (approximately five years after installation) • The Berry pits will be filled naturally from incidental precipitation and groundwater inflows. The SW and Central pit lake will be filled to allow development of a stratified pit lake and discharge to Valentine Lake. • The tailings pond will be pumped to the treatment plant to draw down the storage volume until there is no longer a pond present. During drawdown the tailings surface will be re-graded, a vegetated overburden cover installed on the tailings and the emergency spillway lowered to not allow ponding in the TMF starting at the beginning of Mine Year 17. The seepage collection ditches will not be recirculated back into the tailings pond during this phase. • The seepage collection ditches at the toe of waste rock piles and the TMF, where required based on a pilot study program, will have anaerobic permeable reactive barriers installed to intercept and treat toe and basal seepage prior to release to shallow groundwater. If the pilot study identifies additional treatment is required to the reactive barriers, the sedimentation ponds connected to the ditches will be converted into engineered wetlands and the ditch reactive barriers will be constructed as connecting French drain systems.

Table 1.3 Description of Project Phases of Development

Project Phase	Mine Year Time Frames Incorporated into the Model	Model Years	Description
Decommissioning, Rehabilitation and Closure	Post-Closure: Year 21 onward	22.25	• Other discharges to the environment include groundwater and surface water runoff from the waste rock pile. At this point all water management features for the waste rock and former topsoil, overburden and LGO stockpile areas should be removed, and 'natural' drainage re-established.

The time frame for the Project Expansion phases in years, and the corresponding model year (at the beginning of the model year), are presented on Figure 1.4. The model assumes that construction starts in model Year 0 and operation commences in model Year 2.25.

Figure 1.4 Development Project Phases (Mine Year vs. Model Year)

2 Modelling Approach

The water quantity and WQ models are constructed using GoldSim™ simulation software (GoldSim™) with the contaminant transport module extension. GoldSim™ is commonly used in the mining industry to develop water quantity models and predict WQ at user-defined modelling nodes by combining system dynamics with discrete event simulations. The model is run dynamically with a daily time step for the construction, operation, and decommissioning, rehabilitation and closure (sub-divided into closure and post-closure) phases of the Project Expansion with monthly and annual outputs.

The water quantity and WQ models are project component-based models that do not include a receiving environment water balance. For the Valentine Gold EIS submission, one GoldSim™ model was developed for the Marathon pit complex (Stantec 2020c) and another was developed for the Leprechaun pit complex and TMF (Stantec 2020b). For the Project Expansion, the Leprechaun complex and TMF water quantity / WQ model is updated to include the Berry pit components, as it is planned to receive tailings discharge instead of the Leprechaun pit in Mine Year 9.25 (Golder 2022). Since the development of the Valentine Gold EIS model (Stantec 2020b), Golder's TMF water balance components have been incorporated into the Leprechaun pit complex, Berry pit complex, and TMF site-wide water quantity model to simulate TMF water quantity model processes.

An average climate condition, which is based on Climate Normals is used to evaluate the potential effects of the Project Expansion on surface water and represents the base case for assessment. A probabilistic Monte Carlo analysis is conducted to simulate the variability in climate in a wet and dry year. This allows for the prediction of runoff, seepage and water quality behavior and characteristics over this range of climatic conditions.

The Monte Carlo analysis consisted of a series of model runs of randomly generated yearly precipitation totals using a probabilistic precipitation distribution throughout the year based on a daily time step. A single run in this model consisted of 100 years with different annual precipitation values for each year. This approach enables the analysis of a range of climate scenarios and the development of statistical frequencies and confidence intervals for the flow rates and water quality predicted by the model. The Monte Carlo analysis is set for 100 runs, i.e., running the model 100 times, for different annual precipitation each year. Results of the Monte Carlo analysis are presented as percentiles from the whole range of model results, from 5th percentile (equivalent to a 20-year return period dry year) to 95th percentile (equivalent to 20-year return period wet year).

3 Water Quantity Model Update

3.1 Conceptual Model

The water quantity model relies on climate and hydrological inputs, drainage areas, and characteristics of mine facilities during different phases of the Project Expansion. The water quantity model is developed to predict outflow rates of the mine site, including the sedimentation pond discharges to the FDPs, within the Project Expansion footprint. The Project Expansion water management infrastructure is presented in Figure 1.1. The Berry complex drains and discharges ultimately to Valentine Lake through direct lake tributaries and discharge channels. During Mine Years 1 – 9, the mill area and tailings pond will drain and discharge to Victoria Lake Reservoir; however, during Years 10 – 15, water from the tailings pond will be reclaimed to the mill with intermittent discharge to Victoria Lake Reservoir during Mine Year 15 from the treatment system (water treatment plant and SAGR® unit).

Figure 3.1 presents the schematic structure of the water quantity model and the Berry and TMF FDPs/receivers, and identifies the Approved Project and Project Expansion facilities, contact water (i.e., water that is in contact with Project facilities), and non-contact water (i.e., water not affected by the Approved Project/Project Expansion) flow pathways. The modelled Approved Project and Project Expansion facilities identified in Section 1.2, including the TMF, Berry open pit, and Berry stockpiles, will have drainage and diversion controls to prevent external natural drainage from coming into contact with the Project Expansion and Approved Project facilities and becoming contact water.

Watershed areas for the Project Expansion facilities were delineated based on the site layout (Figure 1.2) and existing ground surface topography. The watershed areas were delineated where runoff from the piles/stockpiles (waste rock, LGO, overburden and topsoil) is expected to report to collection ditches and then to the sedimentation pond. Seepage (toe and a portion of basal) is assumed to drain from the LGO, overburden and topsoil stockpiles to the collection ditches and then the sedimentation pond. The Berry waste rock pile is to be constructed on a relatively steep existing slope, and seepage from the base of the waste rock pile (e.g., toe) is assumed to drain to the seepage collection ditches on the west side of the pile (Figure 1.3). Surface runoff on the east side of the waste rock pile adjacent to the three pits (SW, Central and NE) during operation is assumed to infiltrate into the pile before reaching the toe and be collected in the rock filled drains, ditches, and ponds on the west side of the stockpile (BER-SP-01B, BER-SP-02, BER-SP-03 and rock filled drain).

It is conservatively assumed that these watershed areas are at the ultimate footprint stage of mine development at the beginning of each stockpile being constructed. However, the build out of the stockpile within the drainage footprint is estimated as a percentage of the stockpile surface area for each year of operation (Moose Mountain Technical Services 2022). The remainder of the stockpile area is assumed to be disturbed ground. Table 3.1 presents the stockpile construction start years and the percent buildout of the total stockpile area each mine year of construction and operation phases. Stockpile percent areas are linearly interpolated between each mine year percent value. The pits have also been set as gradually expanding areas over Mine Years 1 – 6 for the NE pit and Mine Years 1 – 9 for the SW and Central pits (Table 3.2) with surface areas for time steps between annual values linearly interpolated. The mill pad draining to PP-SP-01 is assumed to be fully built out at the start of construction in Mine Year -2.25.

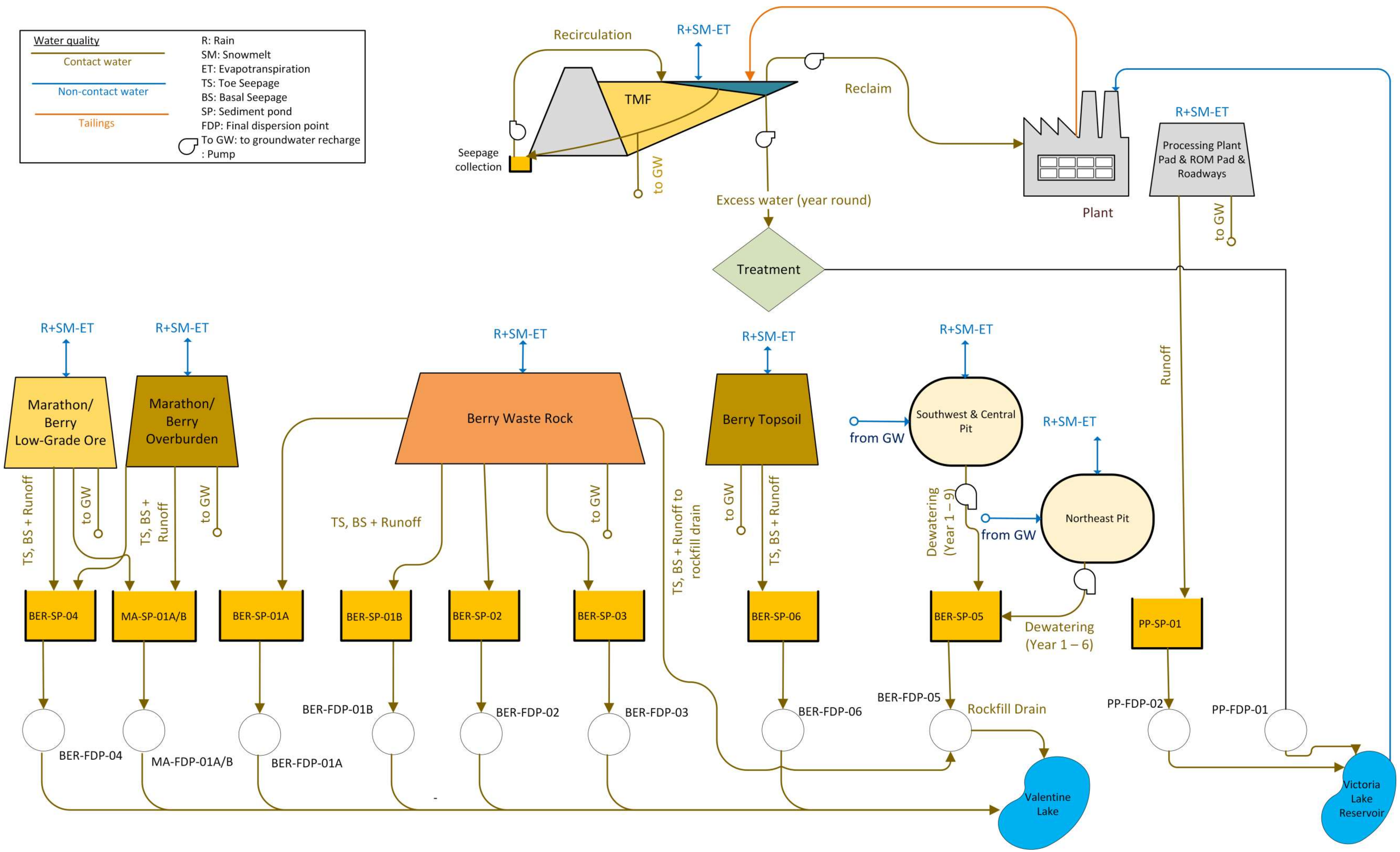


Figure 3.1 Berry Mine Water Management Conceptual Model – Construction / Operation (Mine Year -2.25 to 6)

Table 3.1 Stockpile Construction Start Times and Surface Area Buildout Percentage during Construction and Operation at End of Mine Year

Mine Year	Stockpile Surface Area Buildout (%)								
	Waste Rock						Overburden	Low-Grade Ore	Topsoil
	BER-SP-01A	BER-SP-01B	Rockfill Drain	BER-SP-02	BER-SP-03	BER-SP-03 (Above NE Pit)	MA-SP-01AB/BER-SP-04	MA-SP-01AB/BER-SP-04	BER-SP-06
-2.25	0	0	0	0	0	0	0	0	0
-2	0	0	0	0	0	0	0	0	0
-1	0	0	0	0	0	0	30	0	0
1	0	0	0	0	0	0	53	0	0
2	0	4	22	42	26	0	86	57	52
3	0	5	49	77	49	0	99	85	100
4	6	65	93	98	57	0	99	98	100
5	95	78	100	100	58	0	100	100	100
6	100	100	100	100	58	0	100	100	100
7	100	100	100	100	83	0	100	100	100
8	100	100	100	100	88	0	100	100	100
9	100	100	100	100	95	100	100	100	100
10	100	100	100	100	100	100	100	100	100
11	100	100	100	100	100	100	100	100	100
12	100	100	100	100	100	100	100	100	100
13	100	100	100	100	100	100	100	100	100
14	100	100	100	100	100	100	100	100	100
15	100	100	100	100	100	100	100	100	100

Table 3.2 Berry Pit Annual Surface Area Expansions during Construction and Operation Phases

Mine Year	SW and Central Pit (m^2) [A]	NE Pit Surface Area (m^2)
-1	38469	0
1	231159	101695
2	398418	196963
3	398418	199761
4	398418	199761
5	629847	200964
6	629847	200964
7	629847	200964
8	629847	200964
9	629847	200964

Notes:
[A] The SW pit surface area is approximately 53% of the SW and Central combined pit surface area

Conceptual models present the interactions of the Project facilities during construction, operation, and decommissioning, rehabilitation and closure (sub-divided into closure and post-closure) are presented in Figure 3.1 to Figure 3.6. The flow arrows show the direction of flow accounted for in the water quantity model, either to or away from the Project Expansion facility. To simulate post-closure, the water quantity model is extended to run until the end of Year 100. Accelerated pit fill as well as a natural pit filling scenario are considered, which includes groundwater seepage, direct precipitation, runoff/stockpile infiltration and placement of tailings in the SW pit. No taking of water from local lakes (Valentine or Victoria Lake Reservoir) is assessed to accelerate the filling of the Berry pits.

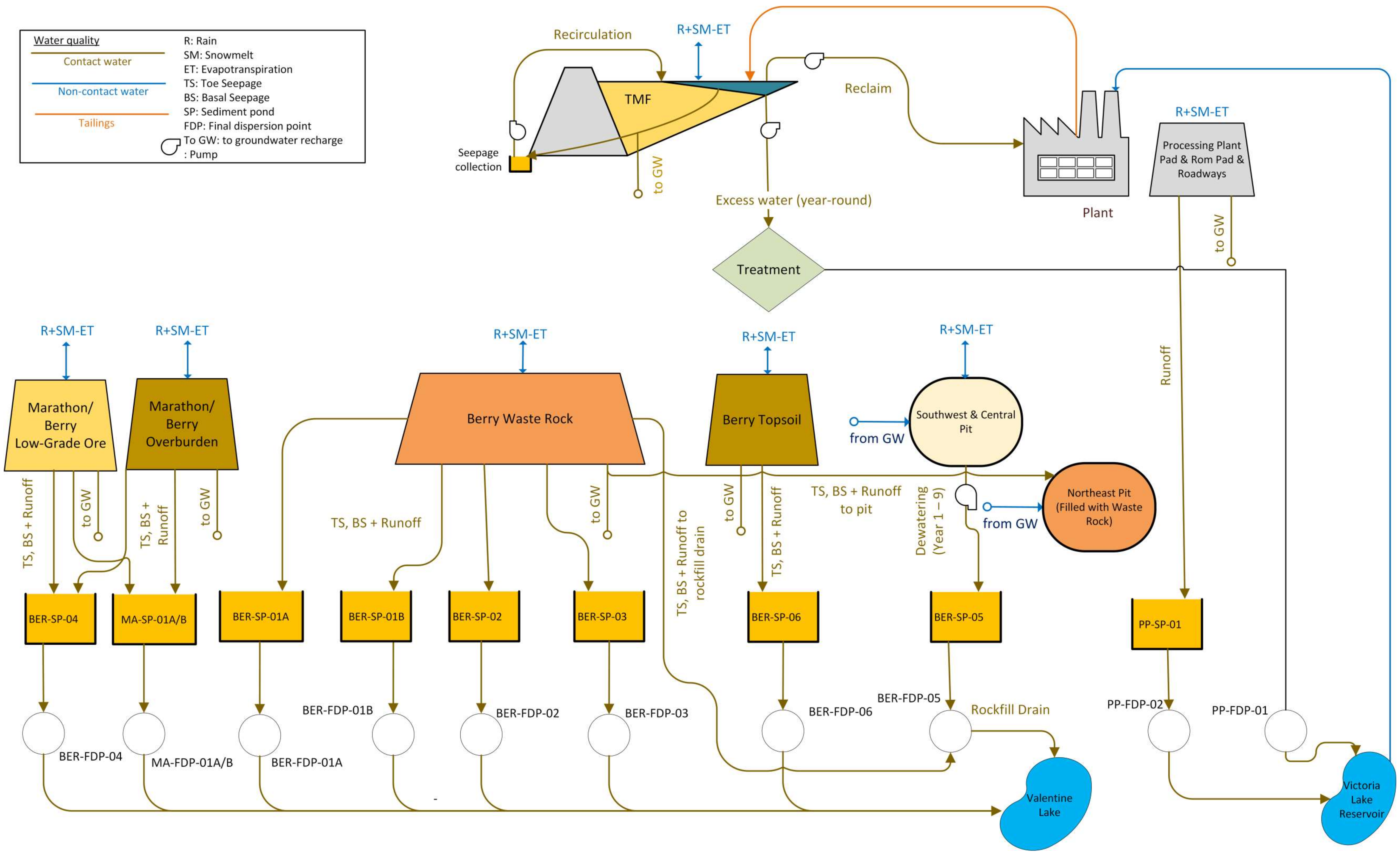


Figure 3.2 Berry Mine Water Management Conceptual Model - Operation (Mine Year 7 to 9)

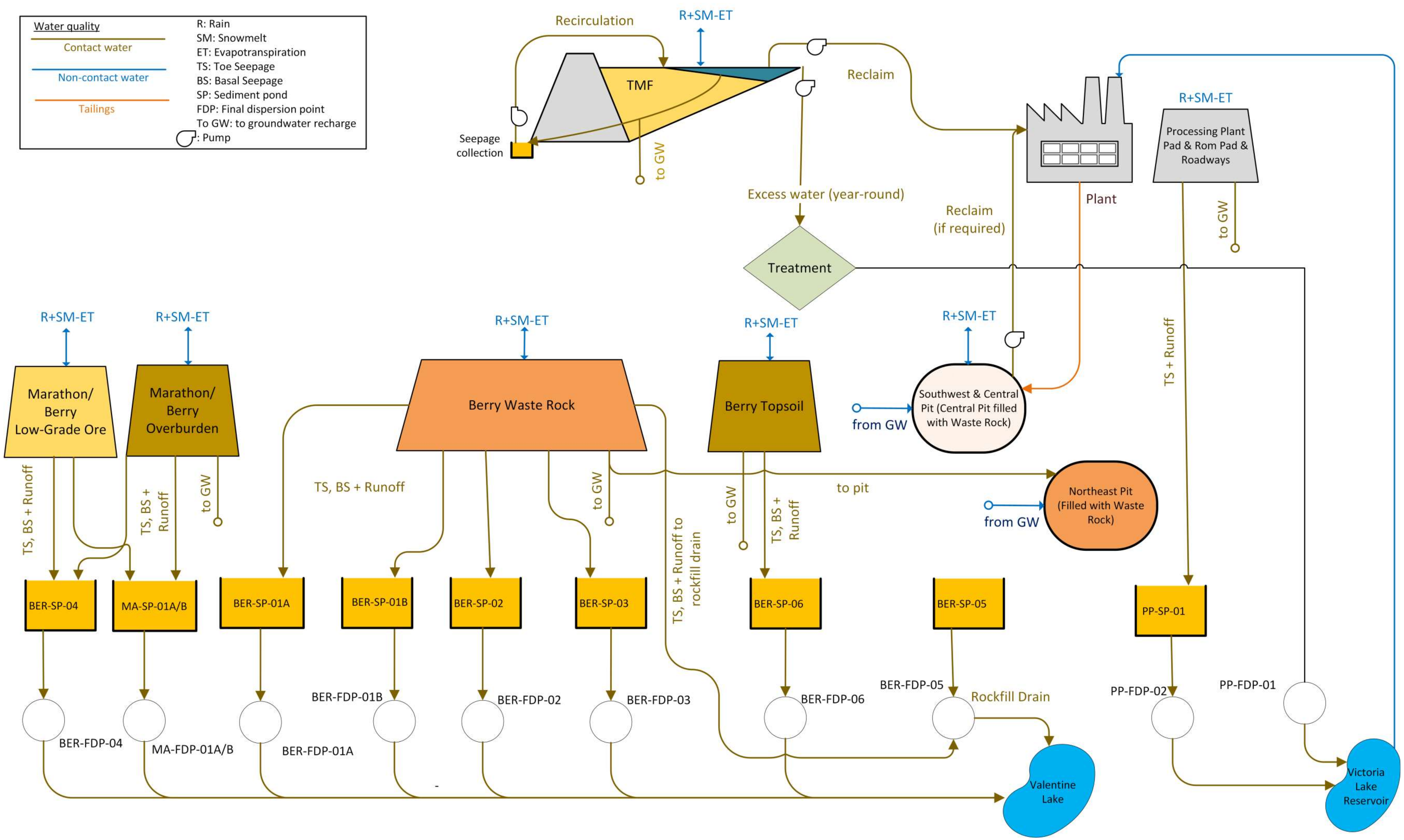


Figure 3.3 Berry Mine Water Management Conceptual Model - Operation (Mine Year 10 to 12)

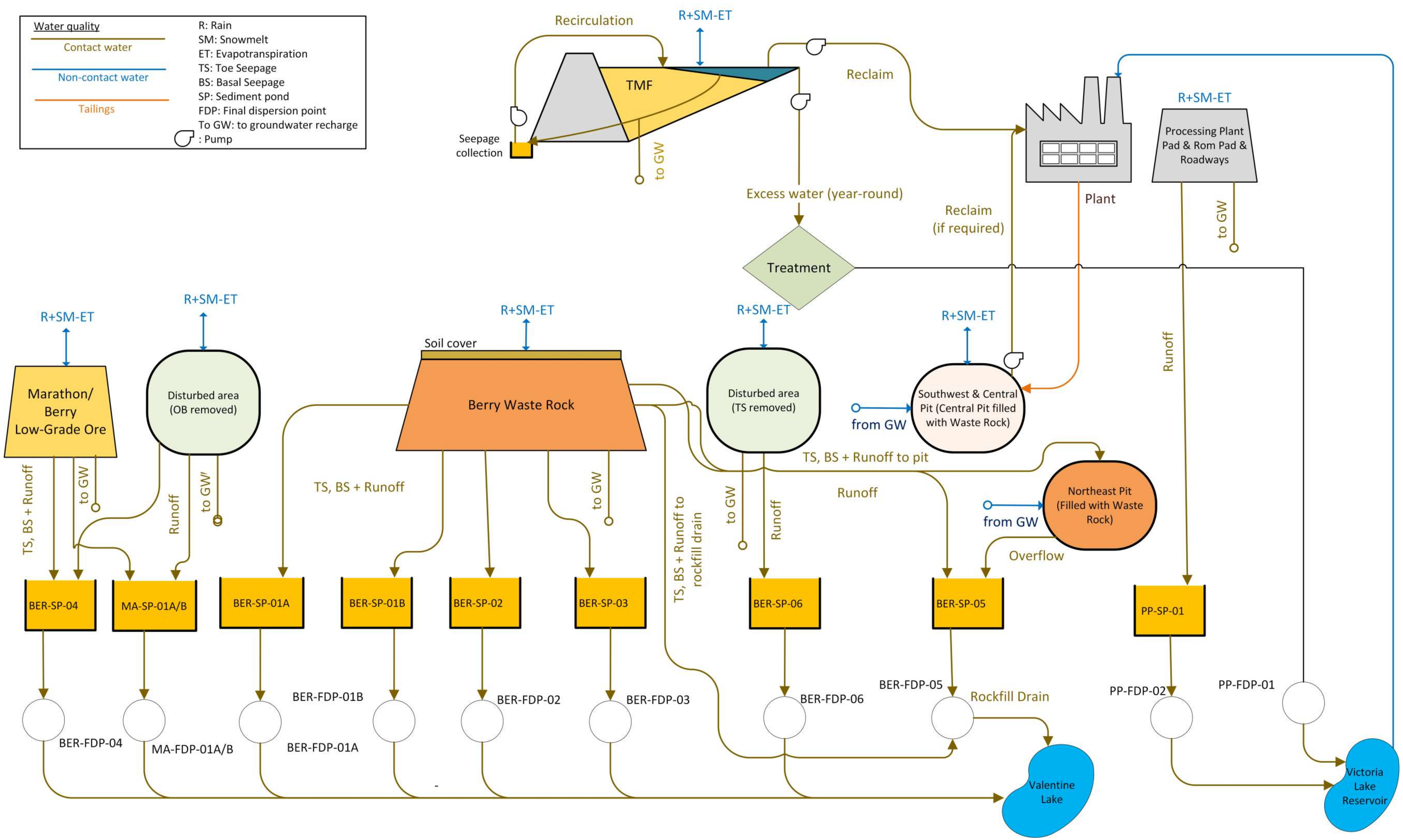


Figure 3.4 Berry Mine Water Management Conceptual Model - Operation (Mine Year 13 to 15)

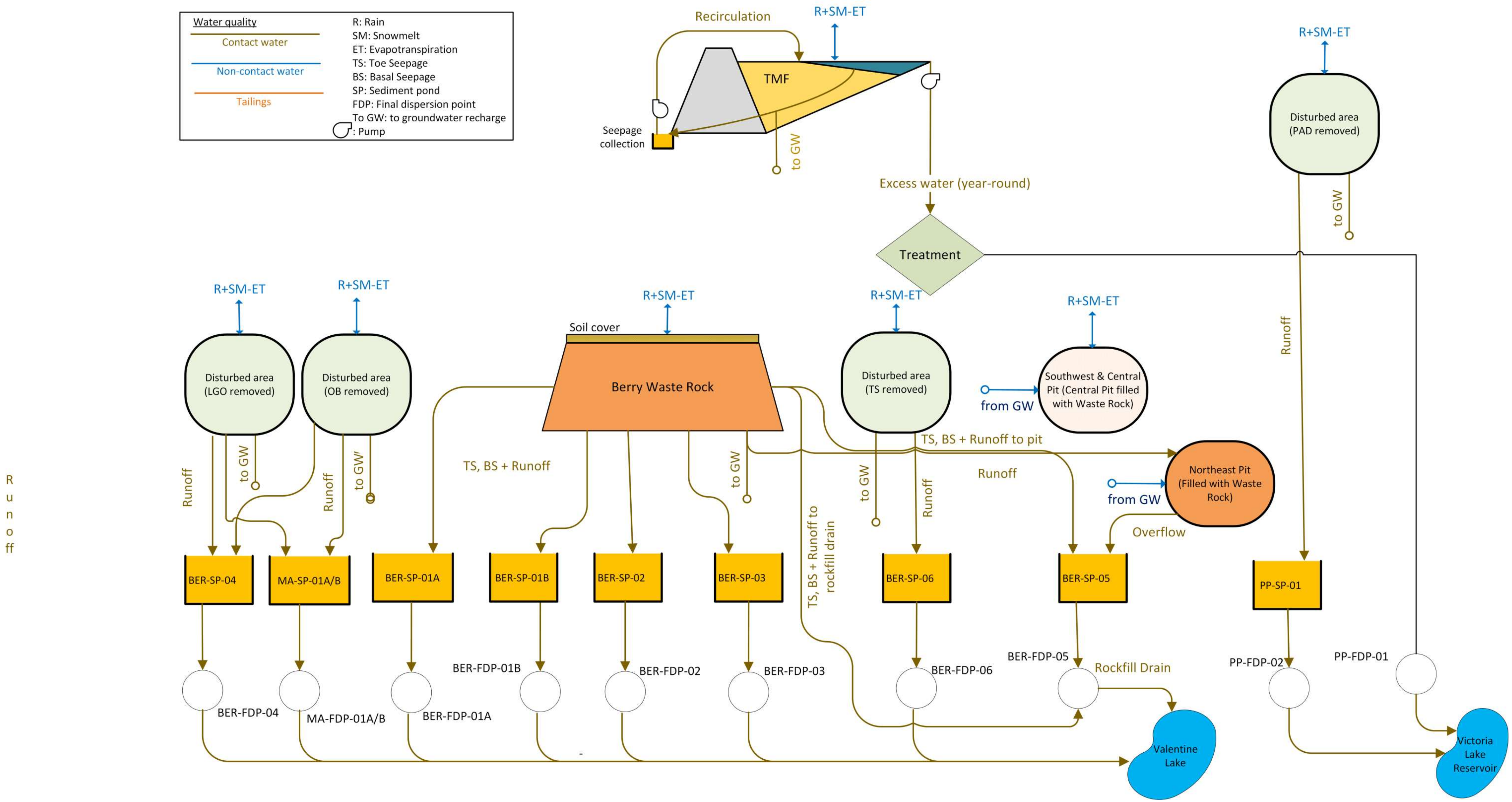


Figure 3.5 Berry Mine Water Management Conceptual Model - Closure (Mine Year 16 until Pit is Full)

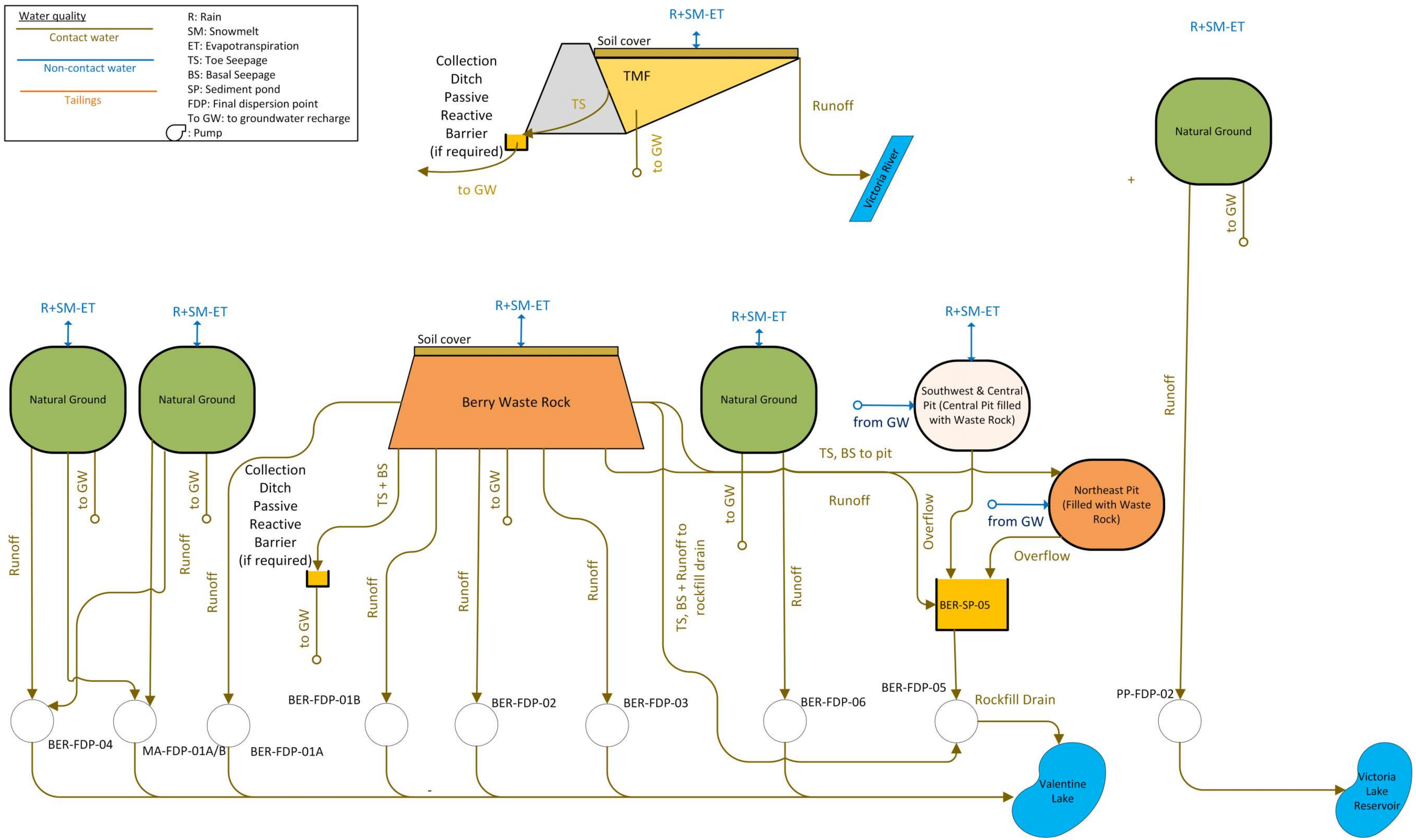


Figure 3.6 Berry Mine Water Management Conceptual Model - Post-Closure (Pit is Full)

3.2 Water Quantity Model Approach

The water quantity model accounts for precipitation, evapotranspiration, infiltration and groundwater gains and runoff at each identified mine facility, except for the open pits and TMF, which are discussed separately.

The conceptual flowpaths for precipitation on a stockpile or waste rock pile are presented in Figure 3.7. Surface runoff (flow 1 in Figure 3.7) is a proportion of direct rain and snowmelt on the stockpile. Proportion factors are described in Section 3.3.1. Net infiltration into the stockpile (flow 2 in Figure 3.7) is equivalent to precipitation minus surface runoff, evapotranspiration, and snow storage. Net infiltration is split into toe seepage (flow 3 in Figure 3.7) and groundwater infiltration (flow 4). A proportion of groundwater infiltration is distributed to deeper regional groundwater flow (flow 5 in Figure 3.7) and will not report to seepage collection ditches or pits. The proportion of groundwater infiltration that reports as seepage to perimeter ditching (flow 6 in Figure 3.7) along with toe seepage (flow 3 in Figure 3.7) is collected in the seepage collection system and carried through the model to the sedimentation ponds. A portion of flow 6 for each stockpile or waste rock pile reports as groundwater seepage to the open pits. The proportion factors for infiltration are described in Section 3.3.4.

The water quantity of the open pits and TMF is based on a runoff coefficient approach. Runoff from the open pit walls and floor during the construction and operation phases is estimated based on the proportion of total precipitation (rainfall plus snowmelt runoff) on the pit multiplied by a runoff coefficient. During the closure and post-closure phases, runoff from the pit walls and on the pit lake is estimated based on the proportion of total precipitation (rainfall plus snowmelt runoff) on the pit multiplied by a runoff coefficient. Runoff from the tailings is estimated in the water quantity model based on the proportion of total precipitation (rainfall plus snowmelt runoff) on the catchment multiplied by a runoff coefficient (Golder 2022).

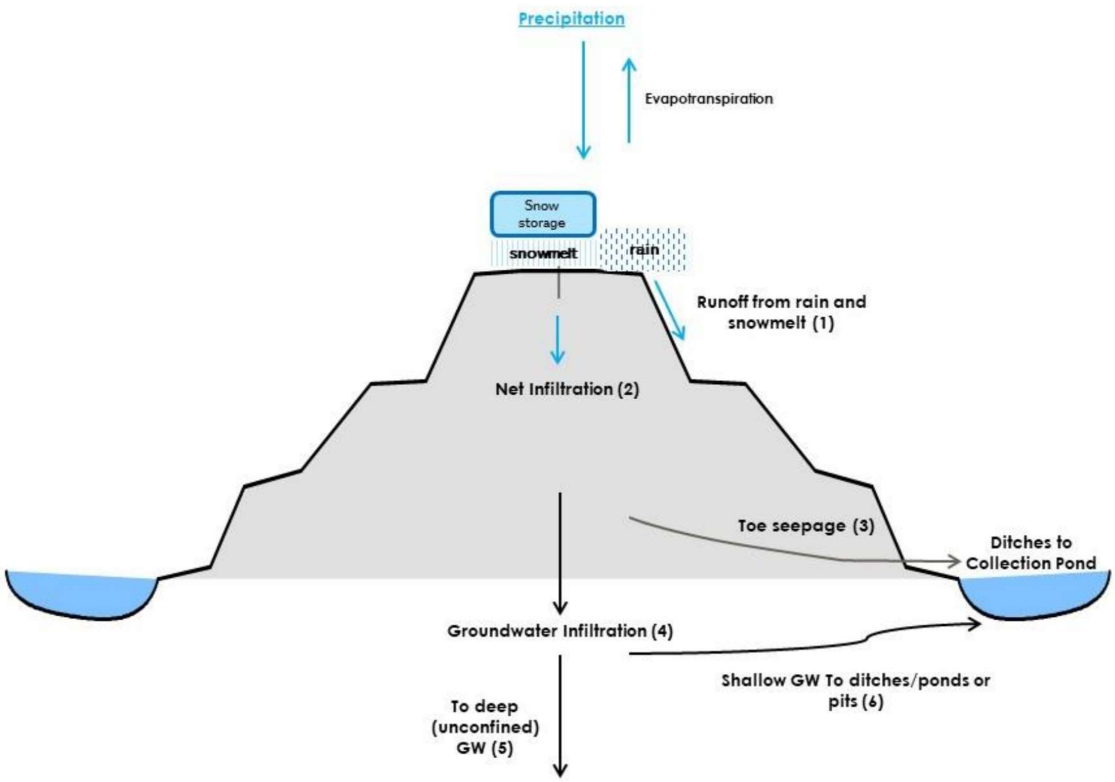


Figure 3.7 Conceptual Stockpile or Waste Rock Pile Flow Pathways

3.3 Model Inputs

3.3.1 Climate and Hydrology

An evaluation of climate hydrologic data for the Approved Project was developed for the Hydrology baseline report (Stantec 2020c). Climate and hydrology inputs in the water quantity model remain the same those used in the Approved Project water quantity model (Marathon 2020). Climate and hydrology inputs to the model are summarized in Table 3.3. Monthly distributions and totals for climate and hydrology inputs at the mine site are represented by precipitation from the Climate Normals (1981-2010) at the Environment and Climate Change Canada (ECCC) Buchans climate station (Station ID 8400698), The 1981-2010 Climate Normal meteorological dataset is the most recent Climate Normal data range available for the Buchans station when this report was prepared. The log-normal probability distribution used in the GoldSim™ model for the Monte Carlo simulation is based on the Buchans climate data, and 95th and 5th percentile annual precipitation totals are approximately equivalent to the 25-year return period wet year and 5-year return period dry year, respectively (Stantec 2020b, c).

Table 3.3 Water Quantity Model Climate Inputs with Monthly Distribution

Parameter	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation (ECCC 1981-2010 Climate Normals)	mm	122.0	98.1	95.0	85.7	86.6	87.8	95.3	123.0	110.4	97.5	111.8	123.1	1236.3
	% of MAP[A]	9.9%	7.9%	7.7%	6.9%	7.0%	7.1%	7.7%	9.9%	8.9%	7.9%	9.0%	10.0%	100.0%
Actual Evapotranspiration (AET) (Thornthwaite model Stantec 2020c)	mm	8.8	9.2	15.3	25.6	44.0	62.6	81.3	71.6	44.6	26.5	15.2	10.5	415.2
	% of MAP[A]	0.7%	0.7%	1.2%	2.1%	3.6%	5.1%	6.6%	5.8%	3.6%	2.1%	1.2%	0.8%	33.6%
Lake Evaporation [B] (Average lake evaporation rate Stantec 2020c)	mm	0.0	0.0	0.0	0.0	46.5	100.5	110.1	96.1	63.0	20.2	0.0	0.0	436.3
	% of MAP[A]	0.0%	0.0%	0.0%	0.0%	3.8%	8.1%	8.9%	7.8%	5.1%	1.6%	0.0%	0.0%	35.3%
Snow Storage	mm	83.3	67.0	66.6	26.2	4.4	0.1	0.0	0.0	0.1	5.0	30.4	76.9	360.0
	% of MAP[A]	6.7%	5.4%	5.4%	2.1%	0.4%	0.0%	0.0%	0.0%	0.0%	0.4%	2.5%	6.2%	29.1%
Snowmelt	mm	25.1	40.9	67.2	151.0	14.9	0.1	0.0	0.0	0.1	5.0	20.4	35.3	360.0
	% of MAP[A]	2.0%	3.3%	5.4%	12.2%	1.2%	0.0%	0.0%	0.0%	0.0%	0.4%	1.7%	2.9%	29.1%

Notes: [A] – Monthly and annual values provided as percent of the mean annual precipitation (MAP).
[B] - Average lake evaporation rate reported at Stephenville (Climate ID 8401700) and Gander (Climate ID 8403800)

Actual evapotranspiration (AET) at the Approved Project and Project Expansion site is estimated based on a USGS Thornthwaite model (Thornthwaite 1948). Inputs to the USGS Thornthwaite model included average climate precipitation and temperature data at Buchans, local soil conditions, and recommended values provided by the USGS (McCabe and Markstrom 2007). The evaporation from ponds (sedimentation and TMF) at the site is represented by the average lake evaporation rate (mm/month) reported at the Stephenville and Gander ECCC climate stations (Station IDs 8401700 and 8403800).

Snow storage and snowmelt is estimated to replicate average climate conditions at the Buchans climate station. The total snow storage is based on the March storage of 60 cm (average climate conditions) converted to snow-water-equivalent. A snow density of 0.35 is used, based on the reported snow density in the Newfoundland region increasing from 0.1 to 0.35 over the winter to account for ice and melt in snow (Sturm et al. 1995). The proportion of precipitation in the cold months is assumed to be stored as snow for the months of November through March with the majority of melt occurring in the months of April through June (Table 3.3). A proportion of the snowmelt is assumed to runoff into the collection ditches, and the remainder is assumed to infiltrate into the pile. Although the mine site is inland, the Project Area is influenced by Newfoundland’s maritime climate, which produces melting conditions throughout the winter and rainfall in all months of the year. Thus, snowmelt can and is expected to occur in all winter months. Snow storage is greater than snowmelt from November to February, and thus there is accumulation in the model. In March, the snow storage is less than the snowmelt, meaning that the snow on the ground begins to decrease at the start of spring runoff.

3.3.2 Waste Rock Piles and Stockpiles

The amount of AET is adjusted in the model based on Project facility and Project phase (Table 3.4). The adjustments are applied to account for the characteristics of stockpile slope, soil storage, and infiltration of each Project facility. A saturated-unsaturated hydrologic model - Hydrologic Evaluation for Landfill Performance (HELP, US Environmental Protection Agency 1994) model developed for the Approved Project estimated a 50% adjustment factor for AET during operation for waste rock (Stantec 2020b, c). During operation for the stockpiles, 90% of AET is represented as the evaporation loss in the water quantity model, as the stockpiles are un-vegetated, and the uptake and transpiration of precipitation will not occur; this is referred to as evapotranspiration (ET) for un-vegetated piles (Table 3.4). Vegetated covers are assumed to have 100% of AET during closure and post-closure phases.

Table 3.4 AET, Snowmelt, Runoff and Toe Seepage Adjustment Factors

Project Facility	Adjustment Factors			
	Percent of Total ET is AET	Percent of Snowmelt as Runoff	Percent of Rain as Runoff	Percent of Net Infiltration as Toe Seepage
Construction and Operation Project Phases				
Low-grade ore stockpile	50%	50%	0%	18%
Topsoil	90%	90%	90%	0%
Overburden	90%	90%	90%	0%
Waste rock pile	50%	50%	0%	18%
Open pits	0%	100%	100%	0%
Rehabilitation and Closure/ Post-Closure Project Phases				
Waste rock pile (i.e., Vegetated Cover)	100%	90%	40%	18%[A]
Tailings Management Facility	100%	100%	100%	-[B]
Open pits	95%	100%	100%	0%

Notes:

[A] Net infiltration within the stockpile reduces with the application of the vegetated soil cover. The proportion of net infiltration reporting as toe seepage remains the same. [B] – output from groundwater model (Stantec 2023b)

To represent vegetative covers in closure and post-closure, 90% of snowmelt runoff from the waste rock piles is assumed, resulting in a decrease of the net infiltration, and therefore a reduction in net infiltration.

The LGO stockpile and waste rock piles during operation are assumed to have 0% runoff for rain events and 50% runoff for snowmelt, which is how runoff was represented in the Valentine Gold EIS model (Marathon 2020). Both piles will be constructed with slopes and benches to allow vehicular traffic and create safe slopes. The relatively flat benches will allow increased infiltration of rain and snowmelt runoff from the upgradient slope and reduce the percentage runoff. Once the waste rock pile has a vegetated cover installed the infiltration rate will be reduced and runoff from rainfall and snowmelt will increase on the bench surfaces.

For the purposes of the model, it is assumed that the pore space in the waste rock and LGO piles is fully saturated within one year of rock beginning to be placed.

3.3.3 Surface Runoff

The same snowmelt and rain runoff factors for the different types of stockpiles (LGO, topsoil, overburden) and waste rock pile and the open pits are used for the Project Expansion water quantity model for operation and closure/post-closure as the Approved Project water quantity model (Table 3.4).

The LGO, topsoil and overburden stockpiles are assumed to be removed at closure. LGO will be processed at the mill, and the topsoil and overburden stockpiles will be used for progressive rehabilitation of rock slopes. Respective areas of these piles are modelled as “prepared ground” during closure and "natural ground" during post-closure, using the runoff coefficients presented in Table 3.5. The natural ground runoff coefficient for all Project phases is based on the USGS Thornthwaite model and included inputs of local climate and soil conditions and guidance provided by USGS (McCabe and Markstrom 2007), which was developed for the Valentine Gold EIS (Marathon 2020). The TMF runoff coefficients are developed by Golder (2022) in support of the Approved Project TMF water balance.

Table 3.5 Runoff Coefficients by Land Use Type for Select Project Facilities and TMF Watershed Areas

Land Use Type	Runoff Coefficient
Natural ground	63% [B]
Prepared Ground	85% [B]
TMF Dry Tailings	40% [A]
Tailings Pond and Wet Tailings	100% [A]
High-Grade Ore (HGO) stockpile	50% [A]
TMF Closure Cover	70% [C]

Notes:
[A] Source - Golder (2022);
[B] Source – Stantec (2020b)
[C] 400 mm low-permeability overburden till cover to be installed

Waste rock piles that are identified to have toe and base seepage that may require additional water treatment during the closure and post-closure sub-phases will have their ditches converted to passive treatment systems. A pilot study will be conducted to determine the appropriate passive technology. Anaerobic permeable reactive barriers are the planned technology to be implemented. If the planned technology is identified to not be adequate during the pilot study, the collection ditches would be converted to permeable reactive barriers with a French drain system that conveys flows to engineered wetlands constructed within the former sedimentation ponds.

3.3.4 Groundwater Infiltration

Groundwater infiltration at the bottom of the piles is flow 6 in Figure 3.7, the shallow groundwater infiltration or groundwater recharge to the seepage collection ditches opposed to toe seepage. The percent of groundwater infiltration at the bottom of the Berry complex piles intercepted by the collection ditches/ponds or pits, is simulated in the groundwater model (Stantec 2023b). The percent of net infiltration recharging to deeper regional groundwater (flow 5 in Figure 3.7), perimeter ditches, and the pit seepage sumps is summarized in Table 3.6. It is assumed that during the first year of operation, net infiltration will be consumed in wetting the pile; therefore, there is no seepage during that period. The groundwater recharge to non-pit receptors recovers after the pits are full above the elevation of fractured bedrock during post-closure, as groundwater flow paths and gradients will stabilize locally, and the pit filling will no longer exercise influence on local groundwater flows (Table 3.6). The LGO, topsoil and overburden stockpiles are not modelled as these Project facilities no longer remain during the closure phase.

Table 3.6 Stockpile Groundwater Recharge by Water Managament Receptor

Receptor	Groundwater Recharge (%)				
	Stockpiles				
	Waste Rock		Low-Grade Ore	Overburden	Topsoil
	Operation	Pit Full above Fractured Bedrock	Operation [A]	Operation [A]	Operation [A]
Northeast Pit	0	0	10	0	0
Central Pit	2	0	0	0	0
Southwest Pit	2.5	0	0	0	0
SP01A	0	0	0	0	0
SP01B	0	0	0	0	0
SP02	0	0	0	0	0
SP03	0	0	0	0	0
SP04	0	0	0	0	0
SP05	0	0	0	0	0
SP06	0	0	0	0	0
Other (groundwater below pits & water management infrastructure) [B]	95.5	100	90	100	100

Notes:
[A] These values become 0% at closure since stockpiles are removed.
[B] Total % of net infiltration accounts for toe seepage (18% for waste rock and LGO)

3.3.5 Open Pit

The Berry pit will begin development in Mine Year 1 with the NE pit/basins ending activity at the end of Mine Year 6 and the SW and Central pits ending development at the end of Mine Year 9. The surface area of each pit by Mine Year is presented in Table 3.7.

Table 3.7 Surface Area of SW, Central and NE Pits during Mining

Mine Year	Surface Area (ha)		
	SW Pit *	Central Pit *	NE Pit
-2.25	0	0	0
-1	0	0	0
1	6.0	0	0.0
2	20.5	2.9	9.8
3	30.5	9.6	19.3
4	30.5	9.6	19.9
5	30.5	9.6	19.9
6	34.0	29.4	19.9
7	34.0	29.4	19.9
8	34.0	29.4	19.9
9	34.0	29.4	19.9

Based on the ultimate pit footprint at the end of Mine Year 9, and the topographic information in the area surrounding the pit, the NE pit has a pit overflow elevation of 404 m asl and a connection elevation to the adjacent Central pit at 420 m asl. The pit overflow is directed towards BER-SP-05 prior to discharge via the rockfill drain to Valentine Lake. The SW and Central pits connect at an elevation of 348 m asl and have a pit overflow elevation of 418 m asl, which will drain to BER-SP-05. The stage, storage and surface area for each pit and the combined Central and SW pit is presented in Table 3.8.

Groundwater inflow rates to the open pit were predicted using the numerical groundwater flow model developed for the Project Expansion (Stantec 2023b).The groundwater inflow rate is dependent on the pit stage, which represents the elevation of the bottom of the pit during pit development, and the water elevation in the pit during subsequent pit filling (Table 3.9).

Up until Mine Year 6 for the NE pit, and Mine Year 9 for the SW and Central pits, groundwater inflow, precipitation and runoff that accumulates in the pits will be pumped to sedimentation pond BER-SP-05.

Beginning in Mine Year 7, the NE pit will be filled with waste rock up to the surface and the Berry waste rock pile will be extended to cover the pit area until the end of waste rock placement at the end of Mine Year 13. The waste rock is assumed to be placed in the pit at a rate that exceeds the rise of accumulated water from groundwater inflow, precipitation, and runoff in the pit. As the NE pit will be located under the Berry waste rock pile it is assumed there will be no evaporation from the saturated waste rock within the pit. The NE pit and the stockpile above it will receive waste rock from the SW and Central pits until the end of Mine 9, and then from the Marathon pit until the end of Mine Year 13.

Beginning in the spring of Mine Year 10, the SW pit will receive tailings from the processing plant until the end of Mine Year 15. The tailings are planned to be released into the SW pit at an elevation of 404 m asl via a spigot that will have a final slope for the tailings solids of 10% that extends to the pit side wall elevation of 348 m asl, however does not go into the Central pit shell (Golder 2022). The minimum water cover depth over the submerged placed tails is estimated to be 14 m.

The Central pit beginning in Mine Year 10 will receive waste rock from the Marathon pit that is assumed to be placed at a rate that exceeds the water infilling rate of the pit up until the pit surface. The waste rock is assumed to be submerged by the pit lake when the combined SW and Central pit lake reaches an elevation of 418 m asl, which will allow lake evaporation to occur.

The NE, Central and SW pits will not have runoff from natural or prepared ground areas diverted to the pits to accelerate filling. Water will not be pumped from Valentine Lake or the Victoria Lake Reservoir to accelerate pit infilling for the Berry complex. The NE, Central and SW pits are assumed to fill by natural processes and the placement of waste rock, and tails within their respective shells.

Table 3.8 Stage Elevation, Projected Surface Area and Volume for Individual NE, Central and SW Pits, and Combined Central and SW Pit Complex

Pit Stage (m asl)	NE Pit			Central Pit			SW Pit		Combined Central and SW Pit		
	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Pit Volume Below Stage with Placed Waste Rock (m^3) A	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Pit Volume Below Stage with Placed Waste Rock (m^3) *	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Pit Volume Below Stage with Placed Waste Rock (m^3) A
198	-	-	-	7,408	-	-	-	-	7,408	-	-
204	-	-	-	8,371	26,387	6,098	-	-	8,371	26,387	6,098
210	-	-	-	9,013	69,145	15,979	3,921	-	12,934	69,145	15,979
216	-	-	-	14,356	128,939	29,798	6,587	24,505	20,943	153,444	54,303
222	-	-	-	16,241	217,792	50,332	7,039	61,005	23,280	278,797	111,337
228	-	-	-	19,077	323,957	74,867	9,128	111,113	28,205	435,070	185,979
234	-	-	-	28,815	453,267	104,750	16,457	175,251	45,271	628,518	280,001
240	-	-	-	31,856	629,779	145,542	19,441	274,082	51,297	903,861	419,624
246	-	-	-	34,628	828,509	191,468	22,136	397,319	56,764	1,225,828	588,787
252	-	-	-	44,322	1,050,052	242,667	30,626	541,331	74,948	1,591,383	783,998
258	9,334	-	-	47,831	1,319,124	304,850	34,110	727,105	81,941	2,046,229	1,031,954
264	10,349	24,011	5,549	51,117	1,615,050	373,238	40,691	939,524	91,808	2,554,574	1,312,762
270	15,827	82,128	18,980	62,942	1,939,210	448,151	56,958	1,196,617	119,900	3,135,827	1,644,768
276	18,010	176,241	40,729	66,456	2,318,699	535,851	61,080	1,532,057	127,536	3,850,756	2,067,908
282	20,388	290,366	67,104	69,694	2,724,826	629,707	65,388	1,906,331	135,081	4,631,157	2,536,038
288	28,155	425,082	98,236	81,611	3,156,017	729,356	82,315	2,323,030	163,925	5,479,047	3,052,386
294	31,424	600,533	138,783	85,147	3,651,810	843,933	86,270	2,823,121	171,417	6,474,931	3,667,054
300	34,536	797,638	184,334	88,872	4,173,700	964,542	90,110	3,354,707	178,983	7,528,407	4,319,249
306	43,187	1,016,471	234,907	101,816	4,724,179	1,091,758	109,115	3,917,217	210,931	8,641,396	5,008,975
312	46,264	1,281,653	296,190	105,599	5,342,114	1,234,563	113,144	4,563,980	218,743	9,906,094	5,798,543
318	49,639	1,570,095	362,849	109,333	5,987,752	1,383,769	117,012	5,248,148	226,345	11,235,900	6,631,917
324	59,737	1,882,567	435,061	123,962	6,660,959	1,539,348	132,755	5,970,085	256,718	12,631,045	7,509,433
330	63,229	2,246,589	519,187	127,865	7,409,331	1,712,296	136,902	6,767,133	264,767	14,176,463	8,479,429
336	66,628	2,636,606	609,320	131,663	8,187,527	1,892,137	145,231	7,603,210	276,894	15,790,737	9,495,348
342	77,822	3,053,455	705,653	154,893	8,995,668	2,078,899	171,286	8,498,126	326,179	17,493,795	10,577,025
348	81,210	3,525,335	814,705	Central and SW Pits connect at 348 m asl					343,927	19,466,857	11,184,284
354	84,710	4,023,657	929,867	-	-	-	-	-	355,224	21,557,584	11,827,758
360	97,466	4,550,006	1,051,506	-	-	-	-	-	396,328	23,727,274	12,495,534
366	101,292	5,141,188	1,188,129	-	-	-	-	-	404,845	26,106,019	13,227,653
372	104,873	5,761,698	1,331,528	-	-	-	-	-	413,177	28,554,694	13,981,293
378	118,497	6,409,845	1,481,315	-	-	-	-	-	454,314	31,069,520	14,755,294

Table 3.8 Stage Elevation, Projected Surface Area and Volume for Individual NE, Central and SW Pits, and Combined Central and SW Pit Complex

Pit Stage (m asl)	NE Pit			Central Pit			SW Pit		Combined Central and SW Pit		
	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Pit Volume Below Stage with Placed Waste Rock (m^3) [A]	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Pit Volume Below Stage with Placed Waste Rock (m^3) *	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Projected Surface Area (m^2)	Pit Volume Below Stage (m^3)	Pit Volume Below Stage with Placed Waste Rock (m^3) [A]
384	122,362	7,126,165	1,646,857	-	-	-	-	-	462,815	33,787,522	15,591,827
390	126,234	7,873,946	1,819,669	-	-	-	-	-	470,996	36,579,148	16,451,020
396	142,467	8,657,330	2,000,709	-	-	-	-	-	507,370	39,443,108	17,332,475
402	156,251	9,542,360	2,205,239	-	-	-	-	-	516,002	42,490,528	18,270,395
408	164,640	10,503,654	2,427,394	-	-	-	-	-	524,608	45,608,896	19,230,151
414	175,861	11,511,762	2,660,368	-	-	-	-	-	562,495	48,799,406	20,212,110
420	184,806	12,588,783	2,909,268	-	-	-	-	-	584,383	52,226,768	21,925,791

Notes:
[A] Assumed waste rock pore space of 0.2311 (Moose Mountain Technical Services 2022)

Table 3.9 Groundwater Inflow Rates to NE, Central and SW Pits

Pit Stage (m asl)	Groundwater Inflow Rate (m^3/d)			
	NE Pit	Central Pit	SW Pit	Combined SW and Central Pits
200	780	680	305	1,460
225	780	680	305	1,460
250	780	680	305	1,460
275	780	680	305	1,460
300	780	680	305	1,460
325	780	680	305	1,460
350	684	585	275	1,269
375	505	415	201	920
400	260	195	115	455
425	25	25	25	50

3.3.6 Tailings Management Facility

The TMF will be constructed in six stages during operation and begin impounding water in Mine Year -1 with the mill flows beginning in Mine Year 1. Within the TMF catchment, natural or undisturbed ground upgradient of the TMF will continue to drain into the tailings pond during operation, which will gradually reduce as the TMF is developed (Table 3.10). Prepared ground associated with the areas in the TMF catchment that are grubbed or graded, such as the perimeter haul roads and the tailings dam embankment will increase in area. In closure the TMF wet and dry tailings area will have a 400 mm low permeability till cover installed to reduce seepage and limit oxidation.

Table 3.10 TMF Watershed Areas for Different Operation Stages

Land Use Type	TMF Operation (Stage 1) Watershed Area (ha) [A]	TMF Operation (Stage 6) Watershed Area (ha) [A]	TMF Closure/Post-Closure Watershed Area (ha) [C]
Natural ground	111	53	53
Prepared Ground	5.3	24	24
TMF Dry Tailings	0	69	0
Tailings Pond and Wet Tailings	6.7	72	0
High-Grade Ore (HGO) stockpile	9.8 [B]	1.0	0
TMF Dry Cover	0	0	142

Notes:
[A] Source – Golder (2022);
[B] The HGO stockpile operates from Mine Year 1 to Mine Year 10, after which it is removed (Golder 2022)
[C] The natural ground and prepared ground within the TMF catchment will continue to contribute infiltration flow to the stored tailings mass, resulting in shorter porewater contact/residence times, which improve pore water quality

Runoff for the TMF is estimated using a different method developed by Golder (2022) than the approach used for the stockpiles (Section 3.3.1). Runoff for the TMF land cover areas (Table 3.10) is estimated using a reservoir storage approach for snow and snowmelt. This approach during the winter months applies a percentage value to the runoff rate which is released that month as runoff (10% - January to March; 50% - December and April), and the remainder is stored and released as part of the spring runoff in April.

Toe seepage from the tailings pond will be intercepted by seepage collection ditches along the downgradient perimeter of the dam. This water will then be recirculated back into the TMF by pumping.

The tailings pond water level will be managed by periodic draw down to keep below the maximum operating water level, which accounts for the Environmental Design Flood. Excess water will be sent to the treatment plant prior to discharge to the Victoria Lake Reservoir. The treatment plant will operate on an eight month to year-round basis. The SAGR® treatment unit requires constant flow to maintain the biological media in the reactor. If treatment flows occur during the winter months (December to March) then this water will be potentially used as high-quality water in the mill and reduce the freshwater intake. The treatment system will operate year-round during wet years when treatment discharge needs to be extended.

Reclaim water needs for the mill will be taken from the tailings pond on a year-round basis with additional water needs being met by taking freshwater from the Victoria Lake Reservoir. The tailings pond is assumed to have a 2 m dead storage depth that is not accessible for reclaim water. During the winter months (December 1 to March 31) ice formation is estimated using the Stefan's equation (Ashton 1986; Ministry of Environment, Conservation and Parks 2003) as ice formation removes storage capacity and contributes to the spring freshet. Tailings water added to the TMF in the winter freezes on the tailings beach and is not available for reclaim (Golder 2022). At the start of each month during the winter (December to March), the required volume to supply mill for the remaining winter months is maintained in the tailings pond provide an adequate water supply for the mill.

The basal seepage, or the proportion of seepage assumed to infiltrate to deeper regional groundwater flow from the base of the dam, is modelled as contact water outflow rates from the tailings impoundment and is assumed to occur throughout the lifespan of the TMF (Golder 2022). As presented in Table 3.11, the seepage rates collected and returned to the tailings pond are on the numerical groundwater modelling results (Stantec 2023b). The seepage rates to the regional groundwater system are based on assumed values from the TMF water balance considering the TMF dam liner and cut-off requirements (Golder 2022).

Table 3.11 TMF Seepage Rates

Mine Phase	Seepage Rate (m^3/d) (% of total seepage)	
	Collected and Returned to TMF [A, C]	Regional Groundwater System [B]
Operation	834 (48%)	900 (52%)
Closure [D]	919 (65%)	500 (35%)
Post-Closure [E,F]	65%	35%

Notes:

[A] Stantec (2023b)

[B] Golder (2022)

[C] During closure/post-closure seepage to the toe seepage collection ditches will not be returned to the TMF

[D] The seepage to the toe seepage collection ditches and regional groundwater system is assumed to continue based on the percentage distribution values when the dry cover is installed.

[E] The annual average condition infiltration rate for the TMF in closure is simulated to be approximately 790 m^3/yr (9.3% of total precipitation) during post-closure and is split at the same closure percentage values to the seepage collection system and Regional groundwater system. As there is no ponded water in the tailings pond with the dry cover the infiltration rate is based on a percentage of the total precipitation (9.3%).

[F] In the first year of the dry cover system being simulated the infiltration rate is simulated to be 4.65% of the total precipitation amount to represent wetting of the cover layer and reduced seepage.

Starting in the spring of Mine Year 10, tailings will be deposited in the Berry SW pit until Mine Year 15. No additional tailings will be placed in the TMF. Reclaim water for the mill will be taken from the TMF. If there is insufficient water in the TMF to meet reclaim needs, water will be taken from the Berry SW pit if the water level in the pit is 100 m or less from the spillway elevation (418 m asl). If there is insufficient water to meet the mill needs fresh water will be taken from the Victoria Lake Reservoir. If during operation there is excess water in the TMF that is required to be removed to prevent a spillway discharge, it will be treated and released via the treatment plant and discharged to the Victoria Lake Reservoir.

Beginning in Mine Year 15, excess water in the tailings pond will be directed to the treatment plant prior to discharge to the Victoria Lake Reservoir. The last year of mill operation has the lowest reclaim demand for the TMF. In Mine Year 17 the tailings pond will be pumped at a high rate (220 m^3/d) to the treatment plant to draw down the water level until there is no pond present. As the pond is drawn down, the tailings surface will be graded, a vegetated overburden cover on the tailings installed and the emergency spillway will be lowered to not allow ponding in the TMF. During the closure phase (Mine Year 17) the seepage collection ditches will be converted to passive treatment systems, if required based on a pilot study program. Anaerobic permeable reactive barriers are the planned technology to be implemented and no seepage would be collected and returned to the tailings pond at that time.

4 Water Quantity Model Results

The water quantity model provides estimates of flows and storage volumes for mine facilities during the construction and operation phases, and the closure and post-closure sub-phases of the decommissioning, rehabilitation, and closure phase of the Project Expansion. It also incorporates the mine plan and water management features of the mine.

The results are presented for the average climate conditions, which includes the probabilistic distribution of climate inputs that on average match the average precipitation. Probabilistic results are generated based on the full range of the 100 Monte Carlo simulations for the probabilistic precipitation distribution. Each model is run for 100 years, and the precipitation is varied independently for each year of each of the simulations. Although the models were run for 100 years, the summary plots in this section are presented with a time range relevant to the results discussed.

4.1 Sedimentation Ponds

The sedimentation ponds are influenced by climate inputs, and collect runoff, toe seepage, shallow groundwater flow from the waste rock pile and LGO, overburden and topsoil stockpiles through seepage collection ditches around these facilities. The BER-SP-05 sedimentation pond receives dewatering from the pits during the operation phase, and pit lake overflow during the closure and post-closure sub-phases. The water quantity model simulates the filling up of the ponds following their initial construction with runoff contributions from the stockpiles and disturbed areas until the pond is full and overflows to the environment. Figure 4.1 presents the initial filling of the sedimentation pond BER-SP-03, which collects runoff from the Berry waste rock pile. Toe seepage and surface runoff are the dominant contributors to inflow to the pond Section 0). For the average condition, the sedimentation pond is predicted to take approximately three months to fill. The other stockpile runoff associated sedimentation ponds exhibit similar trends of taking several months to fill prior to discharge with the main inflows being runoff and toe seepage to the ponds. BER-SP-05 receives dewatering flows from the SW and Central pits, which are constructed first. It is estimated to fill up and discharge in less than two months after receiving inflows predominantly from dewatering (Figure 4.2).

Table 4.1 presents the average outflows of the sedimentation ponds for each mine phase and the closure sub-phase, and post-closure sub-phase (if pond is operating) for the Project Expansion. The BER-SP-05 outflow is represented as BER-FDP-05 for its discharge rates to the environment as it receives runoff and seepage from the waste rock stockpile downstream of the BER-SP-05 outlet prior to discharge to Valentine Lake. Tables presenting a range of sedimentation pond and BER-FDP-05 outflows for the 5th and 95th percentile results, representing the 5-year return period annual dry year and 25-year return period annual wet year precipitation amounts, respectively, are in Appendix A.

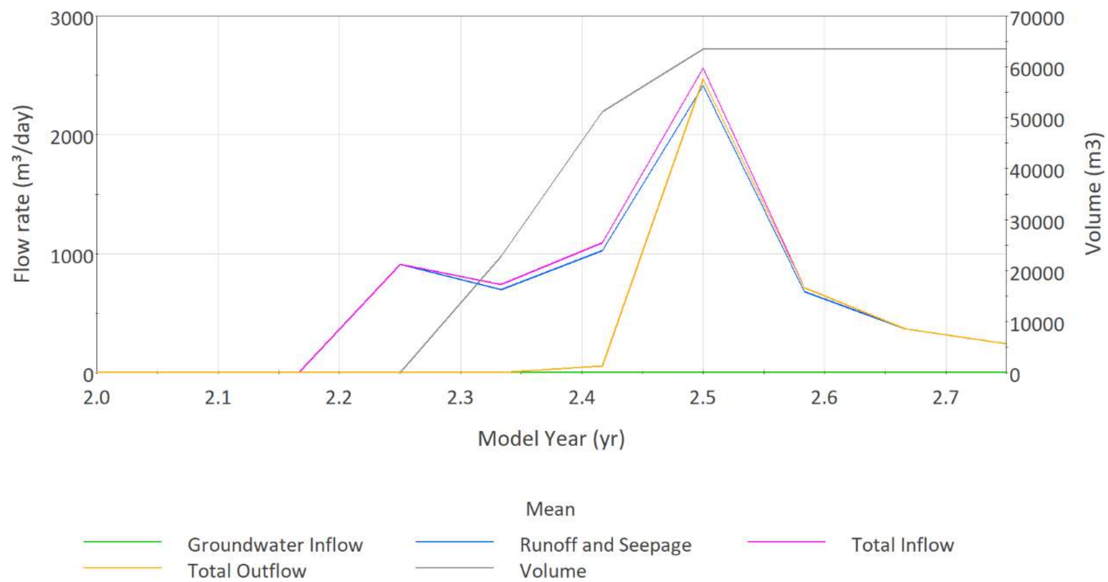


Figure 4.1 Average Condition Volume, Inflows and Outflow of Sedimentation Pond BER-SP-03

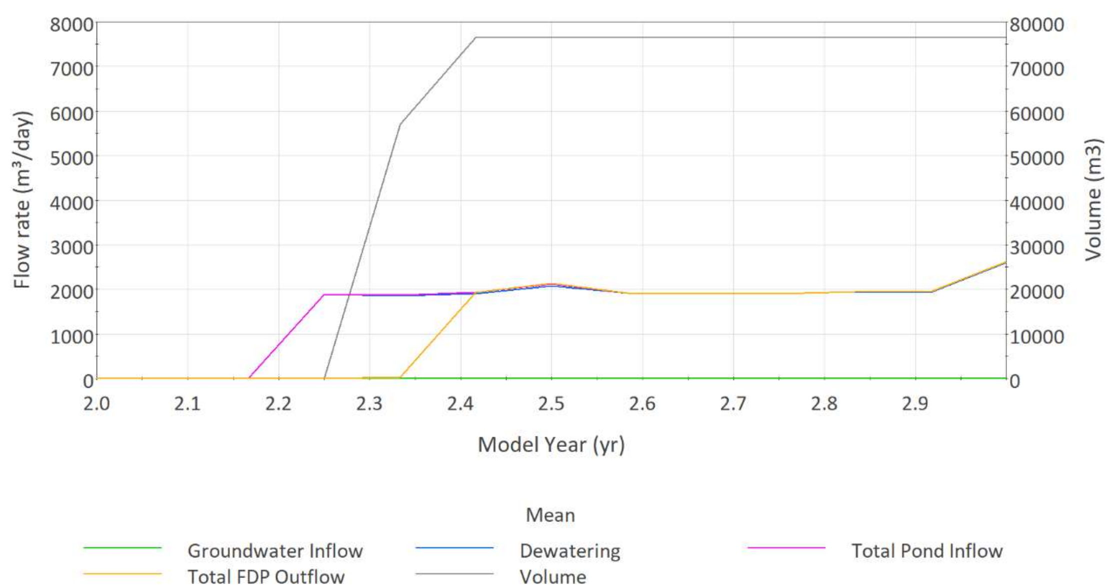


Figure 4.2 Average Condition Volume, Inflows and Outflow of Sedimentation Pond BER-SP-05

Table 4.1 Monthly Average Condition Outflows from Sedimentation Ponds and Downstream Final Discharge Point for BER-SP-05.

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m^3/day)												
BER-SP-01A	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	426	284	629	1514	339	169	138	276	288	331	360	435	427
	Operation (Year 10 to 13)	356	284	578	1340	258	124	116	196	205	237	267	375	361
	Closure (Year 14 to 18)	470	399	615	1456	371	164	88	335	380	486	515	564	487
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-01B	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	666	479	949	2263	548	285	223	480	517	585	646	727	691
	Operation (Year 10 to 13)	494	394	788	1827	366	183	171	289	302	344	385	522	505
	Closure (Year 14 to 18)	572	474	726	1717	441	193	104	398	452	581	615	671	579
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-02	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	481	350	761	1811	397	196	164	318	339	382	432	521	508
	Operation (Year 10 to 13)	436	348	692	1605	322	158	147	252	265	305	342	461	445
	Closure (Year 14 to 18)	464	377	575	1360	350	150	81	314	357	464	491	535	460
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-03	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	590	429	770	2050	467	219	163	384	425	497	558	635	594
	Operation (Year 10 to 13)	475	378	778	1805	337	152	142	245	259	310	352	502	478
	Closure (Year 14 to 18)	565	466	717	1694	432	187	100	387	440	570	604	660	568
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4.1 Monthly Average Condition Outflows from Sedimentation Ponds and Downstream Final Discharge Point for BER-SP-05.

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m^3/day)												
BER-SP-04	Construction (Year -2.25 to-1)	472	367	269	888	372	211	144	381	428	481	321	315	379
	Operation (Year 1 to 9)	656	537	835	1959	532	279	200	504	568	646	705	712	678
	Operation (Year 10 to 15)	612	509	805	1890	506	266	194	481	518	623	652	709	647
	Closure (Year 16 to 20)	707	576	845	1995	583	311	212	578	667	748	788	778	732
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
MA-SP-01AB	Construction (Year -2.25 to-1)	453	352	518	1219	199	122	92	278	358	448	454	452	443
	Operation (Year 1 to 9)	535	435	671	1573	427	215	152	399	454	529	577	580	545
	Operation (Year 10 to 15)	494	404	632	1484	397	198	142	370	417	494	529	551	509
	Closure (Year 16 to 20)	483	391	598	1406	386	194	136	365	427	490	545	528	496
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-FDP-05	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	2790	2560	3331	5443	3301	3170	3244	3709	3636	3569	3621	3403	3481
	Operation (Year 10 to 15)	100	136	235	551	125	55	37	105	108	151	157	210	164
	Closure (Year 16 to 20)	1703	1449	2112	4726	1490	577	447	1320	1523	1990	2099	2224	1805
	Post Closure (from year 21) [A]	2438	2235	3084	6754	2035	702	565	1728	2044	2642	2953	2794	2497
BER-SP-06	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	501	366	577	1421	417	225	153	415	474	539	583	561	515
	Operation (Year 10 to 13)	501	412	604	1427	418	225	153	416	469	540	572	566	525
	Closure (Year 14 to 18)	457	390	572	1350	395	213	145	393	433	513	538	558	496
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
[A] SW/Cen Pit is full and overflows in Mine Year 19

The sedimentation pond BER-SP-01A receives runoff and toe seepage from the Berry waste rock pile and the stockpile does not begin construction until Mine Year 3 (Model Year 4.25) (Figure 4.3). The second year of pond operation has higher inflows than other modeled years as the majority of the drainage area is disturbed ground, which has a higher runoff rate then the waste rock pile (0.83 vs 0 or 0.5 for snowmelt) and the waste rock placed within the pile in the first year is fully saturated and allows infiltration to occur (e.g., toe seepage). The second year highest average annual pond outflow rate is observed for the other waste rock pile sedimentation ponds (Figure 4.4 to Figure 4.6). When the waste rock piles are rehabilitated with a vegetated overburden and topsoil cover during the closure sub-phase, and waste rock runoff areas next to the SW and Central pits will be directed to drain towards BER-SP-05, there is an estimated relatively small increase in flow from the waste rock piles.

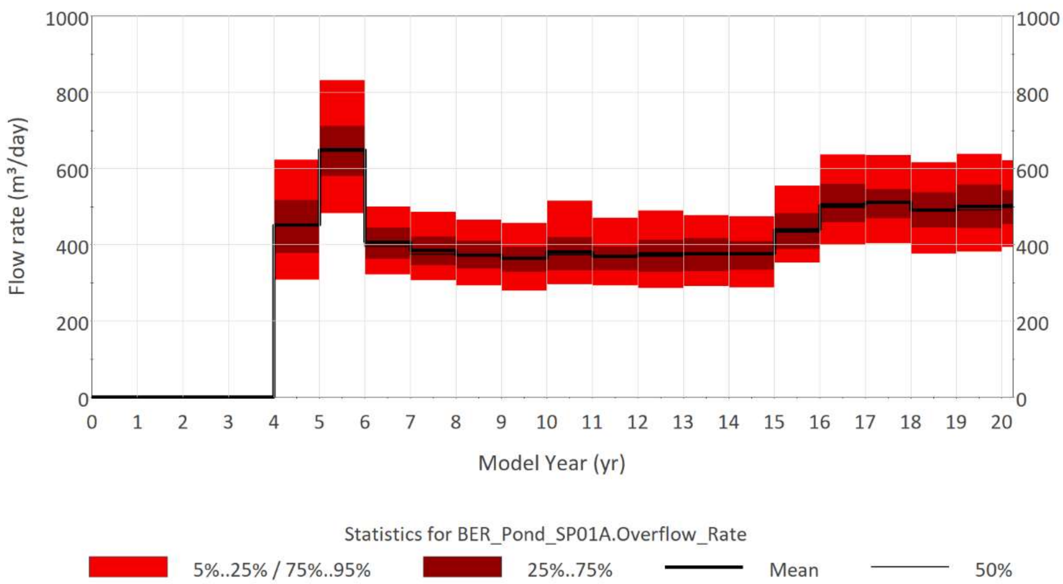


Figure 4.3 Sedimentation Pond BER-SP-01A Annual Outflow Probabilistic Analysis.

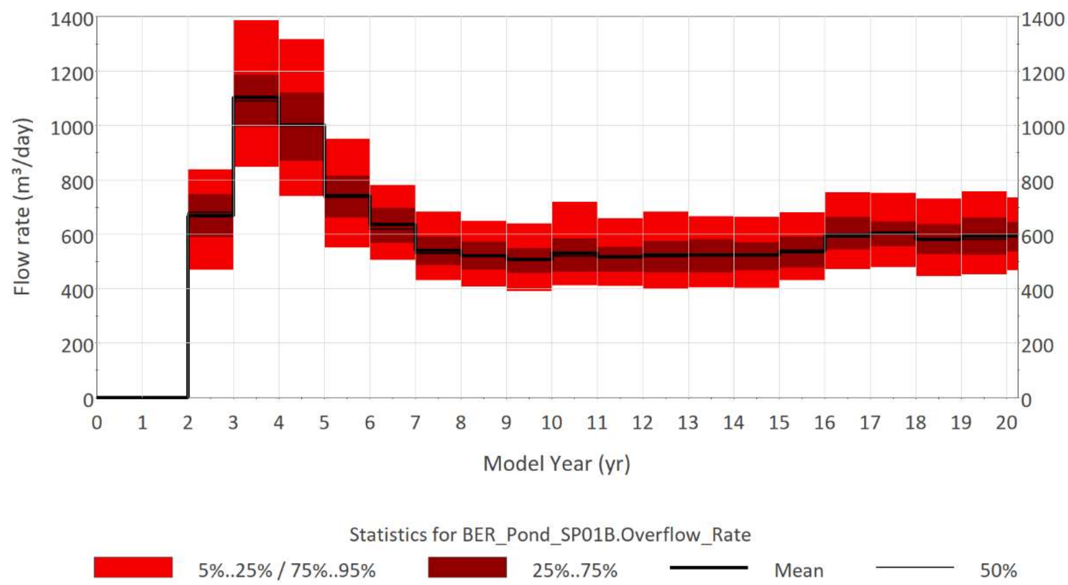


Figure 4.4 Sedimentation Pond BER-SP-01B Annual Outflow Probabilistic Analysis.

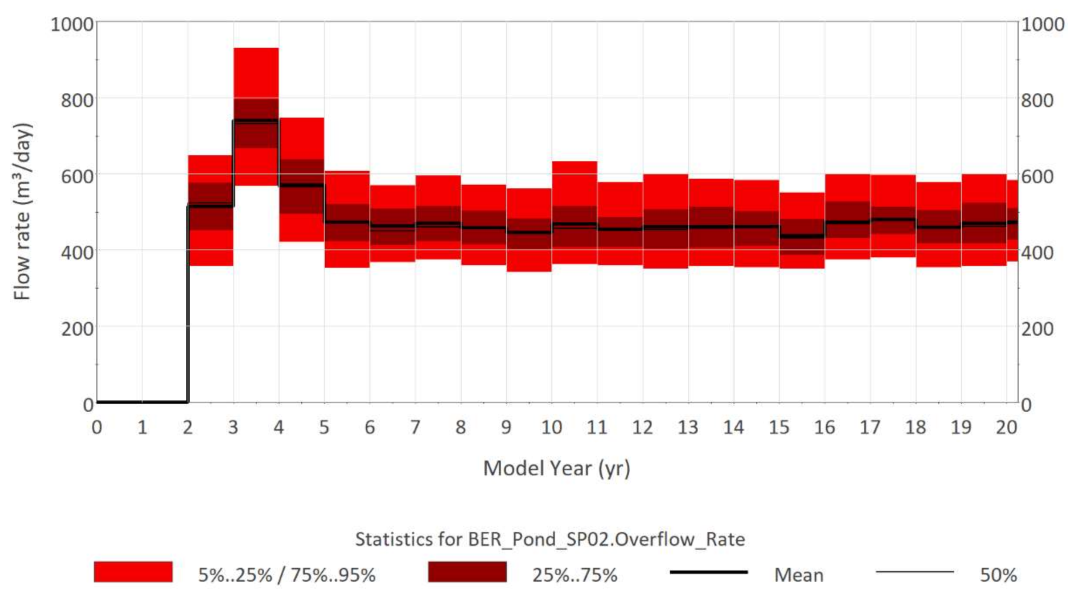


Figure 4.5 Sedimentation Pond BER-SP-02 Annual Outflow Probabilistic Analysis.

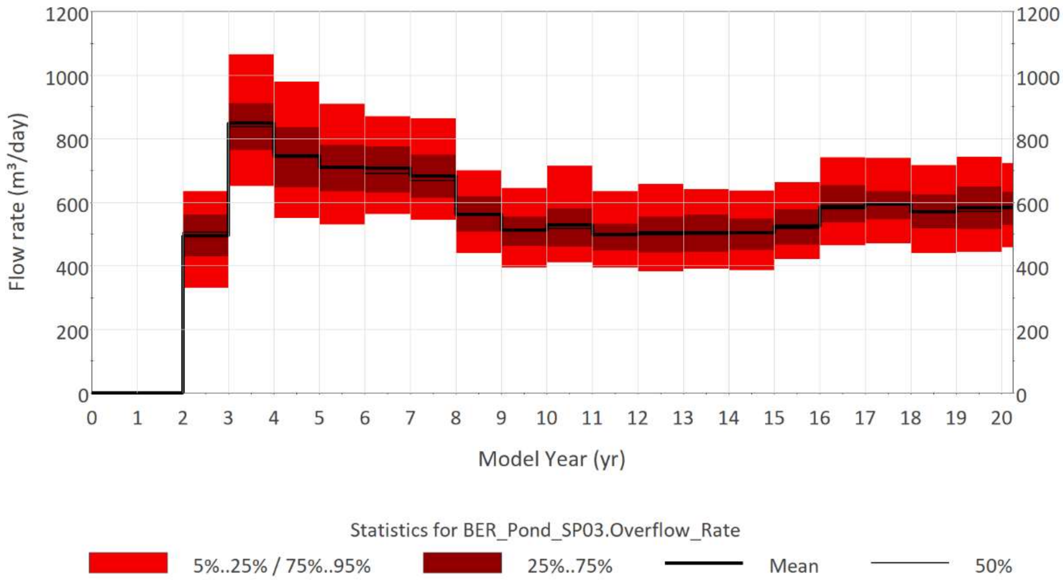


Figure 4.6 Sedimentation Pond BER-SP-03 Annual Overflow Probabilistic Analysis.

The ponds BER-SP-04 and MA-SP-01AB receive runoff and seepage from the combined Marathon and Leprechaun overburden and LGO stockpiles (Figure 4.7 and Figure 4.8). These ponds are early works ponds and will begin receiving runoff from the overburden stockpile area at the start of the construction period (Mine Year -2.25; Model Year 0). As the stockpiles are constructed to full size during the construction and operation periods the drainage areas runoff increases and remains relatively steady. During the closure period, when the LGO stockpile is removed and rehabilitated (Mine Year 16; Model Year 17.25) runoff slightly increases due to the change runoff rate for prepared ground. Following the five-year closure sub-phase where vegetation establishes in the LGO stockpile area, both the overburden and LGO stockpile areas have reduced runoff rates represented as natural ground. During the post-closure sub-phase, the collection ditches are backfilled, and the sedimentation ponds removed.

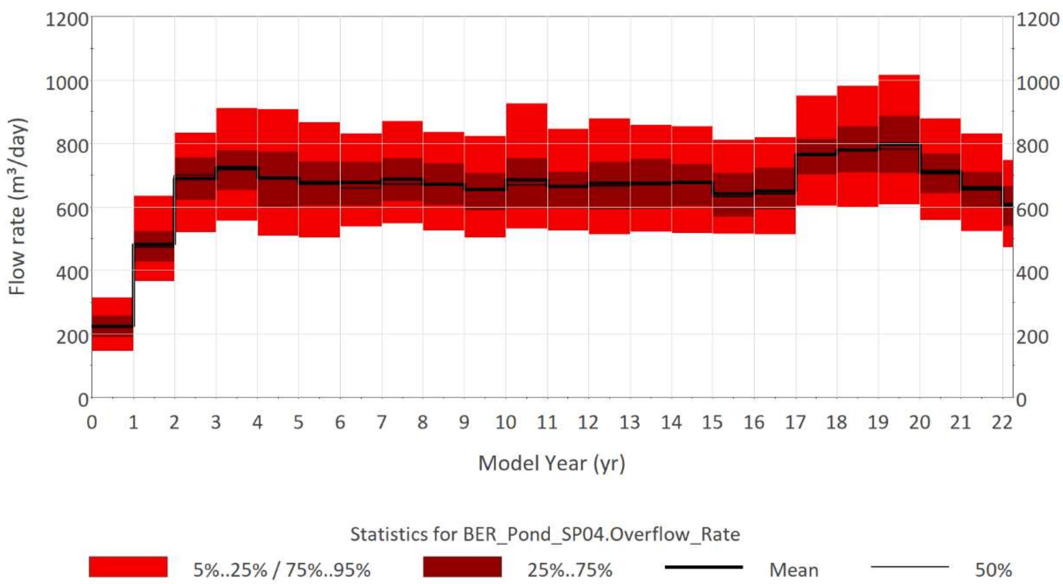


Figure 4.7 Sedimentation Pond BER-SP-04 Annual Outflow Probabilistic Analysis.

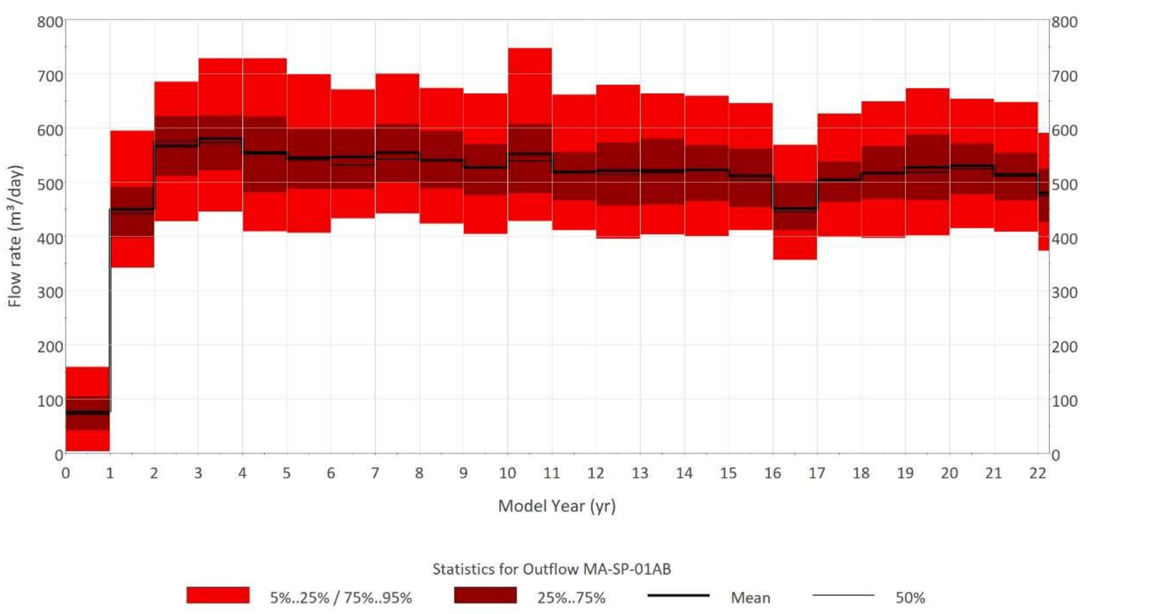


Figure 4.8 Sedimentation Pond MA-SP-01AB Annual Outflow Probabilistic Analysis.

The BER-SP-05 sedimentation pond receives dewatering from the NE, Central and SW pits during the operation phase until the end of Mine Year 9 (Model Year 11.25) (Figure 4.9). There is a brief period where the FDP will only have inflows from runoff and seepage within the rockfill drain area, with an annual average rate of 80 m^3/day (Model Years 12 to 15.25; Mine Years 10.75 to 14). In model year 15.25 (Mine Year 14), the waste rock pile will have the slopes adjacent to the open pit rehabilitated with an earthen cover and runoff flows directed to BER-SP-05. The NE pit for the average condition begins overflow in Model Year 18 (Mine Year 16.75), which discharges to BER-SP-05. The FDP reaches the higher closure and post-closure sub-phase flow rate when the SW and Central pit complex overflows on average in Mine Year 19.3 (Model Year 20.6).

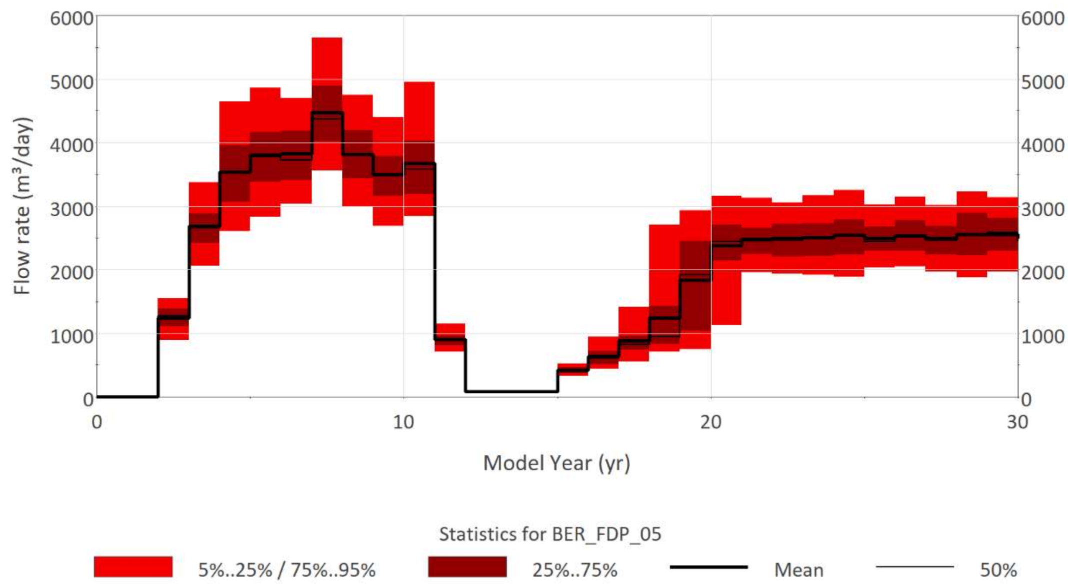


Figure 4.9 Final Discharge Point BER-FDP-05 Annual Outflow Probabilistic Analysis.

The topsoil stockpile associated BER-SP-06 sedimentation pond outflows are highest during operation and the closure sub-phase when a prepared ground runoff coefficient is applied (Figure 4.10). During the post-closure sub-phase runoff is estimated using a natural ground runoff coefficient to represent the vegetated cover and the ditches are backfilled and sedimentation pond outflow breached.

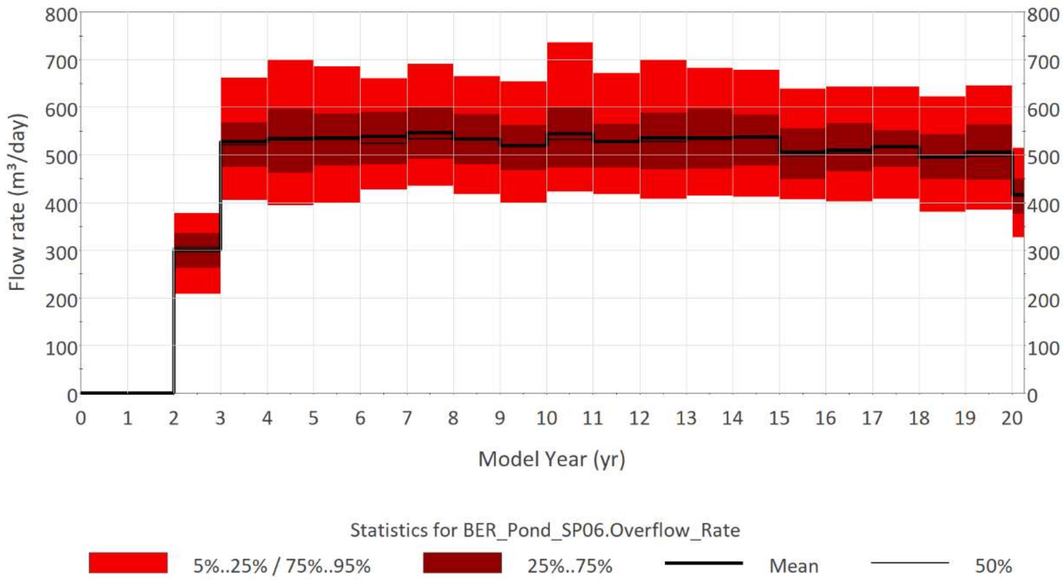


Figure 4.10 Sedimentation Pond BER-SP-06 Annual Outflow Probabilistic Analysis.

4.2 Tailings Management Facility

The water quantity model estimated TMF inflows and outflows, and variations in the storage volume. Figure 4.11 presents tailings storage volume for the average condition and that the TMF has adequate storage capacity during the operation phase and closure sub-phase. The average condition storage volumes are predicted to be below the maximum storage volume at the spillway. Excess water from the TMF is sent to the treatment plant, which is estimated to be required during the period when tailings are placed in the TMF until the end of Mine Year 9 (Model Year 11.25) and restarted during the last year of operation (Mine Year 15; Model Year 16.25) when reclaim demands by the mill are reduced and then end. During the operation period (Mine Years 1 to 9), the average condition daily flow rate to the treatment plant is 1,250 m^3/day, and for the winter months (December to March), the average daily flow is 400 m^3/day. The average winter treatment plant flow rate is approximately 30% of the average annual treatment flow rate. The winter months treated water volume will be potentially used by the mill in place of freshwater from the Victoria Lake Reservoir or discharged to the Victoria Lake Reservoir. In Mine Year 17 (Model Year 18.25) the tailings pond will be drawn down by pumping to the treatment plant, and the TMF tailings area rehabilitated with a soil overburden cover and the emergency spillway breached to not allow ponding in the TMF.

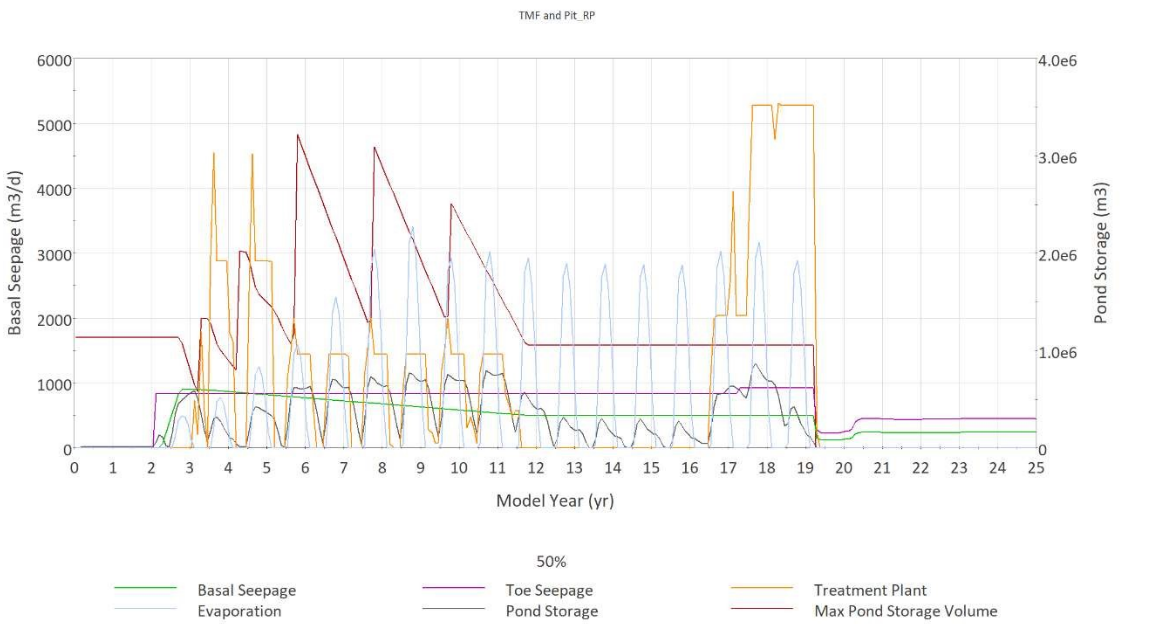


Figure 4.11 Average Climate Condition Tailings Pond Storage and Outflows

The 25-year return period annual wet year predicted TMF storage volumes are presented in Figure 4.12. During Model Year 3 (Mine Year 1.75) the Stage 1 storage volume is potentially exceeded. Stage 2 may need to be constructed earlier to provide adequate storage or the tailings pond has more excess water pumped to the treatment plant at lower storage elevation thresholds than presented in Table 1.1. The TMF storage volume is potentially exceeded in Model Year 17.5 to 18.5 (Mine Year 16.25 to 17.25) and the stage elevation thresholds for pumping water to the treatment plant may need to be adjusted to provide adequate storage.

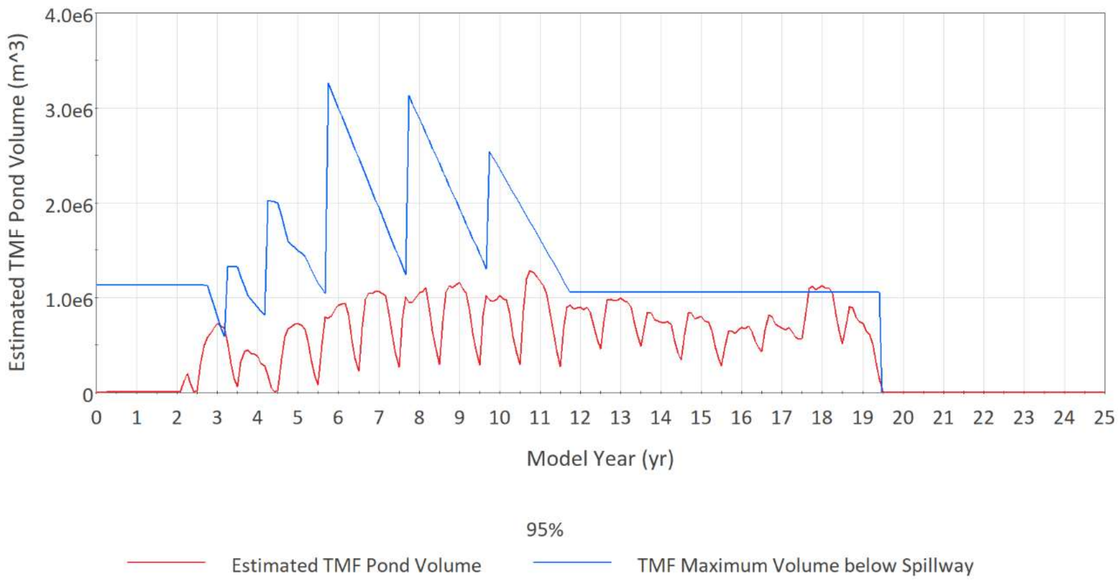


Figure 4.12 25-year Return Period Annual Wet Year (95th Percentile) for Tailings IPond Storage and Maximum Storage Below Spillway

During the operation phase when tailings are deposited in the TMF, TMF reclaim is estimated to not meet mill water requirements substantially during Mine Years 1, 3 and 4 (Model Years 2.25, 4.25 and 5.25) (Figure 4.13). Figure 4.14 presents annual average rates from the different mill water sources. Mine Years 3 and 4 coincide with the Phase Stage 1 and 2 lifts being completed and periods of reduced storage volume in the TMF. During the operation phase when tailings are deposited in the Berry SW Pit, freshwater will be required from the Victoria Lake Reservoir and/or the SW pit to supplement the TMF reclaim. When the Berry SW Pit fills up to within 100 m of the spillway elevation, supplemental reclaim using the Berry pit dewatering pump and pipeline infrastructure will be taken from the pit and sent to the mill, which is estimated to occur in Mine year 12 (Model Year 13) to the end of operation. Supplementing reclaim from the Berry SW pit reduces the freshwater demand up to a maximum of 2,384 m^3/day (Table 4.2).

Table 4.3 presents the annual average condition water inflow and outflow volumes from the TMF during the operation phase.

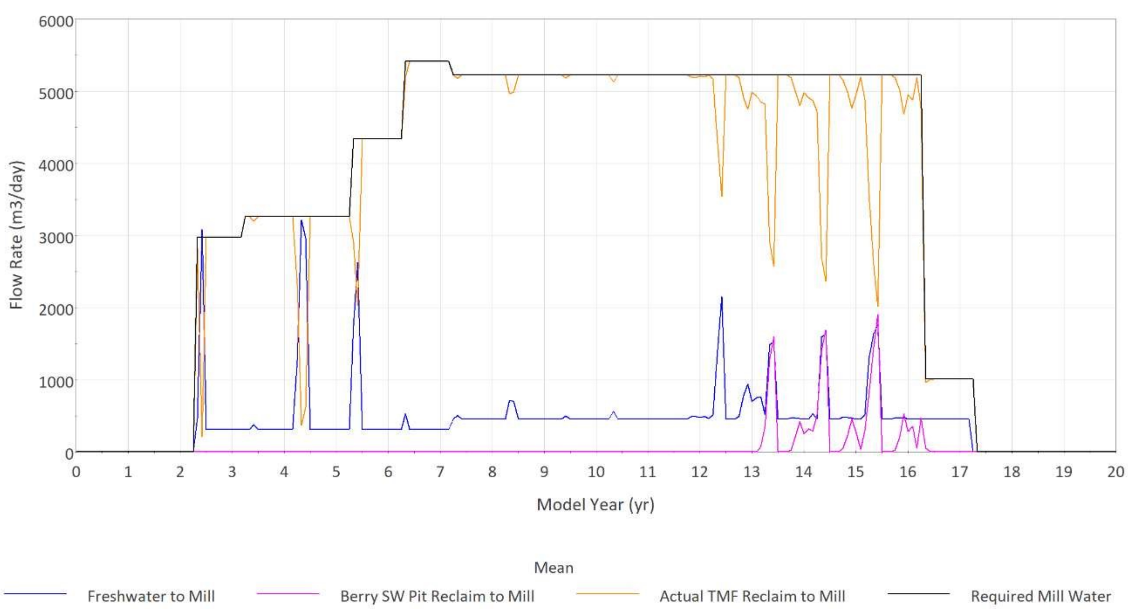


Figure 4.13 Average Condition Tailings Pond, Freshwater and Berry SW Pit Reclaim Rates to Plant

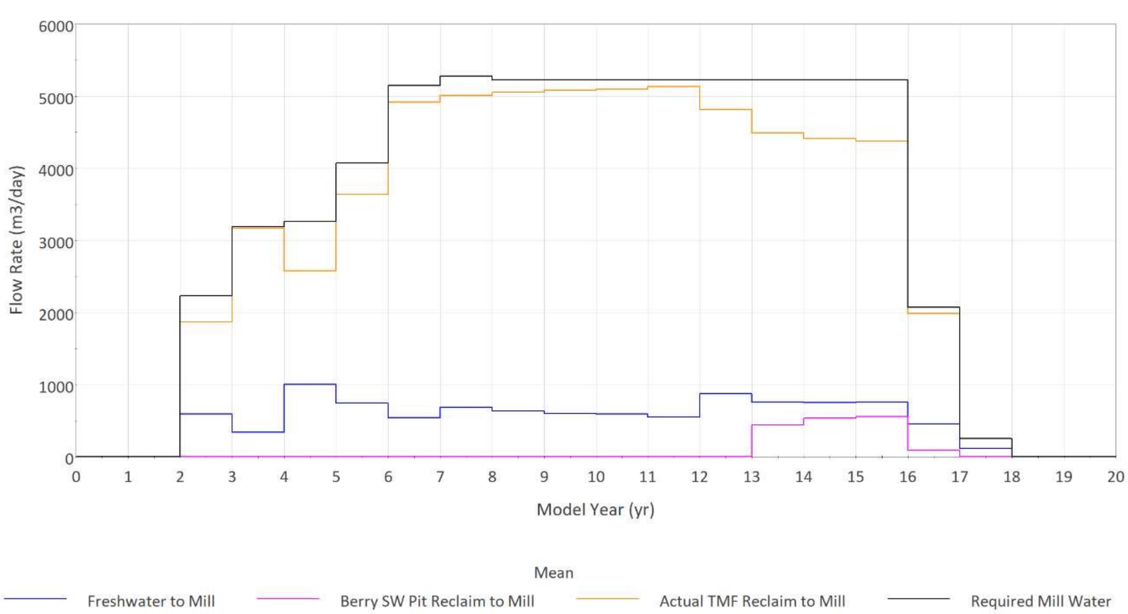


Figure 4.14 Annual Average Flow Rates for the Average Condition for Tailings Pond, Freshwater and Berry SW Reclaim

Table 4.2 Monthly and Annual Average Berry SW Pit Reclaim Rates to Plant

Probability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
	Reclaim Flow Rate (m^3/day)												
Mean	171	533	1,050	1,301	0	0	0	32	219	467	269	235	426
Minimum (5th percentile)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum (95th percentile)	2,384	2,384	2,384	2,384	0	0	0	0	2,288	2,384	1,637	1,718	1,430

Table 4.3 Average Condition TMF Water Quantity Model Flow Summary for Operation

End of Mine Year	Model Year	Life of Mine Activity	Inflows (Mm^3/year)			Tailings to Pit (Mm^3/year)	TMF Outflow (Mm^3/year)							Freshwater make-up required (Mm^3/year)
			Runoff	Tailings	Total		Reclaim	Treatment	Overflow	Evaporation	Basal Seepage	Retained in Tailings	Total	
-1	2.25	TMF and PP active	0.17	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	3.25	Mill Start	1.14	1.13	2.27	0.00	0.86	0.03	0.00	0.06	0.22	0.70	1.88	0.13
2	4.25	Stage 1 Complete	1.39	1.34	2.73	0.00	1.17	0.72	0.00	0.09	0.32	0.84	3.15	0.02
3	5.25	Stage 2 Complete	1.87	1.35	3.22	0.00	0.95	0.75	0.00	0.15	0.30	0.82	2.98	0.24
4	6.25	Stage 3 Complete	1.91	1.72	3.63	0.00	1.43	0.39	0.00	0.19	0.29	1.08	3.38	0.16
5	7.25	-	1.88	2.08	3.96	0.00	1.73	0.37	0.00	0.28	0.25	1.23	3.85	0.08
6	8.25	Stage 4 Complete	2.08	2.16	4.24	0.00	1.82	0.42	0.00	0.38	0.25	1.34	4.20	0.10
7	9.25	-	2.11	2.15	4.26	0.00	1.84	0.39	0.00	0.41	0.23	1.34	4.22	0.07
8	10.25	Stage 5 Complete	2.07	2.15	4.23	0.00	1.86	0.44	0.00	0.36	0.22	1.34	4.21	0.05
9	11.25	-	2.03	2.10	4.13	0.00	1.70	0.46	0.00	0.37	0.18	1.23	3.94	0.05
10	12.25	Switch to Berry Pit Disposal; Stage 6 Complete	2.12	0.51	2.62	1.69	1.87	0.08	0.00	0.36	0.18	0.39	2.88	0.04
11	13.25	-	2.13	0.00	2.13	2.83	1.73	0.00	0.00	0.35	0.18	0.00	2.26	0.17
12	14.25	-	2.12	0.00	2.12	2.84	1.64	0.00	0.00	0.35	0.18	0.00	2.16	0.09
13	15.25	-	2.12	0.00	2.12	2.84	1.64	0.00	0.00	0.35	0.18	0.00	2.16	0.09
14	16.25	-	2.10	0.00	2.10	2.84	1.60	0.00	0.00	0.34	0.18	0.00	2.12	0.11
15	17.25	End of Operation	2.15	0.00	2.15	0.98	0.36	0.78	0.00	0.37	0.18	0.00	1.69	0.00

4.3 Berry Pits

4.3.1 Berry Complex

The NE pit begins operation in Mine Year 1 (Model Year 2.25) and stops operation at the end of Mine Year 6 (Model Year 8.25). Figure 4.15 presents the average groundwater inflow rate to the NE pit and pit wall runoff that make up the dewatering flow rate for the operation period. The inflow rate to the open pit changes during the closure and post-closure sub-phases as a waste rock pile is constructed over top of the pit in Mine Year 9 (Model Year 10.25), which reduces the inflow rate to groundwater seepage for a one-year period while the waste rock becomes saturated. The inflow rate increases as it is assumed runoff and infiltration from the waste rock pile above discharges to the waste rock filled pit. The inflow rate is reduced during the post-closure sub-phase when the waste rock is rehabilitated with an earthen cover and runoff is directed towards sedimentation ponds BER-SP-03 and BER-SP-05. For the average condition, the NE pit water elevation reaches the spillway elevation in Mine Year 16.8 (Model Year 18.1).

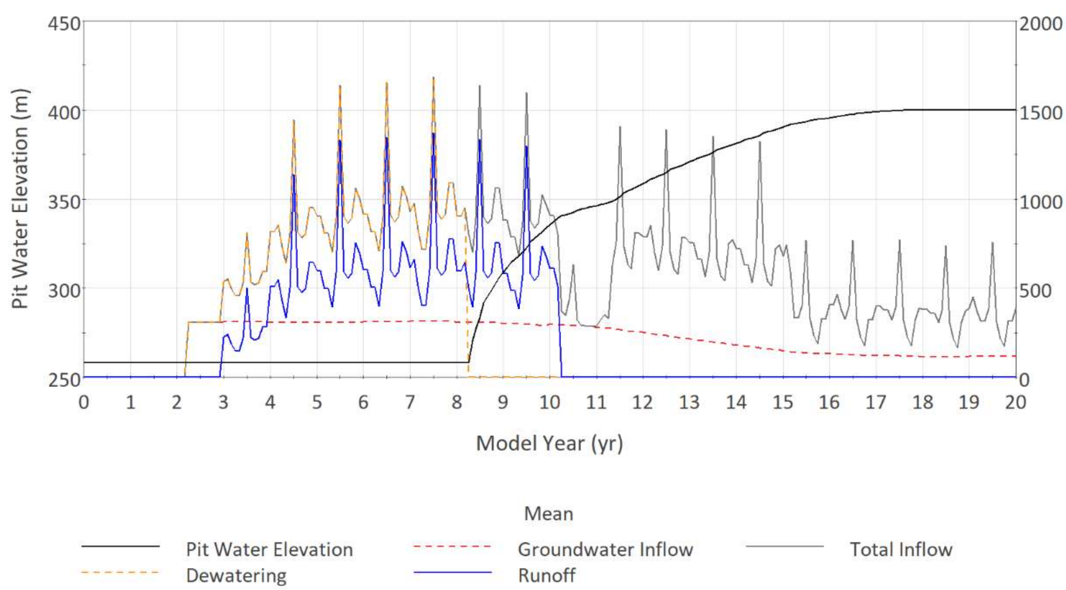


Figure 4.15 Average Scenario for NE Pit Level, Inflows and Dewatering

Figure 4.16 and Table 4.4 present the NE pit probabilistic dewatering rate results, which range from a monthly average low (minimum 5th percentile) of 231 m³/d to 2,130 m³/d (maximum 95th percentile).

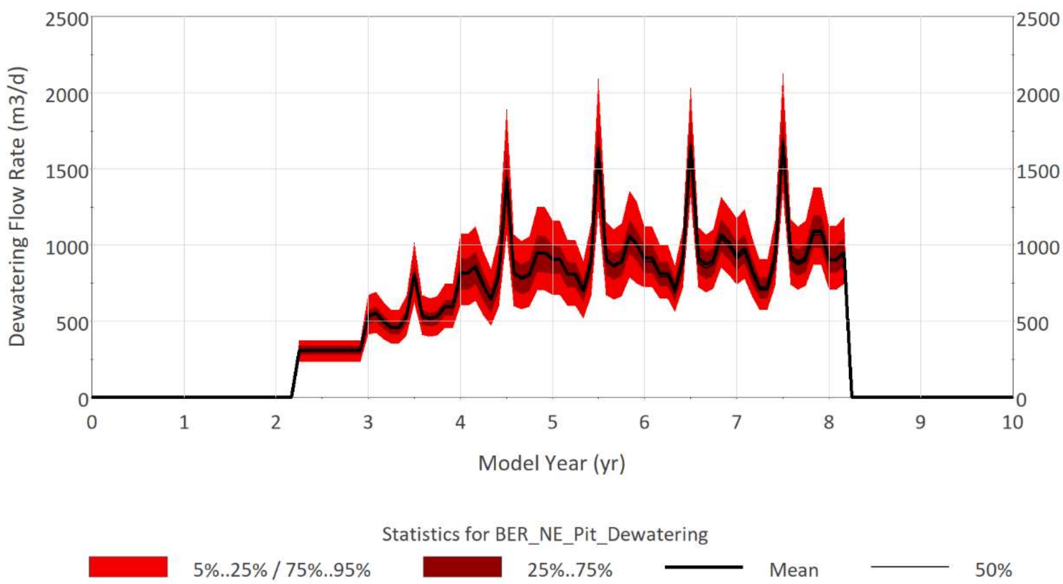


Figure 4.16 Probabilistic Analysis of NE Pit Dewatering Rate

Table 4.4 Monthly Average, 5th Percentile and 95th Percentile NE and SW and Central Pit Complex Dewatering Rates

Pit Complex	Probability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Dewatering Flow Rate (m^3/day)												
NE	Mean	639	587	726	1,257	732	704	724	845	827	833	844	792	793
	Minimum (5th percentile)	231	231	231	231	231	231	231	231	231	410	423	382	274
	Maximum (95th percentile)	1,031	906	1,159	2,130	1,171	1,120	1,157	1,377	1,377	1,174	1,235	1,184	1,228
SW and Central	Mean	2,513	2,324	2,748	4,374	2,768	2,683	2,744	3,114	3,049	2,967	3,004	2,802	2,924
	Minimum (5th percentile)	1,191	1,173	1,206	1,334	1,208	1,201	1,206	1,235	1,226	1,583	1,618	1,510	1,308
	Maximum (95th percentile)	4,214	3,738	4,594	7,875	4,634	4,463	4,586	5,331	5,091	4,645	4,645	4,380	4,757

The model predicts that the NE pit filled with waste rock will take between 7.75 and 9.8 years to fill to the spillway elevation after dewatering stops (5th and 95th percentiles, respectively) (Figure 4.17).

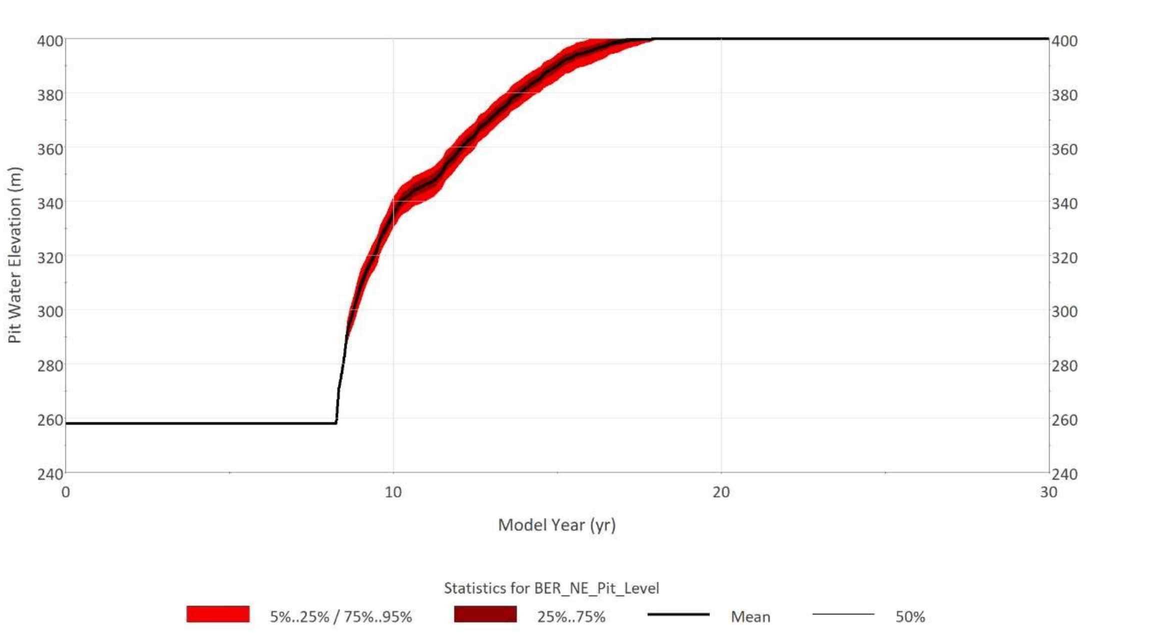


Figure 4.17 Probabilistic Analysis of Natural Filling of NE Pit

The SW and Central pit complex operates from Mine Year 1 to the end of Mine Year 9 (Model Year 2.25 to 11.25) (Figure 4.18). Tailings are deposited in the SW pit portion of the complex from Mine Year 10 to the end of Mine Year 15 (Model Years 11.25 to 17.25).

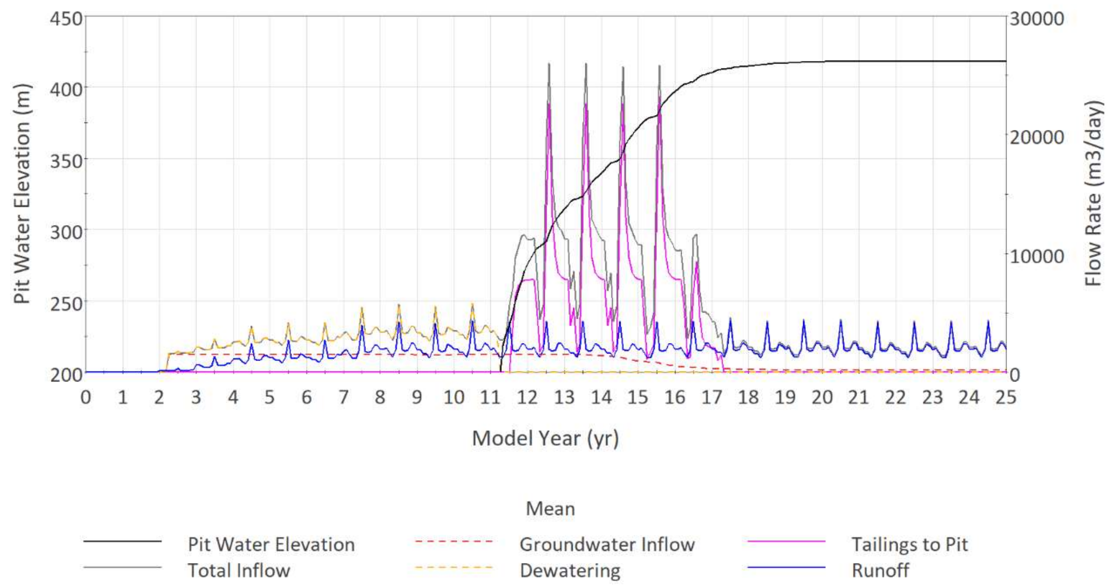


Figure 4.18 Average Scenario for SW and Central Pit Level, Inflows and Dewatering

The probabilistic dewatering results are presented in Figure 4.19 and Table 4.4 with a range of monthly average rates from 1,150 m^3/d (minimum 5^{th} percentile) to 7,875 m^3/d (95^{th} percentile).

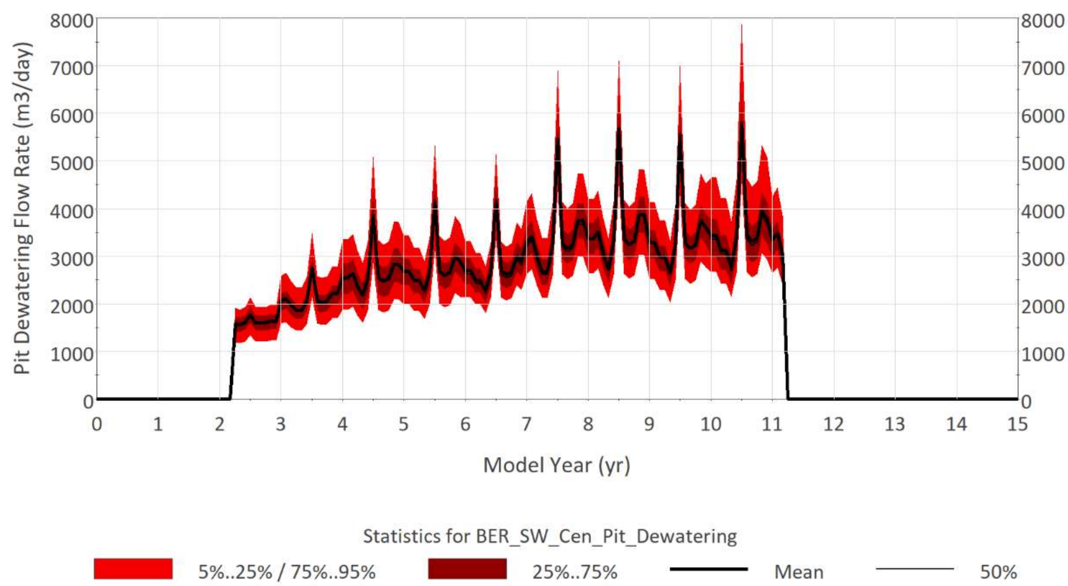


Figure 4.19 Probabilistic Analysis of SW and Central Pit Dewatering Rate

The model predicts that the SW and Central pit complex to fill to the pit lake spillway elevation between 6.3 and 9.75 years from the stop of operation, including placement of mine tailings within the SW pit and backfilling of waste rock in the Central pit (Figure 4.20). The placement of tailings stops at the end of Mine Year 15, which is six years after dewatering stops in the pit complex. The pit lake will overflow to the environment as early as several months after the stop of tailings placement within the open pit for the 25-year return period wet year scenario (95th percentile).

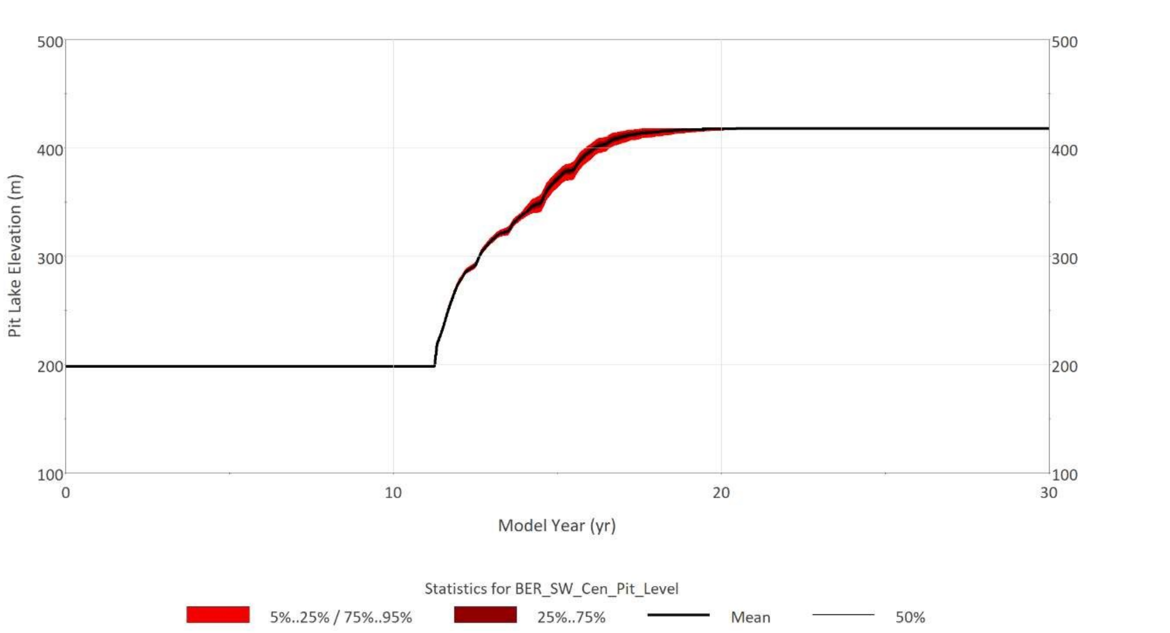


Figure 4.20 Probabilistic Analysis of Tailings Deposition and Natural Filling of SW and Central Berry Pit Complex

4.3.2 Marathon and Leprechaun Pit Complexes

As part of the Project Expansion, the Leprechaun pit will not receive tailings from the mill. The updated water quantity model assessed the length of time to fill the open pit to the spillway elevation of 380 m asl from when the Leprechaun pit stops operation at the end of Mine Year 12 (Mine Year 14.25) using the EIS-assessed freshwater taking rate from Victoria Lake Reservoir of 4 $Mm^{3/}$year to accelerate pit filling (Marathon 2020). The Approved Project model estimated for the average climate condition the Leprechaun pit would fill within eight years after the end of pit operation with the placement of tailings in the pit. The Leprechaun pit with no tailings placed in the pit is predicted to fill within 11 years for the average condition and 5th percentile (5-year return period annual dry year) and 10.6 years for the 95th percentile (25-year return period annual wet year) (Figure 4.21). This estimate will extend the water taking from Victoria Lake Reservoir by three years or less.

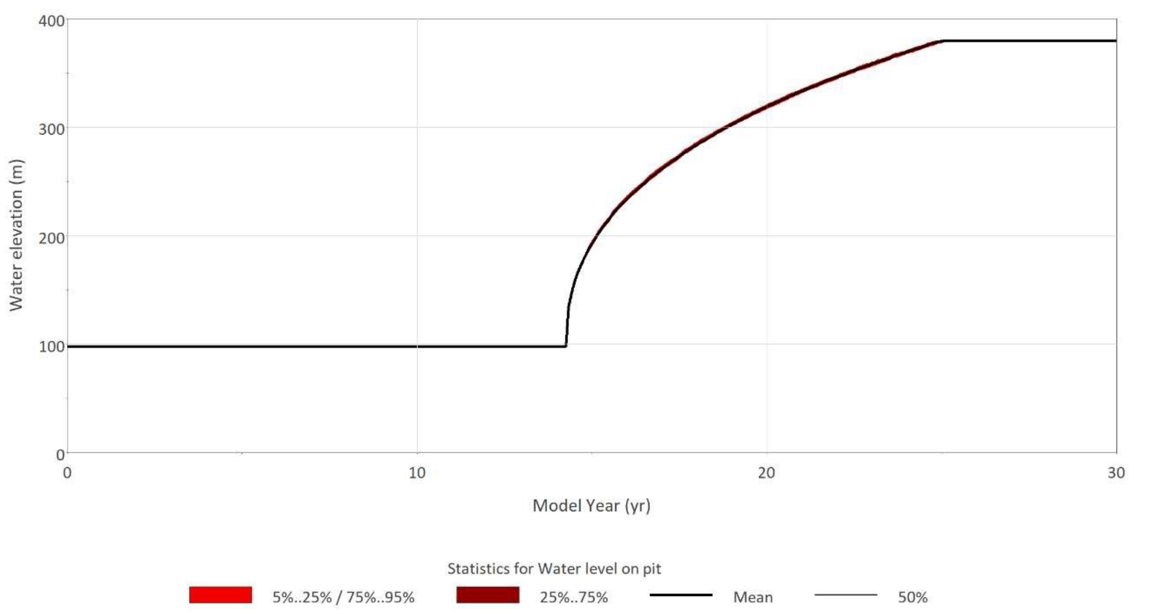


Figure 4.21 Probabilistic Analysis of Accelerated Filling of the Leprechaun Pit Adding Water from Victoria Lake Reservoir

The updated water quantity model for the Project Expansion assessed the length of time to fill the Marathon pit to the spillover elevation of 330 m asl. The model assessed the Approved Project accelerated filling rate of 6.2 Mm^3/year from Valentine Lake, beginning at the end of in-pit mining at the end of Mine Year 13 (Model Year 15.25). Figure 4.22 presents the probabilistic analysis results for when the Marathon pit reaches its spillway elevation due to accelerated filling. The Marathon pit is predicted to fill to the spillway elevation for the climate average condition and 5th percentile condition in 9.3 years, and for the 95th percentile condition in 8.8 years, which is a little over a year longer than estimated by the Approved Project model (Marathon 2020).

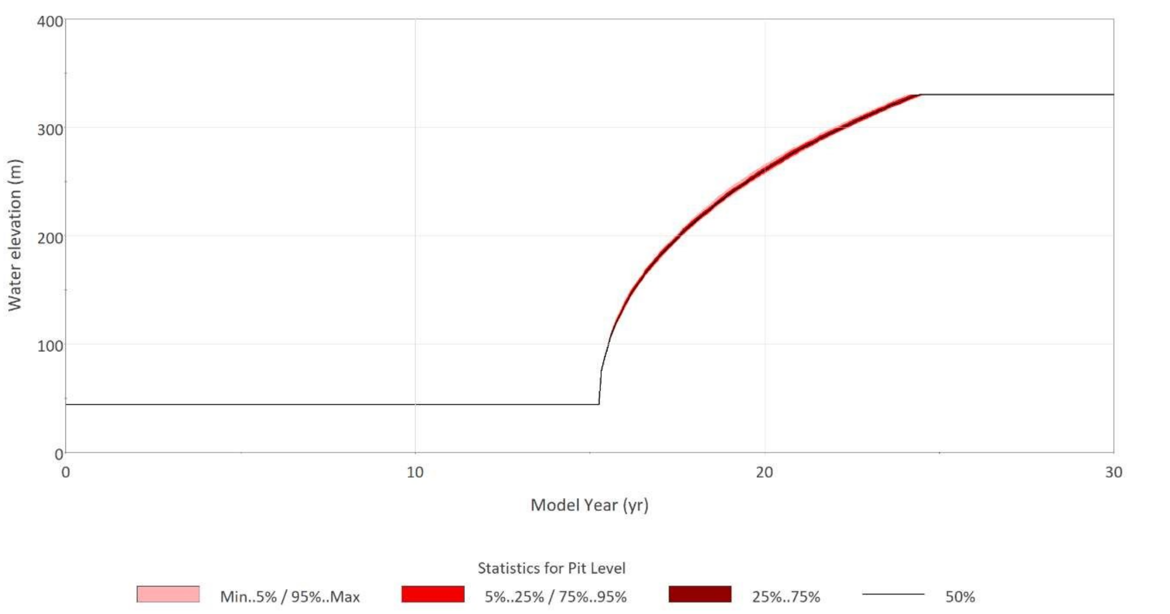


Figure 4.22 Probabilistic Analysis of Accelerated Filling of the Marathon Pit Adding Water from Valentine Lake

5 Water Quality Model Update

5.1 Conceptual Model

The primary objective of the water quality model is to predict concentrations of potential contaminants in mine facilities and final discharge points. The contaminant transport module of GoldSim™ is used to build the water quality model directly linked to the water quantity model. The water quality model consists of a network of individual cells representing:

- waste rock and LGO stockpiles,
- pit walls,
- TMF,
- sediment ponds,
- pit lakes,
- undeveloped areas, and
- other auxiliary Project Expansion facilities

These cells are connected by links representing ditches and channels.

The water quantity model provides direct inputs to storage volumes and water inflow/outflow rates for each cell. The annual infiltration during the first year of the model (mine Year -1) is arbitrarily assigned to pore water in the waste rock pile and LGO stockpile to facilitate wetting of the piles. Therefore, a volume equal to infiltration during the first year is stored within the piles. In subsequent years, the wetting (and stored volume) is maintained for the period that the pile remains in place. Based on this assumption of simulating wetting of solids, no seepage drains from these sources to the sedimentation ponds during the first year.

The water quality inputs to the cells are either a defined concentration or mass-rate (loading) addition to the cell. The concentration in a cell is calculated by GoldSim™ as the mass retained in a cell divided by the volume of the cell at the end of each time step.

The selection of parameters for inclusion in the model is based on criteria listed in the following federal regulatory documents:

- Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CWQG-FAL) by Canadian Council of Ministers of the Environment (CCME 2023)
- *Metal and Diamond Mining Effluent Regulations* of the *Fisheries Act* (MDMER), Table 1 of Schedule 4 (SOR/2002-222, 2023)

The selection of parameters for inclusion in the model is also based on criteria listed in CWQG-FAL. In addition to the parameters listed in these guidelines and regulations, the supporting parameters, such as general water chemistry are added. The full list of parameters, their symbols and applicable reference values are provided in Table B-1 (Appendix B). Trace element concentrations are modelled as total concentrations. Temperature, alkalinity, and pH are not modelled; however, the temperature and pH values were used to calculate the CWQG-FAL values for aluminium (Al), manganese (Mn), un-ionized ammonia ($N\text{-}NH_{3\ UN}$), and zinc (Zn). Cyanate and thiocyanate species were modelled to aid in the calculation of species associated with the cyanide destruction at the mill. CWQG-FAL values that are dependent on hardness, pH or/and temperature observed in the baseline dataset are calculated and shown in Table B-1 (Appendix B). For example, to calculate guidelines for cadmium (Cd), copper (Cu), lead (Pb), and nickel (Ni), the lowest hardness observed in baseline surface water (6.5 mg $CaCO_3$/L) is used. Dissolved Zn and dissolved manganese guidelines (CCME 2023) are used for comparison purposes to the total concentrations predicted by the model.

The CWQG-FAL guideline for phosphorus (P) is narrative and is related to change of receptor's trophic status. In this report, Stantec applied the lowest threshold of 4 µg/L for screening purposes. This threshold corresponds to ultraoligotrophic water bodies, while current drainage at the site likely has mesotrophic or eutrophic status with their corresponding long-term CWQG-FAL guidelines values of 10 – 20 µg/L and 35 – 100 µg/L, respectively.

5.2 Baseline Water Quality Inputs

Data from surface water quality monitoring stations previously used for baseline sources for the Leprechaun Complex and Processing Plant & TMF Complex water quality model (Stantec 2020b), the Approved Project, are assumed to represent the following baseline sources for the Project Expansion water quality model:

- LP-02 and LP-04 for undisturbed runoff from the Berry complex
- R-01 and LP-05 for undisturbed runoff for the Processing Plant and TMF complex
- VICRV-01 for make-up water and water filling the open pit from Victoria Lake Reservoir

The monitoring locations and the original data are provided in Stantec (2020a). The data for each source was aggregated and prepared using the following steps to calculate input statistics. The input statistics previously used for the Approved Project (Stantec 2020b) are used for the Expansion Project:

- Step 1: Concentrations of some elements are reported below detection limits with some detection limits being above the respective CWQG-FAL (e.g., Zn and P etc.). For concentrations below the detection limits, half detection limits are used for model inputs.
- Step 2: Concentrations of some parameters (e.g., fluoride (F), total cyanide (CN_T) and weak-acid dissociable cyanide (CN_{WAD})) were not analyzed at some stations. The concentrations of these parameters measured at some stations were below the detection limits. Thus, these missing inputs are replaced with full detection limits. Un-ionized ammonia values are calculated from total ammonia ($N\text{-}NH_{3\ T}$) using maximum temperature and pH (19°C and 7.8, respectively) measured in surface water, where temperature and/or pH are not available in the original data set.

- Step 3: Outliers are removed using 1.5 of the upper quartile rule (Tukey 1977) assuming that the outliers are associated with measurement errors instead of actual representation of natural variability of the data. These outliers are:
  - Chromium (Cr): LP-05, 5-Sep-11, 69.3 µg/L; R-01, 7-Aug-11, 90.7 µg/L; R-01, 6-Sep-11, 18.8 µg/L
  - Mn: LP-04, 3-Feb-17, 1000 µg/L; LP-05, 21-Feb-13, 724 µg/L
  - P: R-01, 2-Aug-15, 150 µg/L
  - Ni: R-01, 10-Feb-18, 8.4 µg/L
- Step 4: Calculation of statistics for each parameter for probabilistic modelling

The resulting statistics are presented in Table B-2 (Appendix B). Normal distribution is assumed using means and standard deviations as inputs. The distribution is truncated to minimum and maximum values.

Groundwater quality in bedrock around the Berry open pit is represented by monitoring wells 22BH-03A, 22BH-03B, 22BH-04A, and 22BH-04B. Overburden water quality is based on samples from wells 22BH-02 and 22BH-07. Well locations and water chemistry are shown in Gemtec (2022). Water samples were collected from these groundwater wells in June 2022 as part of the Feasibility Study Update on the geotechnical and hydrogeological investigation. The groundwater quality data is processed using the same steps as for surface water. Due to limited data, a triangular distribution for probabilistic model runs is assumed (Table B-3, Appendix B). A triangular distribution requires minimum, the most probable (mean), and maximum values as inputs.

5.3 Model Inputs

5.3.1 Waste Rock Pile, Ore Stockpiles, and Rubble in the Open Pit

Water infiltrating into waste rock pile, LGO stockpile, and runoff and direct precipitation in the open pit are assumed to have water quality of undisturbed runoff (i.e., baseline chemistry). Other source terms include elemental leaching from the rock rubble in the pit and pit walls, and waste rock and ore at the storage areas as a result of physical and chemical processes, and nitrogen species leached from undetonated explosives.

5.3.1.1 Elemental Leaching Rates

Elemental leaching rates are calculated from humidity cell tests containing representative samples of different rock lithologies and ores (Stantec 2023a). The leaching rates are assumed to have triangular distributions that require inputs for minimum, most probable (mean), and maximum values. The statistics are calculated for the first month of the humidity cell tests to represent construction, and operation. The last month of humidity cell testing represents conditions during closure and post-closure when leaching rates are assumed to stabilize (Table B-4, Appendix B). The humidity cell tests for waste rock and LGO materials from the Berry pit have not reached a stabilized condition. Thus, the highest last month leaching rate of the same lithology from Marathon and Leprechaun complex were used as input for the last month rate for the Berry complex. The leaching rates (R_{HC}) are proportioned by the volume or area of lithology exposed in a stockpile, open pit rubble or open pit walls. The percentages of lithologies and the humidity cell identification used for the calculation of the first month and last month leaching rates are shown in Table 5.1.

Table 5.1 Percentages and Inputs for Different Lithologies/Materials

Lithology	% of Lithology	% PAG in Lithology	Humidity Cell ID in Table C-4	
			First Month Rate	Last Month Rate
Waste Rock Pile				
Conglomerate (SED)	27.5	1.2	B SED; B SED-High SFE	M-CG; L-SED
Quartz-Tourmaline-Pyrite Veins (QTP)	2.23	20	B-QTP	M QZ-QE-POR-QTP-MIN; L QZ-QTP
Mafic dykes (MD)	4.72	2.4	B MD	M-MD
Quartz Porphyry (QE-POR)	65.6	18.5	B QPOR	M QZ-QE-POR-QTP-MIN; M QE-POR
Low-Grade Ore Stockpile				
Low-grade ore	100		B LGO	MLGO Comp; LLGO Comp
Open Pit Rubble and Walls				
Conglomerate (SED)	25.1	1.2	B SED; B SED-High SFE	M-CG; L-SED
Quartz-Tourmaline-Pyrite Veins (QTP)	2.03	20	B-QTP	M QZ-QE-POR-QTP-MIN; L QZ-QTP
Mafic dykes (MD)	4.31	2.4	B MD	M-MD
Quartz Porphyry (QE-POR)	60.0	18.5	B QPOR	M QZ-QE-POR-QTP-MIN; M QE-POR
Low-grade ore	2.9	43	B LGO	MLGO Comp; LLGO Comp
High-grade ore	5.7	59	B HGO	M LGO Comp; L QZ-QTP

The leaching rates are multiplied by the mass of the lithology or material present in a mine component and by applying scaling factors (SF) to convert the laboratory leaching rates for differences in temperature, grain size, and water-rock interactions between the laboratory tests and field scale. The scale up factors have stochastic inputs assuming a triangular distribution. Leaching rates are calculated using Equation 5-1:

$$R = M \times R_{HC} \times SF_{TEMPERATURE} \times SF_{SURFACE\ AREA} \times SF_{CONTACT} \times SF_{POSTCLOSURE} \qquad \text{Equation 5-1}$$

where

- M: tonne, mass of rock/ore exposed. Stockpile mass balances from the mine schedule (Table B-5, Appendix B). For the rubble mass, the exposed pit wall area is assumed to be fractured down to 2 m of rubble with the grain size the same as in the stockpile.
- R_{HC}: mg/kg/week, leaching rate from the humidity cell (Table B-4, Appendix B). Rates were developed for short-term and long-term exposure for both PAG and non-PAG rock types as summarized in Stantec (2023a). Source terms are provided in Appendix B.
- $SF_{TEMPERATURE}$: unitless, temperature scaling factor to account for the lower oxidation rate in the field compared to the continuous laboratory temperature of approximately 21°C. $SF_{TEMPERATURE}$ was calculated using a rearranged form of the Arrhenius Equation

$$\frac{k_{field}}{k_{lab}} = e^{\left[\frac{-Ea}{R\left(\frac{1}{T_{lab}} - \frac{1}{T_{field}}\right)}\right]}$$

Where:

- k_{field} = field reaction rate
- k_{lab} = laboratory reaction rate
- E_a = activation energy (kilojoule per mole)
- R = universal gas constant (0.008314 kilojoule per mol per kelvin)
- T_{lab} = laboratory temperature in kelvin
- T_{field} = field temperature in kelvin

- $SF_{GRAIN\ SIZE}$: unitless, scaling factor to account for difference in particle size in HC versus run of mine (ROM).
- $SF_{CONTACT}$: unitless, contact factor accounting for reduction in solute leaching (flushing) due to hydraulic isolation, which is limited in laboratory tests.
- $SF_{POSTCLOSURE}$: unitless, reduction of an element leaching rates starting in closure due to placement of covers.

A summary of the scaling factor ranges applied to each mine component, for which the mined material is a source, is provided in Table 5.2.

Table 5.2 Ranges and Sources of Scale up Factors

Factor	Range	Source
$SF_{TEMPERATURE}$	0.2 – 0.4	Arrhenius's equation assuming temperature range 6-7.4°C (bedrock groundwater temperatures) and activation energies 47 to 58 kJ/mol for pyrite
$SF_{GRAIN\ SIZE}$	0.062 – 0.07*	Fragmentation analysis. Percent of minus 10 mm mass fraction in blasted rock
$SF_{CONTACT}$	0.34 – 0.65	Fraction of water flushing through porous rock matrix and carrying chemical mass load, Lopez et al., (1997) and Kempton (2012)
$SF_{CLOSURE}$	0.53	During closure and post-closure only, Steinepreis (2017)

Notes:
$SF_{GRAIN\ SIZE}$ is based on fragmentation analysis of the mined material from the Leprechaun Complex (Stantec 2020b)

All leaching rates are obtained from neutral drainage because none of the geochemical tests have developed acidic leachate. However, some lithologies are expected to generate acidic drainage resulting in an increase in elemental leaching in localized pockets of PAG materials. In order to account of this increase, neutral leaching rates are inflated by a factor of 10 for Al, antimony (Sn), arsenic (As), barium (Ba), boron (B), Cd, calcium (Ca), Cr, iron (Fe), Pb, magnesium (Mg), Mn, mercury (Hg), molybdenum (Mo), Ni, potassium (K), selenium (Se), silver (Ag), sodium (Na), thallium (Tl), uranium (U), Zn, sulphate (SO4), and fluoride (F) in PAG rock at estimated acid rock drainage (ARD) onset times. PAG rock volumes and ARD onset times are discussed in the geochemistry report (Stantec 2023a). The inflated rates are calculated using Equation 5-1 for the mass of PAG rock in each lithology of waste rock, low-grade ore, and rubble.

5.3.1.2 Nitrogen Rates

Blasting to extract ore and waste rock is the primary source of nitrogen species in a mining environment. Nitrite, nitrate, and ammonia are rinsed from the waste rock and contribute loads to contact water. The mass rate of lost (non-exploded) nitrogen (R_N, in grams per year (g/yr)) is calculated using Equation 5-2:

$$R_N = MR \times PF \times F_N \times L_N \times F_{RN} \qquad \text{Equation 5-2}$$

where

- MR = production rate of blasted material (ktonne/yr). The production rate and annual mass balance of blasted ore and waste rock are provided in Table B-5 (Appendix B)
- P_F = 270 grams per tonne (g/t), powder factor based on Ausenco (2022)
- F_N = 0.333, based on 1/3 of explosives product assumed to be nitrogen, usually as ammonium nitrate (Bailey et al. 2013), dimensionless
- L_N = the rate of nitrogen lost from the blast material; 0.001 to 0.043 with the likely values of 0.002 for the expected and upper cases, respectively, based on 0.2% nitrogen of total nitrogen used from Ferguson and Leask (1988) and 4.3% as maximum observed in dry open pit mines from Golder (2008)
- F_{RN} = 0.1 (or 10%), fraction of nitrogen released from rock and ore while in the open pit, prior to material transfer to storage areas and 0.9 for the waste rock pile and low-grade ore stockpile assuming that another 90% will be leached later based on Golder (2007)

The release of nitrogen species is assumed to be instant upon placement, and the leached nitrogen is speciated as follows based on recommendations from Ferguson and Leask (1988): N-NH_3 - 11%, nitrate (N-NO_3) - 87%, nitrite (N-NO_2) - 2%. Weathering and nitrogen leaching rates are released to pore water of rock and ore stockpiles. Pore water then becomes seepage collected in ditches and ponds. Overall, the development of nitrogen leaching rates in the Expansion Project is the same as in the Approved Project with exceptions that the powder factor is revised to 270 (g/t) and the production rate of blasted material is updated to reflect the updated mining schedule.

5.3.1.3 Runoff Quality from Piles

Runoff from the waste rock pile and the ore and overburden stockpiles during operation is assumed to have quality obtained from shake flask tests of the respective materials (Table B-6, Appendix B). In post closure, runoff quality from covered and rehabilitated areas is assumed to be similar to baseline chemistry. The runoff is mixed with seepage at the nodes representing sedimentation ponds, which are connected to a specific FDP to the environment. An additional load equivalent to 15 mg/L of total suspended solids (TSS) of waste rock or ore is added to the respective sedimentation ponds, assuming MDMER limit for TSS in the discharges. Input concentrations in these solids are presented in Table B-7 (Appendix B).

5.3.2 TMF

5.3.2.1 Input Rates

During operation, the tailings pond will receive mass loadings from the following sources:

- Runoff from natural or undisturbed ground areas
- Discharge from the processing plant based on chemistry of ageing tests at day zero for all parameters, except for ammonia, which is selected for day 28 to account for ammonia generation in the tailings pond as a result of cyanide degradation (Table B-8, Appendix B). The aging test data is processed using the same steps as for surface water quality prior to calculating statistics.
- Water from the tailings pond seepage collection system represented by leachate chemistry from subaqueous columns assuming a triangular probabilistic distribution with inputs shown in Table B-9 (Appendix B).
- Leaching of elements from tailings beaches ($R_{TAILINGS}$) exposed to the atmosphere as described in Equation 5-3.

$$R_{TAILINGS} = R_{HC} \times \rho \times A_{BEACHES} \times D_{BEACHES} \times SF_{O2} \times S_{FT} \qquad \text{Equation 5-3}$$

where

- R_{HC}: mk/kg/week, tailings humidity cell rates for closure and post-closure as shown in Table B-4 (Appendix B). Considering that the mill feed is from three pits (Marathon, Leprechaun, and Berry), the temporal change in the mass fraction of tailings derived from each pit was calculated based on the mill feed schedule (Table B-5, Appendix B). The overall tailing leaching rates are proportioned by the mass fraction from each source: Berry, Leprechaun (sample CND-2), and the remainder from Marathon (sample CND-1) pits. The first and last month leaching rates for the Leprechaun and Marathon tailings are calculated based on the humidity cell CND-2 and CND-1, respectively. The leaching rates for Berry tailings are assumed to be the same as Leprechaun tailings.
- ρ: g/cm^{3,} tailings density
- $A_{BEACHES}$: m^2, the area of exposed tailings in the TMF referred to as beaches (Section 3.3.2.1)
- $D_{BEACHES}$: m, the depth of active oxidation, which is equal to 0.5 m during operation and closure and 0.2 m in post-closure after placement of a vegetated soil cover over the exposed tailings beaches

- SF_{O2}: unitless, scaling factor accounting for differences between fully oxygenated humidity cells and a decrease in oxygen concentrations in pores with depth, assumed to be a reduction to 30% (Kempton 2012)
- S_{FT} = to account for the lower oxidation rate in the field compared to the continuous laboratory temperature of approximately 21°C; the temperature scale up factor ranges from 0 to 1.3 (Kempton 2012) depending on a monthly mean ambient temperature (Table 5.3)

Table 5.3 Temperature of Scale Up Factor for TMF (Kempton 2012)

Temperature	SF_T factor
-40	0
-5	0
0	0.11
10	0.33
20	1
25	1.3

Water use and discharges affect the volume and quality of water in the TMF and in discharges. Water from the TMF is reclaimed by the mill on a year-round basis with an assumed 2 m dead storage that is not available for reclaim water. During operation, excess water from the tailings pond is pumped to a water treatment facility to achieve the MDMER limits before being pumped to the SAGR® unit prior to discharging to the Victoria Lake Reservoir (see Section 5.3.4). Discharge is assumed to meet MDMER.

Toe seepage captured by seepage collection ditches is circulated back by pumping. The quality of toe seepage is represented by the leachate chemistry from subaqueous columns that was previously used in the water quality model for the Leprechaun complex and Processing Plant & TMF complex (Stantec 2020b).

5.3.2.2 Removal Rates

In general, mass load is removed in the tailings pond due to solute precipitation, sorption, settling, and degradation of cyanide. A removal rate is applied to the chemical mass within the TMF reservoir in the WQ model. The removal rate is based on the first order constant derived from the results of aging tests (e.g., 0.077 1/day for total cyanide). These laboratory derived rates are scaled to the field rates using Equation 5-4. These removal rates used in this updated water quality model were previously used for the Leprechaun complex and Processing Plant & TMF complex (Stantec 2020b).

$$R_{DEGRADATION} = K_{AGEING} \times SF_T \times C \qquad \text{Equation 5-4}$$

where

- K_{AGEING}: 1/day, the first order constant derived from laboratory tests for the elements showing a decrease with time (e.g., K_{AGEING} value is greater than 0.01), otherwise, assumed to be zero (no attenuation, Table B-8, Appendix B). An example of regression used for derivation of the constant is illustrated on Figure 5.1 for total cyanide (CN_T).

- S_{FT}: unitless, temperature scaling factor reducing a removal rate (ranges from 0 to 1 depending on a monthly mean ambient air temperature as shown in Table 5.3).
- C: mg/L, predicted concentration of elements

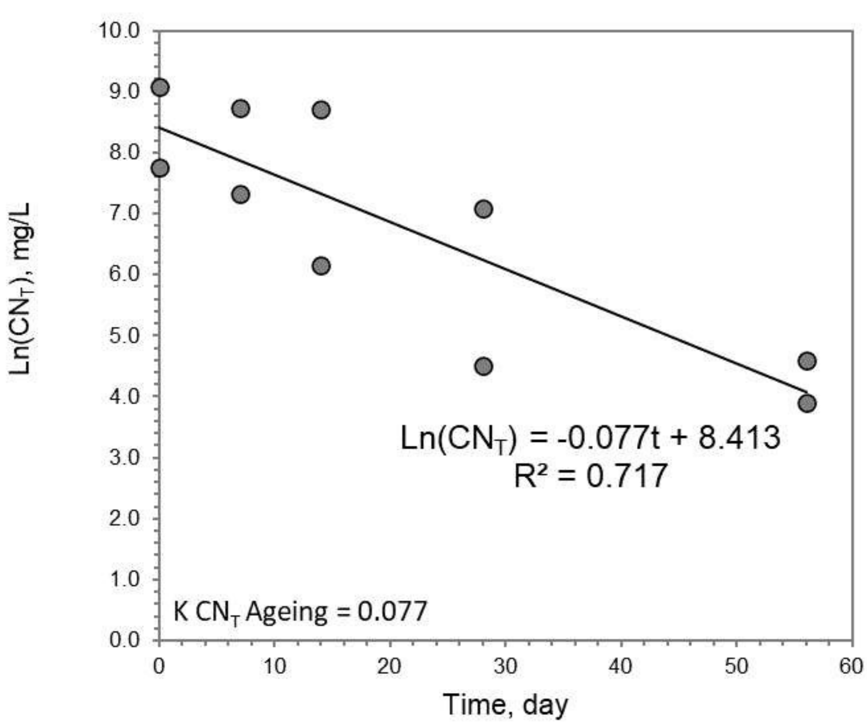


Figure 5.1 Regression Used for Derivation of K_{AGEING} CN_T. CN_T is Total Cyanide (mg/L as Nitrogen); t is time (day); $K_{CNT\ Ageing}$ is the First Order Constant Which is the Slope of the Linear Line.

5.3.3 Berry Pit Complex

Berry Pit complex includes the NE pit and the combined SW and Central pit (treated as one pit). For each pit lake, the model assumes a fully mixed reservoir. The leaching (input) rates from Equations 5-1 and 5-2 are applied to the pit as the pit development starts. Based on the groundwater modelling, during open pit development, 100% of groundwater originates from bedrock; therefore, bedrock water quality is used as the groundwater source term for operation. During closure, approximately 8% for groundwater is represented by overburden water quality and the remainder is bedrock water quality. The pits also receive mass loadings from runoff during pit development towards closure and post-closure.

The NE pit additionally receives a continuous mass loading from two sources: 1) the waste rock that is exposed to the atmosphere within the pit during operation; and 2) the Berry waste rock pile on top of the open pit. The leaching rates for the exposed waste rock are calculated using Equation 5-1. When the waste rock is being wetted/submerged as the water level rises, an equivalent mass load from leaching for one week is added to the reservoir. This mass load simulates the dissolution of water-soluble minerals (i.e., weathering products) on the surface of the waste rock. Then, the submerged waste rock is assumed to remain non-reactive.

The combined SW and Central pit lake additionally receives two continuous mass loads: one from the tailings deposited within the SW pit and the other load from the waste rock deposited in the Central pit. Tailings are assumed to be fully submerged. The leaching rates for the submerged tailings are calculated from the subaqueous column laboratory test results for Berry tailings (BL1021-43 Detox Tls, Table B-8, Appendix B) using Equation 5-1. The mass load from the waste rock in the Central pit is configured following the same approach as for the NE pit. Mass removal rates of elements with K_{Ageing} values greater than 0.01 1/day are applied when the open pit receives tailings slurry from the mill during the operation period.

5.3.4 Solubility Controls

Solubility controls are applied to the model based on the chemical equilibrium state resulting in precipitation or dissolution of minerals. The model passes a mass through the cells (nodes), except for parameters with solubility limits (caps). Because concentrations of some elements are often limited by mineral saturation, these solubility caps are included in the model and applied to the model nodes. The global solubility caps are derived based on the following assumptions:

- In neutral water, dissolved concentrations of Al and iron (Fe) are limited by the solubility of hydroxides of these elements (generally below 100 µg/L). In baseline samples, concentrations of total Al and Fe are much higher and are likely controlled by concentration of TSS (Figure 5.2). It is assumed that TSS of discharges will be below the MDMER limit of 15 mg/L. Therefore, limits for Al (600 µg/L) and Fe (900 µg/L) are based on total concentrations of metals in the baseline sample having 14 mg/L of TSS, which is almost at the MDMER limit.
- Other solubility limits are explored by equilibrating simulated pore water with calcite and atmospheric air in a geochemical software, PHREEQC (Parkhurst and Appelo, 2013). Simulated pore water is found to be slightly supersaturated with rhodochrosite, apatite, and fluoride. These minerals are allowed to precipitate to determine equilibrium concentrations for Mn (1300 µg/L), P (50 µg/L), and F (1600 µg/L), which are set as solubility caps in GoldSim™.

Local solubility caps are set for the SAGR®) unit during operation assuming that the discharge to this unit will be treated down to MDMER limits for CN_T (500 µg/L), Cu (100 µg/L), and $N\text{-}NH_{3\,T}$ (4500 µg/L) with the assumption that 3.8% of total ammonia will be un-ionized (pH 8.0, 20°C; CCME 2023).

All solubility caps, global and local, are above the respective CWQG-FAL values.

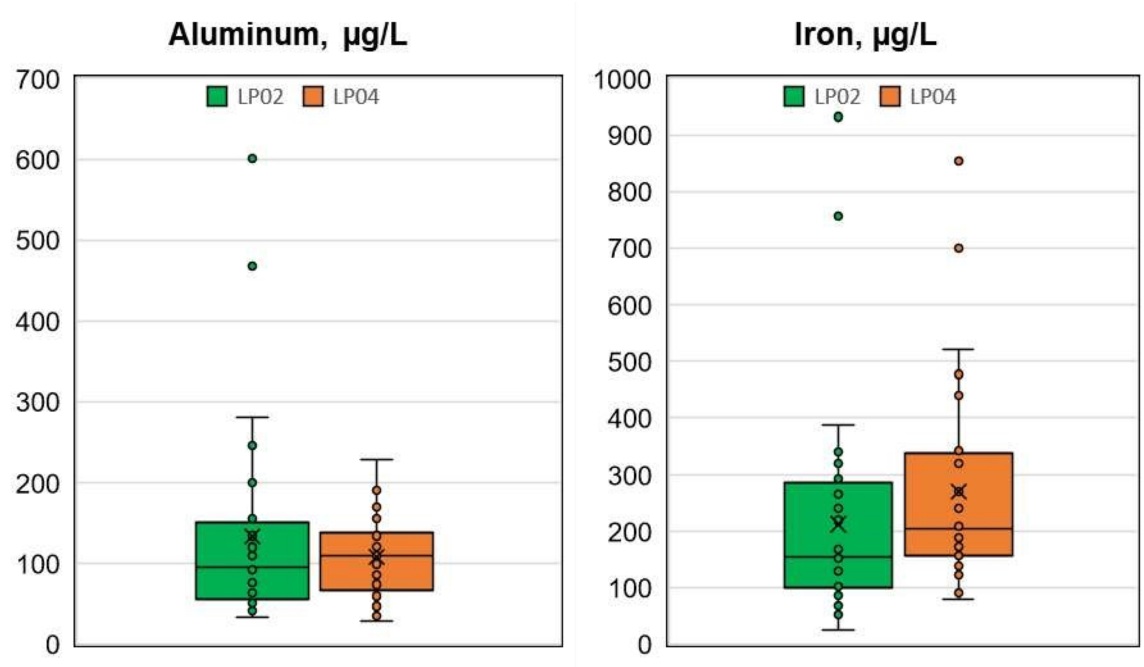


Figure 5.2 Box Plots for Total Al and Fe in Surface Water Stations, LP02 and LP04 (Stantec 2020b)

6 Water Quality Predictions

6.1 Model Runs and Outputs

The water quality model is run in a probabilistic mode with 100 realizations. Each realization is run for 100 years in a daily timestep. Probabilistic water quality inputs are sampled monthly using the Latin Hypercube method (GoldSim 2018). Monthly mean and monthly 95th percentile concentrations are calculated in GoldSim™ for baseline water, selected Project Expansion facilities (waste rock pile, LGO stockpile, and the open pit and tailings pond) and all FDPs. The monthly mean and monthly 95th percentile concentrations are calculated for each mine period (construction, operation, closure, and post-closure). The highest value of the monthly statistics (mean and 95th percentile) for each mine phase is selected and presented in a summary of outputs for the Project Expansion results or baseline (Appendix C). The Project Expansion results are compared to the respective statistics for probabilistically simulated baseline surface water. The results of the model are also compared to MDMER limits and CWQG-FAL guidelines shown in Table B-1 (Appendix B). Only the MDMER limits are directly applicable to the discharges. The CWQGs are used for screening purposes to update the parameters of potential concern (PoPC) identified in the ARD/ML report (Stantec 2023a); guidelines are not applicable to discharges, as they are developed for the receiving environment. The time series plots for monthly mean and monthly 95th percentile concentrations of select parameters in mine components and specific discharges are presented in Appendix D.

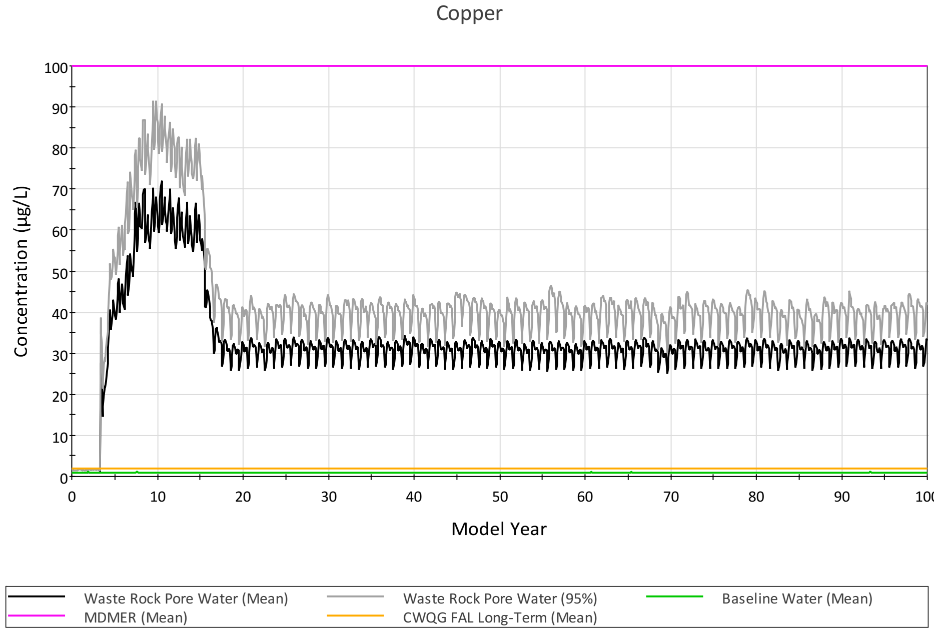
6.2 Project Expansion Components

6.2.1 Waste Rock Pile

Seepage from waste rock is a source of contact water and it will be collected in sedimentation ponds BER-SP-01A, BER-SP-01B, BER-SP-02, and BER-SP-03, LP-SP-03b, and the NE pit. No exceedances of the MDMER limits are predicted in the waste rock seepage when considering the mean and 95th percentile predictions. Concentrations of As, Cd, Cr, Cu, Mo, U, Hg, Zn, P, nitrogen species, and F exceed the long-term CWQG-FAL over an order of magnitude, predominantly during the operation period (Table C-1; Appendix C). Exceedances of CWQG-FAL for Hg, F, and P are possibly modelling artifacts related to high detection limits in the chemistry of the leachates from the humidity cells. Half of the detection limits are used in calculations of leaching rates, which are scaled up to a full-size waste rock pile. Thus, the predicted concentrations of Hg, F, and P may be overestimated. Concentrations of Cu increase during operation, peaking at the end of operation (Mine Year 9, Model Year 11.25) when the mass of waste rock is the greatest (Figure 6.1). Elemental concentrations decrease during closure, because elemental leaching is partially reduced due to soil cover and stabilize during post-closure. Concentrations of $N\text{-}NO_2$, as well as other nitrogen species are flushed from the pile decreasing below the CWQG-FAL and stabilizing to background levels.

The highest un-ionized ammonia concentration during the operation phase (Table C-1; Appendix C) is associated with the modelling artifact. The artifact is observed at the first-time step at which an instant addition of mass loads for the nitrogen species (and other parameters) was added into the pore water cell and the volume changes significantly in comparison to the previous time step. This produces an unrealistic spike in the predicted concentrations. The pore water volume is set to be collected as seepage by the collection ditches instantly after the end of the wetting period in the first year of operation (Figure 6.1). This artifact does not affect the mean or 95th percentile predictions for other elements because their peak concentrations are controlled by their highest chemical mass loads when the accumulated waste rock mass was highest at the end of the operation period.

Other parameters exceeding their long-term CWQG-FAL are Al, Fe, Pb, Mn, Ag, and Se. Most of the trace elements from this list generally follow a trend similar to Cu and Zn, except for Al and P which remain at their solubility limits for many years (Appendix D). Nitrogen species have patterns similar to N-NO_2 (Figure 6.1). The waste rock seepage exceeds the long-term CWQG-FAL for P, Cr, Zn, Al, Mn, and Fe at baseline conditions (Table C-1; Appendix C). P exceedances are likely artificial due to the detection limit (100 µg/L) being about 20 times higher than the CWQG-FAL guideline concentration for P (4 µg/L) in the baseline dataset.



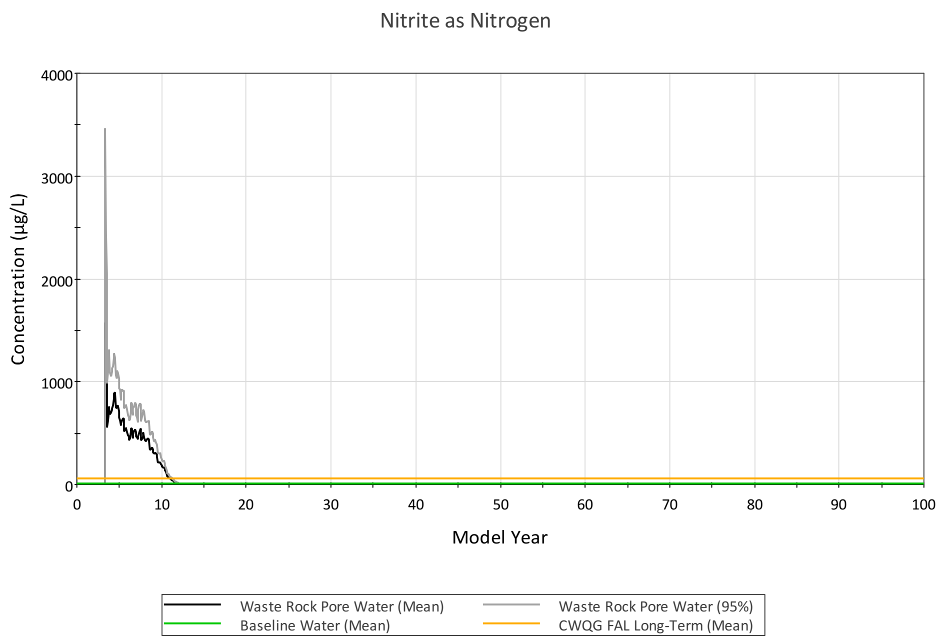


Figure 6.1 Temporal Concentration Trends of Cu and N-NO_2.

6.2.2 Low-Grade Ore Stockpile

Seepage from the LGO stockpile will be collected in BER-SP-04 and MA-SP-01AB sedimentation ponds and discharged to the environment through BER-FDP-04 and MA-FDP_01AB, respectively. Similar to the waste rock pile, no exceedances of MDMER guidelines are predicted in the seepage from the LGO stockpile considering 95th percentile concentrations, except an exceedance of the 95th percentile concentration for un-ionized ammonia due to the modelling artifact (Table C-2; Appendix C). Concentration spikes of nitrogen species at the start of the time step right after the end of the wetting period are modelling artifact as discussed earlier (Section 6.2.1). Concentrations of Zn and other trace elements peak around mine Year 9 when the mass of low-grade ore in the stockpile is the greatest (Appendix D). Afterwards, concentrations decrease as LGO from the stockpile is transferred to the mill and then concentrations reach background concentrations during closure. Overall, concentrations of elements in LGO are lower than in waste rock. Zn, Cu, and nitrogen species may exceed the long-term CWQG-FAL guidelines by over an order of magnitude during the operation phase. Other parameters exceed their long-term CWQG-FAL including Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Mo, P, Se, Ag, U, Zn, nitrogen species, and F. Most of the trace elements from this list generally follow a trend similar to Zn (

Figure 6.2), except for Al, Fe, and P.

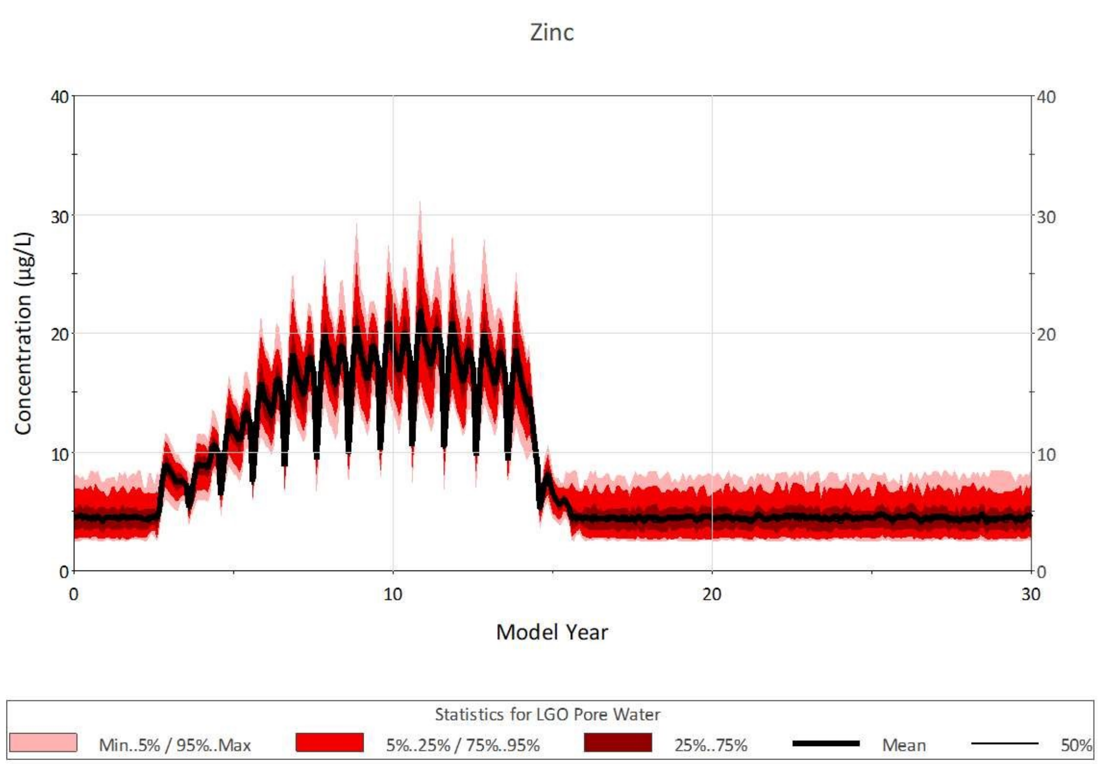


Figure 6.2 Temporal Concentration Trend of Zn in LGO Seepage

6.2.3 Tailings Pond

In the tailings pond, the model predicts exceedances of MDMER limits for Cu, un-ionized ammonia ($N\text{-}NH_{3\ UN}$), and total cyanide (CN_T) during operation (Table C-3; Appendix C). These parameters may require treatment in mine Years 1 to 15 when excess water from the TMF is observed during tailings deposition and during the last year of operation when mill reclaim water is reduced and ceased. Major sources for these parameters during operation are discharges from the processing plant and recirculation of tailings pond toe seepage. Concentrations of CN_T (Figure 6.3) and $N\text{-}NH_{3\ T}$ (Figure 6.4) decrease below the respective MDMER limits when discharge from the Processing Plant is diverted to the Berry combined SW – Central pit during Mine Year 10. Peak concentrations of CN_T and $N\text{-}NH_{3\ T}$ correspond to the low pond water volume periods after pumping to treatment during which the seepage water quality become more predominant. Concentrations of Cu are predicted to decrease to below MDMER limit in about two years after active closure because tailings pond toe seepage is no longer pumped back to the tailings pond at that time (Figure 6.5). However, treatment is not required starting in Mine Year 10 until the end of Mine Year 15 (Model Year 16.25; Figure 6.5) because excess water from the tailings pond (potential overflow) is directed to the mill as reclaim/make up water, rather then discharged to the environment. In Mine Year 17 (Model Year 18.25), the tailings pond will be drawn down by pumping to the treatment plant, Cu concentrations in the tailings pond quickly decrease to near background levels (Figure 6.5). In addition to the predicted MDMER exceedances for Cu, un-ionized ammonia, and total cyanide during operation, Al, As, Cd, Cr, Fe, Mn, Hg, P, Se, Ag, Zn, CN_{WAD}, $N\text{-}NO_2$, $N\text{-}NH_{3\ T}$, CN_{WAD}, and F are predicted to be above long-term CWQG-FAL. These elements are elevated during operation, however, rapidly decrease at the end of the closure period due to active pumping to the treatment plant to prepare for rehabilitation using soil and overburden cover.

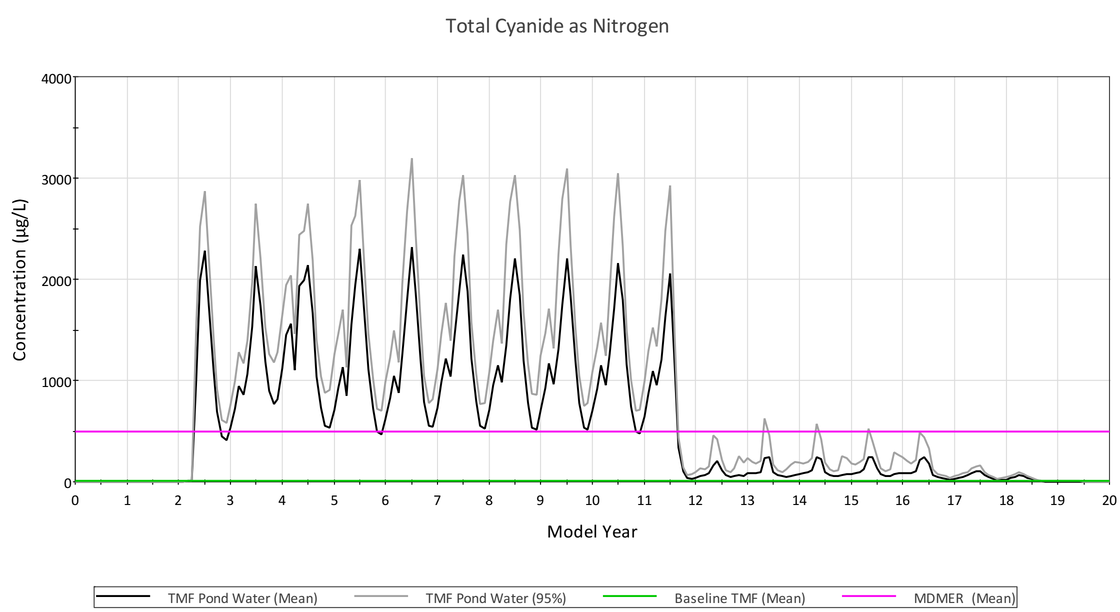


Figure 6.3 Temporal Concentration Trend of Total Cyanide in Tailings Pond Water

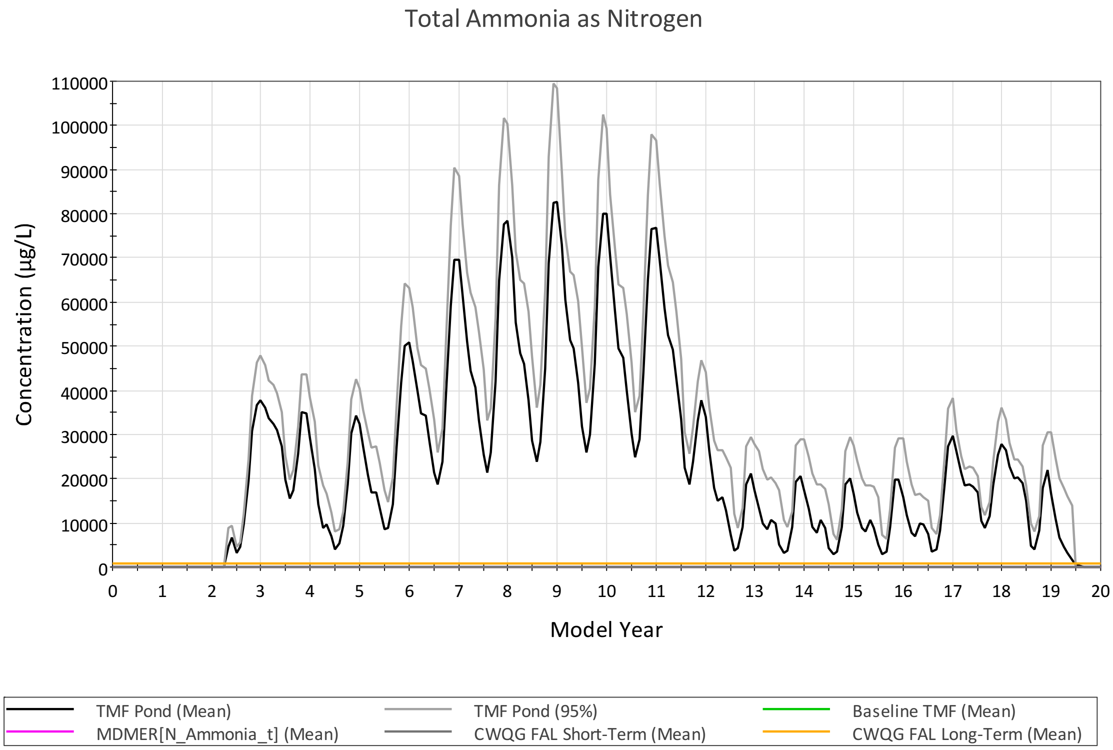


Figure 6.4 Temporal Concentration Trend of Total Ammonia in Tailings Pond Water

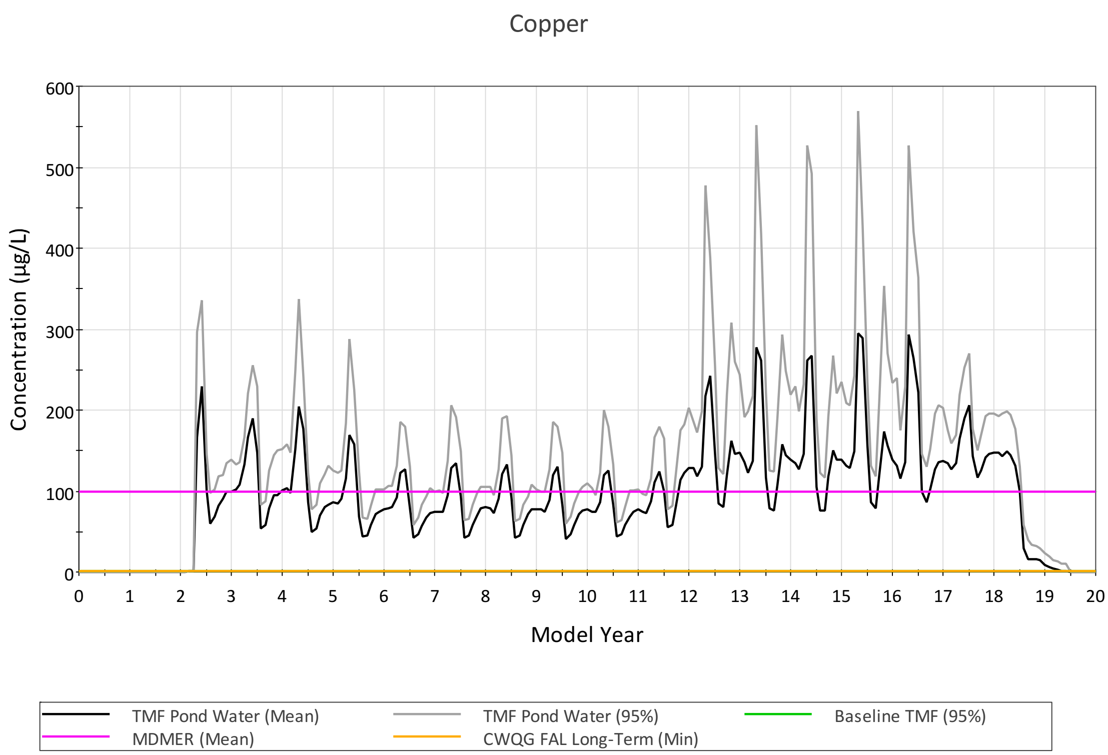


Figure 6.5 Temporal Concentration Trend of Cu in Tailings Pond Water

6.2.4 Berry Complex Pits

No exceedances of MDMER guidelines are predicted in mine water or pit lake overflow from the NE pit at 95th percentile concentrations. After the cessation of dewatering, it is predicted to take approximately 7.75 to 9.8 years to fill the NE pit to the spillway elevation. Thus, the main mass load to the pit water is from the leaching of backfilled waste rock exposed to the atmosphere during this period. When waste rock is fully submerged (NE pit is filled), leaching of waste rock is assumed to stop. The model predicts exceedances of the CWQG-FAL for Al, As, Cd, Cr, Cu, Fe, Mn, Hg, P, Se, Ag, U, Zn, nitrogen species, and F (Table C-4; Appendix C). The concentrations of most parameters start to decrease, for example, the temporal concentration of zinc is shown in Figure 6.6. Mine water and pit overflow are discharged to the environment through sedimentation pond BER-SP-05 to BER-FDP-05.

No exceedances of MDMER guidelines are predicted in mine water or pit lake overflow from the combined SW and Central Pits at 95th percentile concentrations, except for un-ionized ammonia and CN_T. Concentrations of Cu, CN_{WAD}, P, and N-$NH_{3\ T}$ may exceed the long-term CWQG-FAL over 10x (Table C-4; Appendix C). Exceedance of P is a modelling artifact as discussed in Section 6.2.1. Elevated concentrations of Cu (Figure 6.7), N-$NH_{3\ UN}$ (Figure 6.8), CN_{WAD}, and N-$NH_{3\ T}$ in modelled pit lake water coincide with the deposition of tailings slurry in the SW pit and the waste rock in the Central pit in the final years of operation. Concentrations of these parameters start to decrease during closure after the cessation of the tailings deposition and before the pit lake is full. Beside MDMER exceedances for un-ionized ammonia and total cyanide, additional parameters exceeding long-term CWQG-FAL are Al, As, Cd, Cr, Cu, Fe, Mn, Hg, P, Se, Ag, Zn, N-NO_2, N-NO_3, N-$NH_{3\ T}$, N-$NH_{3\ UN}$, and CN_{WAD}. These parameters exceed CWQG-FAL during operation and decrease in closure as a result of reclamation activities (Table C-4; Appendix C). Mine water and pit overflow are discharged to the environment through sedimentation pond BER-SP-05 to BER-FDP-05.

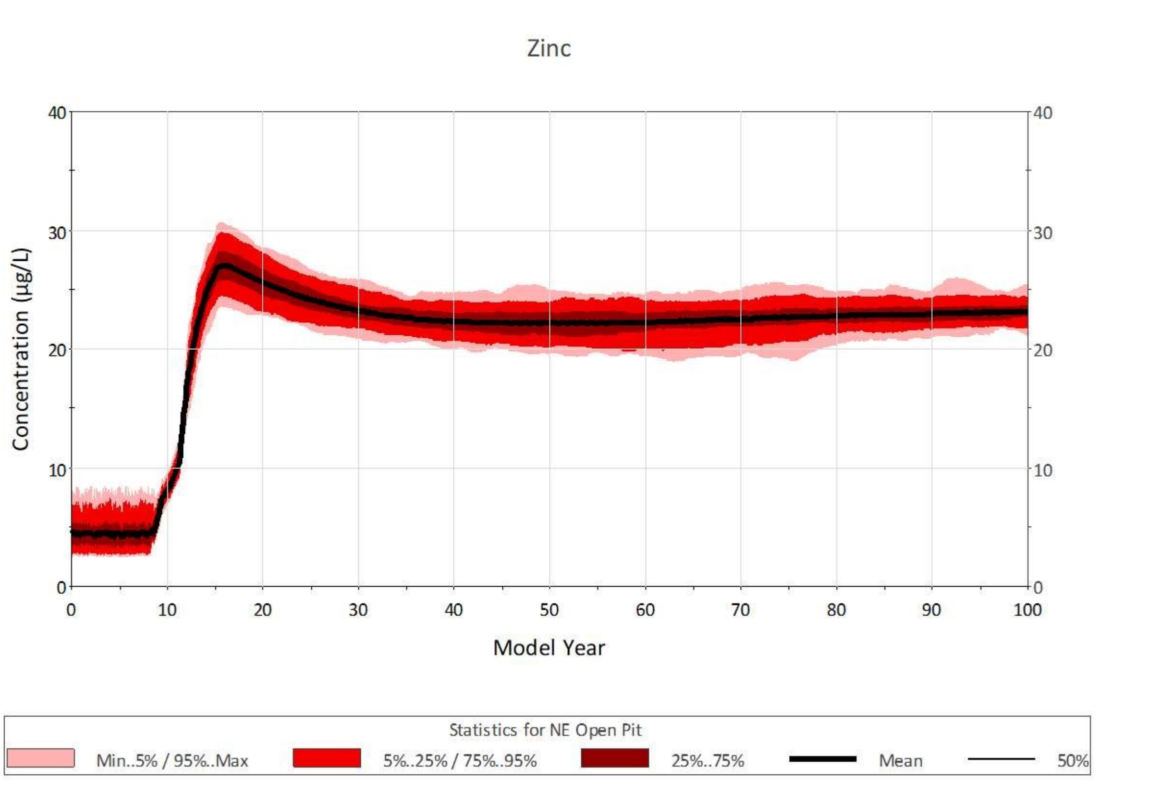


Figure 6.6 Temporal Concentration Trend of Zinc in the NE Pit Water

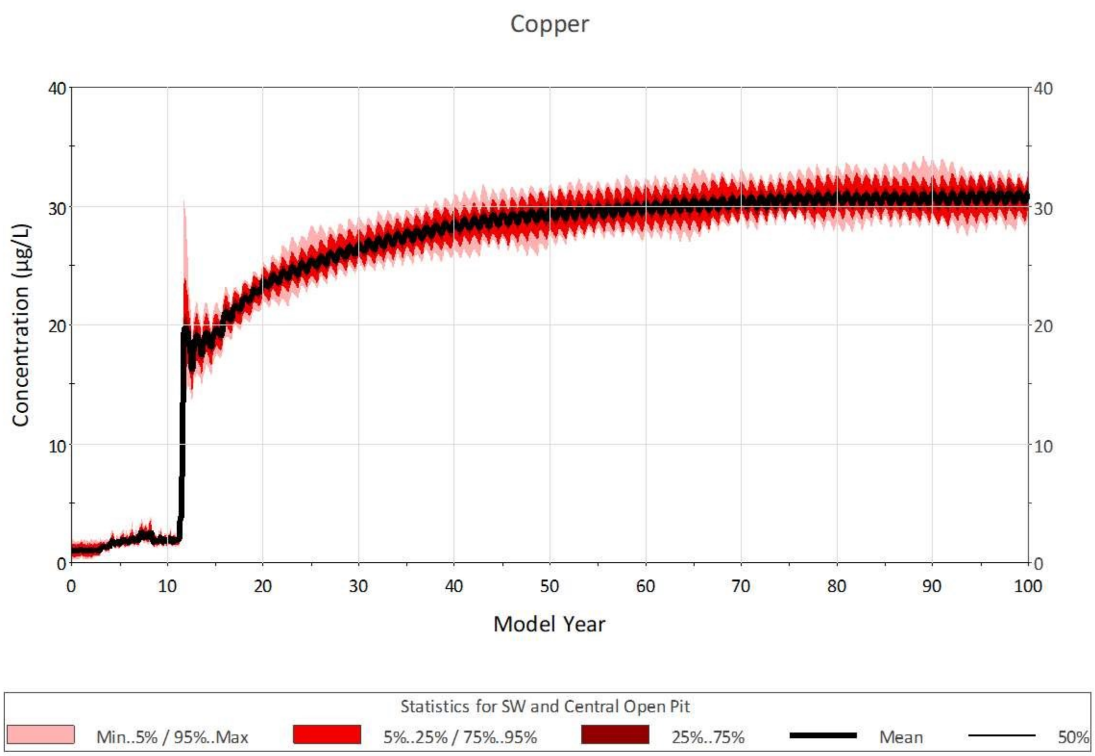


Figure 6.7 Temporal Concentration Trend of Copper in the SW and Central Pit Water

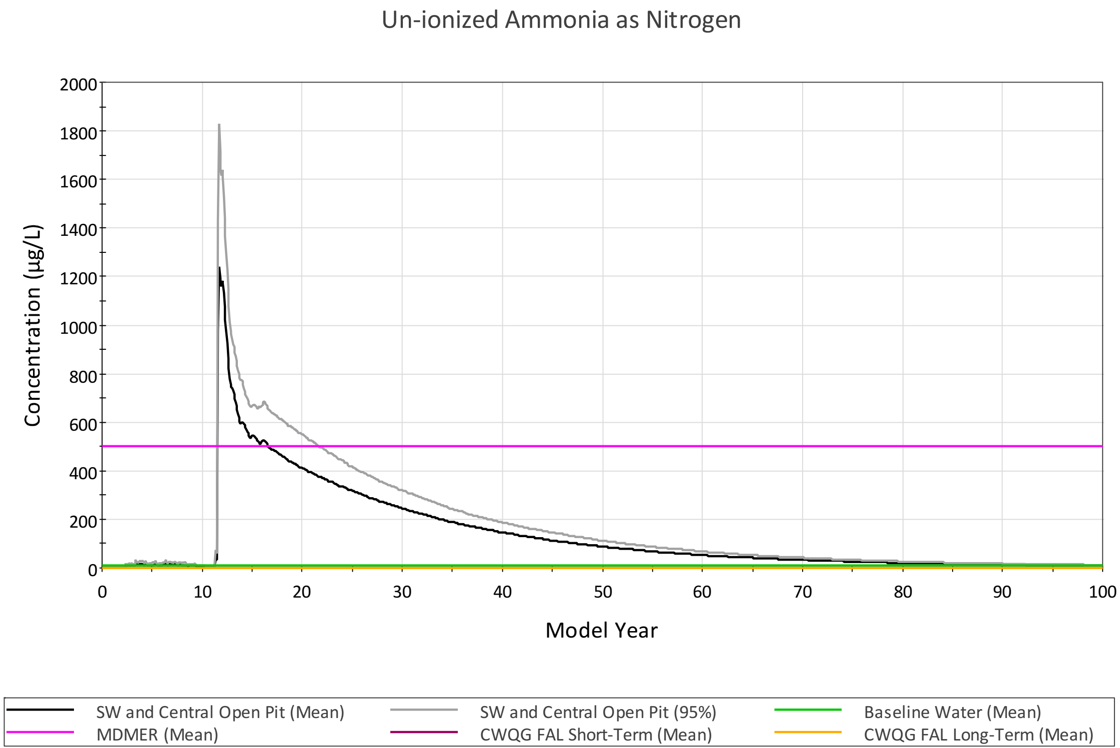


Figure 6.8 Temporal Concentration Trend of Un-ionized Ammonia in the SW and Central Pit Water

6.3 Final Discharge Points

6.3.1 BER-FDP-01A

BER-FDP-01A receives water from BER-SP-01A which collects runoff and seepage from the Berry waste rock pile. No MDMER exceedances are predicted in the discharge considering 95th percentile prediction. During construction, the predicted water quality is similar to the baseline conditions. The long-term CWQG-FAL is exceeded during operation for Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Mo, P, Se, Ag, U, Zn, $N\text{-}NO_2$, $N\text{-}NO_3$, $N\text{-}NH_{3\,T}$, $N\text{-}NH_{3\,UN}$, and F due to the discharge from the waste rock runoff and toe seepage. These exceedances are similar to the exceedances predicted for this discharge point in the Approved Project with an exception that Pb. While Pb exceeds CWQG-FAL in the Project Expansion, it does not in the Approved Project. These parameters decrease during closure. After the waste rock piles are rehabilitated during closure and post-closure sub-phase, the waste rock runoff areas adjacent to the SW and Central pits will be directed to drain towards BER-SP-05. It is assumed that there will not be water within or overflowing from the BER-SP-01A pond to the BER-FDP-01A. Thus, the concentrations during post-closure are shown as “not applicable” denoted as na (Table C-5; Appendix C).

6.3.2 BER-FDP-01B

Similar to BER-FDP-01A, BER-FDP-01B receives discharge from BER-SP-01B which collects runoff and seepage from the Berry waste rock pile. No MDMER exceedances are predicted in the discharge considering 95th percentile prediction. During construction, the water quality is predicted to be similar to the baseline conditions. The long-term CWQG-FAL could be exceeded during operation for Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Mo, P, Se, Ag, U, Zn, N-NO_2, N-NO_3, N-$NH_{3\,T}$, N-$NH_{3\,UN}$, and F due to the discharge from the waste rock runoff and toe seepage. These parameters decrease during active closure. After the waste rock piles are rehabilitated during closure and post-closure phases, the waste rock runoff areas adjacent to the SW and Central pits will be directed to drain towards BER-SP-05. It is assumed that there will not be water within or overflowing from the BER-SP-01B pond to the BER-FDP-01B. Thus, the concentrations during post-closure are shown as “not applicable” denoted as “na” (Table C-6; Appendix C).

6.3.3 BER-FDP-02

Similarly, the BER-FDP-02 receives discharge from BER-SP-02 which collects runoff and seepage from the Berry waste rock pile. No MDMER exceedances are predicted in the discharge considering 95th percentile prediction. During construction, the water quality is predicted to be similar to the baseline conditions. The long-term CWQG-FAL may be exceeded during operation for Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Mo, P, Se, Ag, U, Zn, N-NO_2, N-NO_3, N-$NH_{3\,T}$, N-$NH_{3\,UN}$, and F due to the discharge from the waste rock runoff and toe seepage. These parameters decrease during closure. After the waste rock piles are rehabilitated during closure and post-closure phases, the waste rock runoff areas adjacent to the SW and Central pits will be directed to drain towards BER-SP-05. It is assumed that there will not be water within or overflowing from the BER-SP-02 pond to the BER-FDP-02. Thus, the concentrations during post-closure are shown as “not applicable” (Table C-7; Appendix C).

6.3.4 BER-FDP-03

The BER-FDP-03 receives discharge from BER-SP-03 which collects runoff and seepage from the Berry waste rock pile. No MDMER exceedances are predicted in the discharge considering 95th percentile prediction. During construction, the water quality is predicted to be similar to the baseline conditions. The long-term CWQG-FAL could be exceeded during operation for Al, As, Cd, Cr, Cu, Fe, Mn, Hg, P, Se, Ag, U, Zn, N-NO_2, N-$NH_{3\,T}$, N-$NH_{3\,UN}$, and F due to the discharge from the waste rock runoff and toe seepage. These parameters decrease during closure. After the waste rock piles are rehabilitated during closure and post-closure phases, the waste rock runoff areas adjacent to the SW and Central pits will be directed to drain towards BER-SP-05. It is assumed that there will not be water within or overflowing from the BER-SP-03 pond to the BER-FDP-03. Thus, the concentrations during post-closure are shown as not applicable (Table C-8; Appendix C).

6.3.5 BER-FDP-04 and MA-FDP-01AB

The BER-FDP-04 and MA-FDP-01AB receives discharge from BER-SP-04 which collects runoff and seepage from the Berry / Marathon LGO and the combined Marathon and Leprechaun overburden stockpiles. No MDMER exceedances are predicted in the discharge considering 95th percentile prediction.

During construction, the water quality is predicted to be similar to the baseline conditions. The long-term CWQG-FAL could be exceeded during operation for Al, As, Cd, Cr, Cu, Fe, Mn, Hg, P, Se, Zn, $N\text{-}NO_2$, $N\text{-}NH_{3\ UN}$, and F primarily due to the discharge from the LGO runoff and toe seepage. These parameters decrease during closure. After the LGO stockpile is removed and rehabilitated during closure and post-closure sub-phase, the runoff from the former LGO and overburden areas will be directed to drain towards BER-SP-05. It is assumed that there will not be water within or overflowing from the BER-SP-04 pond to the BER-FDP-04. Thus, the concentrations after post-closure are shown as not applicable (Table C-9; Appendix C).

6.3.6 BER-FDP-05

BER-FDP-05 receives water from BER-SP-05 sedimentation pond, representing NE, Central and SW open pit dewatering and overflow from the pit lakes. No MDMER exceedances are predicted at this discharge point considering 95^{th} percentile prediction. During construction, parameters predicted to exceed CWQG-FAL are Al, Cr, Fe, Mn, P, and Zn, as observed under baseline conditions. During operation, As, Cd, Cu, Hg, Se, Ag, U, $N\text{-}NO_2$, $N\text{-}NH_{3\ T}$, $N\text{-}NH_{3\ UN}$, and F are predicted to exceed the respective long-term CWQG-FAL in addition to the parameters exceeded under baseline conditions (Table C-10; Appendix C). These parameters decrease during post-closure with Al, Cd, Cr, Cu, Fe, Mn, Hg, P, Zn, $N\text{-}NH_{3\ T}$, $N\text{-}NH_{3\ UN}$, and F remaining above the long-term CWQG-FAL (Appendix D). For example, a temporal change in the concentration of copper is shown in Figure 6.9.

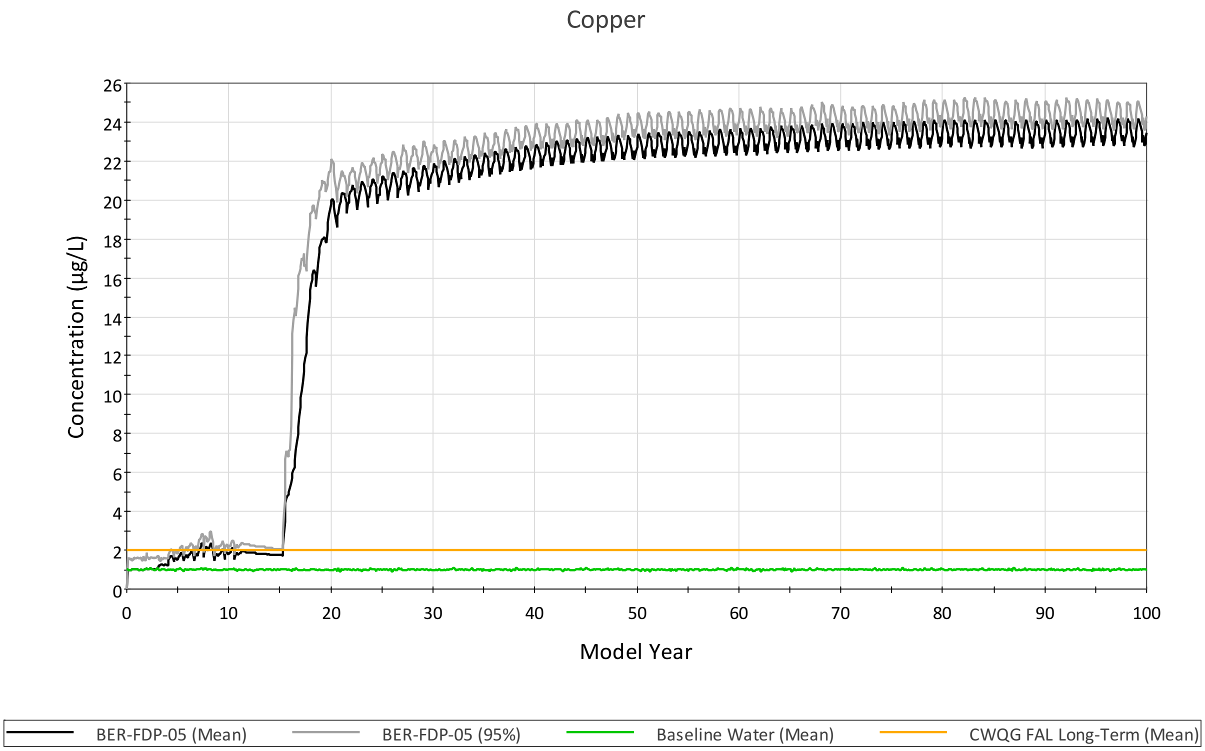


Figure 6.9 Temporal Concentration Trend of Copper in the Water at BER-FDP-05 Discharge Point

6.3.7 BER-FDP-06

BER-FDP-06 receives runoff from the topsoil stockpile, which has better water quality than other discharge points. No MDMER exceedances are predicted for this discharge. During operation, parameters predicted to exceed long-term CWQG-FAL are As, Cd, Cu, Se, and F in addition to the parameters (Al, Cr, Fe, Mn, P, and Zn) exceeding under baseline conditions and during construction phase (Appendix C).

7 Predictions Summary

Using the Valentine Gold EIS Water Quantity and WQ models (Stantec 2020b, c), updates were made to represent the water management infrastructure associated with the proposed Berry complex and updated inflow, outflow, source terms, and dimensions of the existing planned Marathon, Leprechaun, mill and TMF facilities.

7.1 Water Quantity

The following are the updated water quantity model predictions:

- The eight Berry complex sedimentation ponds will take approximately two to three months to fill up prior to discharge via the low-flow outlet with the pit complex dewatering pond (BER-SP-05) to fill up the quickest.
- Average monthly and annual flows from the eight Berry complex sedimentation ponds are typically highest during the operation phase (Mine Years 1 to 9 when the TMF receives tailings and/or Mine Years 10 to 15 when the Berry SW pit receives tailings). At closure (End of Mine Year 13 when placement of waste rock will be complete), the waste rock pile associated ponds (BER-SP-01A, 01B, 02 and 03) are predicted to have similar flow rates to the operation phase due to increased runoff from the rehabilitated pile and diversion of runoff on slopes adjacent to the open pit to drain to BER-SP-05.
- The tailings pond is predicted for the average condition (Climate Normal) to have sufficient storage capacity during the construction and operation phases, and closure with no overflow discharge. For the 25-year return period annual wet year, there are two years during operation that may require changes to treatment plant operation (e.g., triggering longer treatment duration than the typical eight months per year).
- The Berry SW pit reclaim rate during the Mine Year 9 to 15 pit tailings deposition period is estimated to have a monthly averaged pumping rate of 0 m^3/d to 2,284 m^3/d (25-year return period annual wet year) when the pit water elevation is above 318 m asl (100 m below the spillway elevation).
- Process water needs for the process plant will be reclaimed from the tailings pond on a year-round basis with freshwater water needs being met by pumping from the Victoria Lake Reservoir during Mine Years 1 to 9. Additional freshwater from the Victoria Lake Reservoir is expected to be required to meet process water demands during TMF transition periods between the Stage 1 and 2 dam lifts when there is reduced storage volume in the TMF available for reclaim. When tailings deposition is transferred to the Berry SW pit and the only inflows to the TMF are from precipitation, reclaim flow from the Berry SW pit and/or freshwater from the Victoria Lake Reservoir may be required in Mine Years 11 to 15.
- The monthly average NE pit dewatering rate is estimated to range from 231 m^3/d to 2,130 m^3/d for the 5-year return period annual dry year and 25-year return period annual wet year conditions, respectively. The SW and Central pits are estimated to have monthly averaged dewatering rates that range from 1,150 m^3/d to 7,875 m^3/d for the dry and wet scenarios.

- After in-pit mining ceases at the end of Mine Year 6 in the NE pit, it will be filled with waste rock. Once the waste rock in-filling elevation reaches the existing ground surface, the Berry waste rock pile will be extended over the NE pit area. The NE pit is predicted to fill and discharge to the spillway (404 m asl) between 7.75 and 9.8 years after stopping in-pit mining.
- The SW pit will be filled with tailings and waste rock will be placed in the Central pit after in-pit mining is stopped at the end of Mine Year 9. The combined SW and Central pits are estimated to discharge via the spillway between 6.3 and 9.75 years after stopping in-pit mining.
- From the end of Mine Year 12, the Leprechaun pit will take 10.6 and 11 years to fill (without placement of tailings in it following stopping of in-pit mining and a freshwater filling rate from the Victoria Lake Reservoir of 4 Mm^3/year.
- The Marathon pit is estimated to take between 8.8 and 9.3 years for the wet and dry scenarios, respectively, to fill and overflow at the spillway elevation of 330 m asl after stopping in-pit mining at the end of Mine Year 13.

7.2 Water Quality

The following are the updated water quality model predictions for the Project Expansion which are consistent with the water quality predicted for the Approved Project:

- The water quality model shows that there are no MDMER exceedances predicted at all facilities and discharges in the Project Expansion (waste rock pile, stockpiles, open pit, sedimentation ponds and BER-FDP-01 to BER-FDP-06) during all mine phases at 95th percentile confidence level except the following MDMER exceedances:
  - CN_T (95th percentile and mean) in the combined SW and Central pit lake water during the operation and closure phases of the Project Expansion, and below MDMER in post-closure.
  - N-$NH_{3\ UN}$ (95th percentile and mean) in the combined SW and Central pit lake water during operation phase and N-$NH_{3\ UN}$ (mean) during the closure phase.
  - Copper (95th percentile and mean), N-$NH_{3\ UN}$ (95th percentile and mean), and CN_T (95th percentile and mean) in the TMF during the operation phase of the Project Expansion.
- Long-term CWQG-FAL are not applicable to discharges, however, were used to screen PoPC for receivers. Parameters predicted to exceed the respective long-term CWQG-FAL for FDPs (BER-FDP-01A, BER-FDP-01B, and BER-FDP-02) influenced by the seepage from the Berry waste rock pile are Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Mo, P, Se, Ag, U, Zn, N-NO_2, N-NO_3, N-$NH_{3\ T}$, N-$NH_{3\ UN}$, and F during operation. These parameters decrease during closure. Seepage from the Berry waste rock pile also affects BER-FDP-03; however, these discharges have better water quality than the other three FDPs (BER-FDP-01A, BER-FDP-01B, and BER-FDP-02), resulting in less exceedances of CWQG-FAL.
- Seepage from overburden and LGO stockpiles affects the water quality at the BER-FDP-04 and MA-FDP-01AB discharge points. These discharge points have better water quality than other discharge points influenced by the seepage from the Berry waste rock pile. Exceedances of CWQL-FAL during operation are Al, As, Cd, Cr, Cu, Fe, Mn, Hg, P, Se, Zn, N-NO_2, N-$NH_{3\ UN}$, and F. These parameters decrease during closure with predicted nitrogen species concentrations below CWQL-FAL. This discharge point is assumed to stop discharging to the environment during post-closure.

- Overflow water from the BER-SP-05 sedimentation pond that receives dewatering and overflow from Berry Pit complex affects the water quality at the BER-FDP-05. During operation, As, Cd, Cu, Hg, Se, Ag, U, N-NO_2, N-$NH_{3\ T}$, N-$NH_{3\ UN}$, and F are predicted to exceed the respective long-term CWQG-FAL in addition to the parameters elevated under baseline conditions (Al, Cr, Fe, Mn, P, and Zn). Even though the concentrations of these parameters decrease and stabilize during post-closure, the parameters that remain above the long-term CWQG-FAL are Al, Cd, Cr, Cu, Fe, Mn, Hg, P, Zn, N-$NH_{3\ T}$, N-$NH_{3\ UN}$, and F.
- The BER-FDP-06 discharge point has the least number of parameters exceeding the long-term CWQG-FAL than all other FDPs. Exceedances of the long-term CWQG-FAL during operation are As, Cd, Cu, Se, and F in addition to the exceedances (Al, Cr, Fe, Mn, P, and Zn) under baseline conditions and during the construction phase of the Project Expansion.

In summary, final discharge points BER-FDP-01A, BER-FDP-01B, BER-FDP-02, and BER-FDP-03 receive overflow from sedimentation ponds that collect water from runoff and seepage from the Berry waste rock pile during the operation phase. The water quality model results show that there are no MDMER exceedances predicted at these discharge points. There are no MDMER exceedances at BER-FDP-04 and MA-FDP-01AB discharge points that receive seepage from LGO and overburden stockpiles. Final discharge point BER-FDP-05 receives overflow from the sedimentation pond that primarily receives dewatering and overflow from the Berry complex. The BER-FDP-06 discharge point does not exceed MDMER and has the least number of parameters exceeding the long-term CWQG-FAL. BER-FDP-05 is the only point of discharge that discharges water through all phases for the Project Expansion. The water quality model results show that there are no MDMER exceedances predicted at BER-FDP-05. Overall, the predicted water quality results for the Project Expansion are consistent with the predicted water quality for the Approved Project.

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Appendices

Appendix A Water Quantity Model Results

5th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m³/day)												
BER-SP-01A	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	328	219	411	1162	258	129	106	210	220	255	278	337	322
	Operation (Year 10 to 13)	275	219	446	1034	199	96	89	151	158	184	208	291	279
	Closure (Year 14 to 18)	368	312	481	1138	290	128	69	262	297	378	400	439	380
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-01B	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	509	367	639	1733	419	218	171	366	395	448	495	557	522
	Operation (Year 10 to 13)	381	304	608	1411	283	142	132	223	233	266	299	405	391
	Closure (Year 14 to 18)	447	370	567	1342	345	151	81	311	354	452	478	522	452
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-02	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	370	269	510	1389	304	150	126	243	260	294	333	402	384
	Operation (Year 10 to 13)	336	269	534	1239	249	122	114	195	204	237	266	357	343
	Closure (Year 14 to 18)	363	295	450	1063	273	117	63	245	279	361	382	416	359
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-03	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	480	352	613	1425	389	194	150	333	365	419	467	520	471
	Operation (Year 10 to 13)	372	296	606	1405	265	121	113	195	205	245	278	393	375
	Closure (Year 14 to 18)	442	364	560	1324	338	146	78	302	344	443	469	514	444
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

5th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m^3/day)												
BER-SP-04	Construction (Year -2.25 to-1)	358	278	204	483	285	161	110	291	327	364	243	238	272
	Operation (Year 1 to 9)	503	412	641	1505	408	214	154	387	436	499	545	549	521
	Operation (Year 10 to 15)	476	397	627	1473	395	207	151	375	404	486	509	552	504
	Closure (Year 16 to 20)	550	448	657	1551	453	242	165	449	520	580	610	604	569
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
MA-SP-01AB	Construction (Year -2.25 to-1)	344	134	196	463	133	66	45	128	164	333	342	342	210
	Operation (Year 1 to 9)	402	334	515	1209	328	165	117	306	349	408	446	447	420
	Operation (Year 10 to 15)	381	312	488	1146	306	153	110	286	321	383	410	427	393
	Closure (Year 16 to 20)	359	307	463	1089	304	153	106	290	323	389	409	435	386
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-FDP-05	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	2149	1971	2565	4195	2542	2440	2497	2856	2800	2760	2801	2631	2684
	Operation (Year 10 to 15)	79	108	186	435	98	42	28	81	83	115	120	159	128
	Closure (Year 16 to 20)	940	781	1137	2548	768	358	257	740	881	1187	1259	1306	1013
	Post Closure (from year 21) [A]	1883	1727	2383	5220	1573	543	437	1335	1579	2042	2284	2159	1929
BER-SP-06	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	386	282	414	1092	320	173	118	319	364	416	451	433	394
	Operation (Year 10 to 13)	386	318	466	1101	323	174	118	321	362	418	444	438	406
	Closure (Year 14 to 18)	358	305	447	1055	309	166	113	307	339	399	418	434	387
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
[A] SW/Cen Pit is full and overflows in Mine Year 19

25th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m³/day)												
BER-SP-01A	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	380	253	579	1343	300	150	122	244	255	295	321	388	381
	Operation (Year 10 to 13)	315	251	511	1185	228	110	102	173	181	209	236	331	319
	Closure (Year 14 to 18)	425	359	555	1312	334	148	79	301	343	439	465	510	439
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-01B	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	591	426	866	2016	488	254	199	428	462	520	574	645	617
	Operation (Year 10 to 13)	436	349	697	1616	324	162	151	255	267	303	339	460	447
	Closure (Year 14 to 18)	516	427	654	1547	397	174	94	358	408	525	556	607	522
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-02	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	428	312	697	1615	354	175	147	283	303	340	385	464	454
	Operation (Year 10 to 13)	385	308	612	1419	285	140	130	223	234	269	301	407	393
	Closure (Year 14 to 18)	418	340	518	1225	315	135	73	283	323	419	444	483	415
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-03	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	555	407	708	1904	453	226	174	388	425	485	540	600	567
	Operation (Year 10 to 13)	426	340	694	1609	304	139	130	223	235	278	315	447	428
	Closure (Year 14 to 18)	509	420	646	1526	389	168	90	348	397	515	545	597	513
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

25th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m^3/day)												
BER-SP-04	Construction (Year -2.25 to-1)	418	324	476	1127	331	187	128	338	380	430	287	281	422
	Operation (Year 1 to 9)	584	479	744	1745	474	249	178	449	506	575	628	633	604
	Operation (Year 10 to 15)	543	453	715	1679	450	236	172	427	460	556	582	632	575
	Closure (Year 16 to 20)	639	520	763	1801	526	281	191	522	603	671	706	698	660
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
MA-SP-01AB	Construction (Year -2.25 to-1)	400	311	458	1078	310	155	105	299	338	406	407	404	394
	Operation (Year 1 to 9)	464	388	598	1402	380	191	135	355	404	471	514	516	486
	Operation (Year 10 to 15)	437	357	559	1312	351	175	126	327	368	435	466	486	450
	Closure (Year 16 to 20)	415	354	534	1254	350	176	123	334	373	452	476	505	445
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-FDP-05	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	2481	2275	2966	4844	2939	2823	2888	3301	3236	3178	3225	3030	3099
	Operation (Year 10 to 15)	89	120	208	488	110	48	32	91	93	133	138	184	144
	Closure (Year 16 to 20)	1363	1131	1655	3679	1125	485	363	1030	1259	1624	1718	1836	1439
	Post Closure (from year 21) [A]	2182	2001	2761	6046	1822	629	506	1547	1829	2366	2644	2501	2235
BER-SP-06	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	446	326	478	1265	371	200	136	370	422	480	519	500	455
	Operation (Year 10 to 13)	443	364	534	1261	370	199	136	368	415	476	505	498	464
	Closure (Year 14 to 18)	413	351	515	1216	356	191	130	354	391	464	486	504	448
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
[A] SW/Cen Pit is full and overflows in Mine Year 18

75th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m³/day)												
BER-SP-01A	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	466	310	716	1663	372	186	152	304	317	361	393	474	471
	Operation (Year 10 to 13)	389	310	630	1462	282	135	126	214	224	260	294	412	395
	Closure (Year 14 to 18)	515	437	675	1596	406	180	97	367	416	531	563	616	533
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-01B	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	729	525	1064	2477	600	312	244	525	566	639	705	794	758
	Operation (Year 10 to 13)	539	430	859	1993	400	200	186	315	329	377	422	573	552
	Closure (Year 14 to 18)	626	519	796	1883	483	212	114	436	495	635	673	733	634
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-02	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	527	383	856	1981	434	214	180	347	371	417	471	569	558
	Operation (Year 10 to 13)	476	380	755	1750	351	172	161	275	289	335	375	507	486
	Closure (Year 14 to 18)	508	413	631	1491	383	165	89	344	391	507	537	584	504
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-03	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	684	501	871	2338	556	278	213	476	522	595	661	737	696
	Operation (Year 10 to 13)	527	419	856	1985	375	172	160	276	290	347	393	557	530
	Closure (Year 14 to 18)	618	511	786	1857	474	204	110	424	482	622	660	721	622
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

75th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m³/day)												
BER-SP-04	Construction (Year -2.25 to-1)	514	399	292	1365	406	230	157	415	466	525	351	343	446
	Operation (Year 1 to 9)	718	588	913	2144	582	306	219	551	621	705	768	778	741
	Operation (Year 10 to 15)	670	558	881	2069	554	291	212	526	568	682	714	776	709
	Closure (Year 16 to 20)	766	625	917	2166	633	338	230	627	724	816	860	848	796
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
MA-SP-01AB	Construction (Year -2.25 to-1)	493	383	563	1326	382	187	128	363	414	498	499	493	483
	Operation (Year 1 to 9)	572	476	734	1722	467	235	166	436	497	577	629	633	597
	Operation (Year 10 to 15)	540	441	690	1619	433	216	155	403	455	542	580	605	557
	Closure (Year 16 to 20)	503	430	649	1526	426	214	149	406	453	547	577	611	541
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-FDP-05	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	3054	2800	3648	5961	3615	3471	3551	4061	3981	3898	3954	3718	3809
	Operation (Year 10 to 15)	110	149	257	604	137	59	40	113	116	163	169	226	179
	Closure (Year 16 to 20)	1981	1684	2437	5377	1785	654	519	1557	1795	2381	2518	2578	2106
	Post Closure (from year 21) [A]	2669	2447	3376	7394	2228	769	619	1892	2237	2893	3233	3059	2733
BER-SP-06	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	549	401	658	1555	456	246	167	455	519	588	636	613	565
	Operation (Year 10 to 13)	548	449	659	1556	456	246	167	454	512	593	628	621	574
	Closure (Year 14 to 18)	501	427	627	1480	433	233	159	431	474	560	588	609	544
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
[A] SW/Cen Pit is full and overflows in Mine Year 17

95th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m^3/day)												
BER-SP-01A	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	542	361	834	1937	434	217	177	354	370	420	457	553	548
	Operation (Year 10 to 13)	455	362	738	1710	330	158	148	250	262	302	340	478	461
	Closure (Year 14 to 18)	592	502	775	1833	467	206	111	421	478	609	646	707	612
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-01B	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	850	611	1229	2862	692	360	282	606	651	746	822	927	879
	Operation (Year 10 to 13)	631	503	1006	2333	468	234	218	369	385	438	490	665	645
	Closure (Year 14 to 18)	719	596	914	2162	555	244	131	501	569	728	772	841	728
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-02	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	614	446	988	2289	500	247	208	400	427	486	550	664	646
	Operation (Year 10 to 13)	556	444	884	2049	411	202	188	322	338	389	435	588	567
	Closure (Year 14 to 18)	583	475	725	1712	440	189	102	395	450	582	617	670	578
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-SP-03	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	795	582	1014	2702	641	320	246	549	601	692	769	859	807
	Operation (Year 10 to 13)	616	490	1002	2323	439	201	187	323	339	402	455	646	618
	Closure (Year 14 to 18)	710	587	902	2133	544	235	126	487	554	714	757	827	715
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

95th Percentile Monthly Average Flow from Berry Sediment Ponds

Pond/ FDP	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
		Average Flow (m^3/day)												
BER-SP-04	Construction (Year -2.25 to-1)	623	483	354	1614	481	272	186	492	554	608	406	397	526
	Operation (Year 1 to 9)	830	680	1057	2481	673	353	254	637	718	823	897	907	859
	Operation (Year 10 to 15)	778	648	1023	2403	644	338	247	611	659	789	826	898	822
	Closure (Year 16 to 20)	885	722	1059	2500	731	390	265	724	836	936	986	973	917
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
MA-SP-01AB	Construction (Year -2.25 to-1)	597	464	682	1607	445	222	151	430	492	576	577	571	572
	Operation (Year 1 to 9)	666	551	849	1993	540	272	192	505	574	673	734	738	692
	Operation (Year 10 to 15)	631	516	807	1895	506	253	182	472	531	629	673	703	650
	Closure (Year 16 to 20)	578	494	746	1754	490	246	171	467	521	627	662	701	621
	Post Closure (from year 21)	-	-	-	-	-	-	-	-	-	-	-	-	-
BER-FDP-05	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	3555	3258	4230	6920	4192	4025	4118	4711	4617	4543	4609	4331	4426
	Operation (Year 10 to 15)	128	172	298	699	163	71	47	137	140	201	220	297	214
	Closure (Year 16 to 20)	2640	2247	3228	7100	2266	827	670	2049	2396	3104	3280	3343	2763
	Post Closure (from year 21) [A]	3081	2824	3896	8533	2571	887	714	2183	2583	3339	3731	3531	3154
BER-SP-06	Construction (Year -2.25 to-1)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Operation (Year 1 to 9)	639	467	762	1800	528	285	194	526	600	687	742	715	656
	Operation (Year 10 to 13)	640	526	771	1821	534	288	196	531	599	688	729	722	670
	Closure (Year 14 to 18)	576	491	720	1700	498	268	182	495	545	643	675	699	624
	Post Closure (from year 19)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:
[A] SW/Cen Pit is full and overflows in Mine Year 16

Appendix B Water Quality Model Inputs

Table B-1
List of Input Parameters and Water Quality Guidelines

Parameter name	Parameter Symbol	Name in model	Parameter group	Units	Highest RDL	CWQG FAL Guidelines		MDMER Limits
						Short-term	Long-term	
Aluminum	Al	Aluminum	Trace elements	µg/L	5.0	n/v	6 or 100*	n/v
Antimony	Sb	Antimony	Trace elements	µg/L	1.0	n/v	n/v	n/v
Arsenic	As	Arsenic	Trace elements	µg/L	1.0	n/v	5	100
Barium	Ba	Barium	Trace elements	µg/L	1.0	n/v	n/v	n/v
Boron	B	Boron	Trace elements	µg/L	50	29000	1500	n/v
Cadmium	Cd	Cadmium	Trace elements	µg/L	0.017	0.13	0.04	n/v
Calcium	Ca	Calcium	Trace elements	µg/L	100	n/v	n/v	n/v
Chromium	Cr	Chromium	Trace elements	µg/L	1.0	n/v	1*	n/v
Copper	Cu	Copper	Trace elements	µg/L	2.0	n/v	2*	100
Iron	Fe	Iron	Trace elements	µg/L	50	n/v	300	n/v
Lead	Pb	Lead	Trace elements	µg/L	0.50	n/v	1	80
Magnesium	Mg	Magnesium	Trace elements	µg/L	100	n/v	n/v	n/v
Manganese	Mn	Manganese	Trace elements	µg/L	2.0	596	210	n/v
Mercury	Hg	Mercury	Trace elements	µg/L	0.013	n/v	0.026	n/v
Molybdenum	Mo	Molybdenum	Trace elements	µg/L	2.0	n/v	73	n/v
Nickel	Ni	Nickel	Trace elements	µg/L	2.0	n/v	25	250
Phosphorus	P	Phosphorus	Trace elements	µg/L	100	n/v	4	n/v
Potassium	K	Potassium	Trace elements	µg/L	100	n/v	n/v	n/v
Selenium	Se	Selenium	Trace elements	µg/L	1.0	n/v	1	n/v
Silver	Si	Silver	Trace elements	µg/L	0.10	n/v	0.25	n/v
Sodium	Na	Sodium	Trace elements	µg/L	100	n/v	n/v	n/v
Thallium	Tl	Thallium	Trace elements	µg/L	0.10	n/v	0.8	n/v
Uranium	U	Uranium	Trace elements	µg/L	0.10	33	15	n/v
Zinc	Zn	Zinc	Trace elements	µg/L	5.0	11.3	2.2	400
Chloride	Cl	Chloride	General chemistry	µg/L	1000	640000	120000	n/v
Nitrate + Nitrite (as Nitrogen)	$N\text{-}NO_3\text{+}NO_2$	N_Nitrate_Nitrite	General chemistry	µg/L	50	n/v	n/v	n/v
Nitrite (as Nitrogen)	$N\text{-}NO_2$	N_Nitrite	General chemistry	µg/L	10	n/v	60	n/v
Nitrate (as Nitrogen)	$N\text{-}NO_3$	N_Nitrate	General chemistry	µg/L	50	124000	3000	n/v
Total Ammonia (as Nitrogen)	$N\text{-}NH_3$ tot	N_Ammonia_t	General chemistry	µg/L	50	n/v	689	n/v
Unionized Ammonia (as Nitrogen)	$N\text{-}NH_3$ un	N_Ammonia_un	General chemistry	µg/L	1.1	16	16	500
Cyanide total**	CN tot	Cyanide_t	General chemistry	µg/L	10	n/v	n/v	500
Cyanide WAD**	CN(WAD)	Cyanide_WAD	General chemistry	µg/L	1	n/v	5	n/v
Sulphate	SO_4	Sulphate	General chemistry	µg/L	2000	n/v	n/v	n/v
Fluoride**	F	Fluoride	General chemistry	µg/L	60.0	n/v	120	n/v
Radium-226**	Ra-226	Radium_226	Radioactivity	Bq/L	0.005	n/v	n/v	0.37
Cyanate	OCN	CNO-N	Trace elements	µg/L	na	n/v	n/v	n/v
Total Alkalinity (as $CaCO_3$)	Alk tot	Alkalinity	General chemistry	mg/L	5	n/v	n/v	n/v
pH	pH	pH	General chemistry	pH Unit	N/A	n/v	6.5-9.0	6.5-9.5
Hardness (as $CaCO_3$)	Hard	Hardness	General chemistry	mg/L	1	n/v	n/v	n/v
Thiocyanate	SCN	CNS-N	Trace elements	µg/L	na	n/v	n/v	n/v

See Notes on next page

Table B-1
List of Input Parameters and Water Quality Guidelines

Notes:
All concentrations are total (unfiltered) fraction

The most stringent guideline was selected when two or more guidelines are established for the same parameter under the same jurisdiction.

CWQG FAL - Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life by Canadian Council of Ministers of the Environment (CCME 2022).

MDMER - Metal and Diamond Mining Effluent Regulations (Canada), Schedule 4 Table 1 - Authorized Limits of Deleterious Substances, Maximum Authorized Monthly Mean Concentrations (SOR/2002-222 2020).

n/v = no value

*Equations were used to calculate hardness, pH, temperature, and DOC-dependent guidelines for these parameters as per CCME 2022 or as otherwise noted:

Aluminium: the guideline is 5 µg/L if pH < 6.5 or 100 µg/L if pH ≥ 6.5

Cadmium (long term): at hardness < 17 mg/L the guideline is 0.04 µg/L; at hardness between 17 and 280 mg/L the guideline is 10^{0.83(log[hardness]) – 2.46} µg/L; at hardness > 280 mg/L the guideline is 0.37 µg/L.

Cadmium (short term): at hardness < 5.4 mg/L the guideline is 0.11 µg/L; at hardness between 5.3 and 360 the guideline is 10^{1.016(log[hardness]) – 1.71 } µg/L; at hardness > 360 the guideline is 7.7 µg/L.

Chromium (long-term) value is for chromium (VI)

Copper: at hardness < 82 mg/L the guideline is 2 µg/L; at hardness between 82 and 180 mg/L the guideline is 0.2 * e^{0.8545[ln(hardness)]-1.465} µg/L; at hardness > 180 mg/L the hardness is 4 µg/L; at an unknown hardness the guideline is 2 µg/L.

Lead: at hardness < 60 mg/L the guideline is 1 µg/L; at hardness between 60 and 180 mg/L the guideline is e^{1.273[ln(hardness)]-4.705} µg/L; at hardness > 180 mg/L the hardness is 7 µg/L; at an unknown hardness the guideline is 1 µg/L.

Manganese (long term): dissolved manganese guideline is pH and hardness dependent and found using the CWQG calculator in Appendix B of the Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Manganese.

Manganese (short term): dissolved managanese benchmark is found using the benchmark calculator in Appendix B (see Manganese (long term)) or e^{0.878[ln(hardness)] + 4.76} µg/L.

Nickel: at hardness < 60 mg/L the guideline is 25 µg/L; at hardness between 60 and 180 mg/L the guideline is e^{0.76[ln(hardness)]+1.06} µg/L; at hardness > 180 mg/L the hardness is 150 µg/L; at an unknown hardness the guideline is 25 µg/L.

Phosphorus: trigger ranges for phosphorus are provided by Guidance Framework and depend upon trophic index of water body.

Zinc (long term): guideline for dissolved zinc is e^{0.947[ln(hardness)] - 0.815[pH] + 0.398[ln(DOC)] + 4.625} µg/L. The equation is valid between hardness 23.4 and 399 mg $CaCO_3$/L, pH 6.5 and 8.13 and DOC 0.3 to 22.9 mg/L. DOC = dissolved organic carbon.

Zinc (short term): guideline for dissolved zinc is e^(0.833[ln(hardness mg·L-1)] + 0.240[ln(DOC)] + 0.526) µg/L. The benchmark equation is valid between hardness 13.8 and 250.5 mg $CaCO_3$/L and DOC 0.3 and 17.3 mg/L.

Nitrogen (Ammonia): guidelines are pH and temperature dependent and are taken from the Environmental Quality Guidelines for Alberta Surface Water.

Surface water temperature values are the mean daily air temperature, or 0°C if air temperature was negative, on the day of sampling or the closest day with data available, taken from the Government of Canada Daily Data Reports (2011-2019) for Burnt Pond, NL, with values ranging from 0 to 18.5°C.

Groundwater temperature values are from field records where available, or were assumed to be 6.0°C if field temperature records are not available.

**Guideline values' ranges were calculated assuming minimum and/or maximum values of pH (4.61-7.78), hardness (4.0-110 mg $CaCO_3$/L), and TOC (as stand-in for DOC) (2.1-41 mg/L) collected in surface water samples throughout the Site from 2011 to 2019; and temperature values as described below.

Table B-2
Inputs for Background Surface Water Quality

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Combined statistics for LP-02 and LP-04				Combined statistics for R-01 and LP-05				Statistics for VICRV-01 (Victoria Lake)			
Statistics			Short-term	Long-term	Min	Mean	Max	St. Dev.	Min	Mean	Max	St. Dev	Min	Mean	Max	St. Dev
Aluminum	µg/L	-	-	100	28	**107**	**281**	55	8.6	63	**187**	39	23	54	**130**	30
Antimony	µg/L	-	-	-	0.50	0.50	0.51	0.002	0.50	0.50	0.51	0.0017	0.50	0.50	0.51	0.002
Arsenic	µg/L	100	-	5	0.50	0.79	2.5	0.5	0.50	2.5	**9.1**	2.4	0.50	0.50	0.51	0.002
Barium	µg/L	-	-	-	0.50	2.9	13	2	0.50	1.6	4.9	0.66	2.30	5.6	16	4
Boron	µg/L	-	29000	1500	25	25	25	0.08	25	25	25	0.083	25	25	25	0.08
Cadmium	µg/L	-	0.13	0.04	0.0050	0.0080	0.025	0.003	0.0050	0.0081	0.038	0.0046	0.0050	0.0056	0.010	0.002
Calcium	µg/L	-	-	-	2400	7074	39000	4880	2100	6360	23000	3581	1400	2088	4700	1141
Chromium	µg/L	-	-	1	0.50	**1.1**	**8.2**	**1.6**	0.50	0.7	**4.0**	0.59	0.50	0.69	**1.4**	0.3
Copper	µg/L	100	-	2	0.25	0.99	**3.5**	0.4	0.25	1.0	**3.0**	0.41	0.25	0.60	1.1	0.3
Iron	µg/L	-	-	300	25	220	**757**	143	25	175	**460**	91	25	86	**310**	86
Lead	µg/L	80	-	1	0.25	0.26	0.59	0.04	0.25	0.25	0.25	0.00083	0.25	0.36	**1.1**	0.3
Magnesium	µg/L	-	-	-	340	1021	3100	495	300	848	2300	410	320	414	860	172
Manganese	µg/L	-	596	210	9.5	105	**681**	142	7.4	94	**494**	102	4.0	21	100	30
Mercury	µg/L	-	-	0.026	0.0065	0.0079	0.025	0.004	0.0065	0.0068	0.017	0.0015	0.0064	0.0065	0.0066	0.00002
Molybdenum	µg/L	-	-	73	1.0	1.0	2.5	0.2	1.0	1.0	1.0	0.0033	1.0	1.0	1.0	0.003
Nickel	µg/L	250	-	25	0.99	1.0	1.0	0.003	0.99	1.0	1.0	0.0033	0.99	1.0	1.0	0.003
Phosphorus	µg/L	-	-	4	**50**	**50**	**51**	0.2	**50**	**51**	**140**	**11**	**50**	**50**	**51**	0.2
Potassium	µg/L	-	-	-	50	280	867	172	50	129	330	59	170	198	220	16
Selenium	µg/L	-	-	1	0.25	0.48	0.50	0.06	0.25	0.48	0.50	0.061	0.25	0.25	0.25	0.0008
Silver	µg/L	-	-	0.25	0.050	0.050	0.050	6E-17	0.050	0.050	0.051	5E-17	0.050	0.050	0.051	7E-18
Sodium	µg/L	-	-	-	1030	2063	3490	554	1070	1646	2400	323	1400	1738	2100	187
Thallium	µg/L	-	-	0.8	0.050	0.050	0.050	6E-17	0.050	0.050	0.051	5E-17	0.050	0.050	0.051	7E-18
Uranium	µg/L	-	33	15	0.050	0.058	0.24	0.03	0.050	0.054	0.14	0.017	0.050	0.050	0.051	0
Zinc	µg/L	400	11.3	2.2	**2.5**	**3.7**	**8.5**	2	**2.5**	**3.6**	**10**	1.9	**2.5**	**2.5**	**2.5**	0.008
Chloride	µg/L	-	640000	120000	1000	2800	5000	881	500	2395	4200	825	2100	2988	4600	686
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	25	39	170	26	25	50	230	39	51	129	430	115
Nitrite (as Nitrogen)	µg/L	-	-	60	5.0	5.5	25	3	5.0	5.0	5.1	0.017	5.0	11	27	7
Nitrate (as Nitrogen)	µg/L	-	124000	3000	25	38	170	26	25	50	230	39	51	121	420	114
Total Ammonia (as Nitrogen)	µg/L	-	-	689	5.0	37	260	40	25.0	33	170	24	25	25	25	0.08
Un-ionized Ammonia (as	µg/L	500	16	16	0.0070	0.096	0.38	0.1	0.0062	0.10	0.48	0.11	0.0088	0.032	0.12	0.04
Cyanide, Total	µg/L	500	-	-	9.9	10	10	0.03	9.9	10	10	0.033	9.9	10	10	0.03
Cyanide, WAD	µg/L	-	-	5	0.99	1.0	1.0	0.003	0.99	1.0	1.0	0.0033	0.99	1.0	1.0	0.003
Sulphate	µg/L	-	-	-	1000	1156	5500	698	1000	1079	2800	352	990	1000	1010	3
Fluoride	µg/L	-	-	120	59	60	61	0.2	59	60	61	0.20	59	60	61	0.2
Radium-226	Bg/L	0.37	-	-	0.0050	0.0050	0.0051	3E-18	0.0050	0.0050	0.0051	3E-18	0.0050	0.0050	0.0051	2E-05
Cyanate[1]	µg/L	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Total Alkalinity (as $CaCO_3$)	mg/L	-	-	-	5.4	21	99	14	5.0	18	62	11	2.5	5.5	10	3
pH[2]	pH Unit	6.0-9.5	-	6.5-9.0	6.5	7.1	7.8	0.3	6.5	7.1	7.7	0.29	6.5	6.6	7.2	0.2
Hardness (as $CaCO_3$)	mg/L	-	-	-	7.3	22	110	14	6.4	19	64	10	4.7	6.9	15	3
Thiocyanate[1]	µg/L	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0
Temperature[2]	°C	-	-	-	0.0	7.3	19	7	0.0	7.5	19	6.8	3.5	11	18	7
Dissolved Organic Carbon[2]	mg/L	-	-	-	0.99	1.0	1.0	0.003	0.99	1.0	1.0	0.0033	0.99	1.0	1.0	0.003

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their leaching rates are modelled using the nitrogen rate calculation shown in the report text (Section 5.3.1.2).

[2]Temperature, pH, and dissolved organic carbon are included in this table for the calculation of the guideline values for the comparison of the background surface water quality data. Temperature, pH, and dissolved organic carbon are not tracked by the model.

Table B-3
Inputs for Groundwater Water Quality

Parameter	Units	MDMER	CWQG-FAL	**CWQG-FAL**	Berry Bedrock (22BH-03A, 22BH-03B, 22BH-04A, and 22BH-04B)			Berry Overburden (22BH-02 and 22BH-07)		
Statistics			Short-term	Long-term	Min	Median	Max	Min	Median	Max
Aluminum	µg/L	-	-	100	15.9	31.0	**127**	16.4	18.5	20.6
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5
Arsenic	µg/L	100	-	5	0.5	0.5	2.0	0.5	1.8	3.0
Barium	µg/L	-	-	-	7.0	7.5	10	14	17	20
Boron	µg/L	-	29000	1500	5.0	5.0	13	5.0	5.0	5.0
Cadmium	µg/L	-	0.13	0.04	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**
Calcium	µg/L	-	-	-	3000	14500	48000	39000	40000	41000
Chromium	µg/L	-	-	1	1.00	1.0	**20**	1.0	1.0	1.0
Copper	µg/L	100	-	2	2.00	**2.4**	**8.0**	0.5	0.5	0.5
Iron	µg/L	-	-	300	5	11	225	5.0	15	25
Lead	µg/L	80	-	1	0.25	0.25	0.25	0.25	0.25	0.25
Magnesium	µg/L	-	-	-	350	885	3410	2250	2375	2500
Manganese	µg/L	-	596	210	1.0	160	**488**	**362**	**375**	**388**
Mercury	µg/L	-	-	0.026	0.013	0.013	0.013	0.013	0.013	0.013
Molybdenum	µg/L	-	-	73	1.0	1.5	11	6.0	6.5	7.0
Nickel	µg/L	250	-	25	0.50	1.0	2.0	0.50	0.5	0.5
Phosphorus	µg/L	-	-	4	0.025	0.025	0.025	0.025	0.043	0.060
Potassium	µg/L	-	-	-	130	500	24600	940	1005	1070
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	0.5	0.5
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.05	0.05	0.05
Sodium	µg/L	-	-	-	7.1	17	69	10	11	11
Thallium	µg/L	-	-	0.8	0.15	0.15	0.15	0.15	0.15	0.15
Uranium	µg/L	-	33	15	0.25	0.25	6.20	0.60	1.10	1.60
Zinc	µg/L	400	11.3	2.2	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
Chloride	µg/L	-	640000	120000	2000	3500	14000	5000	5500	6000
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	25	25	25	25	25	25
Nitrite (as Nitrogen)	µg/L	-	-	60	25	25	25	25	25	25
Nitrate (as Nitrogen)	µg/L	-	124000	3000	25	25	25	25	25	25
Total Ammonia (as Nitrogen)	µg/L	-	-	689	30	50	120	15.0	153	290
Un-ionized Ammonia (as	µg/L	500	16	16	0.03	0.04	0.37	0.07	0.66	1.26
Cyanide, Total	µg/L	500	-	-	9.9	10	10	9.9	10	10
Cyanide, WAD	µg/L	-	-	5	1.49	1.50	1.51	1.49	1.50	1.51
Sulphate	µg/L	-	-	-	1000	7000	29000	11000	13500	16000
Fluoride	µg/L	-	-	120	60	60	60	60	60	60
Radium-226	Bg/L	0.37	-	-	0.003	0.004	0.300	0.003	0.006	0.010
Cyanate[1]	µg/L	-	-	-	0	0	0	0	0	0
Total Alkalinity (as $CaCO_3$)	mg/L	-	-	-	56.0	96	139	124.0	133	141
pH[2]	pH Unit	6.0-9.5	-	6.5-9.0	6.4	7.3	11	7.5	7.5	7.5
Hardness (as $CaCO_3$)	mg/L	-	-	-	10.9	38.9	135	107	110	113
Thiocyanate[1]	µg/L	-	-	-	0	0	0	0	0	0
Temperature[2]	°C	-	-	-	6.6	6.9	7.6	7.6	7.9	8.2
Dissolved Organic Carbon[2]	mg/L	-	-	-	2.9	3.6	6.1	4.0	4.1	4.2

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their concentrations in groundwater are assumed to be zerc

[2]Temperature, pH, and dissolved organic carbon are included in this table for the calculation of the guideline values for the comparison of the background surface water quality data. Temperature, pH, and dissolved organic carbon are not tracked by the model.

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	B SED	B SED	B SED	B SED-High SFE	B SED-High SFE	B SED-High SFE	M CG	M CG	M CG	M CG	M CG	M CG	L SED	L SED
Period		1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month	1st Month	1st Month
Statistics		Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median
Aluminum	mg/kg/week	8.38E-02	1.07E-01	1.21E-01	3.88E-02	4.19E-02	6.02E-02	6.11E-02	7.15E-02	1.08E-01	3.42E-02	3.52E-02	4.18E-02	9.29E-02	9.94E-02
Antimony	mg/kg/week	4.00E-04	4.17E-04	4.19E-04	3.14E-04	3.15E-04	3.24E-04	3.94E-04	4.02E-04	4.58E-04	4.16E-04	4.17E-04	4.18E-04	4.04E-04	4.14E-04
Arsenic	mg/kg/week	3.72E-04	6.22E-04	3.43E-03	2.79E-04	2.80E-04	3.60E-04	4.47E-04	5.09E-04	6.13E-04	9.27E-05	2.78E-04	3.70E-04	4.49E-04	4.97E-04
Barium	mg/kg/week	4.69E-03	6.07E-03	6.64E-03	1.65E-03	2.32E-03	2.45E-03	5.72E-04	7.09E-04	1.08E-03	2.41E-04	2.68E-04	2.97E-04	5.24E-04	5.74E-04
Boron	mg/kg/week	3.56E-03	7.41E-03	7.45E-03	5.03E-03	9.07E-03	1.19E-02	8.94E-04	1.02E-03	1.75E-03	9.24E-04	9.27E-04	9.28E-04	9.20E-04	9.94E-04
Cadmium	mg/kg/week	1.33E-06	1.39E-06	1.40E-06	7.19E-06	1.33E-05	3.22E-05	1.31E-06	1.34E-06	1.53E-06	1.39E-06	1.39E-06	2.78E-06	1.35E-06	1.38E-06
Calcium	mg/kg/week	3.71E+00	3.86E+00	3.94E+00	4.40E+00	4.91E+00	5.85E+00	1.72E+00	1.85E+00	3.29E+00	1.34E+00	1.37E+00	1.84E+00	1.45E+00	1.53E+00
Chromium	mg/kg/week	3.56E-05	3.70E-05	3.72E-05	2.79E-05	2.88E-05	1.12E-04	3.58E-05	4.07E-05	7.88E-05	3.71E-05	1.39E-04	1.48E-04	3.59E-05	3.68E-05
Copper	mg/kg/week	6.52E-04	9.26E-04	1.24E-03	2.09E-04	2.16E-04	3.50E-04	9.83E-04	1.23E-03	1.53E-03	7.42E-04	9.27E-04	1.02E-03	9.20E-05	3.59E-04
Iron	mg/kg/week	3.11E-03	3.24E-03	3.26E-03	2.44E-03	2.52E-03	5.60E-03	3.13E-03	9.16E-03	1.31E-02	3.23E-03	3.24E-03	3.25E-03	7.36E-03	8.95E-03
Lead	mg/kg/week	4.00E-05	4.17E-05	4.19E-05	3.14E-05	3.24E-05	7.00E-05	4.47E-06	2.63E-05	3.05E-05	4.64E-06	4.64E-06	9.24E-06	4.60E-06	1.79E-05
Magnesium	mg/kg/week	3.63E-01	3.75E-01	4.13E-01	5.33E-01	6.73E-01	9.59E-01	3.36E-01	4.00E-01	6.46E-01	2.84E-01	3.29E-01	3.54E-01	1.40E-01	1.63E-01
Manganese	mg/kg/week	1.16E-02	1.21E-02	2.14E-02	1.79E-02	2.01E-02	2.05E-02	9.19E-03	9.66E-03	2.24E-02	8.06E-03	8.19E-03	1.14E-02	1.42E-02	1.56E-02
Mercury	mg/kg/week	4.45E-06	4.63E-06	4.66E-06	3.49E-06	3.50E-06	3.60E-06	4.38E-06	4.47E-06	5.09E-06	4.64E-06	4.64E-06	9.24E-06	4.49E-06	4.60E-06
Molybdenum	mg/kg/week	8.29E-04	1.36E-03	2.04E-03	2.55E-02	5.35E-02	7.84E-02	3.75E-04	5.25E-04	7.74E-04	1.86E-05	1.02E-04	8.62E-04	5.52E-05	1.35E-04
Nickel	mg/kg/week	4.45E-05	1.86E-04	2.78E-04	1.40E-04	2.88E-04	4.90E-04	4.38E-05	5.09E-05	1.79E-04	4.62E-05	4.64E-05	4.64E-05	4.49E-05	4.60E-05
Phosphorus[1]	mg/kg/week	nd	nd	nd	nd	nd	nd	1.34E-03	1.53E-03	3.50E-03	1.39E-03	1.39E-03	1.39E-03	1.35E-03	1.38E-03
Potassium	mg/kg/week	8.91E-01	1.19E+00	1.32E+00	1.50E+00	1.94E+00	2.51E+00	9.39E-01	1.28E+00	2.02E+00	1.58E-01	1.58E-01	2.06E-01	1.11E+00	1.44E+00
Selenium	mg/kg/week	1.86E-05	7.11E-05	8.33E-05	4.20E-05	5.75E-05	1.05E-04	1.79E-05	6.11E-05	7.88E-05	1.85E-05	1.85E-05	1.86E-05	1.79E-05	1.84E-05
Silver	mg/kg/week	2.22E-05	2.32E-05	2.33E-05	1.75E-05	1.75E-05	1.80E-05	2.19E-05	2.24E-05	2.55E-05	2.31E-05	2.32E-05	2.32E-05	2.24E-05	2.30E-05
Sodium	mg/kg/week	1.17E+00	2.69E+00	4.14E+00	1.15E+00	2.18E+00	3.78E+00	7.15E-01	2.66E+00	3.44E+00	5.54E-02	6.49E-02	6.50E-02	7.36E-01	2.53E+00
Thallium	mg/kg/week	2.22E-06	2.32E-06	2.33E-06	5.58E-06	7.91E-06	1.26E-05	2.19E-06	2.24E-06	2.55E-06	2.31E-06	2.32E-06	4.64E-06	2.24E-06	2.30E-06
Uranium	mg/kg/week	2.47E-04	8.48E-04	3.08E-03	9.42E-03	9.42E-03	1.24E-02	9.28E-04	1.54E-03	1.58E-03	1.79E-04	2.31E-04	3.34E-04	2.25E-04	2.52E-04
Zinc	mg/kg/week	8.89E-04	9.26E-04	9.31E-04	6.98E-04	7.00E-04	7.19E-04	8.75E-04	8.94E-04	1.02E-03	9.24E-04	9.27E-04	9.28E-04	8.97E-04	9.20E-04
Chloride	mg/kg/week	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Nitrite (as Nitrogen)	mg/kg/week	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*
Nitrate (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Un-ionized Ammonia (as	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Cyanide, Total	mg/kg/week	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*
Cyanide, WAD	mg/kg/week	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*
Sulphate	mg/kg/week	9.31E-01	1.85E+00	3.64E+00	2.52E+00	4.26E+00	6.16E+00	8.94E-02	3.50E-01	5.09E-01	9.24E-02	9.27E-02	9.28E-02	9.20E-02	5.38E-01
Fluoride	mg/kg/week	2.67E-02	2.78E-02	2.79E-02	2.09E-02	2.10E-02	2.16E-02	2.63E-02	2.68E-02	3.05E-02	2.77E-02	2.78E-02	2.78E-02	2.76E-02	2.98E-02
Radium-226	Bq/kg/week	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	1.40E+01	2.13E+01	2.22E+01	1.44E+01	1.61E+01	1.82E+01	8.94E+00	1.14E+01	2.04E+01	6.49E+00	7.42E+00	8.32E+00	7.36E+00	8.97E+00
pH[3]	pH Unit	7.67E+00	8.86E+00	9.19E+00	7.69E+00	7.94E+00	8.33E+00	7.55E+00	8.00E+00	8.27E+00	7.05E+00	7.27E+00	7.54E+00	7.12E+00	7.80E+00
Hardness (as $CaCO_3$)	mg/kg/week	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C	no temp	no temp	no temp	no temp	no temp	no temp	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Phosphorus laboratory data shown as "nd" is not available for the first month phosphorus leaching rates from the Berry humidity cells. The highest values from the respective lithology from Marathon and Leprechaun were used as input for phosphorus first month leaching rates.

[2]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their leaching rates are modelled using the nitrogen rate calculation shown in the report text (Section 5.3.1.2).

Values of the parameters shown in italics and shaded are calculated using the respective laboratory detection limits for modelling.

[3]Temperature and pH values are shown for information; these parameters are not modelled. no temp = no temperature data for these Berry humidity cells.

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	L SED	L SED	L SED	L SED	B QTP	B QTP	B QTP	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	L QZ-QTP
Period		1st Month	Last Month	Last Month	Last Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month	1st Month
Statistics		Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min
Aluminum	mg/kg/week	1.28E-01	4.49E-02	4.72E-02	4.88E-02	4.41E-02	5.27E-02	6.26E-02	6.09E-02	7.21E-02	7.92E-02	4.09E-02	4.28E-02	4.32E-02	8.53E-02
Antimony	mg/kg/week	4.47E-04	4.21E-04	4.22E-04	4.24E-04	3.65E-04	3.97E-04	4.32E-04	4.01E-04	4.15E-04	4.32E-04	4.23E-04	4.28E-04	4.28E-04	4.10E-04
Arsenic	mg/kg/week	6.44E-04	9.36E-05	9.38E-05	9.43E-05	9.59E-05	4.41E-04	6.49E-04	2.88E-04	3.56E-04	3.69E-04	9.40E-05	9.50E-05	9.50E-05	9.37E-05
Barium	mg/kg/week	6.46E-04	1.60E-04	3.28E-04	3.47E-04	3.36E-04	3.73E-04	5.12E-04	7.28E-04	8.90E-04	1.06E-03	5.42E-04	5.61E-04	5.64E-04	1.51E-03
Boron	mg/kg/week	2.69E-03	9.36E-04	9.38E-04	9.43E-04	1.15E-02	1.46E-02	1.85E-02	9.22E-04	9.61E-04	3.56E-03	9.40E-04	9.50E-04	9.50E-04	9.37E-04
Cadmium	mg/kg/week	1.49E-06	1.40E-06	1.41E-06	1.41E-06	2.65E-06	2.88E-06	4.06E-06	1.34E-06	1.38E-06	1.44E-06	1.43E-06	3.76E-06	3.80E-06	1.37E-06
Calcium	mg/kg/week	2.27E+00	1.07E+00	1.14E+00	1.26E+00	2.90E+00	3.70E+00	3.87E+00	2.83E+00	2.85E+00	3.93E+00	1.97E+00	2.20E+00	2.39E+00	2.66E+00
Chromium	mg/kg/week	3.98E-05	3.77E-05	1.50E-04	2.25E-04	3.53E-05	3.84E-05	8.92E-05	3.56E-05	3.69E-05	3.84E-05	3.80E-05	9.40E-05	1.05E-04	3.64E-05
Copper	mg/kg/week	5.96E-04	2.81E-04	3.75E-04	1.51E-03	1.05E-03	2.19E-03	4.41E-03	6.23E-04	9.61E-04	1.01E-03	6.65E-04	1.24E-03	1.60E-03	5.62E-04
Iron	mg/kg/week	9.87E-03	3.28E-03	3.28E-03	3.30E-03	3.36E-03	8.11E-03	1.15E-02	3.23E-03	7.12E-03	9.61E-03	3.29E-03	3.33E-03	3.33E-03	3.28E-03
Lead	mg/kg/week	2.98E-05	9.38E-06	9.43E-06	2.81E-05	3.65E-05	3.97E-05	4.32E-05	4.61E-06	1.78E-05	1.92E-05	4.70E-06	4.75E-06	4.75E-06	4.69E-06
Magnesium	mg/kg/week	1.74E-01	9.73E-02	1.10E-01	1.28E-01	2.13E-01	2.46E-01	3.35E-01	1.55E-01	1.78E-01	1.90E-01	9.22E-02	1.02E-01	1.05E-01	2.53E-01
Manganese	mg/kg/week	3.22E-02	8.62E-03	9.16E-03	1.23E-02	1.90E-02	2.10E-02	3.39E-02	1.52E-02	1.60E-02	2.00E-02	1.06E-02	1.14E-02	1.35E-02	1.29E-02
Mercury	mg/kg/week	4.97E-06	4.68E-06	4.69E-06	4.72E-06	4.06E-06	4.41E-06	4.80E-06	4.45E-06	4.61E-06	4.81E-06	4.70E-06	4.75E-06	4.75E-06	4.56E-06
Molybdenum	mg/kg/week	2.78E-04	1.89E-05	1.03E-04	1.41E-04	2.40E-03	4.00E-03	8.28E-03	2.31E-04	3.74E-04	7.30E-04	1.14E-04	1.22E-04	2.47E-04	7.29E-05
Nickel	mg/kg/week	4.97E-05	4.68E-05	4.69E-05	4.72E-05	8.82E-05	1.62E-04	3.84E-04	4.45E-05	4.81E-05	9.22E-05	4.70E-05	4.75E-05	4.75E-05	4.56E-05
Phosphorus[1]	mg/kg/week	1.49E-03	1.40E-03	1.41E-03	1.41E-03	nd	nd	nd	1.34E-03	1.38E-03	1.44E-03	1.41E-03	1.43E-03	1.43E-03	1.37E-03
Potassium	mg/kg/week	1.61E+00	2.92E-01	3.01E-01	3.58E-01	5.59E-01	7.89E-01	1.27E+00	3.55E-01	4.95E-01	5.50E-01	1.05E-01	1.12E-01	1.30E-01	8.06E-01
Selenium	mg/kg/week	3.98E-05	1.87E-05	1.88E-05	1.89E-05	1.92E-05	7.30E-05	1.50E-04	1.78E-05	1.84E-05	5.77E-05	1.88E-05	1.90E-05	1.90E-05	1.82E-05
Silver	mg/kg/week	2.49E-05	2.34E-05	2.35E-05	2.36E-05	2.03E-05	2.21E-05	2.40E-05	2.23E-05	2.31E-05	2.40E-05	2.35E-05	2.38E-05	2.38E-05	2.28E-05
Sodium	mg/kg/week	2.62E+00	5.62E-02	5.63E-02	6.60E-02	8.34E-01	2.04E+00	4.55E+00	5.26E-01	2.06E+00	2.43E+00	7.52E-02	7.60E-02	8.55E-02	3.09E-01
Thallium	mg/kg/week	2.49E-06	2.34E-06	2.35E-06	6.60E-06	2.03E-06	2.21E-06	7.67E-06	2.23E-06	2.31E-06	2.40E-06	2.35E-06	2.38E-06	5.70E-06	2.28E-06
Uranium	mg/kg/week	2.95E-04	1.09E-04	1.62E-04	1.75E-04	4.84E-04	1.35E-03	4.01E-03	1.83E-04	2.17E-04	2.68E-04	5.26E-05	1.17E-04	4.95E-04	6.13E-04
Zinc	mg/kg/week	9.94E-04	9.36E-04	9.38E-04	9.43E-04	8.11E-04	8.82E-04	9.59E-04	8.90E-04	9.22E-04	9.61E-04	9.40E-04	9.50E-04	9.50E-04	9.11E-04
Chloride	mg/kg/week	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Nitrite (as Nitrogen)	mg/kg/week	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*
Nitrate (as Nitrogen)	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Un-ionized Ammonia (as	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Cyanide, Total	mg/kg/week	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*
Cyanide, WAD	mg/kg/week	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*
Sulphate	mg/kg/week	6.96E-01	9.36E-02	9.38E-02	9.43E-02	1.05E+00	1.62E+00	4.94E+00	3.69E-01	1.07E+00	1.15E+00	1.88E-01	2.85E-01	2.85E-01	2.81E-01
Fluoride	mg/kg/week	2.15E-01	2.81E-02	2.81E-02	2.83E-02	2.43E-02	2.65E-02	2.88E-02	2.67E-02	2.77E-02	2.88E-02	2.82E-02	2.85E-02	2.85E-02	2.73E-02
Radium-226	Bq/kg/week	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	1.19E+01	3.74E+00	4.72E+00	5.63E+00	1.14E+01	1.23E+01	1.25E+01	8.30E+00	1.07E+01	1.25E+01	6.58E+00	6.65E+00	1.24E+01	8.43E+00
pH[3]	pH Unit	7.88E+00	7.08E+00	7.12E+00	7.23E+00	7.54E+00	7.98E+00	8.91E+00	7.30E+00	8.00E+00	8.36E+00	7.15E+00	7.23E+00	7.45E+00	7.32E+00
Hardness (as $CaCO_3$)	mg/kg/week	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C	2.20E+01	1.80E+01	2.00E+01	2.20E+01	no temp	no temp	no temp	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	L QZ-QTP	L QZ-QTP	L QZ-QTP	L QZ-QTP	L QZ-QTP	B MD	B MD	B MD	M MD	M MD	M MD	M MD	M MD	M MD
Period		1st Month	1st Month	Last Month	Last Month	Last Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month
Statistics		Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Aluminum	mg/kg/week	1.05E-01	1.09E-01	6.37E-02	6.66E-02	7.80E-02	6.65E-02	7.02E-02	7.61E-02	6.19E-02	6.24E-02	6.58E-02	6.19E-02	6.24E-02	6.58E-02
Antimony	mg/kg/week	4.22E-04	4.34E-04	4.23E-04	4.28E-04	4.28E-04	3.95E-04	4.10E-04	4.13E-04	4.06E-04	4.19E-04	4.29E-04	4.06E-04	4.19E-04	4.29E-04
Arsenic	mg/kg/week	2.73E-04	2.89E-04	9.40E-05	9.50E-05	9.52E-05	2.73E-04	2.75E-04	7.89E-04	9.02E-05	9.31E-05	9.53E-05	9.02E-05	9.31E-05	9.53E-05
Barium	mg/kg/week	1.63E-03	2.05E-03	1.12E-03	1.18E-03	1.22E-03	7.65E-04	9.47E-04	1.38E-03	5.09E-03	5.14E-03	9.78E-03	5.09E-03	5.14E-03	9.78E-03
Boron	mg/kg/week	9.64E-04	2.73E-03	9.40E-04	9.50E-04	9.52E-04	5.47E-03	6.42E-03	9.65E-03	9.02E-04	9.31E-04	9.53E-04	9.02E-04	9.31E-04	9.53E-04
Cadmium	mg/kg/week	1.41E-06	1.45E-06	1.41E-06	1.43E-06	1.43E-06	1.32E-06	1.37E-06	3.67E-06	1.35E-06	1.40E-06	1.43E-06	1.35E-06	1.40E-06	1.43E-06
Calcium	mg/kg/week	2.89E+00	3.64E+00	2.39E+00	2.43E+00	2.76E+00	4.56E+00	4.74E+00	6.38E+00	7.84E+00	1.28E+01	2.18E+01	7.84E+00	1.28E+01	2.18E+01
Chromium	mg/kg/week	3.75E-05	3.86E-05	3.81E-05	8.55E-05	1.32E-04	3.51E-05	3.64E-05	1.10E-04	3.61E-05	3.72E-05	3.81E-05	3.61E-05	3.72E-05	3.81E-05
Copper	mg/kg/week	2.19E-03	3.95E-03	1.88E-04	2.85E-04	3.81E-04	5.47E-04	7.02E-04	8.25E-04	2.79E-04	4.51E-04	6.67E-04	2.79E-04	4.51E-04	6.67E-04
Iron	mg/kg/week	6.38E-03	9.64E-03	3.29E-03	3.33E-03	3.33E-03	6.14E-03	6.42E-03	8.20E-03	3.16E-03	3.26E-03	3.34E-03	3.16E-03	3.26E-03	3.34E-03
Lead	mg/kg/week	1.82E-05	2.89E-05	4.76E-06	1.88E-05	1.90E-05	3.95E-05	4.10E-05	4.13E-05	4.66E-06	9.02E-06	3.81E-05	4.66E-06	9.02E-06	3.81E-05
Magnesium	mg/kg/week	2.85E-01	3.02E-01	1.99E-01	2.03E-01	2.19E-01	4.22E-01	4.99E-01	7.57E-01	5.73E-01	1.37E+00	1.58E+00	5.73E-01	1.37E+00	1.58E+00
Manganese	mg/kg/week	1.57E-02	1.88E-02	1.18E-02	1.20E-02	1.44E-02	1.03E-02	1.04E-02	1.51E-02	1.91E-02	2.23E-02	2.54E-02	1.91E-02	2.23E-02	2.54E-02
Mercury	mg/kg/week	4.69E-06	4.82E-06	4.70E-06	4.75E-06	4.76E-06	4.39E-06	4.56E-06	4.59E-06	4.51E-06	4.66E-06	4.77E-06	4.51E-06	4.66E-06	4.77E-06
Molybdenum	mg/kg/week	9.37E-05	1.45E-04	1.90E-05	6.58E-05	4.75E-04	1.28E-03	2.58E-03	2.76E-03	2.61E-04	4.78E-04	6.77E-04	2.61E-04	4.78E-04	6.77E-04
Nickel	mg/kg/week	4.69E-05	4.82E-05	4.70E-05	4.75E-05	4.76E-05	4.59E-05	2.63E-04	2.73E-04	4.51E-05	4.66E-05	4.77E-05	4.51E-05	4.66E-05	4.77E-05
Phosphorus[1]	mg/kg/week	1.41E-03	1.45E-03	1.41E-03	1.43E-03	1.43E-03	nd	nd	nd	1.35E-03	1.40E-03	1.43E-03	1.35E-03	1.40E-03	1.43E-03
Potassium	mg/kg/week	1.38E+00	1.71E+00	1.03E-01	1.14E-01	1.35E-01	5.41E-01	7.38E-01	1.05E+00	2.26E-01	4.65E-01	5.91E-01	2.26E-01	4.65E-01	5.91E-01
Selenium	mg/kg/week	1.87E-05	4.82E-05	1.88E-05	1.90E-05	1.90E-05	3.64E-05	1.23E-04	1.47E-04	1.80E-05	4.66E-05	7.62E-05	1.80E-05	4.66E-05	7.62E-05
Silver	mg/kg/week	2.34E-05	2.41E-05	2.35E-05	2.38E-05	2.38E-05	2.19E-05	2.28E-05	2.29E-05	2.26E-05	2.33E-05	2.38E-05	2.26E-05	2.33E-05	2.38E-05
Sodium	mg/kg/week	1.18E+00	1.92E+00	4.75E-02	5.71E-02	6.58E-02	8.29E-01	1.55E+00	2.49E+00	2.89E-01	1.49E+00	1.69E+00	2.89E-01	1.49E+00	1.69E+00
Thallium	mg/kg/week	2.34E-06	2.41E-06	2.35E-06	2.38E-06	2.38E-06	2.19E-06	2.28E-06	2.29E-06	2.26E-06	2.33E-06	2.38E-06	2.26E-06	2.33E-06	2.38E-06
Uranium	mg/kg/week	7.78E-04	1.10E-03	1.69E-04	2.39E-04	3.89E-04	9.26E-04	1.10E-03	1.88E-03	9.03E-05	1.08E-04	1.28E-04	9.03E-05	1.08E-04	1.28E-04
Zinc	mg/kg/week	9.37E-04	9.64E-04	9.50E-04	9.52E-04	2.82E-03	8.77E-04	9.11E-04	9.17E-04	9.02E-04	9.31E-04	9.53E-04	9.02E-04	9.31E-04	9.53E-04
Chloride	mg/kg/week	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Nitrite (as Nitrogen)	mg/kg/week	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*
Nitrate (as Nitrogen)	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Un-ionized Ammonia (as	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Cyanide, Total	mg/kg/week	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*
Cyanide, WAD	mg/kg/week	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*
Sulphate	mg/kg/week	5.47E-01	1.06E+00	9.40E-02	9.50E-02	9.52E-02	1.73E+00	3.51E+00	6.60E+00	1.02E+01	2.71E+01	4.67E+01	1.02E+01	2.71E+01	4.67E+01
Fluoride	mg/kg/week	2.81E-02	5.78E-02	2.82E-02	2.85E-02	2.86E-02	2.63E-02	2.73E-02	2.75E-02	2.71E-02	2.79E-02	2.86E-02	2.71E-02	2.79E-02	2.86E-02
Radium-226	Bq/kg/week	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	1.09E+01	1.16E+01	7.52E+00	7.60E+00	8.57E+00	1.37E+01	1.49E+01	1.93E+01	9.31E+00	1.05E+01	1.08E+01	9.31E+00	1.05E+01	1.08E+01
pH[3]	pH Unit	8.14E+00	8.21E+00	7.34E+00	7.41E+00	7.42E+00	7.61E+00	8.33E+00	8.91E+00	7.05E+00	7.26E+00	7.66E+00	7.05E+00	7.26E+00	7.66E+00
Hardness (as $CaCO_3$)	mg/kg/week	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	no temp	no temp	no temp	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	B QPOR	B QPOR	B QPOR	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QZ-QE-POR-QTP-MIN	M QE-POR	M QE-POR	M QE-POR	M QE-POR	M QE-POR
Period		1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month	1st Month	1st Month	1st Month	Last Month	Last Month
Statistics		Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median
Aluminum	mg/kg/week	4.90E-02	5.29E-02	5.79E-02	6.09E-02	7.21E-02	7.92E-02	4.09E-02	4.28E-02	4.32E-02	7.18E-02	7.57E-02	9.22E-02	3.52E-02	5.52E-02
Antimony	mg/kg/week	3.80E-04	4.01E-04	4.18E-04	4.01E-04	4.15E-04	4.32E-04	4.23E-04	4.28E-04	4.28E-04	4.07E-04	4.20E-04	4.26E-04	4.17E-04	4.25E-04
Arsenic	mg/kg/week	8.45E-04	9.28E-04	1.25E-03	2.88E-04	3.56E-04	3.69E-04	9.40E-05	9.50E-05	9.50E-05	1.87E-04	2.84E-04	3.62E-04	9.27E-05	9.45E-05
Barium	mg/kg/week	4.63E-04	5.85E-04	6.08E-04	7.28E-04	8.90E-04	1.06E-03	5.42E-04	5.61E-04	5.64E-04	1.18E-03	1.30E-03	1.43E-03	2.41E-04	1.12E-03
Boron	mg/kg/week	4.23E-03	8.02E-03	8.35E-03	9.22E-04	9.61E-04	3.56E-03	9.40E-04	9.50E-04	9.50E-04	9.33E-04	9.46E-04	2.71E-03	9.27E-04	9.45E-04
Cadmium	mg/kg/week	8.91E-06	1.10E-05	1.58E-05	1.34E-06	1.38E-06	1.44E-06	1.43E-06	3.76E-06	3.80E-06	1.36E-06	1.40E-06	1.42E-06	1.43E-06	2.78E-06
Calcium	mg/kg/week	3.07E+00	3.46E+00	3.54E+00	2.83E+00	2.85E+00	3.93E+00	1.97E+00	2.20E+00	2.39E+00	3.35E+00	3.41E+00	3.52E+00	1.37E+00	2.42E+00
Chromium	mg/kg/week	3.38E-05	3.56E-05	3.71E-05	3.56E-05	3.69E-05	3.84E-05	3.80E-05	9.40E-05	1.05E-04	3.62E-05	3.73E-05	3.78E-05	3.80E-05	1.04E-04
Copper	mg/kg/week	6.50E-04	1.25E-03	2.37E-03	6.23E-04	9.61E-04	1.01E-03	6.65E-04	1.24E-03	1.60E-03	7.23E-04	1.03E-03	1.04E-03	9.51E-05	8.51E-04
Iron	mg/kg/week	2.96E-03	3.12E-03	3.25E-03	3.23E-03	7.12E-03	9.61E-03	3.29E-03	3.33E-03	3.33E-03	3.27E-03	8.14E-03	9.46E-03	3.24E-03	3.31E-03
Lead	mg/kg/week	3.80E-05	4.01E-05	4.18E-05	4.61E-06	1.78E-05	1.92E-05	4.70E-06	4.75E-06	4.75E-06	4.67E-06	1.81E-05	2.84E-05	4.64E-06	4.76E-06
Magnesium	mg/kg/week	1.84E-01	1.88E-01	2.41E-01	1.55E-01	1.78E-01	1.90E-01	9.22E-02	1.02E-01	1.05E-01	2.24E-01	2.69E-01	3.21E-01	1.37E-01	1.58E-01
Manganese	mg/kg/week	1.58E-02	1.68E-02	2.61E-02	1.52E-02	1.60E-02	2.00E-02	1.06E-02	1.14E-02	1.35E-02	1.49E-02	1.71E-02	1.99E-02	8.19E-03	1.29E-02
Mercury	mg/kg/week	4.23E-06	4.46E-06	4.64E-06	4.45E-06	4.61E-06	4.81E-06	4.70E-06	4.75E-06	4.75E-06	4.52E-06	4.67E-06	4.73E-06	4.64E-06	4.73E-06
Molybdenum	mg/kg/week	1.43E-03	3.72E-03	3.87E-03	2.31E-04	3.74E-04	7.30E-04	1.14E-04	1.22E-04	2.47E-04	4.20E-04	4.61E-04	5.11E-04	5.71E-05	2.84E-04
Nickel	mg/kg/week	4.23E-05	1.78E-04	1.86E-04	4.45E-05	4.81E-05	9.22E-05	4.70E-05	4.75E-05	4.75E-05	4.52E-05	4.67E-05	4.73E-05	4.64E-05	4.73E-05
Phosphorus[1]	mg/kg/week	nd	nd	nd	1.34E-03	1.38E-03	1.44E-03	1.41E-03	1.43E-03	1.43E-03	1.36E-03	1.40E-03	1.42E-03	1.39E-03	1.42E-03
Potassium	mg/kg/week	7.19E-01	8.83E-01	1.15E+00	3.55E-01	4.95E-01	5.50E-01	1.05E-01	1.12E-01	1.30E-01	4.21E-01	6.70E-01	6.95E-01	1.00E-01	1.24E-01
Selenium	mg/kg/week	1.02E-04	1.07E-04	1.18E-04	1.78E-05	1.84E-05	5.77E-05	1.88E-05	1.90E-05	1.90E-05	1.87E-05	4.52E-05	5.68E-05	1.85E-05	1.89E-05
Silver	mg/kg/week	2.11E-05	2.23E-05	2.32E-05	2.23E-05	2.31E-05	2.40E-05	2.35E-05	2.38E-05	2.38E-05	2.26E-05	2.33E-05	2.37E-05	2.32E-05	2.36E-05
Sodium	mg/kg/week	1.17E+00	2.95E+00	5.32E+00	5.26E-01	2.06E+00	2.43E+00	7.52E-02	7.60E-02	8.55E-02	4.29E-01	2.02E+00	2.31E+00	5.67E-02	6.49E-02
Thallium	mg/kg/week	2.11E-06	2.23E-06	2.32E-06	2.23E-06	2.31E-06	2.40E-06	2.35E-06	2.38E-06	5.70E-06	2.26E-06	2.33E-06	2.37E-06	2.36E-06	2.38E-06
Uranium	mg/kg/week	4.38E-04	1.29E-03	5.76E-03	1.83E-04	2.17E-04	2.68E-04	5.26E-05	1.17E-04	4.95E-04	1.13E-04	4.43E-04	5.78E-04	6.33E-05	7.51E-05
Zinc	mg/kg/week	8.45E-04	8.91E-04	9.28E-04	8.90E-04	9.22E-04	9.61E-04	9.40E-04	9.50E-04	9.50E-04	9.04E-04	9.33E-04	9.46E-04	9.27E-04	9.45E-04
Chloride	mg/kg/week	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Nitrite (as Nitrogen)	mg/kg/week	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*
Nitrate (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Un-ionized Ammonia (as	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*
Cyanide, Total	mg/kg/week	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*
Cyanide, WAD	mg/kg/week	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*
Sulphate	mg/kg/week	1.30E+00	1.96E+00	5.24E+00	3.69E-01	1.07E+00	1.15E+00	1.88E-01	2.85E-01	2.85E-01	4.67E-01	1.72E+00	1.80E+00	9.27E-02	1.90E-01
Fluoride	mg/kg/week	2.54E-02	2.78E-02	1.07E-01	2.67E-02	2.77E-02	2.88E-02	2.82E-02	2.85E-02	2.85E-02	2.71E-02	2.80E-02	2.84E-02	2.78E-02	2.84E-02
Radium-226	Bq/kg/week	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	1.10E+01	1.21E+01	1.25E+01	8.30E+00	1.07E+01	1.25E+01	6.58E+00	6.65E+00	1.24E+01	1.03E+01	1.18E+01	1.32E+01	6.49E+00	6.62E+00
pH[3]	pH Unit	7.30E+00	7.89E+00	9.03E+00	7.30E+00	8.00E+00	8.36E+00	7.15E+00	7.23E+00	7.45E+00	7.44E+00	8.16E+00	8.32E+00	7.05E+00	7.34E+00
Hardness (as $CaCO_3$)	mg/kg/week	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C	no temp	no temp	no temp	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	M QE-POR	B LGO	B LGO	B LGO	MLGO Comp	MLGO Comp	MLGO Comp	MLGO Comp	MLGO Comp	MLGO Comp	LLGO Comp	LLGO Comp	LLGO Comp	LLGO Comp
Period		Last Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month	1st Month	1st Month	1st Month	Last Month
Statistics		Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min
Aluminum	mg/kg/week	6.99E-02	4.36E-02	4.50E-02	5.67E-02	9.86E-02	1.02E-01	1.08E-01	6.08E-02	6.54E-02	7.00E-02	8.27E-02	1.11E-01	1.26E-01	7.11E-02
Antimony	mg/kg/week	4.28E-04	4.05E-04	4.17E-04	4.19E-04	4.09E-04	4.19E-04	1.24E-03	4.21E-04	4.23E-04	4.26E-04	4.23E-04	1.05E-03	1.15E-03	4.16E-04
Arsenic	mg/kg/week	9.51E-05	9.30E-05	2.78E-04	3.60E-04	3.63E-04	3.73E-04	5.74E-04	1.87E-04	1.88E-04	1.89E-04	2.82E-04	4.38E-04	4.80E-04	9.36E-05
Barium	mg/kg/week	1.21E-03	3.60E-04	4.28E-04	8.06E-04	1.16E-03	2.25E-03	3.07E-03	1.44E-03	1.45E-03	1.47E-03	1.06E-03	1.44E-03	2.71E-03	7.39E-04
Boron	mg/kg/week	9.51E-04	5.58E-03	8.10E-03	1.11E-02	2.80E-03	7.26E-03	1.15E-02	1.87E-03	2.36E-03	2.84E-03	3.76E-03	7.01E-03	1.06E-02	1.85E-03
Cadmium	mg/kg/week	4.73E-06	1.35E-06	1.40E-06	2.78E-06	1.36E-06	7.46E-06	9.57E-06	1.40E-06	1.41E-06	1.42E-06	1.31E-06	2.82E-06	9.60E-06	1.39E-06
Calcium	mg/kg/week	2.89E+00	3.10E+00	3.69E+00	4.79E+00	3.97E+00	4.60E+00	6.79E+00	2.90E+00	3.13E+00	3.35E+00	3.46E+00	4.74E+00	5.52E+00	2.73E+00
Chromium	mg/kg/week	1.48E-04	3.60E-05	3.71E-05	3.72E-05	3.73E-05	8.17E-05	1.44E-04	3.74E-05	3.76E-05	3.78E-05	3.50E-05	3.76E-05	2.11E-04	3.70E-05
Copper	mg/kg/week	9.27E-04	1.67E-03	2.79E-03	7.05E-03	2.72E-04	3.83E-04	6.52E-04	9.36E-05	9.41E-05	9.46E-05	9.40E-05	9.60E-05	3.50E-04	9.24E-05
Iron	mg/kg/week	3.33E-03	3.26E-03	6.30E-03	8.34E-03	3.18E-03	3.26E-03	7.66E-03	3.28E-03	3.29E-03	3.31E-03	3.07E-03	3.29E-03	3.36E-03	3.23E-03
Lead	mg/kg/week	7.56E-05	4.05E-05	4.17E-05	4.19E-05	4.54E-06	9.32E-06	5.74E-05	4.68E-06	1.65E-05	2.84E-05	4.38E-06	4.70E-06	1.92E-05	4.62E-06
Magnesium	mg/kg/week	3.29E-01	1.78E-01	2.13E-01	3.87E-01	3.50E-01	4.51E-01	8.83E-01	1.78E-01	1.98E-01	2.19E-01	3.73E-01	5.08E-01	6.33E-01	3.43E-01
Manganese	mg/kg/week	1.60E-02	2.12E-02	2.56E-02	2.93E-02	1.23E-02	2.17E-02	2.55E-02	2.43E-02	2.54E-02	2.65E-02	1.08E-02	1.66E-02	1.94E-02	1.05E-02
Mercury	mg/kg/week	9.51E-06	4.50E-06	4.64E-06	4.65E-06	4.54E-06	4.66E-06	4.79E-06	4.60E-06	4.68E-06	4.73E-06	4.38E-06	4.70E-06	4.80E-06	4.56E-06
Molybdenum	mg/kg/week	8.62E-04	4.19E-04	8.19E-04	1.67E-03	2.07E-03	2.12E-03	7.66E-03	7.19E-04	7.62E-04	8.05E-04	3.01E-04	1.41E-03	4.09E-03	1.20E-04
Nickel	mg/kg/week	4.76E-05	1.80E-04	1.85E-04	4.65E-04	4.54E-05	4.66E-05	5.74E-04	4.68E-05	4.71E-05	4.73E-05	4.38E-05	4.70E-05	9.60E-04	4.62E-05
Phosphorus[1]	mg/kg/week	1.43E-03	nd	nd	nd	1.40E-03	6.36E-03	1.53E-02	1.40E-03	3.54E-03	5.68E-03	1.41E-03	2.63E-03	1.63E-02	1.39E-03
Potassium	mg/kg/week	1.58E-01	4.27E-01	6.52E-01	1.19E+00	3.75E-01	7.04E-01	1.02E+00	1.15E-01	1.28E-01	1.41E-01	4.58E-01	6.96E-01	9.79E-01	1.88E-01
Selenium	mg/kg/week	1.90E-05	1.86E-05	4.64E-05	1.08E-04	7.46E-05	2.09E-04	3.45E-04	1.87E-05	1.88E-05	1.89E-05	7.52E-05	1.58E-04	2.78E-04	1.85E-05
Silver	mg/kg/week	2.38E-05	2.25E-05	2.32E-05	2.33E-05	2.27E-05	2.33E-05	2.39E-05	2.34E-05	2.35E-05	2.37E-05	2.19E-05	2.35E-05	2.40E-05	2.31E-05
Sodium	mg/kg/week	7.61E-02	9.11E-01	2.95E+00	6.76E+00	8.11E-01	3.50E+00	5.24E+00	1.31E-01	1.65E-01	1.99E-01	1.25E+00	2.62E+00	4.74E+00	1.76E-01
Thallium	mg/kg/week	4.64E-06	2.25E-06	2.32E-06	2.33E-06	2.27E-06	2.33E-06	2.39E-05	2.34E-06	2.35E-06	2.37E-06	2.19E-06	2.35E-06	1.44E-05	2.31E-06
Uranium	mg/kg/week	3.56E-04	2.49E-04	7.05E-04	8.37E-04	1.05E-04	5.42E-04	2.81E-03	7.76E-05	1.14E-04	1.51E-04	1.90E-04	4.80E-04	7.15E-04	2.34E-04
Zinc	mg/kg/week	9.51E-04	9.00E-04	9.27E-04	9.30E-04	9.08E-04	9.32E-04	9.57E-04	9.36E-04	1.41E-03	1.89E-03	8.76E-04	9.40E-04	9.60E-04	9.24E-04
Chloride	mg/kg/week	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Nitrite (as Nitrogen)	mg/kg/week	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*
Nitrate (as Nitrogen)	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Un-ionized Ammonia (as	mg/kg/week	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*
Cyanide, Total	mg/kg/week	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*
Cyanide, WAD	mg/kg/week	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*
Sulphate	mg/kg/week	2.84E-01	1.58E+00	3.15E+00	1.02E+01	3.17E+00	5.54E+00	1.05E+01	6.62E-01	7.06E-01	7.49E-01	1.41E+00	4.32E+00	8.32E+00	3.70E-01
Fluoride	mg/kg/week	2.85E-02	2.70E-02	2.78E-02	2.79E-02	2.72E-02	2.80E-02	5.74E-02	2.76E-02	2.81E-02	2.84E-02	2.63E-02	2.82E-02	2.88E-02	2.74E-02
Radium-226	Bq/kg/week	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	8.56E+00	1.08E+01	1.11E+01	1.12E+01	1.40E+01	1.91E+01	2.11E+01	8.42E+00	1.01E+01	1.04E+01	1.13E+01	1.31E+01	2.21E+01	9.24E+00
pH[3]	pH Unit	7.57E+00	7.23E+00	7.88E+00	8.96E+00	7.94E+00	8.08E+00	8.09E+00	7.61E+00	7.67E+00	7.71E+00	7.86E+00	7.95E+00	8.46E+00	7.67E+00
Hardness (as $CaCO_3$)	mg/kg/week	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C	2.20E+01	no temp	no temp	no temp	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	LLGO Comp	LLGO Comp	B HGO	B HGO	B HGO	MLGO Comp	MLGO Comp	MLGO Comp	MLGO Comp	MLGO Comp	MLGO Comp	L QZ-QTP	L QZ-QTP	L QZ-QTP
Period		Last Month	Last Month	1st Month	1st Month	1st Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month	1st Month	1st Month	1st Month
Statistics		Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max
Aluminum	mg/kg/week	7.63E-02	8.14E-02	3.65E-02	3.73E-02	3.83E-02	9.86E-02	1.02E-01	1.08E-01	6.08E-02	6.54E-02	7.00E-02	8.53E-02	1.05E-01	1.09E-01
Antimony	mg/kg/week	4.19E-04	4.21E-04	4.00E-04	4.01E-04	4.11E-04	4.09E-04	4.19E-04	1.24E-03	4.21E-04	4.23E-04	4.26E-04	4.10E-04	4.22E-04	4.34E-04
Arsenic	mg/kg/week	1.39E-04	1.85E-04	2.67E-04	2.74E-04	4.45E-04	3.63E-04	3.73E-04	5.74E-04	1.87E-04	1.88E-04	1.89E-04	9.37E-05	2.73E-04	2.89E-04
Barium	mg/kg/week	8.04E-04	8.69E-04	2.65E-04	2.67E-04	6.05E-04	1.16E-03	2.25E-03	3.07E-03	1.44E-03	1.45E-03	1.47E-03	1.51E-03	1.63E-03	2.05E-03
Boron	mg/kg/week	2.33E-03	2.81E-03	7.30E-03	9.78E-03	1.34E-02	2.80E-03	7.26E-03	1.15E-02	1.87E-03	2.36E-03	2.84E-03	9.37E-04	9.64E-04	2.73E-03
Cadmium	mg/kg/week	1.40E-06	1.40E-06	1.33E-06	1.37E-06	8.01E-06	1.36E-06	7.46E-06	9.57E-06	1.40E-06	1.41E-06	1.42E-06	1.37E-06	1.41E-06	1.45E-06
Calcium	mg/kg/week	2.84E+00	2.95E+00	4.22E+00	4.22E+00	7.18E+00	3.97E+00	4.60E+00	6.79E+00	2.90E+00	3.13E+00	3.35E+00	2.66E+00	2.89E+00	3.64E+00
Chromium	mg/kg/week	3.72E-05	3.74E-05	3.56E-05	3.56E-05	3.65E-05	3.73E-05	8.17E-05	1.44E-04	3.74E-05	3.76E-05	3.78E-05	3.64E-05	3.75E-05	3.86E-05
Copper	mg/kg/week	9.30E-05	9.36E-05	7.30E-04	1.33E-03	2.31E-03	2.72E-04	3.83E-04	6.52E-04	9.36E-05	9.41E-05	9.46E-05	5.62E-04	2.19E-03	3.95E-03
Iron	mg/kg/week	3.26E-03	3.28E-03	3.20E-03	6.22E-03	9.79E-03	3.18E-03	3.26E-03	7.66E-03	3.28E-03	3.29E-03	3.31E-03	3.28E-03	6.38E-03	9.64E-03
Lead	mg/kg/week	4.65E-06	4.68E-06	4.00E-05	4.11E-05	8.90E-05	4.54E-06	9.32E-06	5.74E-05	4.68E-06	1.65E-05	2.84E-05	4.69E-06	1.82E-05	2.89E-05
Magnesium	mg/kg/week	3.77E-01	4.12E-01	2.20E-01	3.08E-01	5.30E-01	3.50E-01	4.51E-01	8.83E-01	1.78E-01	1.98E-01	2.19E-01	2.53E-01	2.85E-01	3.02E-01
Manganese	mg/kg/week	1.07E-02	1.09E-02	2.62E-02	3.17E-02	3.58E-02	1.23E-02	2.17E-02	2.55E-02	2.43E-02	2.54E-02	2.65E-02	1.29E-02	1.57E-02	1.88E-02
Mercury	mg/kg/week	4.62E-06	4.68E-06	4.45E-06	4.45E-06	4.57E-06	4.54E-06	4.66E-06	4.79E-06	4.60E-06	4.68E-06	4.73E-06	4.56E-06	4.69E-06	4.82E-06
Molybdenum	mg/kg/week	2.29E-04	3.37E-04	1.90E-03	3.68E-03	6.70E-03	2.07E-03	2.12E-03	7.66E-03	7.19E-04	7.62E-04	8.05E-04	7.29E-05	9.37E-05	1.45E-04
Nickel	mg/kg/week	4.65E-05	4.68E-05	1.78E-04	2.67E-04	2.74E-04	4.54E-05	4.66E-05	5.74E-04	4.68E-05	4.71E-05	4.73E-05	4.56E-05	4.69E-05	4.82E-05
Phosphorus[1]	mg/kg/week	1.40E-03	1.40E-03	nd	nd	nd	1.40E-03	6.36E-03	1.53E-02	1.40E-03	3.54E-03	5.68E-03	1.37E-03	1.41E-03	1.45E-03
Potassium	mg/kg/week	1.91E-01	1.95E-01	4.04E-01	6.00E-01	1.06E+00	3.75E-01	7.04E-01	1.02E+00	1.15E-01	1.28E-01	1.41E-01	8.06E-01	1.38E+00	1.71E+00
Selenium	mg/kg/week	1.86E-05	1.87E-05	1.83E-05	7.12E-05	1.42E-04	7.46E-05	2.09E-04	3.45E-04	1.87E-05	1.88E-05	1.89E-05	1.82E-05	1.87E-05	4.82E-05
Silver	mg/kg/week	2.33E-05	2.34E-05	2.22E-05	2.23E-05	2.28E-05	2.27E-05	2.33E-05	2.39E-05	2.34E-05	2.35E-05	2.37E-05	2.28E-05	2.34E-05	2.41E-05
Sodium	mg/kg/week	2.05E-01	2.34E-01	1.03E+00	2.84E+00	5.62E+00	8.11E-01	3.50E+00	5.24E+00	1.31E-01	1.65E-01	1.99E-01	3.09E-01	1.18E+00	1.92E+00
Thallium	mg/kg/week	2.33E-06	2.34E-06	2.22E-06	2.28E-06	4.45E-06	2.27E-06	2.33E-06	2.39E-05	2.34E-06	2.35E-06	2.37E-06	2.28E-06	2.34E-06	2.41E-06
Uranium	mg/kg/week	3.57E-04	4.80E-04	4.41E-04	5.03E-04	4.94E-03	1.05E-04	5.42E-04	2.81E-03	7.76E-05	1.14E-04	1.51E-04	6.13E-04	7.78E-04	1.10E-03
Zinc	mg/kg/week	9.30E-04	9.36E-04	8.89E-04	8.90E-04	9.13E-04	9.08E-04	9.32E-04	9.57E-04	9.36E-04	1.41E-03	1.89E-03	9.11E-04	9.37E-04	9.64E-04
Chloride	mg/kg/week	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*	*4.50E-05*	*5.00E-05*	*5.50E-05*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Nitrite (as Nitrogen)	mg/kg/week	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*
Nitrate (as Nitrogen)	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Un-ionized Ammonia (as	mg/kg/week	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Cyanide, Total	mg/kg/week	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*
Cyanide, WAD	mg/kg/week	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.95E-07*	*5.50E-07*	*6.05E-07*
Sulphate	mg/kg/week	3.72E-01	3.74E-01	3.10E+00	5.33E+00	1.25E+01	3.17E+00	5.54E+00	1.05E+01	6.62E-01	7.06E-01	7.49E-01	2.81E-01	5.47E-01	1.06E+00
Fluoride	mg/kg/week	2.77E-02	2.81E-02	2.67E-02	2.67E-02	2.74E-02	2.72E-02	2.80E-02	5.74E-02	2.76E-02	2.81E-02	2.84E-02	2.73E-02	2.81E-02	5.78E-02
Radium-226	Bq/kg/week	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	1.03E+01	1.09E+01	1.00E+01	1.24E+01	1.25E+01	1.40E+01	1.91E+01	2.11E+01	8.42E+00	1.01E+01	1.04E+01	8.43E+00	1.09E+01	1.16E+01
pH[3]	pH Unit	7.68E+00	9.06E+00	7.30E+00	7.99E+00	8.67E+00	7.94E+00	8.08E+00	8.09E+00	7.61E+00	7.67E+00	7.71E+00	7.32E+00	8.14E+00	8.21E+00
Hardness (as $CaCO_3$)	mg/kg/week	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C	2.00E+01	2.20E+01	no temp	no temp	no temp	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	L QZ-QTP	L QZ-QTP	L QZ-QTP	Marathon Tailings (CND1)	Marathon Tailings (CND1)	Marathon Tailings (CND1)	Marathon Tailings (CND1)	Marathon Tailings (CND1)	Marathon Tailings (CND1)	Leprechaun Tailings (CND2)	Leprechaun Tailings (CND2)	Leprechaun Tailings (CND2)	Leprechaun Tailings (CND2)	Leprechaun Tailings (CND2)
Period		Last Month	Last Month	Last Month	1st Month	1st Month	1st Month	Last Month	Last Month	Last Month	1st Month	1st Month	1st Month	Last Month	Last Month
Statistics		Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median	Max	Min	Median
Aluminum	mg/kg/week	6.37E-02	6.66E-02	7.80E-02	1.00E-02	1.70E-02	2.30E-02	1.50E-02	1.50E-02	1.50E-02	1.60E-02	2.70E-02	5.70E-02	2.60E-02	2.60E-02
Antimony	mg/kg/week	4.23E-04	4.28E-04	4.28E-04	3.90E-04	4.20E-04	4.30E-04	4.50E-04	4.50E-04	4.50E-04	3.90E-04	4.10E-04	4.30E-04	4.40E-04	4.40E-04
Arsenic	mg/kg/week	9.40E-05	9.50E-05	9.52E-05	2.60E-04	6.50E-04	1.00E-03	3.00E-04	3.00E-04	3.00E-04	8.70E-05	9.10E-05	9.50E-05	1.00E-04	1.00E-04
Barium	mg/kg/week	1.12E-03	1.18E-03	1.22E-03	1.80E-03	2.60E-03	2.60E-03	1.70E-03	1.70E-03	1.70E-03	2.10E-03	2.90E-03	3.00E-03	3.10E-03	3.10E-03
Boron	mg/kg/week	9.40E-04	9.50E-04	9.52E-04	8.70E-04	4.80E-03	9.40E-03	1.00E-03	1.00E-03	1.00E-03	8.70E-04	9.50E-04	4.50E-03	2.00E-03	2.00E-03
Cadmium	mg/kg/week	1.41E-06	1.43E-06	1.43E-06	1.40E-06	2.80E-06	9.40E-06	9.00E-06	9.00E-06	9.00E-06	1.30E-06	6.30E-06	1.70E-05	3.90E-06	3.90E-06
Calcium	mg/kg/week	2.39E+00	2.43E+00	2.76E+00	1.80E+01	3.70E+01	4.70E+01	4.20E+01	4.20E+01	4.20E+01	1.10E+01	1.70E+01	2.70E+01	3.10E+01	3.10E+01
Chromium	mg/kg/week	3.81E-05	8.55E-05	1.32E-04	3.50E-05	3.70E-05	2.00E-04	1.40E-04	1.40E-04	1.40E-04	3.50E-05	3.80E-05	1.80E-04	7.90E-05	7.90E-05
Copper	mg/kg/week	1.88E-04	2.85E-04	3.81E-04	1.40E-03	2.20E-03	5.50E-03	1.80E-03	1.80E-03	1.80E-03	1.30E-03	5.20E-03	6.80E-03	1.80E-03	1.80E-03
Iron	mg/kg/week	3.29E-03	3.33E-03	3.33E-03	7.80E-03	1.90E-02	2.70E-02	1.70E-02	1.70E-02	1.70E-02	1.50E-02	3.60E-02	7.50E-02	5.10E-02	5.10E-02
Lead	mg/kg/week	4.76E-06	1.88E-05	1.90E-05	4.60E-06	2.60E-05	4.70E-05	1.00E-05	1.00E-05	1.00E-05	4.40E-06	9.00E-06	4.70E-05	1.00E-05	1.00E-05
Magnesium	mg/kg/week	1.99E-01	2.03E-01	2.19E-01	1.40E+00	2.70E+00	2.80E+00	2.60E+00	2.60E+00	2.60E+00	1.60E+00	2.70E+00	4.80E+00	9.30E+00	9.30E+00
Manganese	mg/kg/week	1.18E-02	1.20E-02	1.44E-02	5.00E-02	9.60E-02	1.40E-01	1.70E-01	1.70E-01	1.70E-01	1.80E-02	3.10E-02	3.90E-02	4.60E-02	4.60E-02
Mercury	mg/kg/week	4.70E-06	4.75E-06	4.76E-06	4.30E-06	4.70E-06	4.80E-06	5.00E-06	5.00E-06	5.00E-06	4.40E-06	4.50E-06	4.70E-06	4.90E-06	4.90E-06
Molybdenum	mg/kg/week	1.90E-05	6.58E-05	4.75E-04	9.10E-04	1.50E-03	2.00E-03	9.70E-04	9.70E-04	9.70E-04	5.80E-04	6.10E-04	9.20E-04	1.20E-03	1.20E-03
Nickel	mg/kg/week	4.70E-05	4.75E-05	4.76E-05	2.90E-04	3.70E-04	3.70E-04	3.00E-04	3.00E-04	3.00E-04	4.70E-05	9.00E-05	9.50E-05	9.80E-05	9.80E-05
Phosphorus[1]	mg/kg/week	1.41E-03	1.43E-03	1.43E-03	1.30E-03	1.40E-03	1.40E-03	1.50E-03	1.50E-03	1.50E-03	1.30E-03	1.40E-03	1.40E-03	1.50E-03	1.50E-03
Potassium	mg/kg/week	1.03E-01	1.14E-01	1.35E-01	5.30E-01	1.20E+00	1.50E+00	3.60E-01	3.60E-01	3.60E-01	8.10E-01	1.00E+00	1.20E+00	7.50E-01	7.50E-01
Selenium	mg/kg/week	1.88E-05	1.90E-05	1.90E-05	4.80E-05	9.40E-05	1.20E-04	7.00E-05	7.00E-05	7.00E-05	5.40E-05	9.00E-05	1.40E-04	1.70E-04	1.70E-04
Silver	mg/kg/week	2.35E-05	2.38E-05	2.38E-05	2.20E-05	2.30E-05	2.40E-05	2.50E-05	2.50E-05	2.50E-05	2.20E-05	2.30E-05	2.40E-05	2.50E-05	2.50E-05
Sodium	mg/kg/week	4.75E-02	5.71E-02	6.58E-02	2.60E+00	9.70E+00	1.60E+01	3.20E+00	3.20E+00	3.20E+00	4.80E+00	8.20E+00	1.50E+01	4.20E+00	4.20E+00
Thallium	mg/kg/week	2.35E-06	2.38E-06	2.38E-06	2.20E-06	2.30E-06	2.40E-06	2.50E-06	2.50E-06	2.50E-06	2.20E-06	2.30E-06	2.40E-06	2.50E-06	2.50E-06
Uranium	mg/kg/week	1.69E-04	2.39E-04	3.89E-04	7.30E-05	1.20E-04	1.60E-04	3.80E-05	3.80E-05	3.80E-05	6.80E-05	1.10E-04	6.80E-04	1.10E-04	1.10E-04
Zinc	mg/kg/week	9.50E-04	9.52E-04	2.82E-03	8.70E-04	9.40E-04	9.50E-04	1.00E-03	1.00E-03	1.00E-03	8.70E-04	9.50E-04	2.70E-03	9.80E-04	9.80E-04
Chloride	mg/kg/week	*4.50E-05*	*5.00E-05*	*5.50E-05*	*8.70E-02*	*4.60E-01*	*7.60E-01*	*1.00E-01*	*1.00E-01*	*1.00E-01*	*1.70E-01*	*3.60E-01*	*6.60E-01*	*9.80E-02*	*9.80E-02*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*
Nitrite (as Nitrogen)	mg/kg/week	*4.95E-06*	*5.50E-06*	*6.05E-06*	*5.00E-06*	*5.50E-06*	*6.10E-06*	*5.00E-06*	*5.50E-06*	*6.10E-06*	*5.00E-06*	*5.50E-06*	*6.10E-06*	*5.00E-06*	*5.50E-06*
Nitrate (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*
Un-ionized Ammonia (as	mg/kg/week	*2.48E-05*	*2.75E-05*	*3.03E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*	*3.00E-05*	*2.50E-05*	*2.80E-05*
Cyanide, Total	mg/kg/week	*4.95E-06*	*5.50E-06*	*6.05E-06*	*5.00E-06*	*5.50E-06*	*6.10E-06*	*5.00E-06*	*5.50E-06*	*6.10E-06*	*5.00E-06*	*5.50E-06*	*6.10E-06*	*5.00E-06*	*5.50E-06*
Cyanide, WAD	mg/kg/week	*4.95E-07*	*5.50E-07*	*6.05E-07*	*4.30E-03*	*4.30E-03*	*4.30E-03*	*5.00E-03*	*5.00E-03*	*5.00E-03*	*4.40E-03*	*4.40E-03*	*4.40E-03*	*9.80E-03*	*9.80E-03*
Sulphate	mg/kg/week	9.40E-02	9.50E-02	9.52E-02	5.40E+01	9.20E+01	1.30E+02	6.20E+01	8.70E+01	1.00E+02	3.30E+01	7.10E+01	1.23E+02	4.30E+01	5.90E+01
Fluoride	mg/kg/week	2.82E-02	2.85E-02	2.86E-02	2.80E-02	2.90E-02	1.40E-01	3.00E-02	3.00E-02	3.00E-02	5.70E-02	6.60E-02	1.20E-01	1.50E-01	1.50E-01
Radium-226	Bq/kg/week	*2.25E-06*	*2.50E-06*	*2.75E-06*	*2.30E-06*	*2.50E-06*	*2.80E-06*	*2.30E-06*	*2.50E-06*	*2.80E-06*	*2.30E-06*	*2.50E-06*	*2.80E-06*	*2.30E-06*	*2.50E-06*
Cyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01	2.20E+01	1.80E+01	2.00E+01
Total Alkalinity (as $CaCO_3$)	mg/kg/week	7.52E+00	7.60E+00	8.57E+00	5.00E+00	8.00E+00	1.40E+01	7.00E+00	8.00E+00	8.20E+00	7.80E+00	1.00E+01	2.10E+01	1.00E+01	1.10E+01
pH[3]	pH Unit	7.34E+00	7.41E+00	7.42E+00	7.10E+00	7.20E+00	7.70E+00	7.20E+00	7.30E+00	7.40E+00	7.30E+00	8.30E+00	8.50E+00	7.40E+00	7.60E+00
Hardness (as $CaCO_3$)	mg/kg/week	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*	*4.50E-04*	*5.00E-04*
Thiocyanate[2]	mg/kg/week	0.00E+00	0.00E+00	0.00E+00	4.50E-04	5.00E-04	5.50E-04	4.50E-04	5.00E-04	5.50E-04	4.50E-04	5.00E-04	5.50E-04	4.50E-04	5.00E-04
Temperature[3]	°C	1.80E+01	2.00E+01	2.20E+01											

Table B-4
Input Leaching Rates (mg/kg/week) and pH Values from Humidity Cells

Parameter	Units	Leprechaun Tailings (CND2)	BL1021-43 Detox Tls	BL1021-43 Detox Tls	BL1021-43 Detox Tls
Period		Last Month	1st Month	1st Month	1st Month
Statistics		Max	Min	Median	Max
Aluminum	mg/kg/week	2.60E-02	6.30E-03	9.90E-03	1.35E-02
Antimony	mg/kg/week	4.40E-04	3.89E-04	4.08E-04	4.27E-04
Arsenic	mg/kg/week	1.00E-04	1.50E-04	1.80E-04	2.25E-04
Barium	mg/kg/week	3.10E-03	2.79E-03	4.19E-03	4.75E-03
Boron	mg/kg/week	2.00E-03	1.80E-02	1.95E-02	2.79E-02
Cadmium	mg/kg/week	3.90E-06	9.90E-06	1.05E-05	1.08E-05
Calcium	mg/kg/week	3.10E+01	3.94E+01	4.30E+01	5.00E+01
Chromium	mg/kg/week	7.90E-05	1.80E-05	5.50E-05	7.20E-05
Copper	mg/kg/week	1.80E-03	2.03E-02	7.97E-02	1.39E-01
Iron	mg/kg/week	5.10E-02	1.58E-03	1.58E-03	1.50E-02
Lead	mg/kg/week	1.00E-05	4.36E-06	8.96E-06	4.68E-05
Magnesium	mg/kg/week	9.30E+00	2.41E+00	3.03E+00	3.24E+00
Manganese	mg/kg/week	4.60E-02	2.44E-02	3.82E-02	5.15E-02
Mercury	mg/kg/week	4.90E-06	1.35E-05	2.00E-05	1.08E-04
Molybdenum	mg/kg/week	1.20E-03	8.15E-03	1.54E-02	1.70E-02
Nickel	mg/kg/week	9.80E-05	5.40E-04	8.55E-04	2.21E-03
Phosphorus[1]	mg/kg/week	1.50E-03	1.30E-03	1.36E-03	1.42E-03
Potassium	mg/kg/week	7.50E-01	8.33E-01	1.24E+00	1.64E+00
Selenium	mg/kg/week	1.70E-04	4.76E-05	8.96E-05	1.20E-04
Silver	mg/kg/week	2.50E-05	1.13E-05	1.13E-05	1.13E-05
Sodium	mg/kg/week	4.20E+00	9.05E+01	1.04E+02	1.18E+02
Thallium	mg/kg/week	2.50E-06	2.16E-06	2.27E-06	2.37E-06
Uranium	mg/kg/week	1.10E-04	6.80E-05	1.08E-04	1.58E-04
Zinc	mg/kg/week	9.80E-04	8.65E-04	9.35E-04	9.52E-04
Chloride	mg/kg/week	*9.80E-02*	*8.65E-02*	*3.62E-01*	*6.64E-01*
Nitrate + Nitrite (as Nitrogen)	mg/kg/week	*3.00E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Nitrite (as Nitrogen)	mg/kg/week	*6.10E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*
Nitrate (as Nitrogen)	mg/kg/week	*3.00E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Total Ammonia (as Nitrogen)	mg/kg/week	*3.00E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Un-ionized Ammonia (as	mg/kg/week	*3.00E-05*	*2.48E-05*	*2.75E-05*	*3.03E-05*
Cyanide, Total	mg/kg/week	*6.10E-06*	*4.95E-06*	*5.50E-06*	*6.05E-06*
Cyanide, WAD	mg/kg/week	*9.80E-03*	*4.33E-03*	*4.33E-03*	*4.33E-03*
Sulphate	mg/kg/week	9.80E+01	3.42E+02	3.55E+02	3.60E+02
Fluoride	mg/kg/week	1.50E-01	3.60E-02	4.05E-02	4.50E-02
Radium-226	Bq/kg/week	*2.80E-06*	*2.25E-06*	*2.50E-06*	*2.75E-06*
Cyanate[2]	mg/kg/week	2.20E+01	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/kg/week	1.40E+01	2.39E+01	2.93E+01	3.51E+01
pH[3]	pH Unit	7.80E+00	7.72E+00	7.76E+00	7.80E+00
Hardness (as $CaCO_3$)	mg/kg/week	*5.50E-04*	*4.50E-04*	*5.00E-04*	*5.50E-04*
Thiocyanate[2]	mg/kg/week	5.50E-04	0.00E+00	0.00E+00	0.00E+00
Temperature[3]	°C		no temp	no temp	no temp

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V:\1214\active\121417555\03_data\analytical\Water_Balance\Results\Berry_Leprechaun_TMF\Water Quality\Tables\Appendix B Water Quality Model Inputs\Table B4 Input leaching rates and pH values from humidity cells.xlsx

Table B-5
Berry Project Mass Inputs

End of Mine Year	End of Model Year	Berry LGO mine rate	Berry HGO Mine Rate	Berry Waste Rock Mine Rate	Berry/Marathon LGO Stockpile Balance	Berry Waste Rock Storage Balance	Mill Feed		
							Marathon	Leprechaun	Berry
Year	Year	ktonne/yr	ktonne/yr	ktonne/yr	ktonne	ktonne	%	%	%
-2.25	0.25	0	0	0	0	0	0	0	0
-2	1.25	0	0	0	0	0	0	0	0
-1	2.25	0	0	0	23	0	0	0	0
1	3.25	419	728	9436	1244	9431	0	0	0
2	4.25	619	994	20621	3103	30023	0.39	0.41	0.20
3	5.25	660	1185	21346	4453	51369	0.44	0.34	0.22
4	6.25	791	1721	22044	5485	73413	0.43	0.29	0.28
5	7.25	762	1699	27926	5972	101336	0.37	0.25	0.38
6	8.25	401	1012	27438	6322	128776	0.34	0.23	0.43
7	9.25	494	706	19745	6322	148535	0.35	0.25	0.40
8	10.25	549	1134	9889	6690	158425	0.37	0.25	0.38
9	11.25	313	912	2099	6870	160528	0.36	0.26	0.38
10	12.25	0	0	0	6189	160534	0.34	0.28	0.38
11	13.25	0	0	0	6189	160534	0.34	0.31	0.35
12	14.25	0	0	0	5467	160534	0.36	0.33	0.31
13	15.25	0	0	0	3630	160534	0.41	0.31	0.29
14	16.25	0	0	0	744	160534	0.43	0.30	0.28
15	17.25	0	0	0	0	160534	0	0	0
20	22.25	0	0	0	0	160534	0	0	0
	100	0	0	0	0	160534	0	0	0

Notes:
HGO = High Grade Ore
LGO = Low Grade Ore

Table B-6
Shake Flask Extraction as Input of Runoff from Waste Rock, Ore and Overburden Piles

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Waste Rock				Ore		Berry OB			
Statistics			Short-term	Long-term	B QPOR	B SED	B MD	B QTP	B LGO	B HGO	Min	Mean	Max	St. Dev.
Aluminum	µg/L	-	-	100	**1.23E+03**	**8.84E+02**	**5.52E+02**	**9.25E+02**	**7.45E+02**	**8.91E+02**	5.50E+01	**1.50E+02**	**2.74E+02**	7.48E+01
Antimony	µg/L	-	-	-	*4.50E-01*	*4.50E-01*	*4.50E-01*	*4.50E-01*	*4.50E-01*	*4.50E-01*	4.50E-01	8.40E-01	2.50E+00	6.20E-01
Arsenic	µg/L	100	-	5	3.30E+00	2.10E+00	1.00E+00	1.60E+00	1.60E+00	1.50E+00	2.90E+00	**1.11E+01**	**3.31E+01**	**9.68E+00**
Barium	µg/L	-	-	-	9.10E-01	1.99E+01	2.58E+00	9.90E-01	6.20E-01	7.60E-01	2.05E+00	4.99E+00	8.31E+00	1.90E+00
Boron	µg/L	-	29000	1500	5.00E+00	1.90E+01	1.30E+01	4.80E+01	2.90E+01	2.70E+01	3.00E+00	4.40E+00	7.00E+00	1.28E+00
Cadmium	µg/L	-	0.13	0.04	**6.30E-02**	4.00E-03	**6.70E-02**	**4.90E-02**	7.00E-03	1.00E-02	1.50E-03	2.68E-02	**1.22E-01**	3.45E-02
Calcium	µg/L	-	-	-	6.97E+03	6.68E+03	1.06E+04	8.05E+03	1.10E+04	9.15E+03	1.10E+02	7.27E+03	1.68E+04	6.71E+03
Chromium	µg/L	-	-	1	2.30E-01	*4.00E-02*	1.70E-01	1.60E-01	*4.00E-02*	9.00E-02	4.00E-02	2.48E-01	5.90E-01	1.53E-01
Copper	µg/L	100	-	2	6.00E-01	8.00E-01	7.00E-01	1.40E+00	1.10E+00	**2.10E+00**	1.30E+00	**3.70E+00**	**1.48E+01**	**4.07E+00**
Iron	µg/L	-	-	300	*3.50E+00*	*3.50E+00*	*3.50E+00*	2.60E+01	8.00E+00	1.20E+01	4.30E+01	2.72E+02	**5.98E+02**	1.75E+02
Lead	µg/L	80	-	1	*4.50E-02*	*4.50E-02*	*4.50E-02*	*4.50E-02*	*4.50E-02*	*4.50E-02*	4.00E-02	2.99E-01	**1.05E+00**	2.96E-01
Magnesium	µg/L	-	-	-	4.50E+02	9.50E+02	1.44E+03	7.46E+02	7.38E+02	6.27E+02	5.70E+01	6.86E+02	1.65E+03	6.06E+02
Manganese	µg/L	-	596	210	1.12E+00	1.43E+00	1.50E+00	2.03E+00	5.17E+00	2.27E+00	4.74E+00	6.77E+01	**2.23E+02**	7.54E+01
Mercury	µg/L	-	-	0.026	*5.00E-03*	*5.00E-03*	*5.00E-03*	*5.00E-03*	*5.00E-03*	*5.00E-03*	5.00E-03	5.50E-03	1.00E-02	1.50E-03
Molybdenum	µg/L	-	-	73	1.85E+00	1.50E+00	3.04E+00	5.72E+00	5.41E+00	1.43E+00	2.10E-01	2.92E+00	7.53E+00	2.60E+00
Nickel	µg/L	250	-	25	1.00E-01	*5.00E-02*	1.00E-01	2.00E-01	*5.00E-02*	1.00E-01	2.00E-01	5.90E-01	9.00E-01	2.02E-01
Phosphorus	µg/L	-	-	4	***1.00E+02***	***1.00E+02***	***1.00E+02***	***1.00E+02***	***1.00E+02***	***1.00E+02***	**9.90E+01**	**1.00E+02**	**1.00E+02**	1.67E-01
Potassium	µg/L	-	-	-	2.90E+03	4.48E+03	2.80E+03	2.74E+03	3.00E+03	1.98E+03	3.47E+02	1.77E+03	3.60E+03	1.19E+03
Selenium	µg/L	-	-	1	**1.09E+00**	2.40E-01	**1.28E+00**	**1.20E+00**	1.80E-01	2.10E-01	2.00E-02	5.01E-01	**1.37E+00**	4.62E-01
Silver	µg/L	-	-	0.25	*2.50E-02*	*2.50E-02*	*2.50E-02*	*2.50E-02*	*2.50E-02*	*2.50E-02*	2.48E-02	2.50E-02	2.50E-02	3.47E-18
Sodium	µg/L	-	-	-	5.35E+03	6.70E+03	3.62E+03	5.75E+03	6.30E+03	6.90E+03	1.40E+03	2.06E+03	3.32E+03	5.32E+02
Thallium	µg/L	-	-	0.8	7.00E-03	*2.50E-03*	6.00E-03	8.00E-03	*2.50E-03*	*2.50E-03*	6.00E-03	2.17E-02	2.50E-02	6.69E-03
Uranium	µg/L	-	33	15	1.69E-01	1.46E-01	2.20E-02	2.62E-01	3.18E-01	1.71E-01	2.30E-02	4.43E-01	1.82E+00	6.51E-01
Zinc	µg/L	400	11.3	2.2	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	1.00E+00	1.80E+00	**6.00E+00**	1.47E+00
Chloride	µg/L	-	640000	120000	*1.00E+03*	*1.00E+03*	*1.00E+03*	*1.00E+03*	*1.00E+03*	*1.00E+03*	9.90E+02	1.00E+03	1.00E+03	1.67E+00
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	4.95E+01	5.00E+01	5.00E+01	8.33E-02
Nitrite (as Nitrogen)	µg/L	-	-	60	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	9.90E+00	1.00E+01	1.00E+01	1.67E-02
Nitrate (as Nitrogen)	µg/L	-	124000	3000	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	4.95E+01	5.00E+01	5.00E+01	8.33E-02
Total Ammonia (as Nitrogen)	µg/L	-	-	689	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	*5.00E+01*	4.95E+01	5.00E+01	5.00E+01	8.33E-02
Un-ionized Ammonia (as	µg/L	500	16	16	**1.90E+01**	**1.90E+01**	**1.90E+01**	**1.90E+01**	**1.90E+01**	**1.90E+01**	3.12E-01	3.84E+00	1.24E+01	4.27E+00
Cyanide, Total	µg/L	500	-	-	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	*1.00E+01*	9.90E+00	1.00E+01	1.00E+01	1.67E-02
Cyanide, WAD	µg/L	-	-	5	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	9.90E-01	1.00E+00	1.00E+00	1.67E-03
Sulphate	µg/L	-	-	-	*2.50E+03*	1.10E+04	7.80E+03	6.60E+03	1.20E+04	1.20E+04	1.00E+03	3.60E+03	1.40E+04	3.80E+03
Fluoride	µg/L	-	-	120	**1.60E+02**	**1.40E+02**	**1.30E+02**	8.00E+01	8.00E+01	6.00E+01	6.00E+01	**1.28E+02**	**1.90E+02**	3.66E+01
Radium-226	Bq/L	0.37	-	-	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	*5.00E-02*	4.95E-02	5.00E-02	5.00E-02	6.94E-18
Cyanate[1]	µg/L	-	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Alkalinity (as $CaCO_3$)	mg/L	-	-	-	2.90E+01	3.50E+01	3.80E+01	3.30E+01	3.40E+01	3.10E+01	4.00E+03	2.29E+04	5.10E+04	1.89E+04
pH[2]	pH Unit	6.0-9.5	-	6.5-9.0	8.09E+00	8.03E+00	7.94E+00	7.91E+00	7.89E+00	8.00E+00	7.23E+00	7.98E+00	8.95E+00	6.38E-01
Hardness (as $CaCO_3$)	µg/L	-	-	-	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	*1.00E+00*	9.90E-01	1.00E+00	1.00E+00	1.67E-03
Thiocyanate[1]	µg/L	-	-	-	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their concentrations in the shake flask extraction solution of waste rock, ore, and overburden are assumed to be zero.

[2]pH is included in this table for information only; pH is not not tracked by the model.

Values of the parameters shown in italics are calculated using the respective laboratory detection limits for modelling.

Table B-7
Total Element Concentrations in Waste Rock and Ore (mg/kg)

Parameter	Units	Waste Rock				Ore	
Statistics		B QPOR	B SED	B MD	B QTP	B LGO	B HGO
Aluminum	mg/kg	7.4E+03	1.0E+04	2.6E+04	6.1E+03	6.6E+03	6.9E+03
Antimony	mg/kg	*3.0E+00*	*3.0E+00*	*3.0E+00*	*3.0E+00*	*3.0E+00*	*3.0E+00*
Arsenic	mg/kg	9.7E-01	9.3E-01	4.6E+00	1.1E+00	2.7E+00	1.1E+00
Barium	mg/kg	2.2E+01	8.3E+01	1.8E+01	9.8E+00	1.5E+01	1.0E+01
Boron	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Cadmium	mg/kg	1.9E-01	1.0E-01	1.1E-01	7.5E-02	4.0E-02	3.0E-02
Calcium	mg/kg	8.6E+03	1.9E+04	2.4E+04	7.5E+03	1.5E+04	1.2E+04
Chromium	mg/kg	3.5E+00	1.3E+01	5.8E+01	6.2E+00	4.7E+00	7.1E+00
Copper	mg/kg	1.8E+01	4.2E+01	3.8E+01	2.6E+01	2.6E+01	2.6E+01
Iron	mg/kg	1.7E+04	2.1E+04	4.8E+04	1.5E+04	3.1E+04	2.5E+04
Lead	mg/kg	1.3E+00	1.8E+00	5.0E+00	8.5E-01	5.8E+00	1.7E+00
Magnesium	mg/kg	2.2E+03	7.2E+03	1.7E+04	2.1E+03	2.6E+03	2.8E+03
Manganese	mg/kg	3.8E+02	8.1E+02	9.0E+02	3.7E+02	5.6E+02	4.1E+02
Mercury	mg/kg	*2.5E-02*	*2.5E-02*	*2.5E-02*	*2.5E-02*	*2.5E-02*	*2.5E-02*
Molybdenum	mg/kg	1.8E+00	1.9E+00	1.3E+00	1.6E+00	3.8E+00	5.7E+00
Nickel	mg/kg	1.3E+00	1.3E+01	2.0E+01	2.2E+00	2.6E+00	2.8E+00
Phosphorus[1]	mg/kg	2.8E+01	5.9E+01	5.9E+01	2.8E+01	7.7E+00	6.3E+00
Potassium	mg/kg	4.9E+02	7.4E+02	3.5E+02	2.8E+02	5.9E+02	3.2E+02
Selenium	mg/kg	*3.5E-01*	*3.5E-01*	*3.5E-01*	*3.5E-01*	*3.5E-01*	*3.5E-01*
Silver	mg/kg	*5.0E-01*	*5.0E-01*	*5.0E-01*	*5.0E-01*	*5.0E-01*	*5.0E-01*
Sodium[1]	mg/kg	2.7E+03	2.0E+03	2.0E+03	2.7E+03	3.8E+03	3.8E+03
Thallium	mg/kg	*1.0E-02*	*1.0E-02*	*1.0E-02*	*1.0E-02*	*1.0E-02*	*1.0E-02*
Uranium	mg/kg	1.4E-01	6.2E-01	1.6E-01	1.1E-01	1.0E-01	1.0E-01
Zinc	mg/kg	2.6E+01	3.9E+01	7.5E+01	2.4E+01	2.5E+01	2.6E+01
Chloride	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Nitrate + Nitrite (as Nitrogen)	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Nitrite (as Nitrogen)	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Nitrate (as Nitrogen)	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Total Ammonia (as Nitrogen)	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Un-ionized Ammonia (as	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Cyanide, Total	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Cyanide, WAD	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Sulphate	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Fluoride	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Radium-226	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Cyanate[2]	mg/kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Total Alkalinity (as $CaCO_3$)	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Hardness (as $CaCO_3$)	mg/kg	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02	1.0E-02
Thiocyanate[2]	mg/kg	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Phosphorus and sodium laboratory data is not available. The highest values from the respective lithology from Marathon and Leprechaun were used as input to the model for the Project.

[2]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their concentrations in waste rock and ore are assumed to be zero.

Values of the parameters shown in italics and shaded are calculated using the respective laboratory detection limits for modelling.

Table B-8
Inputs for Process Water Quality and Ageing Constants

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Ageing Tests (CND1 and CND2) Day 0[3]			K Ageing
Statistics			Short-term	Long-term	Min	Median	Max	Mean
Aluminum	µg/L	-	-	100	96	98	100	0.021
Antimony	µg/L	-	-	-	11	14	16	0.014
Arsenic	µg/L	100	-	5	3	**9**	**16**	0.004
Barium	µg/L	-	-	-	16	27	38	0
Boron	µg/L	-	29000	1500	87	89	91	0
Cadmium	µg/L	-	0.13	0.04	0.039	**0.042**	**0.044**	0
Calcium	µg/L	-	-	-	84500	109000	133000	0
Chromium	µg/L	-	-	1	0.47	**2.04**	**3.61**	0.047
Copper	µg/L	100	-	2	**10**	**13**	**15**	0
Iron	µg/L	-	-	300	**846**	**1930**	**3010**	0.07
Lead	µg/L	80	-	1	0	0	0	0.032
Magnesium	µg/L	-	-	-	4520	6270	8010	0
Manganese	µg/L	-	596	210	28	31	34	0
Mercury	µg/L	-	-	0.026	**0**	**1**	**1**	0.073
Molybdenum	µg/L	-	-	73	**74**	**80**	**85**	0
Nickel	µg/L	250	-	25	1	2	3	0
Phosphorus	µg/L	-	-	4	**31**	**31**	**31**	0
Potassium	µg/L	-	-	-	19500	20100	20600	0
Selenium	µg/L	-	-	1	**4.3**	**4.3**	**4.3**	0.031
Silver	µg/L	-	-	0.25	**0.5**	**0.5**	**0.5**	0.064
Sodium	µg/L	-	-	-	462000	475000	487000	0
Thallium	µg/L	-	-	0.8	0.002	0.003	0.003	0
Uranium	µg/L	-	33	15	1.640	2.320	3.000	0
Zinc	µg/L	400	11.3	2.2	**3.000**	**4.500**	**6.000**	0.023
Chloride	µg/L	-	640000	120000	27000	31000	35000	0
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	297	300	303	0
Nitrite (as Nitrogen)	µg/L	-	-	60	**149**	**150**	**152**	0
Nitrate (as Nitrogen)	µg/L	-	124000	3000	297	300	303	0
Total Ammonia (as Nitrogen)	µg/L	-	-	689	**2300**	**2400**	**2500**	0
Un-ionized Ammonia (as	µg/L	500	16	16	**477**	**770**	**1062**	0
Cyanide, Total	µg/L	500	-	-	2360	5600	8840	0.077
Cyanide, WAD	µg/L	-	-	5	**80**	**105**	**130**	0.032
Sulphate	µg/L	-	-	-	960000	970000	980000	0
Fluoride	µg/L	-	-	120	**560**	**855**	**1150**	0
Radium-226	Bq/L	0.37	-	-	0.005	0.005	0.005	0
Cyanate[1]	µg/L	-	-	-	0	0	0	0
Total Alkalinity (as $CaCO_3$)	mg/L	-	-	-	73	82	90	0
pH[2]	pH	6.0-9.5	-	6.5-9.0	7.91	7.95	7.99	0
Hardness (as $CaCO_3$)	µg/L	-	-	-	0.99	1.00	1.01	0
Thiocyanate[1]	µg/L	-	-	-	0	0	0	0

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their concentrations in the shake flask extraction solution of waste rock, ore, and overburden are assumed to be zero.

[2]pH is included in this table for information only; pH is not not tracked by the model.

[3]Total and un-ionized ammonia results for day 28 to account for the ammonia formation in the TMF pond as a result of CN

K Ageing = the first order of constant derived from laboratory tests (see Valentine Gold Project: Leprechaun Project Acid Rock Drainage/Metal Leaching (ARD/ML) Assessment Report for complete results

Table B-9
Inputs for TMF Seepage Quality

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Construction and Operation				Closure and Post-Closure			
Statistics			Short-term	Long-term	Min	Median	Max	St.dev.	Min	Median	Max	St.dev.
Aluminum	µg/L	-	-	100	1.5E+01	2.6E+01	6.6E+01	1.1E+01	2.1E+01	2.2E+01	2.4E+01	9.4E-01
Antimony	µg/L	-	-	-	2.1E+00	5.3E+00	1.1E+01	2.2E+00	1.8E+00	2.0E+00	2.1E+00	9.6E-02
Arsenic	µg/L	100	-	5	2.2E+00	**8.1E+00**	**1.8E+01**	**5.9E+00**	1.5E+00	**9.2E+00**	**1.8E+01**	**7.6E+00**
Barium	µg/L	-	-	-	1.0E+01	3.2E+01	7.9E+01	1.7E+01	4.1E+00	9.6E+00	1.6E+01	4.1E+00
Boron	µg/L	-	29000	1500	6.0E+01	7.6E+01	8.9E+01	7.6E+00	2.3E+01	3.1E+01	3.6E+01	5.1E+00
Cadmium	µg/L	-	0.13	0.04	2.4E-02	**6.2E-02**	**1.2E-01**	2.7E-02	5.0E-03	1.6E-02	3.3E-02	9.1E-03
Calcium	µg/L	-	-	-	3.3E+04	8.1E+04	2.0E+05	4.6E+04	2.2E+04	2.6E+04	2.9E+04	2.3E+03
Chromium	µg/L	-	-	1	4.0E-02	2.0E-01	**1.8E+00**	4.3E-01	4.0E-02	9.0E-02	2.8E-01	8.8E-02
Copper	µg/L	100	-	2	**4.0E+01**	**9.4E+02**	**1.7E+03**	**4.3E+02**	**5.1E+02**	**8.3E+02**	**1.1E+03**	**2.2E+02**
Iron	µg/L	-	-	300	1.3E+01	3.2E+01	9.6E+01	2.1E+01	3.2E+01	7.0E+01	9.6E+01	2.1E+01
Lead	µg/L	80	-	1	5.0E-03	5.8E-02	2.0E-01	5.9E-02	2.0E-02	2.3E-02	3.0E-02	4.7E-03
Magnesium	µg/L	-	-	-	2.4E+03	9.6E+03	2.3E+04	5.4E+03	1.7E+03	2.4E+03	3.3E+03	6.5E+02
Manganese	µg/L	-	596	210	2.8E+01	9.6E+01	**3.2E+02**	8.2E+01	2.3E+01	2.7E+01	3.3E+01	3.5E+00
Mercury	µg/L	-	-	0.026	5.0E-03	**1.9E-01**	**1.0E+00**	**2.9E-01**	5.0E-03	7.5E-03	1.0E-02	2.5E-03
Molybdenum	µg/L	-	-	73	4.1E+01	**8.0E+01**	**1.1E+02**	1.8E+01	1.2E+01	2.4E+01	4.2E+01	9.7E+00
Nickel	µg/L	250	-	25	7.0E-01	3.9E+00	8.0E+00	2.6E+00	5.0E-01	1.2E+00	2.4E+00	6.6E-01
Phosphorus	µg/L	-	-	4	**1.3E+01**	**3.5E+01**	**1.9E+02**	**3.9E+01**	**5.0E+00**	**9.0E+00**	**1.7E+01**	**4.2E+00**
Potassium	µg/L	-	-	-	1.5E+04	2.4E+04	3.0E+04	3.9E+03	5.9E+03	9.2E+03	1.4E+04	2.6E+03
Selenium	µg/L	-	-	1	2.7E-01	9.0E-01	**3.4E+00**	7.8E-01	2.0E-01	3.3E-01	6.6E-01	1.6E-01
Silver	µg/L	-	-	0.25	2.5E-02	**8.2E-01**	**4.5E+00**	**1.1E+00**	2.5E-02	2.5E-02	2.5E-02	3.5E-18
Sodium	µg/L	-	-	-	2.6E+05	4.5E+05	5.2E+05	7.0E+04	8.1E+04	1.2E+05	1.6E+05	3.3E+04
Thallium	µg/L	-	-	0.8	2.5E-03	7.3E-03	1.6E-02	4.6E-03	2.5E-03	4.6E-03	9.0E-03	2.4E-03
Uranium	µg/L	-	33	15	2.1E+00	3.6E+00	5.0E+00	8.1E-01	9.6E-01	1.9E+00	3.3E+00	7.9E-01
Zinc	µg/L	400	11.3	2.2	2.0E+00	**5.4E+00**	**1.6E+01**	**3.4E+00**	1.0E+00	1.5E+00	2.0E+00	5.0E-01
Chloride	µg/L	-	640000	120000	1.5E+04	3.0E+04	4.0E+04	6.4E+03	4.0E+03	7.8E+03	1.3E+04	2.9E+03
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	3.0E+02	3.0E+02	3.0E+02	5.0E-01	3.0E+02	3.0E+02	3.0E+02	5.0E-01
Nitrite (as Nitrogen)	µg/L	-	-	60	**1.5E+02**	**1.5E+02**	**1.5E+02**	2.5E-01	**1.5E+02**	**1.5E+02**	**1.5E+02**	2.5E-01
Nitrate (as Nitrogen)	µg/L	-	124000	3000	3.0E+02	3.0E+02	3.0E+02	5.0E-01	3.0E+02	3.0E+02	3.0E+02	5.0E-01
Total Ammonia (as Nitrogen)	µg/L	-	-	689	**3.1E+03**	**2.3E+04**	**4.2E+04**	**1.1E+04**	**1.5E+04**	**2.1E+04**	**2.8E+04**	**5.0E+03**
Un-ionized Ammonia (as	µg/L	500	16	16	**1.4E+02**	**1.5E+03**	**2.9E+03**	**8.5E+02**	**9.1E+02**	**1.3E+03**	**1.7E+03**	**2.9E+02**
Cyanide, Total	µg/L	500	-	-	1.0E+01	7.5E+02	1.7E+03	7.0E+02	8.4E+02	1.3E+03	1.7E+03	3.3E+02
Cyanide, WAD	µg/L	-	-	5	1.0E+00	**6.2E+02**	**1.7E+03**	**6.0E+02**	**6.0E+02**	**9.5E+02**	**1.2E+03**	**2.6E+02**
Sulphate	µg/L	-	-	-	2.4E+05	9.3E+05	1.2E+06	2.1E+05	1.8E+05	2.9E+05	4.1E+05	8.7E+04
Fluoride	µg/L	-	-	120	**5.3E+02**	**1.3E+03**	**2.2E+03**	**5.3E+02**	**5.6E+02**	**1.2E+03**	**1.8E+03**	**5.0E+02**
Radium-226	Bq/L	0.37	-	-	5.0E-03	5.0E-03	5.0E-03	8.7E-19	5.0E-03	5.0E-03	5.0E-03	8.3E-06
Cyanate[1]	µg/L	-	-	-	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Total Alkalinity (as $CaCO_3$)	mg/L	-	-	-	1.2E+02	1.7E+02	2.3E+02	3.2E+01	1.2E+02	1.4E+02	1.8E+02	2.3E+01
pH[2]	pH	6.0-9.5	-	6.5-9.0	8.0E+00	8.2E+00	8.4E+00	1.1E-01	8.2E+00	8.3E+00	8.3E+00	3.1E-02
Hardness (as $CaCO_3$)	µg/L	-	-	-	9.9E-01	1.0E+00	1.0E+00	1.7E-03	9.9E-01	1.0E+00	1.0E+00	1.7E-03
Thiocyanate[1]	µg/L	-	-	-	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Notes: See Table B-1 notes for details on the parameters and guidelines.

[1]Cyanate and thiocyanate are two main species generated from the cyanide destruction processes at the mill. Their concentrations in the shake flask extraction solution of waste rock, ore, and overburden are assumed to be zero.

[2]pH is included in this table for information only; pH is not not tracked by the model.

[3]Total and un-ionized ammonia results for day 28 to account for the ammonia formation in the TMF pond as a result of CN degradation

K Ageing = the first order of constant derived from laboratory tests (see Valentine Gold Project: Leprechaun Project Acid Rock Drainage/Metal Leaching (ARD/ML) Assessment Report for complete results

Appendix C Water Quality Model Results

Table C-1 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase in Waste Rock Pore Water

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile	Berry Waste Rock Pile
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**600**	**600**	**600**	**600**	**600**	**600**
Antimony	µg/L	-	-	-	0.5	0.5	1	0.5	35.4	27.8	17.7	13.3	21.9	16.2	21.9	16.2
Arsenic	µg/L	100	-	5	2.0	1.1	2	1.1	**73.4**	**58.3**	**6.0**	4.6	**6.9**	**5.2**	**6.9**	**5.2**
Barium	µg/L	-	-	-	7.3	3.9	7	3	138	117	44	33	48	35	48	35
Boron	µg/L	-	29000	1500	25	25	25	25	436	367	43	33	51	38	51	38
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.50**	**0.42**	**0.11**	**0.09**	**0.12**	**0.09**	**0.12**	**0.09**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	235122	193818	115368	87355	139585	103620	139585	103620
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**9.5**	**7.3**	**5.3**	**3.8**	**5.8**	**4.3**	**5.8**	**4.3**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**91.4**	**72.0**	**44.0**	**33.7**	**46.5**	**34.3**	**46.5**	**34.3**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**306**	**549**	280	**556**	**301**	**556**	**301**
Lead	µg/L	80	-	1	0.36	0.29	0.4	0.3	**2.6**	**2.2**	**1.1**	0.8	**1.3**	0.9	**1.3**	0.9
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	24302	19381	12575	9344	14514	10697	14514	10697
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**1320**	**1320**	**551**	**423**	**677**	**509**	**677**	**509**
Mercury	µg/L	-	-	0.026	0.017	0.011	0.02	0.01	**0.51**	**0.41**	**0.26**	**0.19**	**0.30**	**0.23**	**0.30**	**0.23**
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	**159.5**	**133.6**	16.9	12.3	20.5	14.7	20.5	14.7
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	9.9	8.1	2.1	1.6	2.6	1.9	2.6	1.9
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	60928	51655	8395	6306	8815	6515	8815	6515
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	**5.9**	**5.0**	0.9	0.7	**1.1**	0.8	**1.1**	0.8
Silver	µg/L	-	-	0.25	0.05	0.05	0.1	0.1	**2.0**	**1.6**	**1.0**	**0.7**	**1.2**	**0.9**	**1.2**	**0.9**
Sodium	µg/L	-	-	-	3306	2260	3306	2236	188088	152641	5764	4335	5957	4502	5957	4502
Thallium	µg/L	-	-	0.8	0.05	0.05	0.1	0.1	0.3	0.2	0.2	0.1	0.2	0.1	0.2	0.1
Uranium	µg/L	-	33	15	0.14	0.09	0.1	0.1	**151.3**	**107.9**	9.4	7.0	9.9	7.1	9.9	7.1
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7**	**4.7**	**80.2**	**63.2**	**40.3**	**30.3**	**47.9**	**35.3**	**47.9**	**35.3**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3020	4689	3020	4752	3080	4752	3080
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	154353	70012	97	56	104	58	104	58
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**3469**	**1574**	12	8	12	8	12	8
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	**150884**	**68439**	102	56	100	57	102	57
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**19083**	**8657**	126	59	135	61	135	61
Un-ionized Ammonia (as Nitrogen)	µg/L	500	16	16	5.1	2.34	5	2.29	725(*)	**329**	4.79	2.23	5.12	2.34	5.12	2.34
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	10	10	10	10
Cyanide, WAD	µg/L	-	-	5	1	1	1	1	1	1	1	1	1	1	1	1
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	174212	142544	69312	52142	76040	53723	76040	53723
Fluoride	µg/L	-	-	120	60	60	60	60	**1600**	**1600**	**1600**	**1204**	**1405**	**1036**	**1600**	**1204**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.208	0.164	0.103	0.077	0.105	0.079	0.105	0.079

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
(*)Model artifact, see Section 6.2.1 for explanation

Table C-2 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase in Low Grade Ore Pore Water

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	Marathon/Berry LGO Pile	Marathon/Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile	Marathon/ Berry LGO Pile
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**228**	**128**	**233**	**131**	**233**	**131**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	20	15	0.5	0.5	0.5	0.5	0.5	0.5
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**12**	**9.3**	1.8	1.1	2.0	1.1	2.0	1.1
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	53	41	7.2	3.9	7.3	3.7	7.3	3.9
Boron	µg/L	-	29000	1500	25	25	25	25	239	179	25	25	25	25	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.17**	**0.12**	0.02	0.01	0.02	0.01	0.02	0.01
Calcium	µg/L	-	-	-	19620	9767	17073	8957	145542	113939	18074	9393	18252	9767	18252	9767
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**5.0**	**2.5**	**4.7**	**2.4**	**5.1**	**2.4**	**5.1**	**2.4**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**43**	**31**	1.7	1.1	1.8	1.1	1.8	1.1
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	274	**549**	270	**556**	286	**556**	286
Lead	µg/L	80	-	1	0.36	0.29	0.4	0.3	0.91	0.66	0.3	0.3	0.36	0.29	0.36	0.29
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	15492	11442	2097	1180	2217	1250	2217	1250
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**666**	**497**	**398**	186	**448**	194	**448**	194
Mercury	µg/L	-	-	0.026	0.017	0.011	0.02	0.01	**0.141**	**0.110**	0.0	0.0	0.017	0.011	0.017	0.011
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	**111.6**	**77.2**	1.5	1.2	1.5	1.2	1.5	1.2
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	8.7	5.5	1.0	1.0	1.0	1.0	1.0	1.0
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	22280	17200	622	335	761	353	761	353
Selenium	µg/L	-	-	1	0.5	0.5	0.50	0.45	**5.2**	**3.9**	0.5	0.5	0.5	0.5	0.5	0.5
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.05	**0.71**	**0.55**	0.1	0.1	0.05	0.05	0.05	0.05
Sodium	µg/L	-	-	-	3306	2260	3306	2236	109542	79351	3212	2184	3306	2260	3306	2260
Thallium	µg/L	-	-	0.8	0.05	0.05	0.1	0.1	0.28	0.18	0.1	0.1	0.05	0.05	0.05	0.05
Uranium	µg/L	-	33	15	0.14	0.09	0.1	0.1	**34.69**	**23.47**	0.1	0.1	0.14	0.09	0.14	0.09
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**4.7**	**28.2**	**22.0**	**7.4**	**4.8**	**7.9**	**4.8**	**7.9**	**4.8**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3020	4689	3020	4752	3080	4752	3080
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	231744	105478	97	56	104	58	104	58
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**5208**	**2371**	12	8	12	8	12	8
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	**226536**	**103107**	102	56	100	57	102	57
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**28645**	**13039**	126	59	135	61	135	61
Un-ionized Ammonia (as	µg/L	500	16	16	5.1	2.34	4.8	2.3	1088.51(*)	**495.48**	4.8	2.2	5.12	2.34	5.1	2.3
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	10	10	10	10
Cyanide, WAD	µg/L	-	-	5	1.01	1.00	1.0	1.0	1.01	1.00	1.0	1.0	1.01	1.00	1.01	1.00
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	187415	141198	2822	1726	3082	1774	3082	1774
Fluoride	µg/L	-	-	120	60	60	60	60	**1100**	**835**	60	60	60	60	60	60
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.079	0.065	0.005	0.005	0.005	0.005	0.005	0.005

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
(*)Model artifact, see Section 6.2.1 for explanation

Table C-3 Highest Value of the Monthly Mean and 95th Percentile Concentrations in TMF Pond for Each Project Phase

Parameter	Units	MDMER	CWQG-FAL	**CWQG-FAL**	Baseline	Baseline	TMF	TMF	TMF	TMF	TMF	TMF	TMF	TMF	TMF	TMF
Project Phase					All	ALL	1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	97	54	**362**	**168**	na	na	na	na	na	na
Antimony	µg/L	-	-	-	0.5	0.5	0.4	0.4	6.7	3.3	na	na	na	na	na	na
Arsenic	µg/L	100	-	5	2.0	1.1	4.9	2.4	**10**	**6.0**	na	na	na	na	na	na
Barium	µg/L	-	-	-	7.3	3.9	2.2	1.4	41	22	na	na	na	na	na	na
Boron	µg/L	-	29000	1500	25	25	20	20	76	54	na	na	na	na	na	na
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.01	0.01	**0.10**	**0.06**	na	na	na	na	na	na
Calcium	µg/L	-	-	-	19620	9767	9854	5878	399905	214630	na	na	na	na	na	na
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**1.4**	0.8	**3.1**	**1.3**	na	na	na	na	na	na
Copper	µg/L	100	-	2	1.9	1.1	1.3	0.8	**569**	**294**	na	na	na	na	na	na
Iron	µg/L	-	-	300	**556**	286	241	142	**662**	248	na	na	na	na	na	na
Lead	µg/L	80	-	1	0.36	0.29	0.21	0.20	0.50	0.26	na	na	na	na	na	na
Magnesium	µg/L	-	-	-	2217	1264	1158	736	72408	38135	na	na	na	na	na	na
Manganese	µg/L	-	596	210	**448**	194	**219**	102	**1320**	**701**	na	na	na	na	na	na
Mercury	µg/L	-	-	0.026	0.017	0.011	0.008	0.006	**0.288**	**0.103**	na	na	na	na	na	na
Molybdenum	µg/L	-	-	73	1.5	1.2	0.8	0.8	40	25	na	na	na	na	na	na
Nickel	µg/L	250	-	25	1.0	1.0	0.8	0.8	4.9	3.0	na	na	na	na	na	na
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**45**	**50**	**50**	na	na	na	na	na	na
Potassium	µg/L	-	-	-	761	353	176	112	13333	7496	na	na	na	na	na	na
Selenium	µg/L	-	-	1	0.5	0.5	0.4	0.3	**2.3**	**1.0**	na	na	na	na	na	na
Silver	µg/L	-	-	0.25	0.05	0.05	0.04	0.04	**0.98**	**0.41**	na	na	na	na	na	na
Sodium	µg/L	-	-	-	3306	2260	1656	1306	205920	138492	na	na	na	na	na	na
Thallium	µg/L	-	-	0.8	0.05	0.05	0.04	0.04	0.11	0.08	na	na	na	na	na	na
Uranium	µg/L	-	33	15	0.14	0.09	0.07	0.05	1.89	1.27	na	na	na	na	na	na
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**5.1**	**3.5**	**19**	**9.1**	na	na	na	na	na	na
Chloride	µg/L	-	640000	120000	4752	3080	2605	1898	15926	11283	na	na	na	na	na	na
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	92	49	208	141	na	na	na	na	na	na
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	4.2	4.0	**68**	51	na	na	na	na	na	na
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	87	49	209	143	na	na	na	na	na	na
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	60	36	**109404**	**82635**	na	na	na	na	na	na
Un-ionized Ammonia (as Nitrogen)	µg/L	500	16	16	5	2.34	2.3	1.37	**4157**	**3140**	na	na	na	na	na	na
Cyanide, Total	µg/L	500	-	-	10	10	8.1	7.8	3195	2322	na	na	na	na	na	na
Cyanide, WAD	µg/L	-	-	5	1.01	1.00	0.8	0.78	**582**	**372**	na	na	na	na	na	na
Sulphate	µg/L	-	-	-	3082	1774	1397	1028	1016000	541986	na	na	na	na	na	na
Fluoride	µg/L	-	-	120	60	60	49	47	**1600**	**820**	na	na	na	na	na	na
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0	0.004	0.035	0.021	na	na	na	na	na	na

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na : Predicted concentrations are not available because there is no water in the Project Expansion facility during the project phase

Table C-4 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase in Combined SW and Central Pit and NE Pit Water

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	SW and Central Pit	NE Pit	NE Pit	NE Pit	NE Pit	NE Pit	NE Pit	NE Pit	NE Pit	NE Pit	NE Pit
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure	1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**587**	**559**	**233**	**131**	**587**	**559**	**222**	**124**	**600**	**600**	**600**	**600**	**600**	**600**	**600**	**600**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	3.9	3.1	3.1	2.8	0.5	0.5	3.1	2.8	0.5	0.5	13.0	11.7	12.7	11.5	11.7	10.7	12.7	11.5
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**10.9**	**8.6**	**9.4**	**8.6**	2.0	1.5	**9.4**	**8.6**	1.8	1.1	**14.7**	**12.8**	**12.2**	**11.0**	**9.9**	**9.0**	**12.2**	**11.0**
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	30.5	26.1	21.3	20.2	18.4	17.7	21.3	20.2	6.7	3.4	47.0	43.1	45.8	41.9	40.6	37.8	45.8	41.9
Boron	µg/L	-	29000	1500	25	25	25	25	73	58	54	51	46	45	54	51	25.2	25.0	85.8	76.1	73.8	67.3	61.0	55.5	73.8	67.3
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.11**	**0.10**	**0.07**	**0.07**	**0.07**	**0.06**	**0.07**	**0.07**	0.02	0.01	**0.16**	**0.15**	**0.15**	**0.14**	**0.13**	**0.12**	**0.15**	**0.14**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	155535	111717	105658	98585	87579	82762	105658	98585	17073	8957	105631	96307	103450	94634	93497	87538	103450	94634
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**5.0**	**2.5**	**4.7**	**2.4**	**5.1**	**2.4**	**5.1**	**2.4**	**5**	**2.3**	**5**	**3.3**	**5**	**3.2**	**5**	**3.3**	**5**	**3.3**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**24.0**	**21.6**	**25.7**	**24.5**	**32.8**	**31.2**	**32.8**	**31.2**	2	1.1	**35**	**31.3**	**34**	**30.8**	**31**	**28.3**	**34**	**30.8**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**352**	**549**	**340**	**556**	286	**556**	**340**	**536**	281	**520**	**309**	**549**	294	**556**	292	**556**	294
Lead	µg/L	80	-	1	0.36	0.29	0.36	0.29	0.45	0.40	0.35	0.33	0.36	0.29	0.36	0.33	0.36	0.29	0.96	0.87	0.94	0.85	0.85	0.78	0.94	0.85
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	24282	16863	16254	15078	12820	12072	16254	15078	1983	1192	9758	8904	9638	8789	8797	8221	9638	8789
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**643**	**505**	**474**	**441**	**448**	**392**	**474**	**441**	**392**	178	**561**	**517**	**553**	**510**	**509**	**478**	**553**	**510**
Mercury	µg/L	-	-	0.026	0.017	0.011	0.016	0.01	**0.09**	**0.06**	**0.06**	**0.05**	0.02	0.01	**0.06**	**0.05**	0.02	0.01	**0.18**	**0.16**	**0.18**	**0.16**	**0.16**	**0.15**	**0.18**	**0.16**
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	27	20	20	18	17	16	20	18	1.4	1.2	33	30	29	26	24	22	29	26
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	3.2	2.5	2.3	2.1	2.0	2.0	2.3	2.1	1.0	1.0	2.5	2.3	2.4	2.2	2.0	1.9	2.4	2.2
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	10266	8285	6842	6440	5681	5433	6842	6440	622	329	13801	12478	12436	11348	10306	9475	12436	11348
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	**1.7**	**1.4**	**1.3**	**1.2**	0.5	0.5	**1.3**	**1.2**	0.5	0.5	**1.8**	**1.6**	**1.5**	**1.4**	**1.3**	**1.2**	**1.5**	**1.4**
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.05	**0.37**	**0.25**	**0.26**	0.22	0.05	0.05	**0.26**	0.22	0.05	0.05	**0.73**	**0.66**	**0.72**	**0.65**	**0.66**	**0.61**	**0.72**	**0.65**
Sodium	µg/L	-	-	-	3306	2260	3306	2236	104984	75809	78233	72472	67586	63955	78233	72472	3306	2236	34760	29795	24627	22204	18990	17036	24627	22204
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.16	0.14	0.11	0.10	0.10	0.09	0.11	0.10	0.05	0.05	0.15	0.15	0.15	0.14	0.14	0.14	0.15	0.14
Uranium	µg/L	-	33	15	0.14	0.09	0.13	0.1	6.3	4.3	3.1	2.7	2.6	2.3	3.1	2.7	0.1	0.1	**24**	**21**	**20**	**18**	**16**	15	**20**	**18**
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**4.7**	**11**	**9.7**	**7.4**	**7.2**	**7.9**	**4.8**	**7.9**	**7.2**	**7.4**	**4.7**	**30**	**27**	**29**	**27**	**27**	**25**	**29**	**27**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	12978	10233	8546	8088	7113	6801	8546	8088	4506	3021	5760	5516	4689	3132	4752	3111	4752	3132
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	14956	6761	1121	859	854	663	1121	859	97	56	32672	16556	2512	2149	1834	1579	2512	2149
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**355**	**189**	57	50	46	41	57	50	11	8	**752**	**395**	**68**	59	52	46	**68**	59
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	**14621**	6610	1102	842	836	650	1102	842	93	55	**31939**	**16185**	2456	2101	1793	1544	2456	2101
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**48177**	**32695**	**16610**	**12707**	**12796**	**9632**	**16610**	**12707**	128	60	**4168**	**2176**	379	331	290	257	379	331
Un-ionized Ammonia (as Nitrogen)	µg/L	500	16	16	5.1	2.34	4.85	2.29	**1831**	**1242**	**631**	**483**	**486**	**366**	**631**	**483**	5	2	**158**	**83**	14	13	11	10	14	13
Cyanide, Total	µg/L	500	-	-	10	10	10	10	6328	4614	4865	3814	10	10	4865	3814	10	10	16	15	10	10	10	10	10	10
Cyanide, WAD	µg/L	-	-	5	1.01	1.00	1.01	1.00	**866**	**465**	**705**	**386**	1	1	**705**	**386**	1	1	2	2	1	1	1	1	1	1
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	418271	284416	292658	267698	249469	233139	292658	267698	2871	1726	63710	57839	62140	56501	55409	51319	62140	56501
Fluoride	µg/L	-	-	120	60	60	60	60	**833**	**624**	**569**	**534**	**472**	**449**	**569**	**534**	60	60	**1025**	**958**	**1030**	**954**	**985**	**876**	**1030**	**954**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.060	0.055	0.044	0.043	0.041	0.040	0.044	0.043	0.005	0.005	0.093	0.085	0.090	0.083	0.079	0.074	0.090	0.083

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100

Table C-5 Highest Value of the Monthly Mean and 95th Percentile Concentrations in Water for Each Project Phase at BER-FDP-01A Discharge Point

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A	BER-FDP-01A
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**600**	**600**	na	na	**600**	**600**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	19.1	15.2	4.0	3.1	na	na	4.0	3.1
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**40**	**34**	**21**	**12**	na	na	**21**	**12**
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	76.7	67.0	11.6	9.7	na	na	11.6	9.7
Boron	µg/L	-	29000	1500	25	25	25	25	245	211	25	25	na	na	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.29**	**0.25**	**0.08**	**0.05**	na	na	**0.08**	**0.05**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	130398	110660	26921	21227	na	na	26921	21227
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2**	**5.3**	**4.3**	**4.7**	**2.5**	na	na	**4.7**	**2.5**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1	**49.5**	**39.3**	**12.9**	**10.1**	na	na	**12.9**	**10.1**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**329**	**549**	**332**	na	na	**549**	**332**
Lead	µg/L	80	-	1	0.36	0.29	0.4	0.3	**1.4**	**1.3**	0.7	0.5	na	na	0.7	0.5
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	13338	10814	2888	2243	na	na	2888	2243
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**643**	**562**	**398**	**211**	na	na	**398**	**211**
Mercury	µg/L	-	-	0.026	0.017	0.011	0.02	0.01	**0.28**	**0.22**	**0.05**	**0.04**	na	na	**0.05**	**0.04**
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1	**85.8**	**75.1**	6.2	4.8	na	na	6.2	4.8
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1	5.5	4.7	1.0	1.0	na	na	1.0	1.0
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	34148	29807	3206	2549	na	na	3206	2549
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	**3.5**	**3.1**	0.9	0.6	na	na	0.9	0.6
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.1	**1.1**	**0.9**	0.2	0.1	na	na	0.2	0.1
Sodium	µg/L	-	-	-	3306	2260	3306	2236	104038	87828	3212	2623	na	na	3212	2623
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.17	0.13	0.05	0.05	na	na	0.05	0.05
Uranium	µg/L	-	33	15	0.14	0.09	0.13	0.08	**75.8**	**60.6**	2.23	1.75	na	na	2.23	1.75
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**4.68**	**43.7**	**35.1**	**9.16**	**7.36**	na	na	**9.16**	**7.36**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3246	4689	3020	na	na	4689	3020
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	17167	12470	97	59	na	na	97	59
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**390**	**284**	12	9	na	na	12	9
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	**16781**	12190	102	59	na	na	102	59
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**2146**	**1565**	121	64	na	na	121	64
Un-ionized Ammonia (as	µg/L	500	16	16	5.1	2.34	4.85	2	**81.55**	**59.47**	4.61	2.44	na	na	4.61	2.44
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	na	na	10	10
Cyanide, WAD	µg/L	-	-	5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	na	na	1.0	1.0
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	95575	80923	16044	12817	na	na	16044	12817
Fluoride	µg/L	-	-	120	60	60	60	60	**1106**	**1026**	**397**	**314**	na	na	**397**	**314**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.129	0.105	0.056	0.052	na	na	0.056	0.052

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Table C-6 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase at BER-FDP-01B Discharge Point

Parameter	Units	MDMER	CWQG-FAL	**CWQG-FAL**	Baseline	Baseline	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B	BER-FDP-01B
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**600**	**600**	na	na	**600**	**600**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	19.4	15.5	4.6	3.6	na	na	4.6	3.6
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**40.3**	**34.0**	**19.0**	**11.7**	na	na	**19.0**	**11.7**
Barium	µg/L	-	-	-	7.3	3.9	7	3.4	78	68	13	11	na	na	13	11
Boron	µg/L	-	29000	1500	25	25	25	25	247	213	25	25	na	na	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.29**	**0.25**	**0.07**	**0.05**	na	na	**0.07**	**0.05**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	132836	112026	30518	24627	na	na	30518	24627
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**5.4**	**4.3**	**4.7**	**2.5**	na	na	**4.7**	**2.5**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**50**	**40**	**14**	**11**	na	na	**14**	**11**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**324**	**549**	**327**	na	na	**549**	**327**
Lead	µg/L	80	-	1	0.36	0.29	0.36	0.29	**1.46**	**1.28**	0.66	0.47	na	na	0.66	0.47
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	13606	11003	3285	2606	na	na	3285	2606
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**652**	**570**	**398**	**217**	na	na	**398**	**217**
Mercury	µg/L	-	-	0.026	0.017	0.011	0.02	0.01	**0.28**	**0.23**	**0.06**	**0.05**	na	na	**0.06**	**0.05**
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	**86.8**	**76.0**	6.4	5.1	na	na	6.4	5.1
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	5.5	4.7	1.0	1.0	na	na	1.0	1.0
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	34518	30144	3312	2688	na	na	3312	2688
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	**3.5**	**3.1**	0.9	0.6	na	na	0.9	0.6
Silver	µg/L	-	-	0.25	0.05	0.05	0.1	0.1	**1.1**	**0.9**	0.2	0.2	na	na	0.2	0.2
Sodium	µg/L	-	-	-	3306	2260	3306	2236	105140	88884	3212	2688	na	na	3212	2688
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.17	0.14	0.05	0.05	na	na	0.05	0.05
Uranium	µg/L	-	33	15	0.14	0.09	0.13	0.08	**76.7**	**61.3**	2.57	2.02	na	na	2.57	2.02
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**5**	**44.5**	**35.7**	**11**	**8.5**	na	na	**10.8**	**8.5**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3221	4689	3020	na	na	4689	3020
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	17065	12472	97	59	na	na	97	59
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**388**	**284**	12	9	na	na	12	9
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	**16680**	12192	102	59	na	na	102	59
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**2133**	**1564**	121	63	na	na	121	63
Un-ionized Ammonia (as	µg/L	500	16	16	5.1	2.34	4.85	2	**81.05**	**59.43**	5	2.41	na	na	4.61	2.41
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	na	na	10	10
Cyanide, WAD	µg/L	-	-	5	1	1	1.0	1.0	1.0	1.0	1.0	1.0	na	na	1.0	1.0
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	96573	81892	18224	14763	na	na	18224	14763
Fluoride	µg/L	-	-	120	60	60	60	60	**1118**	**1038**	**455**	**363**	na	na	**455**	**363**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0	0.130	0.106	0	0.053	na	na	0.058	0.053

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Table C-7 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase at BER-FDP-02 Discharge Point

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02	BER-FDP-02
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**600**	**600**	na	na	**600**	**600**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	19.1	15.2	4.9	3.8	na	na	4.9	3.8
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**39.6**	**33.4**	**17.7**	**11.1**	na	na	**17.7**	**11.1**
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	76.5	66.8	14.0	11.4	na	na	14.0	11.4
Boron	µg/L	-	29000	1500	25	25	25	25	243	210	25	25	na	na	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.29**	**0.25**	**0.07**	**0.05**	na	na	**0.07**	**0.05**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	130247	110336	32549	26136	na	na	32549	26136
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**5**	**2.3**	**5.3**	**4.3**	**4.7**	**2.5**	na	na	**4.7**	**2.5**
Copper	µg/L	100	-	2	1.9	1.1	2	1.1	**49.5**	**39.2**	**14.8**	**11.7**	na	na	**14.8**	**11.7**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**324**	**549**	**325**	na	na	**549**	**325**
Lead	µg/L	80	-	1	0.36	0.29	0.4	0.3	**1.4**	**1.3**	0.6	0.5	na	na	0.6	0.5
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	13346	10802	3491	2774	na	na	3491	2774
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**643**	**563**	**398**	**221**	na	na	**398**	**221**
Mercury	µg/L	-	-	0.026	0.017	0.011	0	0.011	**0.28**	**0.22**	**0.07**	**0.05**	na	na	**0.07**	**0.05**
Molybdenum	µg/L	-	-	73	1.5	1.2	1	1.2	**85.6**	**74.8**	6.5	5.2	na	na	6.5	5.2
Nickel	µg/L	250	-	25	1.0	1.0	1	1.0	5.4	4.7	1.0	1.0	na	na	1.0	1.0
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	33909	29673	3309	2738	na	na	3309	2738
Selenium	µg/L	-	-	1	0.5	0.5	0	0.5	**3.5**	**3.1**	0.8	0.6	na	na	0.8	0.6
Silver	µg/L	-	-	0.25	0.05	0.05	0	0.05	**1.07**	**0.85**	0.25	0.19	na	na	0.25	0.19
Sodium	µg/L	-	-	-	3306	2260	3306	2236	103554	87486	3212	2720	na	na	3212	2720
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.17	0.14	0.05	0.05	na	na	0.05	0.05
Uranium	µg/L	-	33	15	0.14	0.09	0.13	0.08	**75**	**60**	2.68	2.12	na	na	2.68	2.12
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7**	**4.7**	**44**	**35**	**11.5**	**9.1**	na	na	**11.5**	**9.1**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3187	4689	3020	na	na	4689	3020
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	22740	17558	97	58	na	na	97	58
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**517**	**401**	12	9	na	na	12	9
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	**22223**	**17165**	102	59	na	na	102	59
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**2848**	**2212**	121	63	na	na	121	63
Un-ionized Ammonia (as	µg/L	500	16	16	5.1	2.34	5	2.29	**108**	**84**	4.61	2.40	na	na	4.61	2.40
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	na	na	10	10
Cyanide, WAD	µg/L	-	-	5	1	1	1	1	1	1	1	1	na	na	1	1
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	94909	80603	19155	15561	na	na	19155	15561
Fluoride	µg/L	-	-	120	60	60	60	60	**1097**	**1023**	**479**	**383**	na	na	**479**	**383**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.127	0.104	0.058	0.052	na	na	0.058	0.052

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Table C-8 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase at BER-FDP-03 Discharge Point

Parameter	Units	MDMER	CWQG-FAL	**CWQG-FAL**	Baseline	Baseline	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03	BER-FDP-03
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**600**	**600**	**600**	**600**	na	na	**600**	**600**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	15.7	13	4.2	3.3	na	na	4.2	3.3
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**20.2**	**17**	**18.3**	**11.7**	na	na	**18.3**	**11.7**
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	41	35	12	10	na	na	12	10
Boron	µg/L	-	29000	1500	25	25	25	25	134	117	25	25	na	na	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.15**	**0**	**0.07**	**0.05**	na	na	**0.07**	**0.05**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	107114	85816	27879	22686	na	na	27879	22686
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**5.0**	**4**	**4.7**	**2.5**	na	na	**4.7**	**2.5**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**41.2**	**33**	**13.0**	**10.5**	na	na	**13.0**	**10.5**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**325**	**549**	**328**	na	na	**549**	**328**
Lead	µg/L	80	-	1	0.36	0.29	0.36	0.29	0.99	1	0.63	0.46	na	na	0.63	0.46
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	10972	9139	2973	2398	na	na	2973	2398
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**502**	**415**	**398**	**213**	na	na	**398**	**213**
Mercury	µg/L	-	-	0.026	0.017	0.011	0.016	0.011	**0.23**	**0.19**	**0.05**	**0.04**	na	na	**0.05**	**0.04**
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	43.2	38	6.1	4.9	na	na	6.1	4.9
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	3.2	3	1.0	1.0	na	na	1.0	1.0
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	17096	14902	3133	2563	na	na	3133	2563
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	**2.0**	**2**	0.8	0.6	na	na	0.8	0.6
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.05	**0.88**	**1**	0.21	0.16	na	na	0.21	0.16
Sodium	µg/L	-	-	-	3306	2260	3306	2236	53181	44505	3212	2646	na	na	3212	2646
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.14	0	0.05	0.05	na	na	0.05	0.05
Uranium	µg/L	-	33	15	0.14	0.09	0.13	0.08	**38**	**30**	2.30	1.85	na	na	2.30	1.85
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**4.7**	**36**	**30**	**9.7**	**7.8**	na	na	**9.7**	**7.8**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3179	4689	3020	na	na	4689	3020
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	10820	8337	97	59	na	na	97	59
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**249**	**194**	12	9	na	na	12	9
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	10577	8151	102	59	na	na	102	59
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**1370**	**1073**	121	64	na	na	121	64
Un-ionized Ammonia (as	µg/L	500	16	16	5.1	2.34	4.85	2.29	**52**	**41**	4.61	2.43	na	na	4.61	2.43
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	na	na	10	10
Cyanide, WAD	µg/L	-	-	5	1	1	1	1	1	1	1	1	na	na	1	1
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	65896	51839	16499	13573	na	na	16499	13573
Fluoride	µg/L	-	-	120	60	60	60	60	**960**	**901**	**409**	**334**	na	na	**409**	**334**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.111	0	0.056	0.051	na	na	0.056	0.051

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Table C-9 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase at BER-FDP-04 and MA-FDP-01AB Discharge Points

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	BER-FDP-04	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB	MA_FDP_SP01AB
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure	1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**149**	**311**	**267**	**272**	**234**	na	na	**272**	**234**	**222**	**124**	**535**	**426**	**271**	**252**	na	na	**271**	**252**
Antimony	µg/L	-	-	-	0.5	0.5	1.0	0.8	4.3	3.5	1.3	0.9	na	na	1.3	0.9	0.5	0.5	4.8	4.1	1.0	0.8	na	na	1.0	0.8
Arsenic	µg/L	100	-	5	2.0	1.1	**10**	**7.5**	**18.8**	**12.5**	**15**	**11.0**	na	na	**15**	**11.0**	1.8	1	**20.3**	**15.7**	**10.7**	**8**	na	na	**10.7**	**8.2**
Barium	µg/L	-	-	-	7.3	3.9	6.7	4.5	13.4	11.5	7.2	4.4	na	na	7.2	4.4	6.7	3.4	16.3	13.2	7.2	4.4	na	na	7.2	4.4
Boron	µg/L	-	29000	1500	25	25	25	25	47	40	25	25	na	na	25	25	25	25	77	61	25	25	na	na	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.03	0.02	**0.08**	**0.05**	**0.05**	0.03	na	na	**0.05**	0.03	0.02	0.01	**0.08**	**0.06**	0.04	0.03	na	na	0.04	0.03
Calcium	µg/L	-	-	-	19620	9767	17073	10550	33213	28052	17548	9596	na	na	17548	9596	17073	8957	37668	32591	17548	9586	na	na	17548	9586
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.5**	**5.0**	**2.4**	**4.7**	**2.4**	na	na	**4.7**	**2.4**	**4.7**	**2.3**	**6.2**	**4.6**	**4.7**	**2.4**	na	na	**4.7**	**2.4**
Copper	µg/L	100	-	2	1.9	1.1	**4.5**	**3.2**	**12**	**10**	**6.2**	**4.3**	na	na	**6.2**	**4.3**	1.9	1.1	**13**	**11**	**4.5**	**3.5**	na	na	**4.5**	**3.5**
Iron	µg/L	-	-	300	**556**	286	**536**	**319**	**520**	**319**	**549**	**315**	na	na	**549**	**315**	**536**	281	**900**	**793**	**549**	293	na	na	**549**	293
Lead	µg/L	80	-	1	0.36	0.29	0.42	0.34	0.63	0.44	0.48	0.34	na	na	0.48	0.34	0.36	0.29	**1.29**	1.00	0.36	0.30	na	na	0.36	0.30
Magnesium	µg/L	-	-	-	2217	1264	1983	1317	3263	2817	2097	1185	na	na	2097	1185	1983	1192	4234	3266	2097	1188	na	na	2097	1188
Manganese	µg/L	-	596	210	**448**	194	**392**	**214**	**443**	**220**	**398**	188	na	na	**398**	188	**392**	178	**587**	**444**	**398**	187	na	na	**398**	187
Mercury	µg/L	-	-	0.026	0.017	0.011	0.02	0.01	**0.03**	**0.03**	0.02	0.01	na	na	0.02	0.01	0.02	0.01	**0.04**	**0.03**	0.02	0.01	na	na	0.02	0.01
Molybdenum	µg/L	-	-	73	1.5	1.2	2.8	2.1	20.6	16.8	4.1	2.9	na	na	4.1	2.9	1.4	1.2	23.8	19.7	3.5	3.0	na	na	3.5	3.0
Nickel	µg/L	250	-	25	1.0	1.0	1.01	1.00	1.85	1.53	1.01	1.00	na	na	1.01	1.00	1.01	1.00	3.55	2.77	1.01	1.00	na	na	1.01	1.00
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**
Potassium	µg/L	-	-	-	761	353	1305	1021	5450	4684	2021	1501	na	na	2021	1501	622	329	6138	5373	1667	1395	na	na	1667	1395
Selenium	µg/L	-	-	1	0.5	0.5	0.6	0.5	**1.5**	**1.2**	0.7	0.5	na	na	0.7	0.5	0.5	0.5	**2.0**	**1.6**	0.5	0.5	na	na	0.5	0.5
Silver	µg/L	-	-	0.25	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	na	na	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	na	na	0.1	0.1
Sodium	µg/L	-	-	-	3306	2260	3306	2387	20206	16577	3212	2327	na	na	3212	2327	3306	2236	22680	19551	3212	2475	na	na	3212	2475
Thallium	µg/L	-	-	0.8	0.05	0.05	0.1	0.1	0.1	0.1	0.1	0.1	na	na	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	na	na	0.1	0.1
Uranium	µg/L	-	33	15	0.14	0.09	0.5	0.4	6.9	5.1	0.9	0.6	na	na	0.9	0.6	0.1	0.1	7.7	5.9	0.8	0.6	na	na	0.8	0.6
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**5.0**	**7.5**	**6.4**	**7.2**	**4.6**	na	na	**7.2**	**4.6**	**7.4**	**4.7**	**15.9**	**12.2**	**7.2**	**4.6**	na	na	**7.2**	**4.6**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3119	4621	3020	4689	3020	na	na	4689	3020	4506	3021	9240	6988	4689	3020	na	na	4689	3020
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	61	4864	3602	97	56	na	na	97	56	97	56	8575	6142	109	81	na	na	109	81
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	9	**117**	**88**	12	9	na	na	12	9	11	8	**215**	**148**	12	8	na	na	12	8
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	61	4752	3522	102	57	na	na	102	57	93	55	8387	6005	108	80	na	na	108	80
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	70	638	486	121	62	na	na	121	62	128	60	**1207**	**832**	121	62	na	na	121	62
Un-ionized Ammonia (as Nitrogen)	µg/L	500	16	16	5.1	2.34	4.8	2.7	**24.3**	**18.4**	4.6	2.3	na	na	4.6	2.3	4.8	2.3	**45.9**	**31.6**	4.6	2.4	na	na	4.6	2.4
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	na	na	10	10	10	10	40	31	10	10	na	na	10	10
Cyanide, WAD	µg/L	-	-	5	1	1	1	1	1	1	1	1	na	na	1	1	1	1	4	3	1	1	na	na	1	1
Sulphate	µg/L	-	-	-	3082	1774	4316	3260	36295	31027	5980	4563	na	na	5980	4563	2871	1726	42091	36689	5667	4949	na	na	5667	4949
Fluoride	µg/L	-	-	120	60	60	103	91	**284**	**253**	**124**	102	na	na	**124**	102	60	60	**327**	**287**	98	88	na	na	98	88
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.026	0.026	0.051	0.049	0.039	0.039	na	na	0.039	0.039	0.005	0.005	0.074	0.059	0.032	0.032	na	na	0.032	0.032

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Table C-10 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase at BER-FDP-05 Discharge Point

Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05	BER-FDP-05
Project Phase							1-Construction	1-Construction	2A-Operation (Mine Year 1 - 9)	2A-Operation (Mine Year 1 - 9)	2B-Operation (Mine Year 10 - 15)	2B-Operation (Mine Year 10 - 15)	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**597**	**592**	**533**	**513**	**597**	**592**	**377**	**320**	**233**	**162**	**377**	**320**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	1.1	1.0	5.8	3.1	5.8	3.1	6.2	4.9	2.6	2.3	6.2	4.9
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	3.6	3.1	**18.3**	**13.1**	**18.3**	**13.1**	**17.2**	**13.1**	3.0	2.8	**17.2**	**13.1**
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	12	11	22	12	22	12	23	21	20	19	23	21
Boron	µg/L	-	29000	1500	25	25	25	25	25	25	33	27	33	27	45	43	44	43	45	43
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.02	0.01	**0.05**	**0.05**	**0.08**	**0.06**	**0.08**	**0.06**	**0.09**	**0.08**	**0.07**	**0.06**	**0.09**	**0.08**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	26916	26540	46517	25209	46517	26540	76513	71500	73416	69717	76513	71500
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**4.9**	**2.3**	**5.0**	**2.4**	**5**	**2.4**	**4.7**	**2.5**	**5.1**	**2.4**	**5.1**	**2.5**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**3.0**	**2.4**	**17.0**	**10.2**	**17**	**10.2**	**22.1**	**20.8**	**25.3**	**24.2**	**25.3**	**24.2**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**515**	270	**520**	**332**	**520**	**332**	**549**	**327**	**556**	289	**556**	**327**
Lead	µg/L	80	-	1	0.36	0.29	0.36	0.29	0.36	0.29	0.63	0.47	1	0.47	0.73	0.54	0.36	0.29	0.73	0.54
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	2209	1626	4351	2492	4351	2492	10520	9791	9998	9494	10520	9791
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**429**	**260**	**443**	**222**	**443**	**260**	**409**	**370**	**448**	**364**	**448**	**370**
Mercury	µg/L	-	-	0.026	0.017	0.011	0.016	0.011	0.018	0.016	**0.075**	**0.037**	**0**	**0.037**	**0.083**	**0.064**	**0.036**	**0.033**	**0.083**	**0.064**
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	7.3	6.5	14.0	7.7	14	7.7	16.3	14.8	14.8	14.0	16.3	14.8
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.1	1	1.1	1.9	1.8	1.8	1.8	1.9	1.8
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	3262	2932	6125	3632	6125	3632	6520	5953	5439	5156	6520	5953
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	0.6	0.6	**1.0**	0.8	**1**	0.8	**1.1**	0.9	0.5	0.5	**1.1**	0.9
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.05	0.07	0.06	**0.30**	0.16	**0**	0.16	**0.33**	**0.26**	0.15	0.13	**0.33**	**0.26**
Sodium	µg/L	-	-	-	3306	2260	3306	2236	7159	6149	11225	6066	11225	6149	49924	46527	48312	45825	49924	46527
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.10	0.10	0.07	0.06	0.10	0.10	0.10	0.09	0.10	0.09	0.10	0.09
Uranium	µg/L	-	33	15	0.14	0.09	0.1	0.1	4.7	3.2	8.5	4.0	8.5	4.0	9.1	7.2	4.7	4.3	9.1	7.2
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**4.7**	**7.5**	**4.7**	**13.2**	**7.9**	**13.2**	**7.9**	**14.6**	**11.6**	**7.9**	**6.2**	**14.6**	**11.6**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3659	4586	3014	4621	3659	5860	5495	5692	5403	5860	5495
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	9179	5245	1031	461	9179	5245	1067	898	825	711	1067	898
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	**220**	**130**	33	20	**220**	**130**	42	37	39	36	42	37
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	8973	5128	1009	449	8973	5128	1044	879	807	697	1044	879
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	**1205**	**719**	181	109	**1205**	**719**	**10109**	**6827**	**8662**	**6529**	**10109**	**6827**
Un-ionized Ammonia (as Nitrogen)	µg/L	500	16	16	5.1	2.34	4.85	2.29	**46**	**27**	6.87	4.12	**46**	**27**	**384**	**259**	**329**	**248**	**384**	**259**
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	10	10	339	47	10	10	339	47
Cyanide, WAD	µg/L	-	-	5	1	1	1	1	1	1	1	1	1	1	**71**	**12**	1	1	**71**	**12**
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	12196	10840	28199	14844	28199	14844	179547	167019	175042	164364	179547	167019
Fluoride	µg/L	-	-	120	60	60	60	60	**167**	**138**	**503**	**283**	**503**	**283**	**539**	**497**	**481**	**453**	**539**	**497**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.030	0.030	0.064	0.055	0.064	0.055	0.066	0.060	0.041	0.040	0.066	0.060

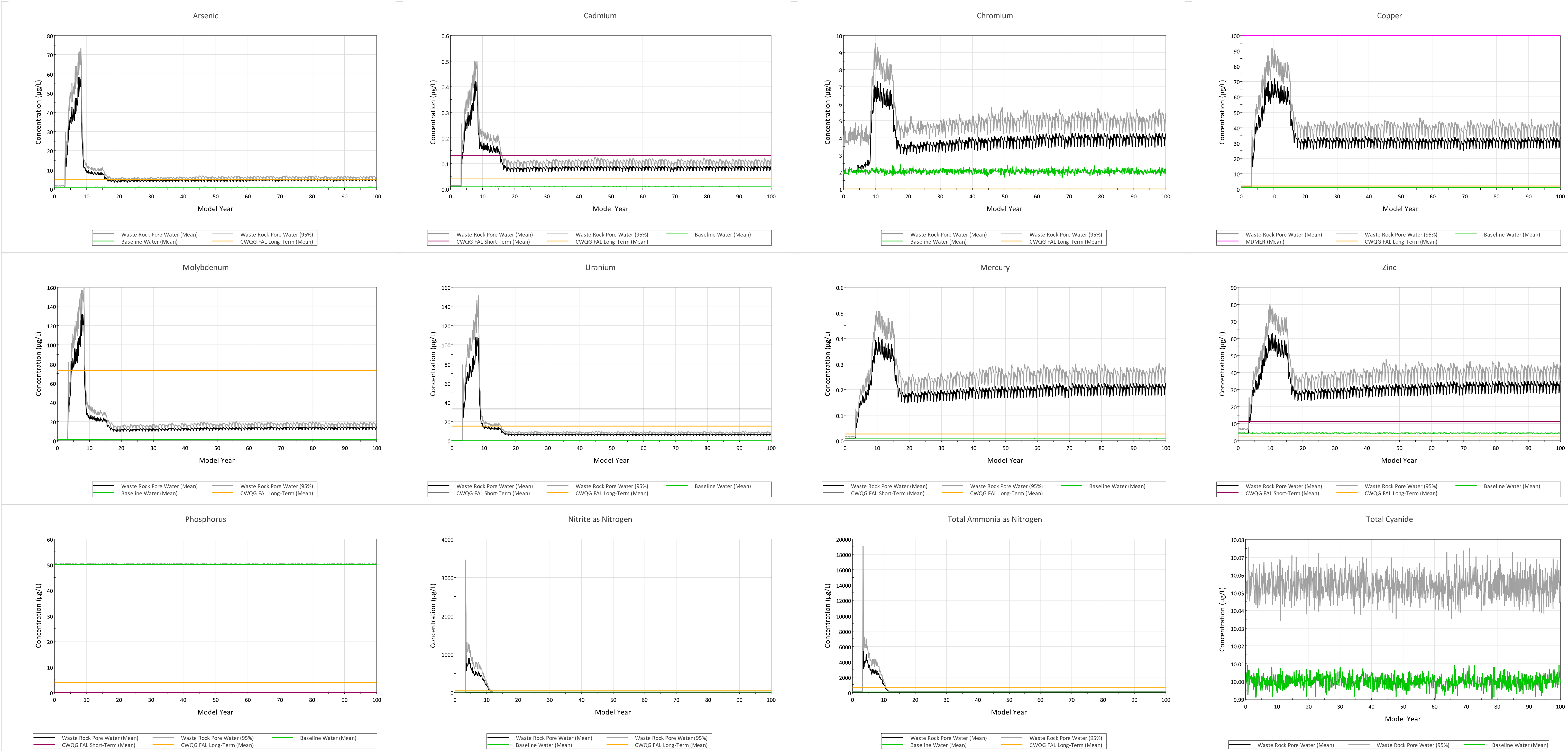
Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Table C-11 Highest Value of the Monthly Mean and 95th Percentile Concentrations for Each Project Phase at BER-FDP-06 Discharge Point

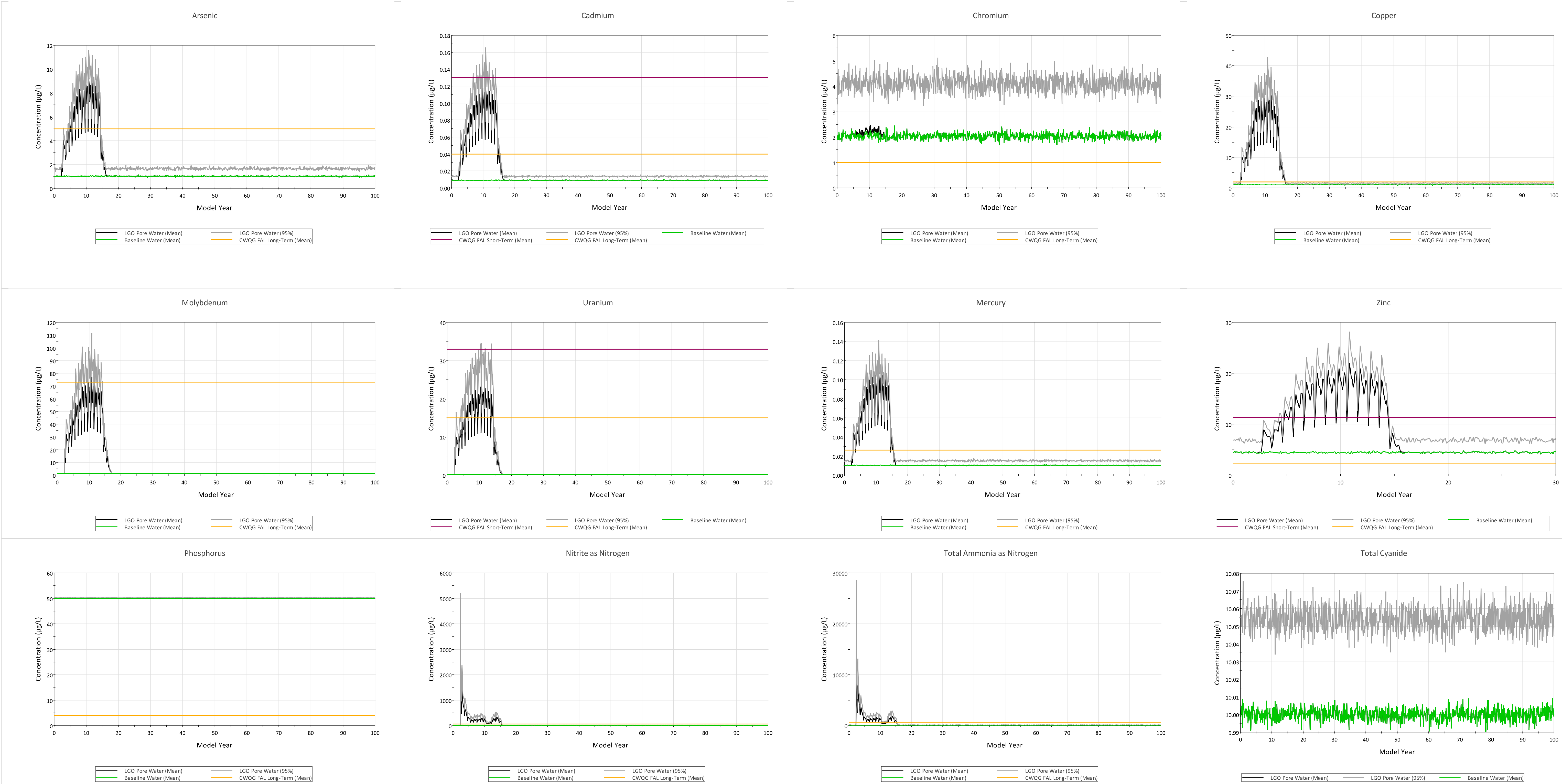
Parameter	Units	MDMER	CWQG-FAL	CWQG-FAL	Baseline	Baseline	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06	BER-FDP-06
Project Phase							1-Construction	1-Construction	2-Operation	2-Operation	3-Closure	3-Closure	4-Post-closure	4-Post-closure	5-Closure and Post-closure	5-Closure and Post-closure
Statistics			Short-term	Long-term	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean	Max of 95th	Max of mean
Aluminum	µg/L	-	-	100	**233**	**133**	**222**	**124**	**233**	**174**	**231**	**169**	na	na	**231**	**169**
Antimony	µg/L	-	-	-	0.5	0.5	0.5	0.5	1.8	1.2	1.8	1.1	na	na	1.8	1.1
Arsenic	µg/L	100	-	5	2.0	1.1	1.8	1.1	**25.1**	**14.3**	**24.8**	**14.3**	na	na	**24.8**	**14.3**
Barium	µg/L	-	-	-	7.3	3.9	6.7	3.4	7.3	5.4	7.2	5.4	na	na	7.2	5.4
Boron	µg/L	-	29000	1500	25	25	25	25	25	25	25	25	na	na	25	25
Cadmium	µg/L	-	0.13	0.04	0.02	0.01	0.0	0.0	**0.1**	**0.0**	**0.1**	**0.0**	na	na	**0.1**	**0.0**
Calcium	µg/L	-	-	-	19620	9767	17073	8957	19620	10862	17548	10575	na	na	17548	10575
Chromium	µg/L	-	-	1	**5.1**	**2.4**	**4.7**	**2.3**	**5**	**2.6**	**5**	**2.4**	na	na	**4.7**	**2.4**
Copper	µg/L	100	-	2	1.9	1.1	1.9	1.1	**10**	**5.7**	**10**	**5.6**	na	na	**10.0**	**5.6**
Iron	µg/L	-	-	300	**556**	286	**536**	281	**520**	**349**	**549**	**350**	na	na	**549**	**350**
Lead	µg/L	80	-	1	0.36	0.29	0.36	0.29	1	0.44	1	0.42	na	na	0.72	0.42
Magnesium	µg/L	-	-	-	2217	1264	1983	1192	2209	1301	2097	1231	na	na	2097	1231
Manganese	µg/L	-	596	210	**448**	194	**392**	178	**443**	**215**	**398**	195	na	na	**398**	195
Mercury	µg/L	-	-	0.026	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	na	na	0.02	0.01
Molybdenum	µg/L	-	-	73	1.5	1.2	1.4	1.2	6	3.6	6	3.5	na	na	5.5	3.5
Nickel	µg/L	250	-	25	1.0	1.0	1.0	1.0	1	1.0	1	1.0	na	na	1.0	1.0
Phosphorus	µg/L	-	-	4	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	na	na	**50**	**50**
Potassium	µg/L	-	-	-	761	353	622	329	2924	1909	2771	1874	na	na	2771	1874
Selenium	µg/L	-	-	1	0.5	0.5	0.5	0.5	**1**	0.7	**1**	0.6	na	na	**1.0**	0.6
Silver	µg/L	-	-	0.25	0.05	0.05	0.05	0.05	0	0.05	0	0.05	na	na	0.05	0.05
Sodium	µg/L	-	-	-	3306	2260	3306	2236	3190	2427	3212	2396	na	na	3212	2396
Thallium	µg/L	-	-	0.8	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	na	na	0.05	0.05
Uranium	µg/L	-	33	15	0.14	0.09	0.13	0.08	1	0.73	1	0.70	na	na	1.29	0.70
Zinc	µg/L	400	11.3	2.2	**7.9**	**4.8**	**7.4**	**4.7**	**7**	**5.0**	**7**	**4.6**	na	na	**7.2**	**4.6**
Chloride	µg/L	-	640000	120000	4752	3080	4506	3021	4621	3156	4689	3020	na	na	4689	3020
Nitrate + Nitrite (as Nitrogen)	µg/L	-	-	-	104	58	97	56	97	61	97	62	na	na	97	62
Nitrite (as Nitrogen)	µg/L	-	-	60	12	8	11	8	12	10	12	10	na	na	12	10
Nitrate (as Nitrogen)	µg/L	-	550000	13000	102	57	93	55	100	62	102	62	na	na	102	62
Total Ammonia (as Nitrogen)	µg/L	-	-	689	135	61	128	60	128	70	121	67	na	na	121	67
Un-ionized Ammonia (as Nitrogen)	µg/L	500	16	16	5.1	2.34	4.85	2.29	5	2.66	5	2.55	na	na	4.61	2.55
Cyanide, Total	µg/L	500	-	-	10	10	10	10	10	10	10	10	na	na	10	10
Cyanide, WAD	µg/L	-	-	5	1	1	1.01	1.00	1	1.00	1	1.00	na	na	1.01	1.00
Sulphate	µg/L	-	-	-	3082	1774	2871	1726	9508	5491	9491	5130	na	na	9491	5130
Fluoride	µg/L	-	-	120	60	60	60	60	**165**	**133**	**162**	**127**	na	na	**162**	**127**
Radium-226	Bg/L	0.37	-	-	0.005	0.005	0.005	0.005	0.049	0.049	0.049	0.048	na	na	0.049	0.048

Notes: See Table C-1 notes for details on the parameters and guidelines.
1-Construction = Model Year 0 - 2.25
2-Operation = Model Year 2.25 - 17.25
3-Closure = Model Year 17.25 - 22.25
4-Post-closure = Model Year 22.25 - 100
5-Closure and Post-closure = Model Year 17.25 - 100
na = Predicted concentrations are not available because there is no water in the Project

Appendix D Time Series Model Result Figures for Selected Parameter

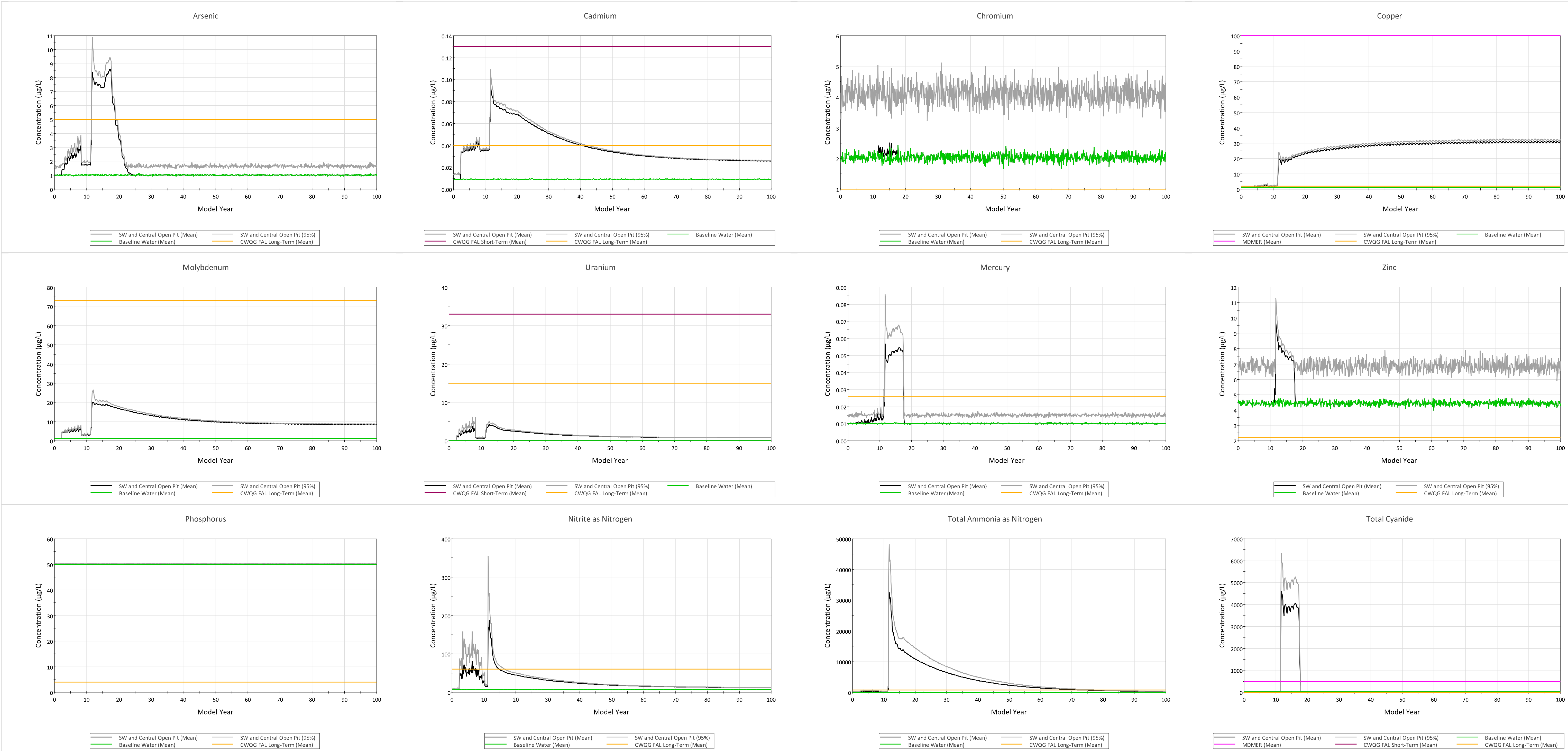


Waste Rock Pore Water Plots

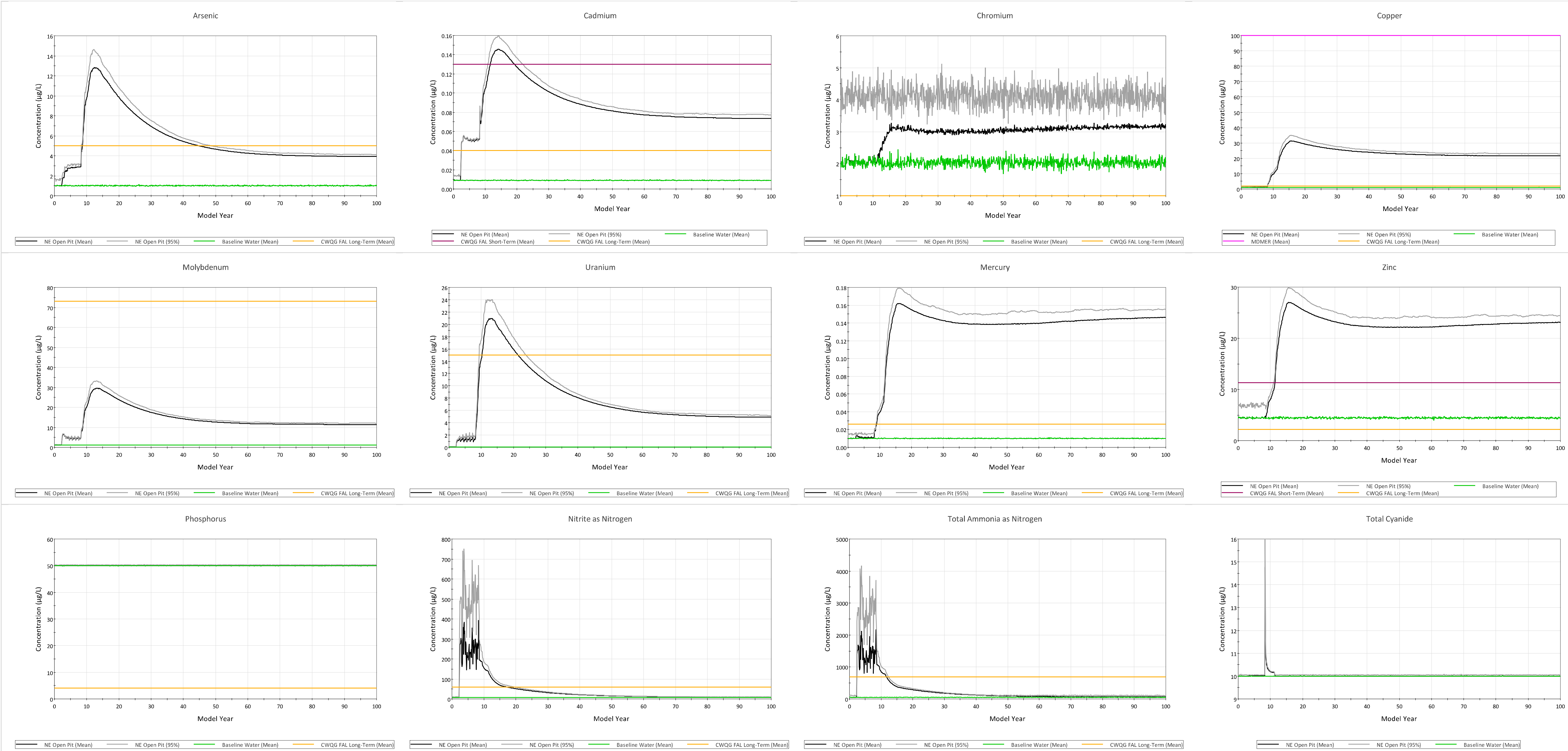


Low Grade Ore Pore Water Plots

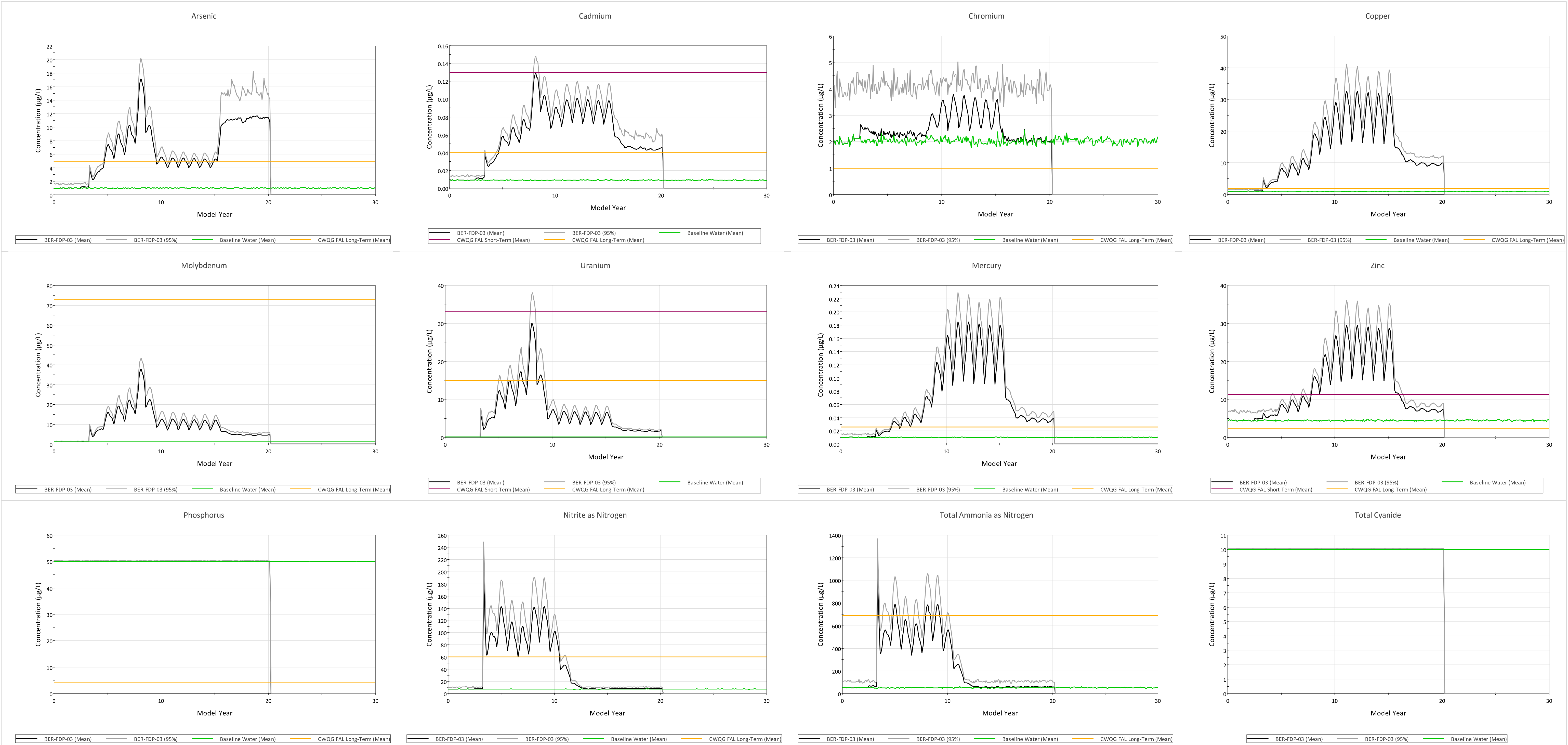
TMF Pond Plots



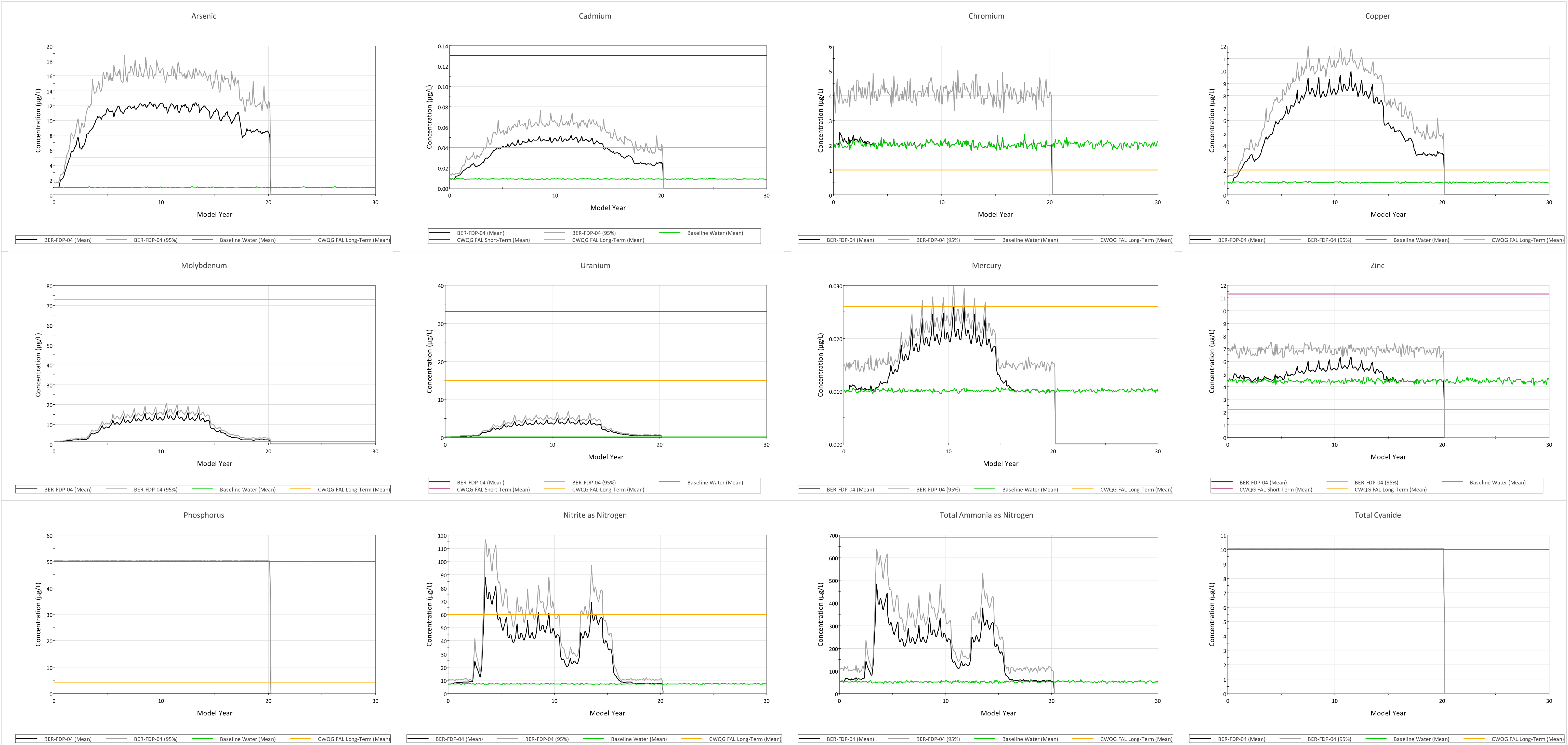
SW and Central Pit Plots


Arsenic
Cadmium
Chromium
Copper
Molybdenum
Uranium
Mercury
Zinc
Phosphorus
Nitrite as Nitrogen
Total Ammonia as Nitrogen
Total Cyanide
Concentration (µg/L)
Model Year
NE Open Pit (Mean)
NE Open Pit (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
CWQG FAL Short-Term (Mean)
MDMER (Mean)

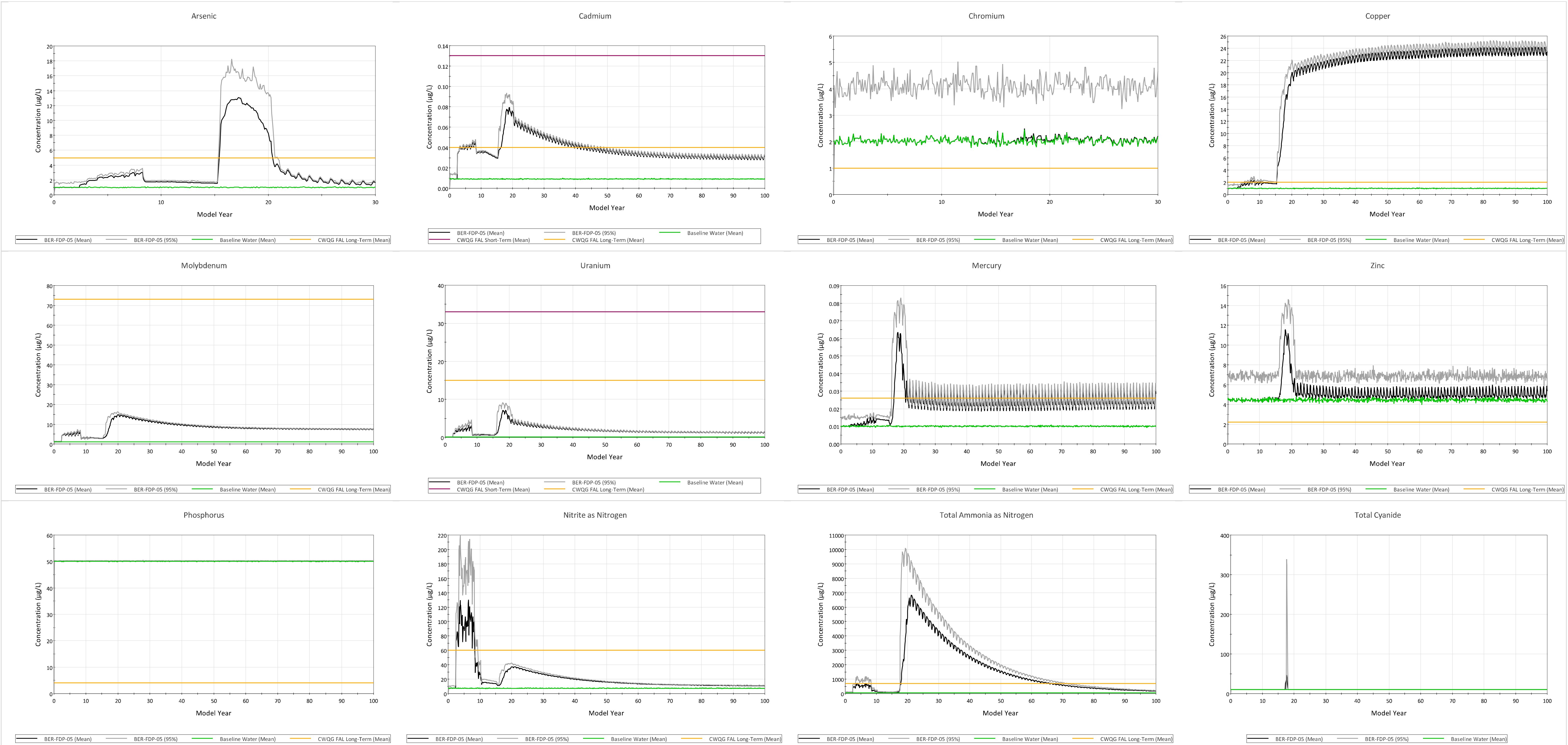
NE Pit Plots


Arsenic
Cadmium
Chromium
Copper
Molybdenum
Uranium
Mercury
Zinc
Phosphorus
Nitrite as Nitrogen
Total Ammonia as Nitrogen
Total Cyanide
Concentration (µg/L)
Model Year
BER-FDP-03 (Mean)
BER-FDP-03 (95%)
Baseline Water (Mean)
CWQG FAL Short-Term (Mean)
CWQG FAL Long-Term (Mean)

BER-FDP-03


Arsenic
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Cadmium
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Short-Term (Mean)
CWQG FAL Long-Term (Mean)
Chromium
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Copper
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Molybdenum
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Uranium
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Short-Term (Mean)
CWQG FAL Long-Term (Mean)
Mercury
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Zinc
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Short-Term (Mean)
CWQG FAL Long-Term (Mean)
Phosphorus
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Nitrite as Nitrogen
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Total Ammonia as Nitrogen
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Total Cyanide
Concentration (µg/L)
Model Year
BER-FDP-04 (Mean)
BER-FDP-04 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)

BER-FDP-04



Arsenic
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Cadmium
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Short-Term (Mean)
CWQG FAL Long-Term (Mean)
Chromium
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Copper
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Molybdenum
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Uranium
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Short-Term (Mean)
CWQG FAL Long-Term (Mean)
Mercury
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Zinc
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Phosphorus
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Nitrite as Nitrogen
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Total Ammonia as Nitrogen
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)
CWQG FAL Long-Term (Mean)
Total Cyanide
Concentration (µg/L)
Model Year
BER-FDP-05 (Mean)
BER-FDP-05 (95%)
Baseline Water (Mean)

BER-FDP-05