BACK RIVER PROJECT
Responses to Review of Water and Load Balance Report and Hydrodynamic and Water Quality Modelling of Goose Lake Report

21 November 2022

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Responses to Review of 2021 Water and Load Balance Report and Hydrodynamic and Water Quality Modelling of Goose Lake Report Comments

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1. Introduction

Sabina Gold & Silver Corp. (Sabina), submitted its 2021 Water and Load Balance Report and Hydrodynamic and Water Quality Modelling of Goose Lake Report to the Nunavut Water Board (NWB) on 4 April 2022, as required by the Back River Gold Mine Project Certificate No. 007. Interested Parties were then requested by the NWB to provide comments on the 2021 Water and Load Balance Report and Hydrodynamic and Water Quality Modelling of Goose Lake Report.

On 30 June 2022, the NWB received comments from the following interested parties:

- Kitikmeot Inuit Association (KIA) = 16 comments;
- Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) = 8 comments; and
- Environment and Climate Change Canada = 7 comments.

2. Responses to Comments

2.1 RESPONSE TO KITIKMEOT INUIT ASSOCIATION

KIA-NWB-01: No vertical TDS profile data

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 4.0 Model Calibration and 4.4 TDS Concentrations

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Detailed Review Comment

Observed TDS data is not available for vertical profiles. Therefore, model performance for predicted TDS concentrations was based on similarity in patterns of observed specific conductivity values and predicted TDS concentrations. Given that parameter concentrations are used as indicators to determine the impact the project will have on the receiving environment it is important to assess model performance against observed concentrations and not patterns.

Recommendation/Request:

It is recommended that TDS vertical profiles be collected in Goose Lake in the upcoming open water season to further assist with model calibration and evaluate model performance.

Sabina Response:

Sabina believes the measured specific conductivity profiles used in calibration of the modelled total dissolved solid (TDS) profiles are sufficient based on the following rationale:

- The TDS concentration and specific conductivity for samples from a given waterbody are typically related. Conductivity is the measure of a water's capability to conduct an electric charge, which depends on the concentrations of ions in the water. The largest portion of TDS is typically the dissolved ion concentrations. The more salts that are dissolved in the water, the higher the electric conductivity is expected to be (Wetzel 2001, Rusydi 2018).
- Goose Lake is a shallow lake (i.e., average depth of 3 m) and the observed specific conductivity profile data show that the lake is relatively well-mixed vertically (Appendix A, Figures A5 to A8 of the Hydrodynamic and Water Quality Modelling of Goose Lake Report).
- The TDS data, which was collected from the surface layer of Goose Lake (i.e., the upper 1 m), was used in model calibration. Predicted and observed surface TDS concentrations during the calibration period are presented on Figure 6 of the Hydrodynamic and Water Quality Modelling of the Goose Lake report.
- The model's predicted surface TDS concentrations closely matched the observed TSD concentration data. The model's predicted vertical TDS profiles also closely matched the vertical pattern observed in the monitored specific conductivity profiles; both modelled TDS concentrations and monitored conductivity profiles were consistent with a lack of vertical stratification expected in a shallow lake. The combined calibration using surface TDS concentrations and conductivity profiles throughout Goose Lake show that overall, the model is tracking the movement of water and dissolved constituents (represented by TDS) reasonably well throughout the vertical and lateral extents of the lake.

Sabina will continue to collect vertical profiles of specific conductivity which will provide the required information for assessing vertical gradients in TDS concentrations in Goose Lake.

References:

Wetzel, R. G. (2001). Limnology: Lake and River Ecosystems (3rd ed.). San Diego, CA: Academic Press.

Rusydi A. 2018. Correlation between conductivity and total dissolved solid in various type of water: A review. IOP Conf. Series: Earth and Environmental Science 118 012019

KIA-NWB-02: Mixing Zone Incorrectly Identified

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 7.1 Predicted Concentrations at the Edge of Mixing Zones

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Section: Appendix B Goose Lake Model – Timeseries of Predicted Constituent Concentrations at the Edges of Mixing Zones during the Forecast Period

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Detailed Review Comment

Sabina states, *"The Goose Lake Model predictions at the edge of mixing zones for each mine-affected inflow (i.e., PN04, PN05, and PN08) are presented in Table 6 and Table 7, and Appendix B (timeseries plots). For PN04 and PN08 mine-affected inflows, the model results were extracted an arc located at a radius of approximately 180 to 220 m from the discharge point to Goose Lake. For PN05, model results were extracted along the arc located at a radius of approximately 390 to 440 m, because the mesh cells located within the approximately 200 m radius from the PN05 discharge point did not contain water for the full duration of each year (i.e., the lake is frozen to bottom during winter at these locations) and thus the closest cell with unfrozen water for the entire year was selected to extract results."*

The CCME[1] defines the physical mixing zone as, *"the area up to the point where there is virtually no measurable difference between receiving water and effluent mixed with receiver." They also note, "The size of the physical mixing zone is not fixed but varies over time with factors such as: effluent flow rate and concentration, design of the outfall, ambient properties (depth, velocity, density, etc.), and concentrations of the substances in both the receiving environment and the effluent. Additionally, the size of the physical mixing zones also may differ for each contaminant because the mixing process itself may differ for different parameters."*

Given that several parameters exceed the outlined objectives at what Sabina calls the *"edge of the mixing zone"* for mine-affect inflows PN04, PN05 and PN08 indicates that 180 to 220 m for PN04 and PN08 and 390 to 440 m for PN05 are not the mixing zone for several parameters. In addition, Mackenzie Valley Land and Water Board[2] provides guidance specific to northern environments stating, *"for lakes – regulated mixing zones should have a maximum radius of 100 m or 25% of the width of the lake (whichever is smaller), not exceed 10% of the available volume for mixing and not extend closer to shore than the mean low water mark."* Other relevant Nunavut projects that abide by this 100 m mixing zone include the Meliadine project both within the marine environment (Melvin Bay[3]) and freshwater environment (Meliadine Lake[4]).

Parameters that exceeded benchmarks in the current hydrodynamic model at the edge of Sabina's defined mixing zone include cadmium, iron, nickel, phosphorus, selenium and zinc for PN04. Chloride, iron, nickel, phosphorus and selenium for PN05. Cadmium, chloride, iron, nickel, phosphorus, selenium and zinc for PN08. The following

[1] Canadian Council of Ministers of the Environment (CCME), 2008. Technical Supplement 2: Canada-2ide Strategy for the Management of Municipal Wastewater Effluent, Environmental Risk Management Framework and Guidance, June 2008.

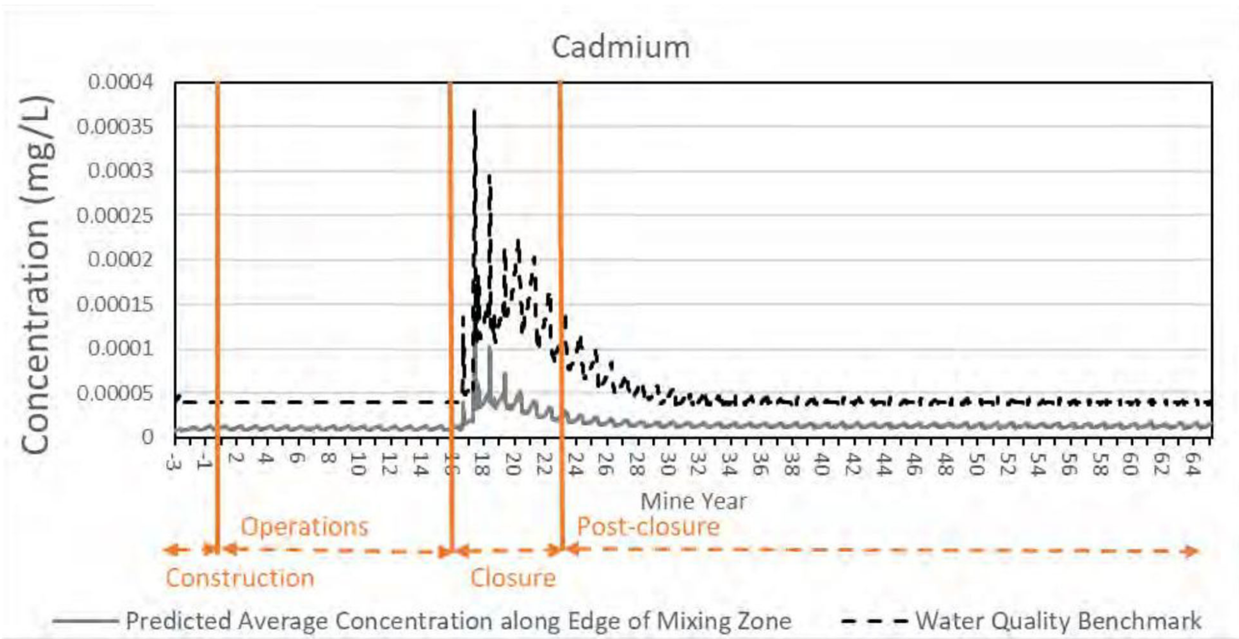
[2] Mackenzie Valley Land and Water Board. 2017. Guidelines for Effluent Mixing Zones. Mackenzie Valley Land and Water Board, Gwich'in Land and Water Board, Sahtu Land and Water Board, Wek'èezhìi Land and Water Board, Government of the Northwest Territories. 35 pages.

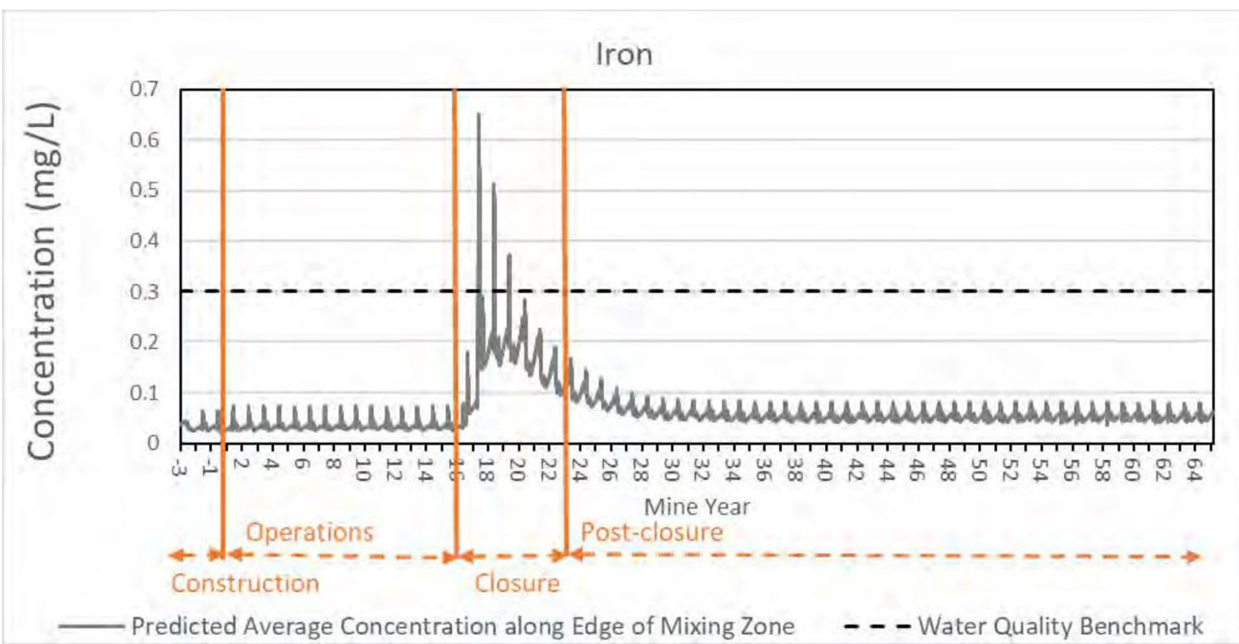
[3] Agnico Eagle 2020. Meliadine Gold Mine – Final Environmental Impact Statement Addendum. Environmental Assessment of Treated Groundwater Effluent Discharge into Marine Environment, Rankin Inlet. 455 pages.

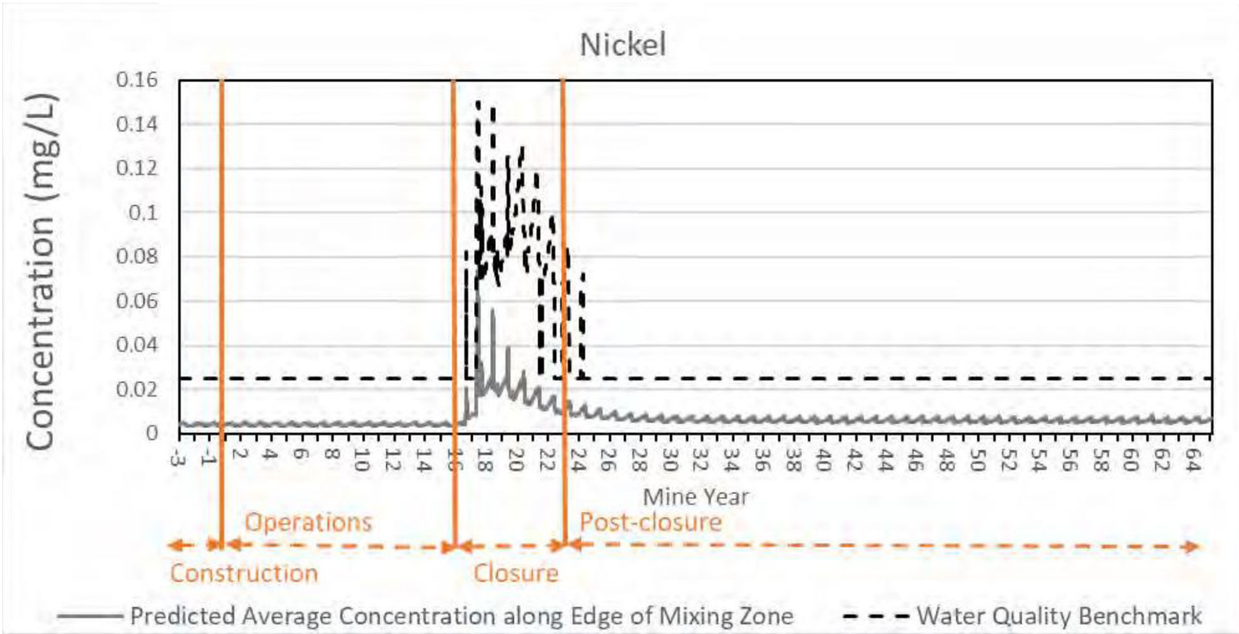
[4] Golder Associates Ltd. 2020. Water Quality Management and Optimization Plan – Implementation Plan for Total Dissolved Solids. 54 pages.

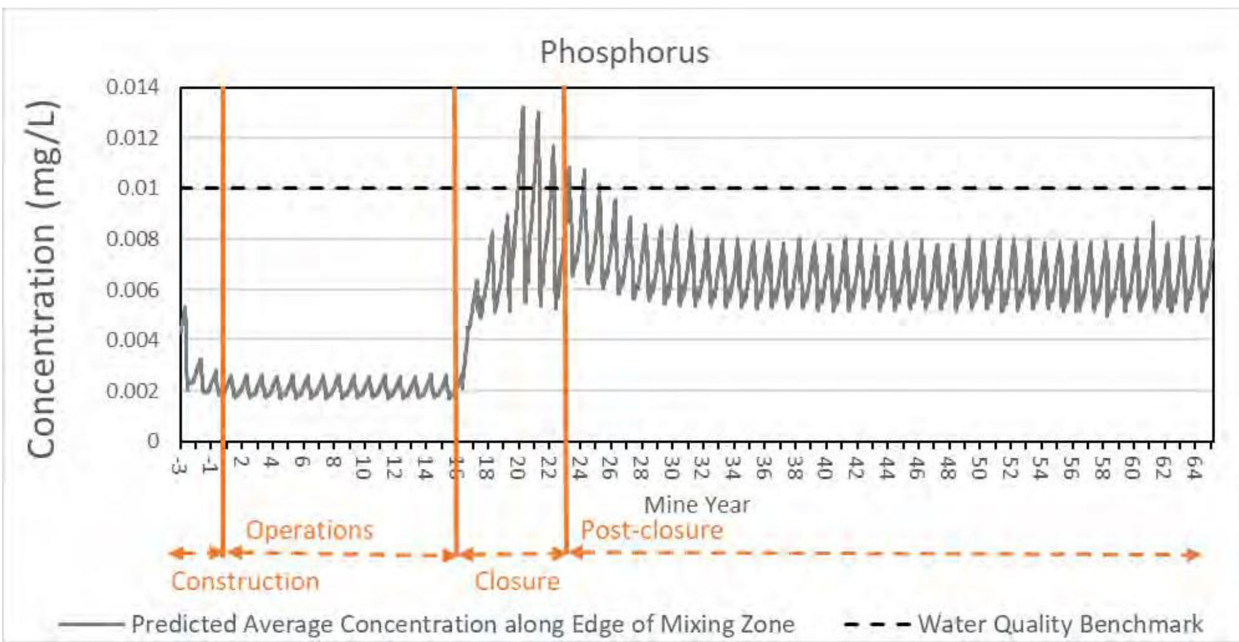
timeseries predicted constituent concentration figures from Appendix B illustrate the exceedance of parameter specific objectives.

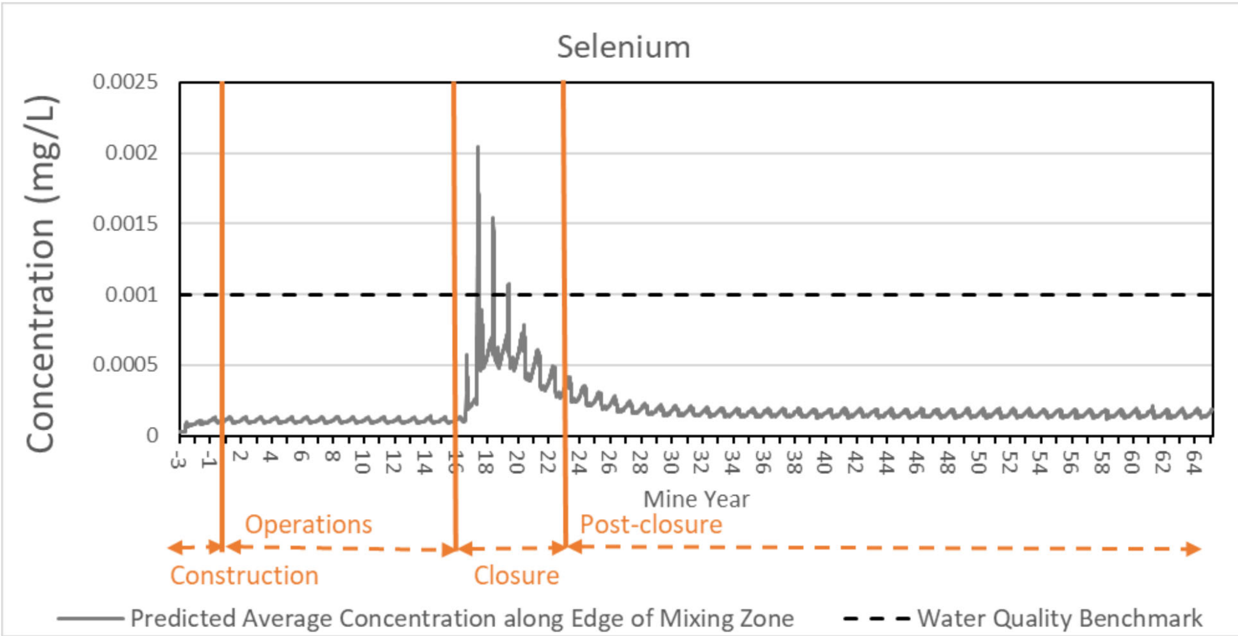
Figure B1: Predicted Timeseries Concentration of Water Quality Constituents in Goose Lake at the Edge of Mixing Zone for PN04 over the Construction, Operations, Closure and Post-closure Periods






Nickel
Concentration (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark


Phosphorus
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark


Selenium
Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark

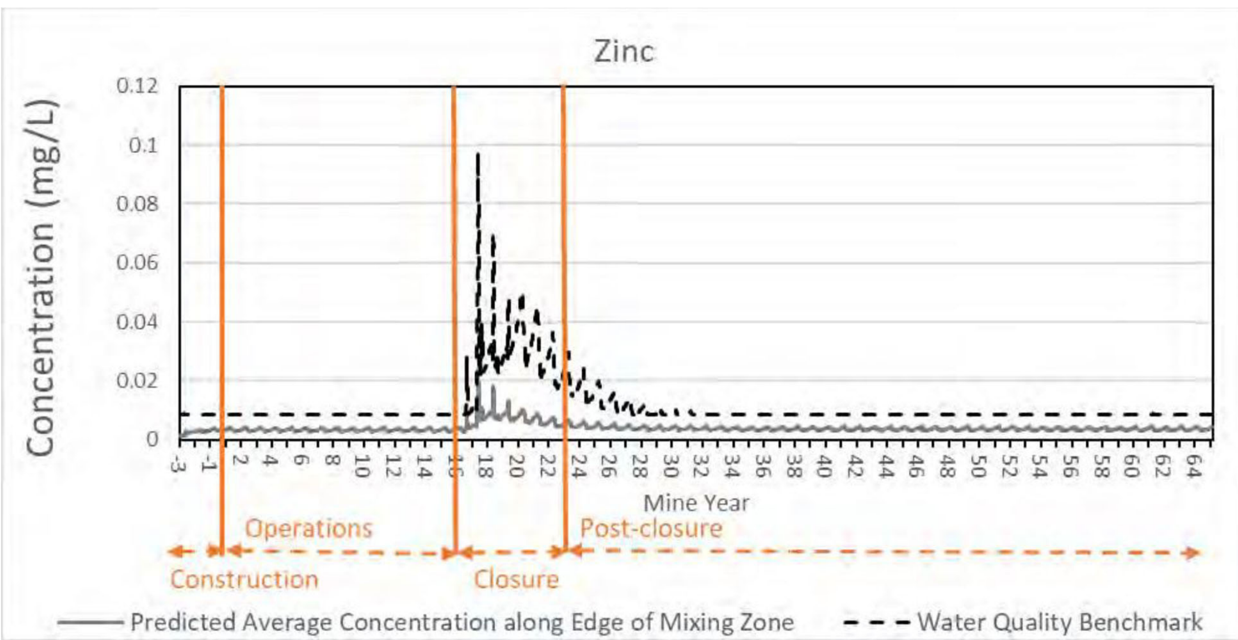
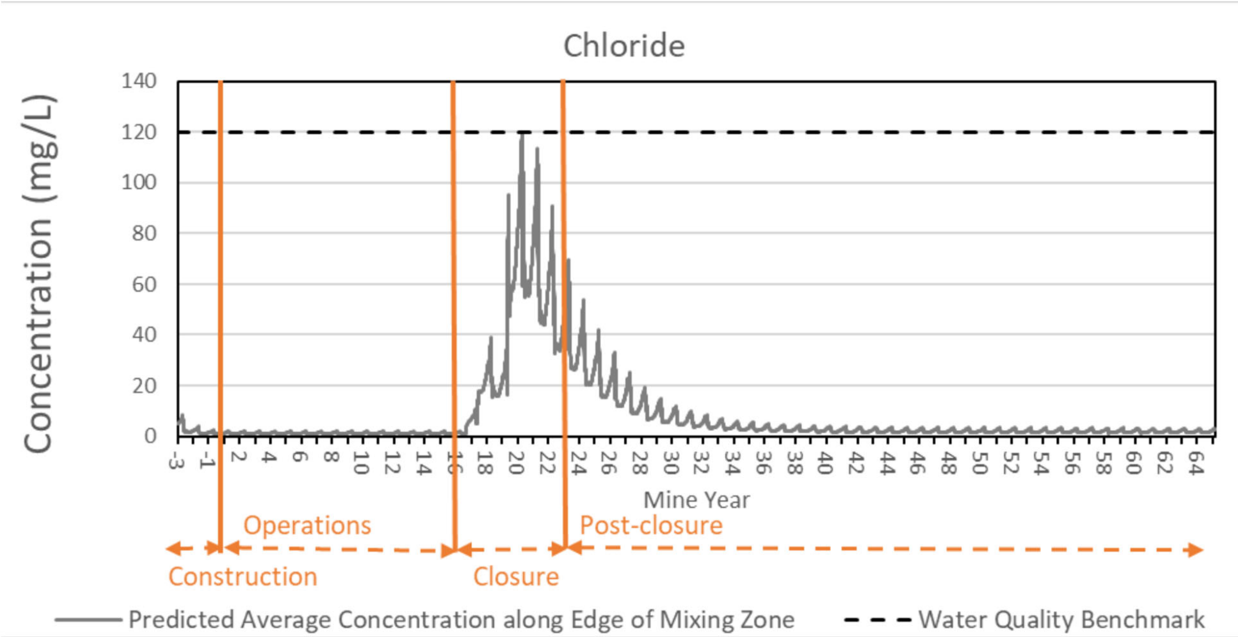
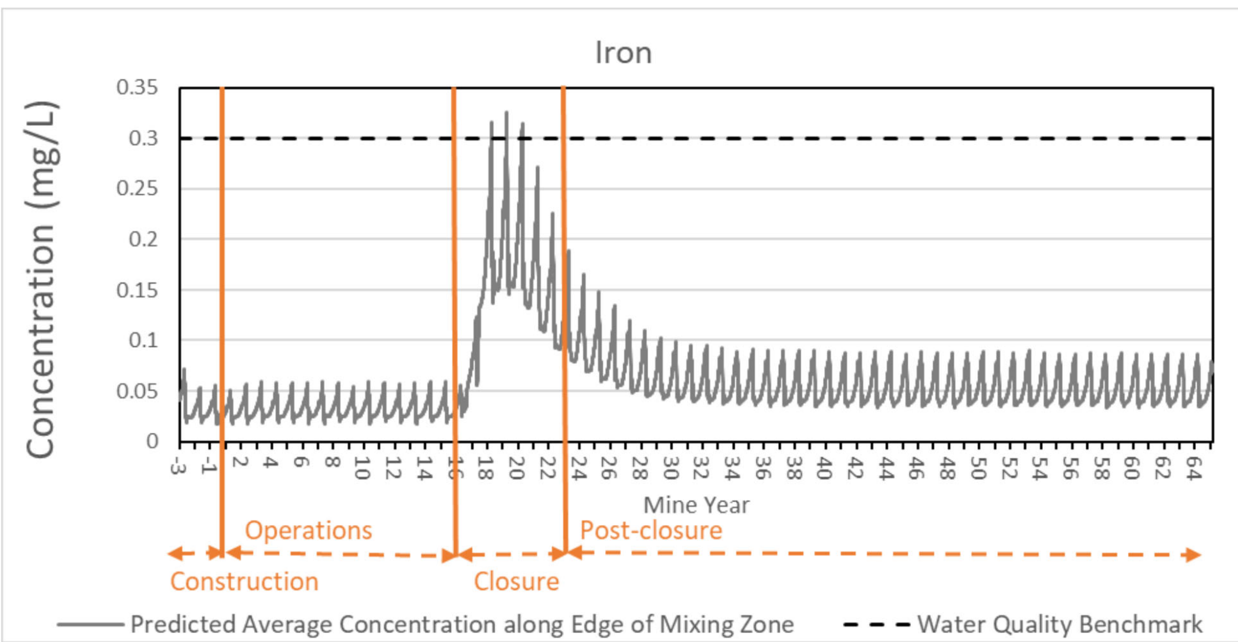
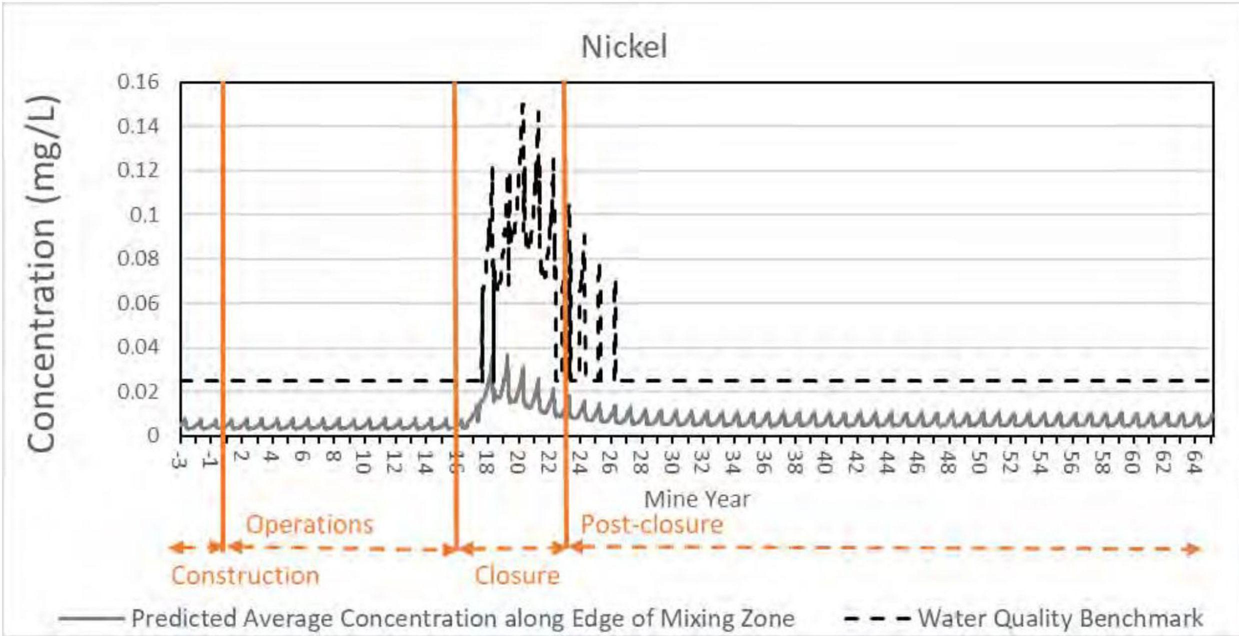

Zinc
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark

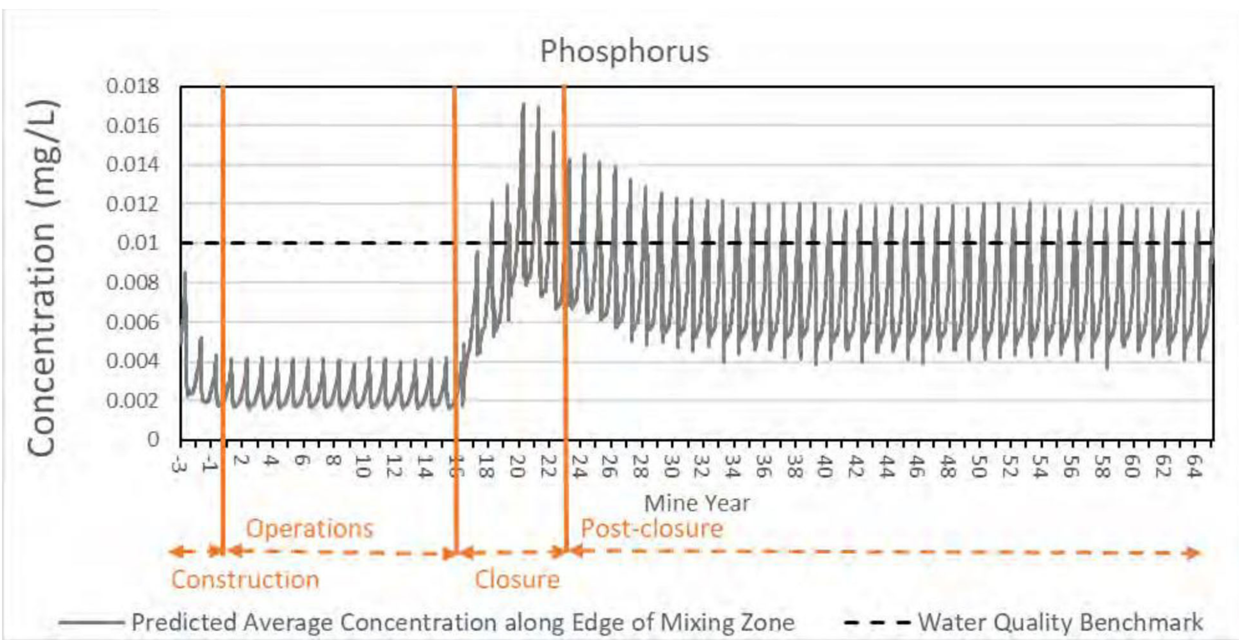
Figure B2: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at the Edge of Mixing Zone for PN05 over the Construction, Operations, Closure and Post-closure Periods







Nickel
Concentration (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark



Phosphorus
Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark

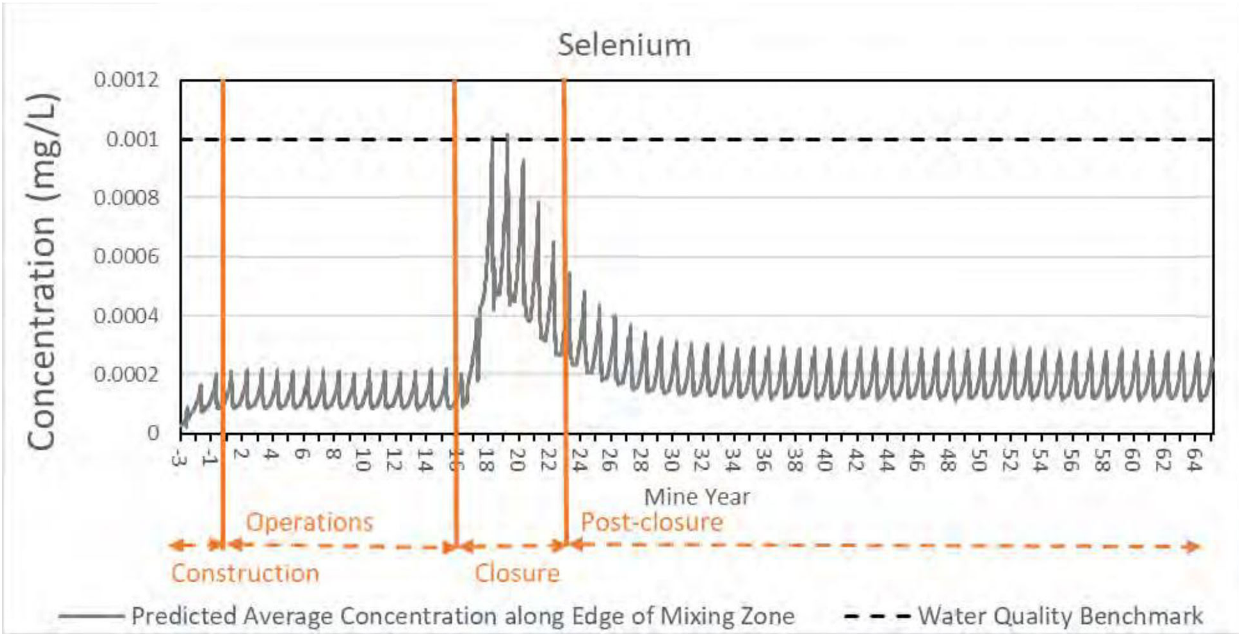
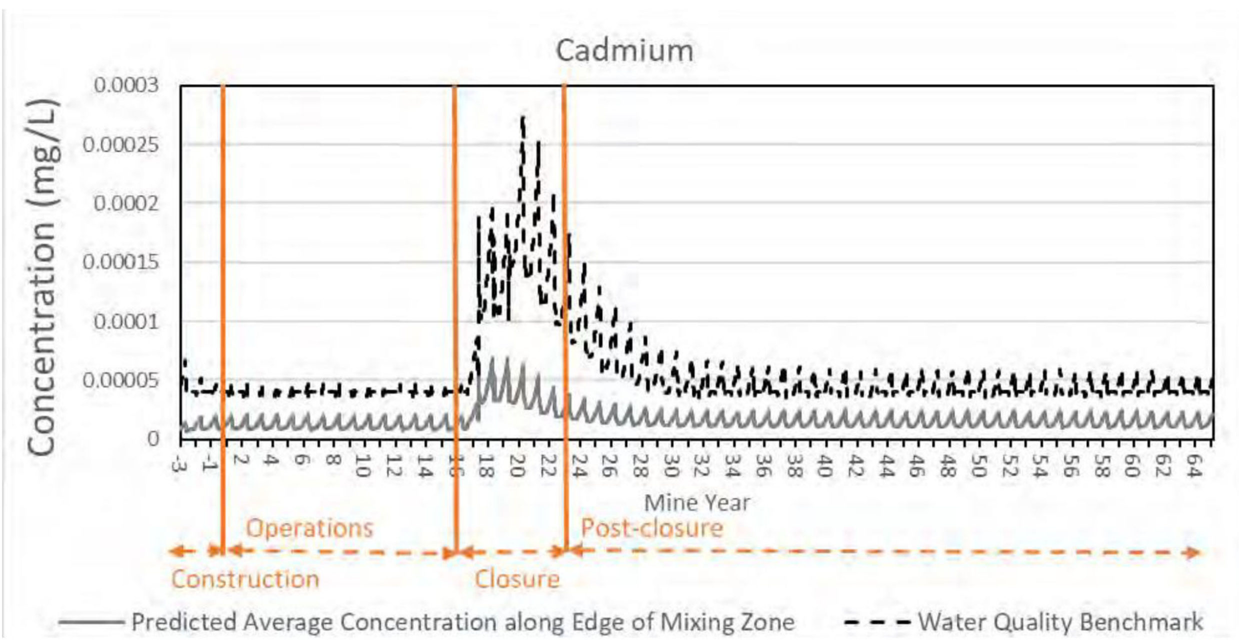
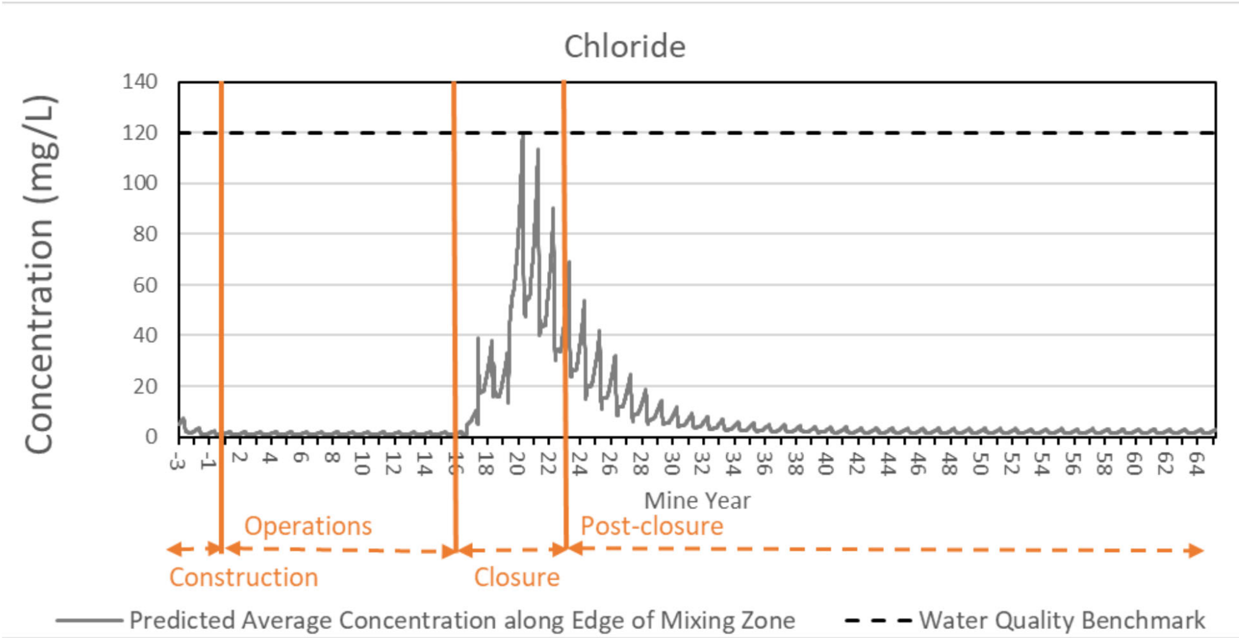
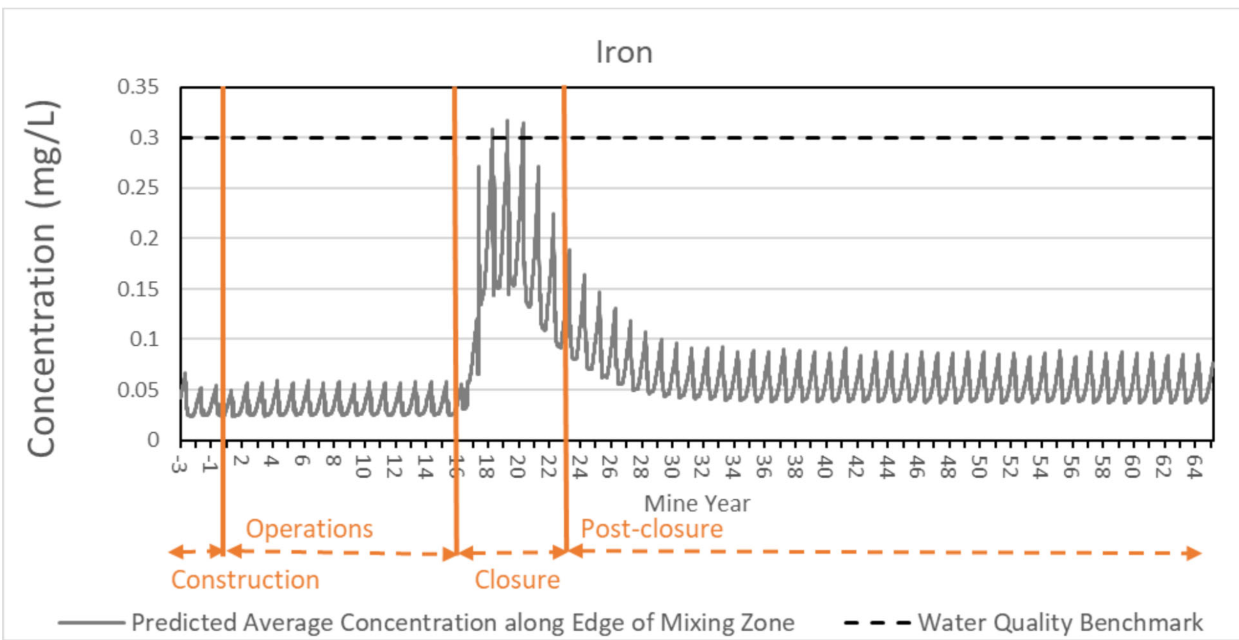
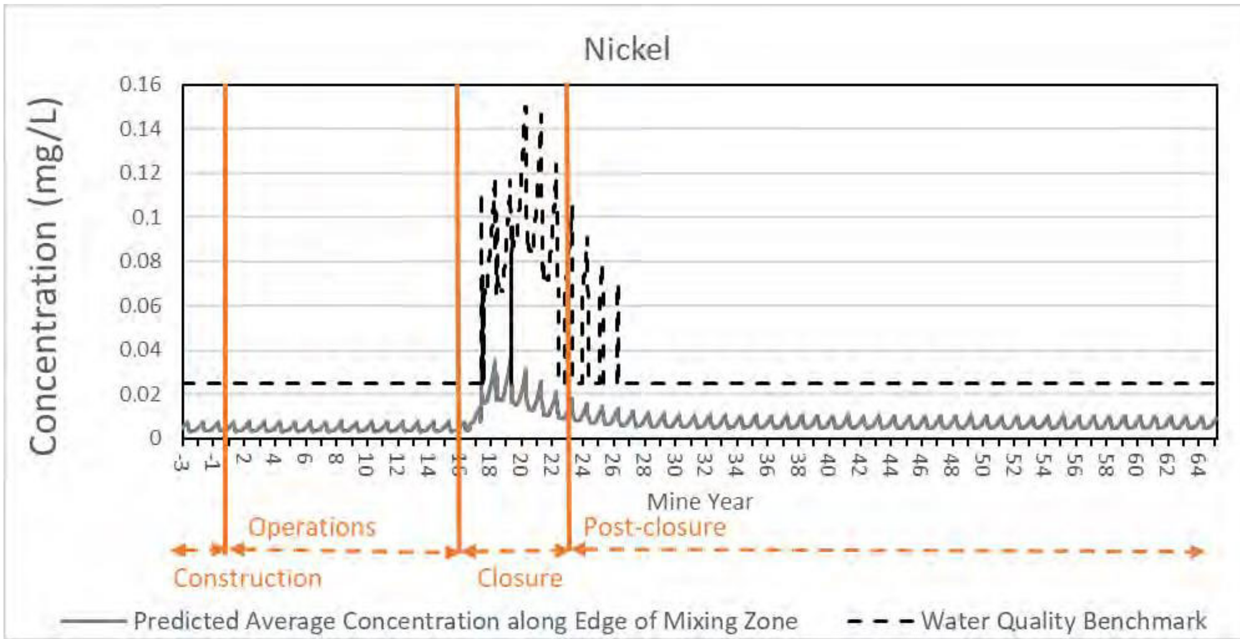


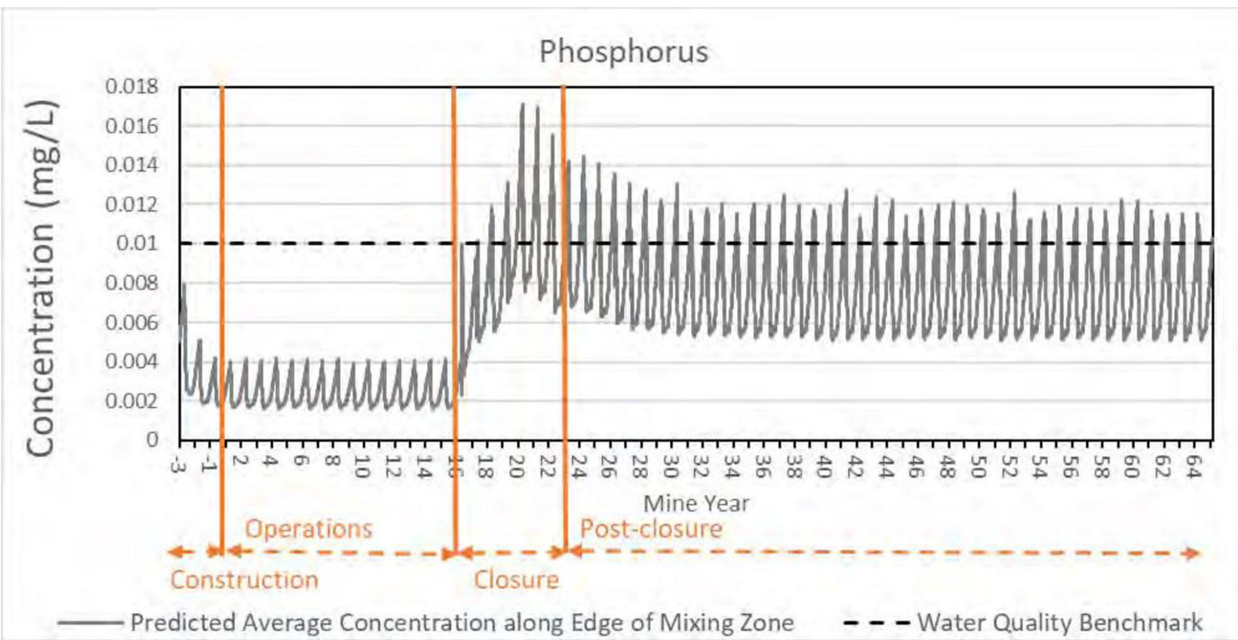
Figure B3: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at the Edge of Mixing Zone for PN08 over the Construction, Operations, Closure and Post-closure Periods

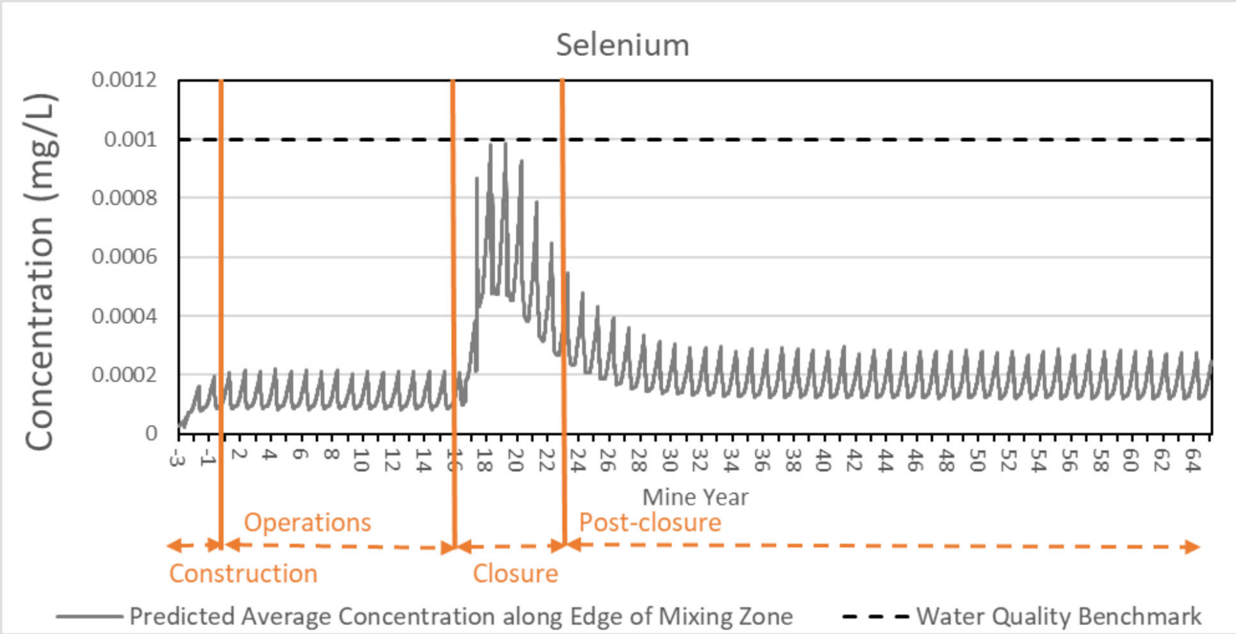



Chloride
Concentration (mg/L)
0
20
40
60
80
100
120
140
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark


Iron
Concentration (mg/L)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark


Nickel
Concentration (mg/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark


Phosphorus
Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Mine Year
Operations
Post-closure
Construction
Closure
Predicted Average Concentration along Edge of Mixing Zone
Water Quality Benchmark



Therefore, the current hydrodynamic model does not abide by the regulated 100 m radius for mixing zones in northern environments and has not properly defined the mixing zone for cadmium, chloride, iron, nickel, phosphorus, selenium and zinc. This presents a more substantial potential risk to aquatic life in Goose Lake.

Recommendation/Request:

It is recommended that Sabina determine and commit to implementing mitigation efforts to abide by the 100 m radius for mixing zones in northern environments and provide a model to verify that this regulation can be met.

Sabina Response:

Due to Sabina's commitment to treat mine-affected inflows to Goose Lake during Closure, the size of the mixing zones does not need to be revised because they have already been minimized to the extent practical, which is one of the key principles in establishing the size of a mixing zone in MVLWB et al. (2017). As an example, for the two metals that are predicted to be above water quality benchmarks (i.e., Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report) at the edge of mixing zones in Goose Lake (i.e., iron and selenium), Sabina has proposed treatment such that maximum concentrations in discharges are below the water quality benchmarks (Table 20 and Appendix F of Golder [2022]). Therefore, Sabina is not proposing larger mixing zones as an alternative to reasonable and practical treatment of effluent, which is another key principle in establishing the size of a mixing zone in MVWLB et al. (2017).

Applying the guidance of a 100 m mixing zone provided by MVLWB et al. (2017) is not appropriate for all waterbodies. The waterbodies and their associated mixing zones in the examples provided by KIA for other Nunavut projects are not comparable to Goose Lake and its proposed mixing zones because of the additional constraints to mixing that occur in Goose Lake relative to these other waterbodies. Goose Lake is shallower (e.g., 56% of the mixing zone area at PN05 has water depths of less than 1 m, which are expected to freeze to the bottom) and has areas which become disconnected from other areas in the lake (e.g., the 'tail' and the 'neck' of Goose Lake) during ice-covered conditions. The overall size of the proposed mixing zones in Goose Lake is much smaller, in terms of volume, than the referenced mixing zones for the Meliadine project. For example, the mixing zone at Melvin Bay has a radius of 100 m around the submerged discharge diffuser but the associated volume of this mixing zone is approximately

1,000,000 to 2,000,000 m^3 (depending on the tide; Agnico Eagle 2021), which is a much larger volume than the total volume of the proposed mixing zones for Goose Lake (i.e., approximately 532,000 m^3 during open-water conditions and 228,000 m^3 during ice-covered conditions). Similarly, the volume of the mixing zone in Meliadine Lake is also much larger than the volume of the mixing zones in Goose Lake; the Meliadine Lake mixing zone is an ellipsoid shape that has a radius of 100 m (i.e., from a 30 m piped diffuser in the middle of the south basin in the lake) with a depth of approximately 8 m (i.e., total volume of the mixing zone is approximately 1,200,000 m^3; Golder 2019). The total volume of water available for mixing in the proposed mixing zones is also less than 5% of the Goose Lake total volume during open-water conditions and less than 3% during ice-covered conditions; these percentages are consistent with the guidance from MVLWB et al. (2017) that mixing zones should not make up more than 10% of the available lake volume for mixing.

Two other relevant guiding principles in the establishment of mixing zones from MVLWB et al. (2017) are that, while water quality objectives (e.g., the water quality benchmarks in Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report) may be exceeded within the mixing zone, discharges to the mixing zone cannot be acutely toxic (i.e., no potential for acute toxicity within the mixing zone) and mixing zones should not impair the uses of a water body. Maximum predicted concentrations in all discharges to the proposed mixing zones are below both Metal and Diamond Mining Effluent Regulations (MDMER) discharge limits (Appendix G in the Water and Load Balance Model Report, Golder 2022), which are federally recognized discharge limits for environmental protection, and Canadian Council of Ministers of the Environment (CCME) acute water quality guidelines (see IR response KIA-NWB-16, Attachments KIA-A and KIA-B). Predicted lake concentrations at the edge of the mixing zones for PN04, PN05, and PN08 are not expected to be harmful to aquatic life (i.e., resulting in impairment of Goose Lake) because either:

- maximum predicted concentrations at these locations are less than water quality benchmarks (i.e., chronic CCME guidelines, chronic federal environmental quality guidelines (FEQG) for the protection of aquatic life or site-specific water quality objectives); or
- predicted concentrations that are above these water quality benchmarks occur at a frequency that would not result in chronic effects (i.e., infrequent exceedances of a chronic guideline will not cause chronic effects to aquatic life).

Due to the scale of the plots presented in the Hydrodynamic and Water Quality Modelling of Goose Lake Report, visual confirmation of whether predicted concentrations were above or below the water quality benchmark was not always possible when predicted concentrations were near the benchmark. Sabina clarifies that the predicted concentrations in Goose Lake did not exceed water quality benchmarks for:

- cadmium, nickel, and zinc at the edge of the proposed mixing zone at PN04;
- chloride and nickel at the edge of the proposed mixing zone at PN05; and
- cadmium, chloride, nickel, and selenium at the edge of the proposed mixing zone at PN08 (Figures KIA-NWB-2-1 to KIA-NWB-2-9).

Constituents with predicted concentrations that exceeded water quality benchmarks in the current hydrodynamic model at the edge of Sabina's defined mixing zone include iron, phosphorus, and selenium at the edge of the proposed mixing zones at PN04 and PN05, and iron and phosphorus at the edge of the proposed mixing zones at PN08. The water quality benchmarks used to compare to predicted concentrations are based on concentrations that have the potential to cause chronic effects to aquatic life (i.e., iron and selenium) or change the trophic status (i.e., phosphorus). Sabina confirms that the predicted local (i.e., at the edge of the mixing zone) and short-term (i.e., less than 5% of predicted concentrations) exceedances of the water quality benchmarks for iron and selenium are not expected to result in effects to aquatic life in Goose Lake. In addition, if the draft Federal Environmental Quality Guideline for iron is used for comparison to hydrodynamic model predictions, as suggested by Environment

Climate Change Canada (see IR response ECCC-1), predicted iron concentrations at the edge of the three mixing zones are below the draft FEQG (Figures KIA-NWB-2-10 to KIA-NWB-2-12). Concentrations of phosphorus at the edge of the mixing zones during open-water conditions are predicted to remain below its water quality benchmark and within a range that will not change the current trophic status of Goose Lake; localized and short-term exceedances of the benchmark that only occur during ice-cover conditions are not expected to result in a change in trophic status of Goose Lake (see IR responses KIA-NWB-4 and KIA-NWB-5) during a period when algal productivity is expected to be relatively low. Additionally, the predicted phosphorus concentrations are expected to be an overestimate of future lake concentrations due to conservative assumptions in the model (e.g., model does not consider biological uptake during the open-water season, which would result in a seasonal reduction of phosphorus concentrations).

Overall, Sabina expects that the proposed mitigation to treat mine-affected discharges to Goose Lake, and the associated proposed size of the mixing zones (i.e., less than 5% of the total lake volume) based on the results of the current hydrodynamic model, will result in no adverse effects to aquatic life in Goose Lake. Sabina confirms that in situ monitoring in Goose Lake will be undertaken in accordance with the requirements of the Type A Water Licence 2AM-BRP1831 Amendment No. 1 and the Aquatic Effect Management Plan to confirm the hydrodynamic model predictions and verify that risks to aquatic life are negligible.

References:

Agnico Eagle (Agnico Eagle Mines Limited). 2021. Waterline FEIS Addendum Final Written Submission Responses. Submitted to: Nunavut Impact Review Board. Submitted by: Agnico Eagle Mines Limited – Meliadine Division. May 17, 2021.

Golder (Golder Associates Ltd.). 2019. Cycle 1 Environmental Effects Monitoring Report and 2018 Aquatic Effects Monitoring Program Annual Report Agnico Eagle Mines Limited – Meliadine Gold Mine. Submitted to: Agnico Eagle Mines Limited. March 27, 2019.

MVLWB, GLWB, SLWB, WLWB, and GNWT (Mackenzie Valley Land and Water Board, Gwich'in Land and Water Board, Sahtu Land and Water Board, Wek'èezhìı Land and Water Board, Government of the Northwest Territories). 2017. Guidelines for Effluent Mixing Zones. September 2017.

Golder. 2022. Back River Project Water and Load Balance Report. Submitted to: Sabina Gold & Silver Corp. Reference No. 21505757-122-R-Rev0-100. 30 August 2022

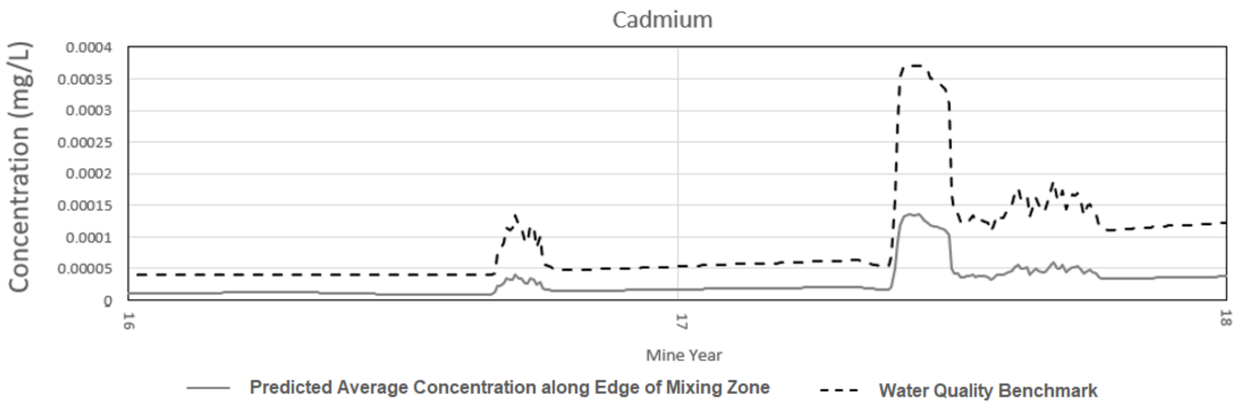


Figure KIA-NWB-2-1: Predicted Cadmium Concentrations at the Edge of the Mixing Zone at PN04, Years 16 and 17

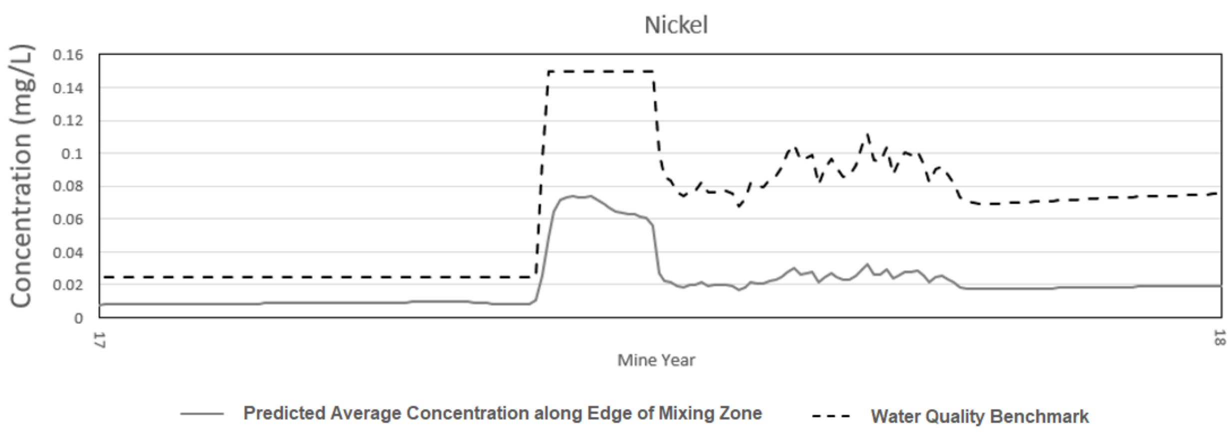


Figure KIA-NWB-2-2: Predicted Nickel Concentrations at the Edge of the Mixing Zone at PN04, Year 17

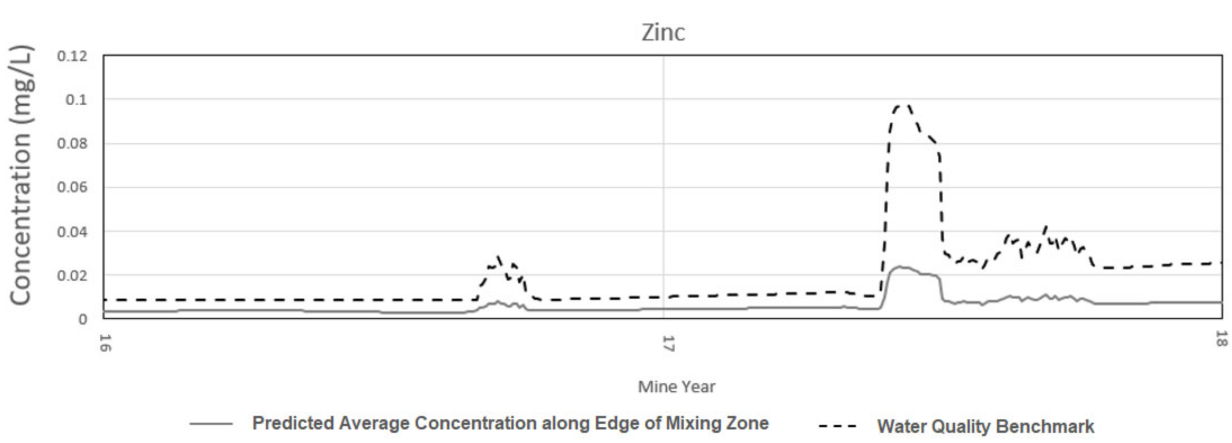


Figure KIA-NWB-2-3: Predicted Zinc Concentrations at the Edge of the Mixing Zone at PN04, Years 16 and 17

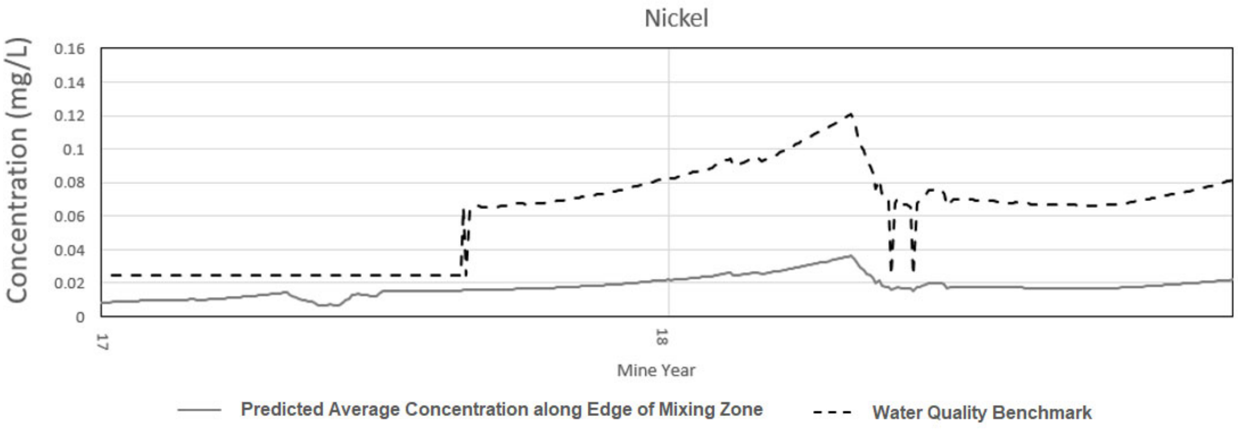


Figure KIA-NWB-2-4: Predicted Nickel Concentrations at the Edge of the Mixing Zone at PN05, Years 17 and 18

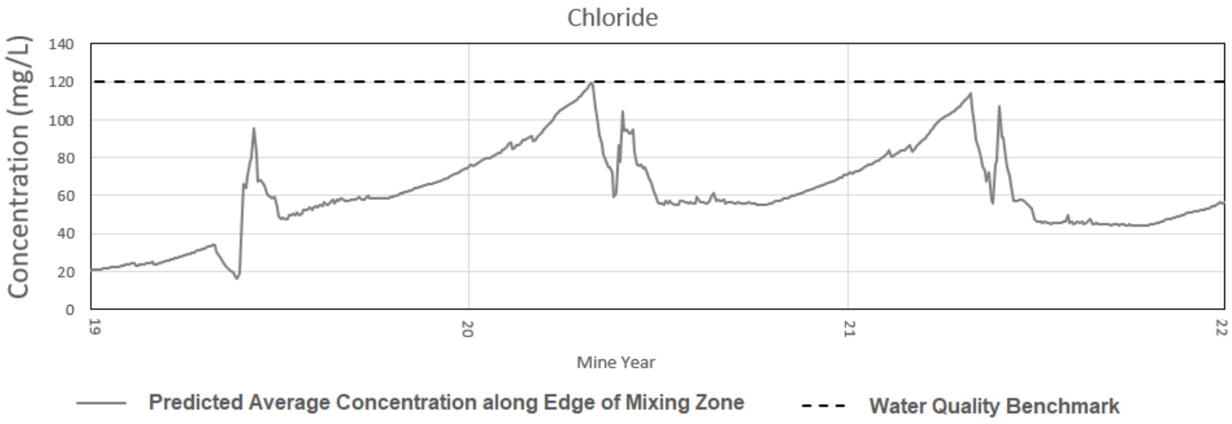


Figure KIA-NWB-2-5: Predicted Chloride Concentrations at the Edge of the Mixing Zone at PN05, Years 19 to 21

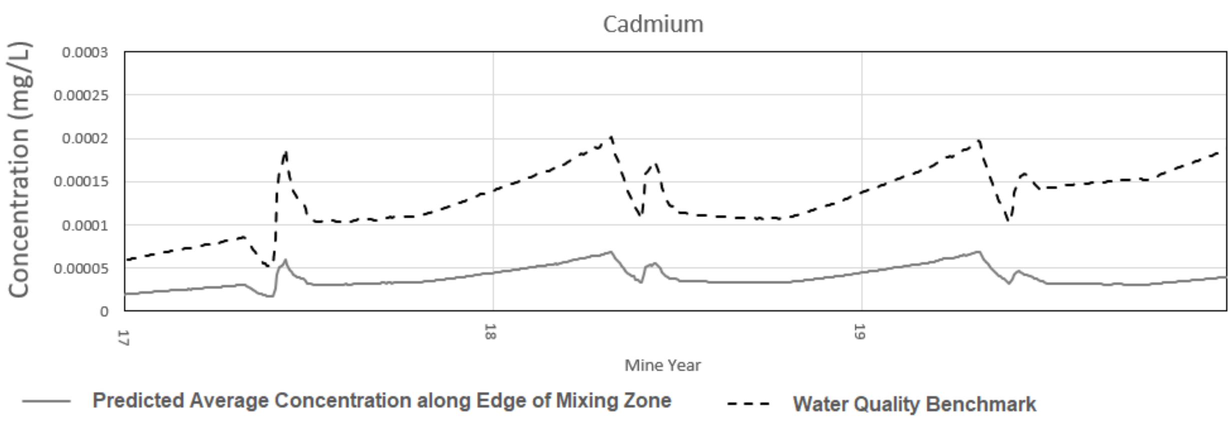


Figure KIA-NWB-2-6: Predicted Cadmium Concentrations at the Edge of the Mixing Zone at PN08, Years 17 to 19

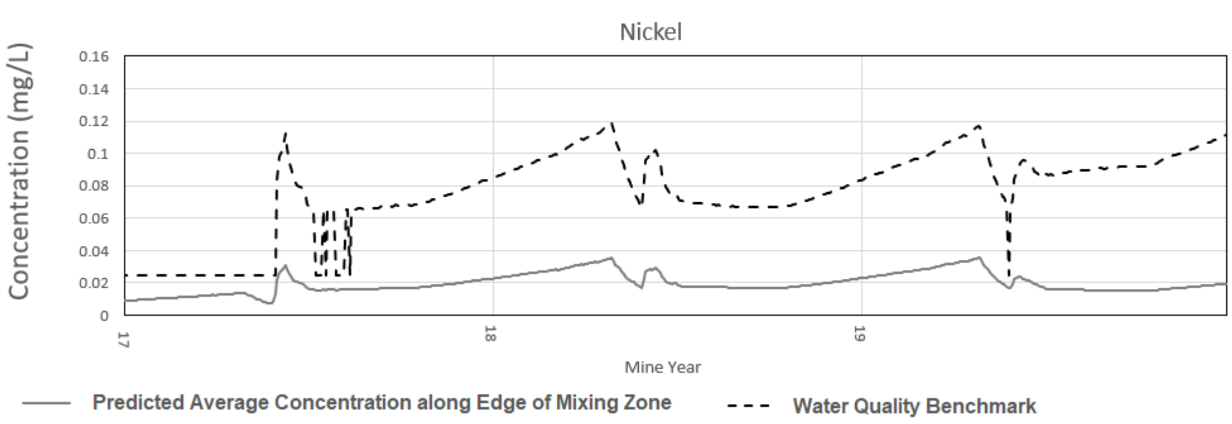


Figure KIA-NWB-2-7: Predicted Nickel Concentrations at the Edge of the Mixing Zone at PN04, Years 17 to 19

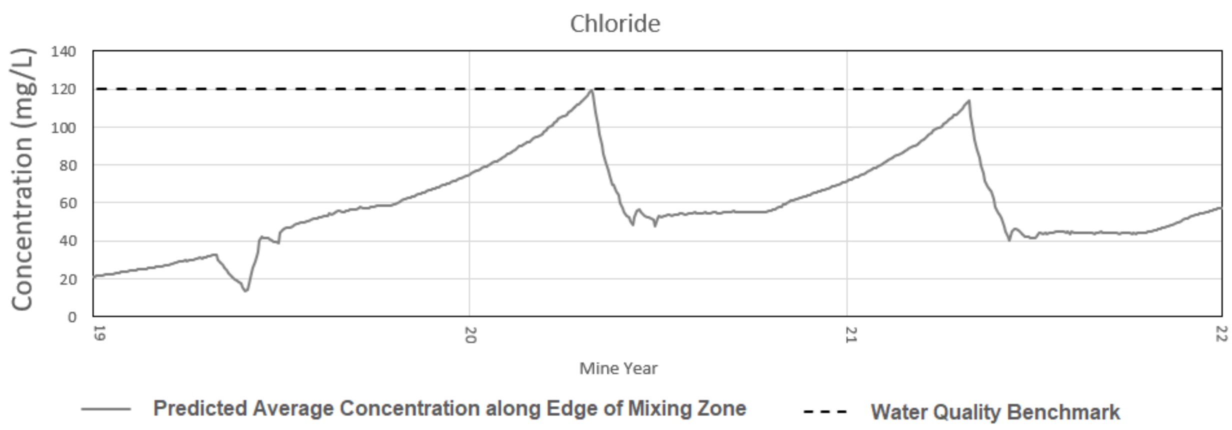


Figure KIA-NWB-2-8: Predicted Chloride Concentrations at the Edge of the Mixing Zone at PN08, Years 19 to 21

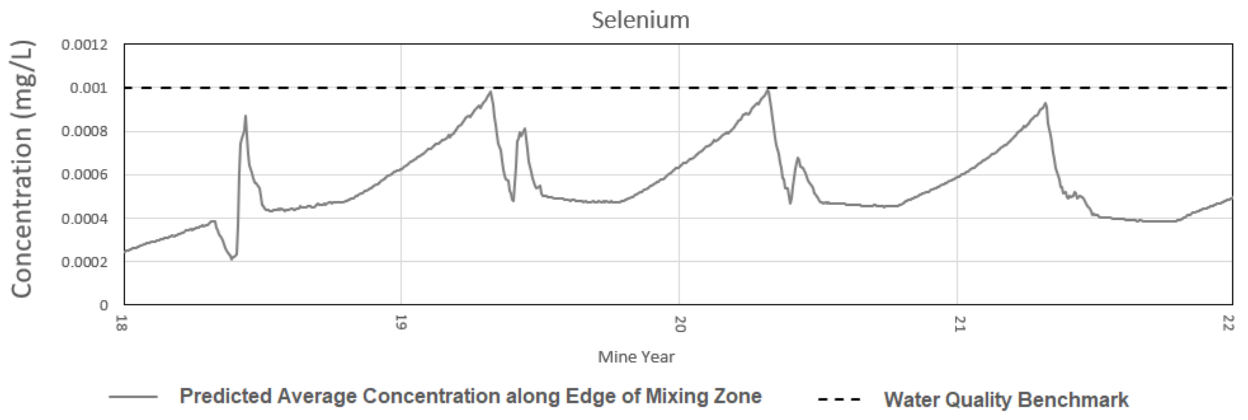
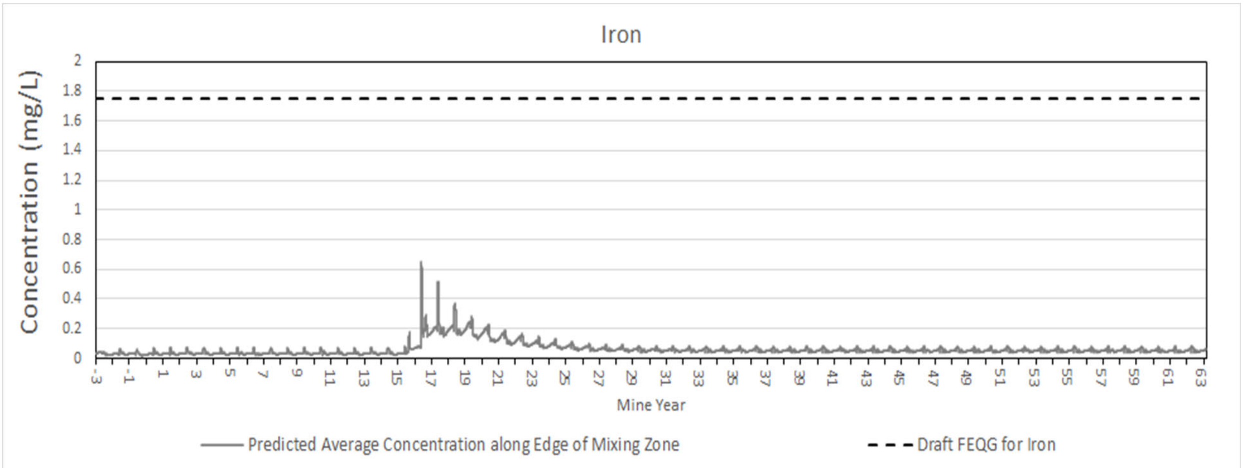
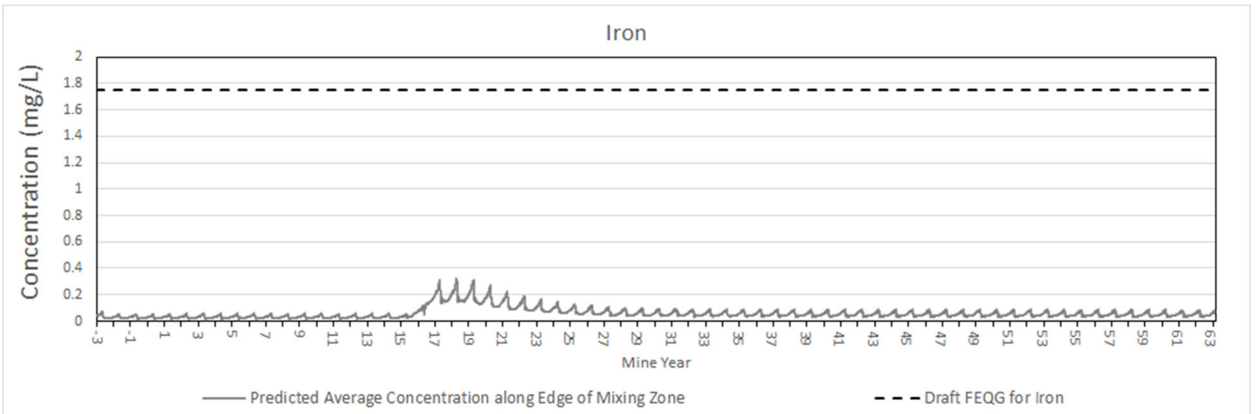


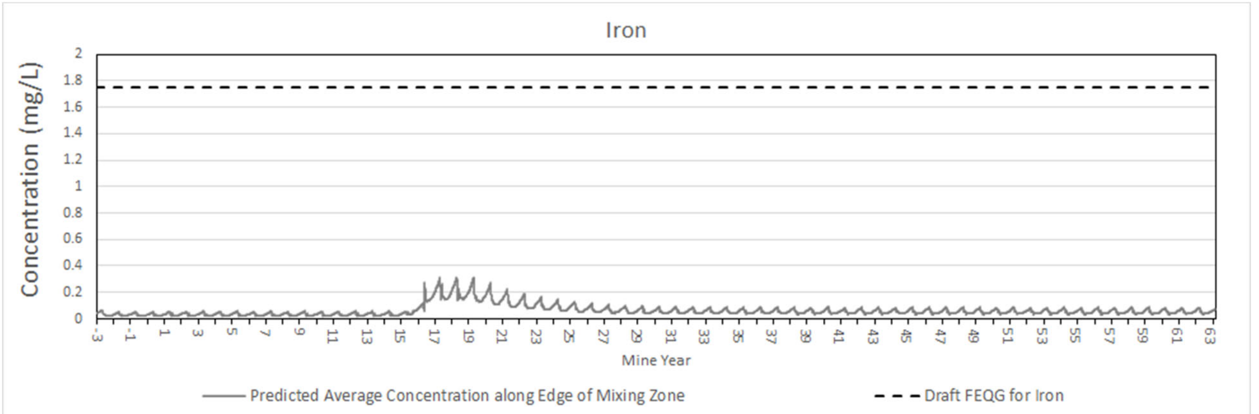
Figure KIA-NWB-2-9: Predicted Selenium Concentrations at the Edge of the Mixing Zone at PN08, Years 18 to 21



KIA-NWB-2-10: Predicted Iron Concentrations at the Edge of the Mixing Zone at PN04 (Screened against the Draft FEQG for Iron)



KIA-NWB-2-11: Predicted Iron Concentrations at the Edge of the Mixing Zone at PN05 (Screened against the Draft FEQG for Iron)



KIA-NWB-2-12: Predicted Iron Concentrations at the Edge of the Mixing Zone at PN08 (Screened against the Draft FEQG for Iron)

KIA-NWB-03: Impacts of mine influenced inflow on lake freezing.

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 7.1 Predicted Concentrations at the Edge of Mixing Zones

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Section: 8.0 Sensitivity Analysis

Page: 35 of 105

Detailed Review Comment

Sabina states, "*The Goose Lake Model predictions at the edge of mixing zones for each mine-affected inflow (i.e., PN04, PN05, and PN08) are presented in Table 6 and Table 7, and Appendix B (timeseries plots). For PN04 and PN08 mine-affected inflows, the model results were extracted along an arc located at a radius of approximately 180 to 220 m from the discharge point to Goose Lake. For PN05, model results were extracted along the arc located at a radius of approximately 390 to 440 m, because the mesh cells located within the approximately 200 m radius from the PN05 discharge point did not contain water for the full duration of each year (i.e., the lake is frozen to bottom during winter at these locations) and thus the closest cell with unfrozen water for the entire year was selected to extract results.*" However, Sabina does not indicate whether there may or may not be impacts on lake freezing due to warmer inflows from the mine site or if mine affected inflows will only occur during the open water season in the updated modelled scenario.

Furthermore, in the sensitivity scenarios Sabina only provides Lake Outlet timeseries data for the open water season, *"since there is no outflow from the lake during the ice cover season."* If there is the potential for mine-affect inflows to impact the freeze thaw patterns of Goose Lake, then the sensitivity analysis should be updated to include the ice-covered season.

Recommendation/Request:

It is recommended that Sabina discuss the potential impacts on lake freezing resulting from mine affected inflows to Goose Lake or clarify if mine affected inflows will only occur during the open water season. If mine-affected inflows may impact the freeze thaw patterns in Goose Lake than it is recommended that the sensitivity analysis be updated to include the ice-covered season.

Sabina Response:

Sabina does not anticipate any potential impacts on the freeze-thaw patterns in Goose Lake as a result of mine-affected inflows to the water body. The mine-affected inflows reaching Goose Lake at PN04, PN05, and PN09 are expected to maintain the same temperature as unaffected (i.e., natural) inflows to the lake under current and historical conditions. Sabina confirms mine-affected inflows start entering Goose Lake each year in spring and end in fall, which is similar to natural inflows observed under existing conditions. In summary, the temperature and hydrographs proposed for mine-affected inflows will be similar to those of existing inflows in both timing and temperature, and therefore, no effects on lake freezing are anticipated.

KIA-NWB-04: Inappropriate phosphorus aquatic water quality guideline

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 2.3 Modelled Constituents and Screening Criteria

Table 1: Modelled Constituents and Surface Water Quality Effects Benchmarks for the Protection of Aquatic Life

Page: 8 and 9 of 105

Back River Project Final Environmental Impact Statement Supporting Volume 6: Freshwater Environment Appendix V6-3A

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Detailed Review Comment

Sabina used a water quality benchmark of 0.01 mg/L for phosphorus stating, *"This value is the upper limit of the oligotrophic range (CCME 2004) to maintain the current trophic status of Goose Lake (Golder 2019)."* However, according to the Back River Project baseline report Goose Neck, Goose Central and Goose Tail were all considered ultraoligotrophic with phosphorus concentration below 0.004 mg/L (see Table 3.2-1 below). Given the current trophic status of Goose Lake at all evaluated locations is classified as ultraoligotrophic, the water quality benchmark should be <0.004 mg/L following CCME[5] guidance to maintain the existing trophic status. This is further corroborated by the 50th percentile background concentration of 0.0037 mg/L and 0.0034 mg/L for the entire lake provided in Table 6 and Table 8, respectively. The current benchmark reflects a different trophic status and would permit an increase in nutrients which could result in a more productive lake.

Table 3.2-1. Lake Water Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	pH	Ammonia (as N)	Fluoride (F)	Chloride (Cl)	Nitrate (as N)	Nitrite (as N)	Total Phosphorus	Free Cyanide
			6.5-9.0	temperature - and pH-dependent	0.12[b] mg/L	640 mg/L	2.935[b] mg/L	0.06 mg/L	Trophic Status[c]	0.005 mg/L
Llama	5		0	0	0	0	0	0	Ultraoligotrophic	0
Umwelt	3		0	0	0	0	0	0	Oligotrophic - Mesotrophic	0
Giraffe	3		0	0	0	0	0	0	Ultraoligotrophic	0
Goose Neck	3		0	0	0	0	0	0	Ultraoligotrophic	0
Goose Central	3		0	0	0	0	0	0	Ultraoligotrophic	0
Goose Tail	1		100	0	0	0	0	0	Ultraoligotrophic	0
Propellor	5		0	0	0	0	0	0	Ultraoligotrophic - Oligotrophic	0
Reference B	5		0	0	0	0	0	0	Ultraoligotrophic - Oligotrophic	0
Total	28									

Recommendation/Request:

It is recommended that Sabina update their phosphorus water quality benchmark for phosphorus from 0.01 mg/L to <0.004 mg/L to reflect the current trophic status of Goose Lake. Alternatively, Sabina may provide updated baseline water quality data (i.e., up to and including the most recent monitoring year) for Goose Lake to substantiate the use of a higher water quality benchmark. Sabina should be sure to follow the CCME[6] Guidance Manual for Developing Nutrient Guidelines and propose mitigations to maintain the existing trophic status in Goose Lake when discharges occur if required.

[5] Canadian Council of Ministers of the Environment (CCME). 2004. Canadian water quality guidelines for the protection of aquatic life: Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems. In: Canadian environmental quality guidelines, 2004, Canadian Council of Ministers of the Environment, Winnipeg.

[6] Canadian Council of Ministers of the Environment (CCME). 2016. Guidance manual for developing nutrient guidelines for rivers and streams.

Sabina Response:

Sabina notes that the most recently published Aquatic Baseline Synthesis Report with an assessment of the trophic status in Goose Lake, which was based on baseline data collected from 2010 to 2018, showed that phosphorus concentrations in Goose Lake indicated the lake was ultra-oligotrophic during ice-covered conditions but oligotrophic during open-water conditions (Golder 2019). This most recently published report (Golder 2019) considered a larger dataset (i.e., 24 ice-cover samples and 68 open-water samples) relative to the assessment completed on the 2011 data alone for the Final Environmental Impact Statement (FEIS) (i.e., 3 ice-cover samples and 4 open-water samples in Table 3.2-1 of the Back River Project FEIS Appendix V6-3A referenced by KIA above) and therefore, captures more natural variability in phosphorus concentrations. The reported 50th percentile concentrations (with the 5th to 95th percentile concentrations ranges) of 0.0037 mg/L (0.0023 to 0.0070 mg/L) and 0.0034 mg/L (0.0025 to 0.0074 mg/L) for different stations in Goose Lake provided in Table 6 and Table 8, respectively of the Hydrodynamic and Water Quality Modelling of Goose Lake Report provide additional evidence that the range of typical phosphorus concentrations in Goose Lake overlaps with the oligotrophic range. The ranges presented in Table 6 and Table 8 were based on 2011 to 2018 data (Golder 2019) and more recently collected data in 2021 (Golder 2022). The use of the upper range of the oligotrophic status (i.e., 0.01 mg/L) as the water quality benchmark (Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report) for phosphorus concentrations in Goose Lake is consistent with the value used to develop phosphorus effluent quality criteria for discharges to Goose Lake during Operations (Sabina 2021) and which are approved in the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Part F, Condition 21; NWB 2021).

References:

Golder (Golder Associates Ltd). 2019. Sabina Gold & Silver Corp. Back River Project – Aquatic Baseline Synthesis Report. Appendix A to the Aquatic Effects Management Plan. Submitted to Sabina Gold & Silver Corp. July 2019. Ref No. 18114181-047-RPT-Rev0.

Golder. 2022. Sabina Back River Project – 2021 Aquatic Baseline Report. Draft completed in June 2022.

NWB (Nunavut Water Board). 2021. Water Licence 2AM-BRP1831 (Amendment No. 1) for Sabina Gold and Silver Corp.'s Back River Project. Issued August 31, 2021.

Sabina (Sabina Gold and Silver Corp.). 2021. Response to Information Request from Kitikmeot Inuit Association (KIA-TC-02). June 25, 2021.

KIA-NWB-05: Permanent Increase in Phosphorus Concentrations

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: Appendix B Goose Lake Model – Timeseries of Predicted Constituent Concentrations at the Edges of Mixing Zones during the Forecast Period

Section: Appendix C Goose Lake Model – Timeseries of Predicted Constituent Concentrations at the Assessment Stations during the Forecast Period

Page 53, 59, 65, 73, 79, 85

Detailed Review Comment

Phosphorus concentrations are predicted to increase during the closure period in Goose Lake (all sites included in the hydrodynamic model) and remain elevated in perpetuity. It represents a shift in trophic status from ultra-oligotrophic (phosphorus concentrations <0.004 mg/L) to oligotrophic (phosphorus concentrations between 0.004 mg/L and 0.01 mg/L). This could have a significant impact on the phytoplankton and macrophyte community including increases or shifts in composition which may subsequently impact higher trophic levels.

Figure B1: Predicted Timeseries Concentration of Water Quality Constituents in Goose Lake at the Edge of Mixing Zone for PN04 over the Construction, Operations, Closure and Post-closure Periods

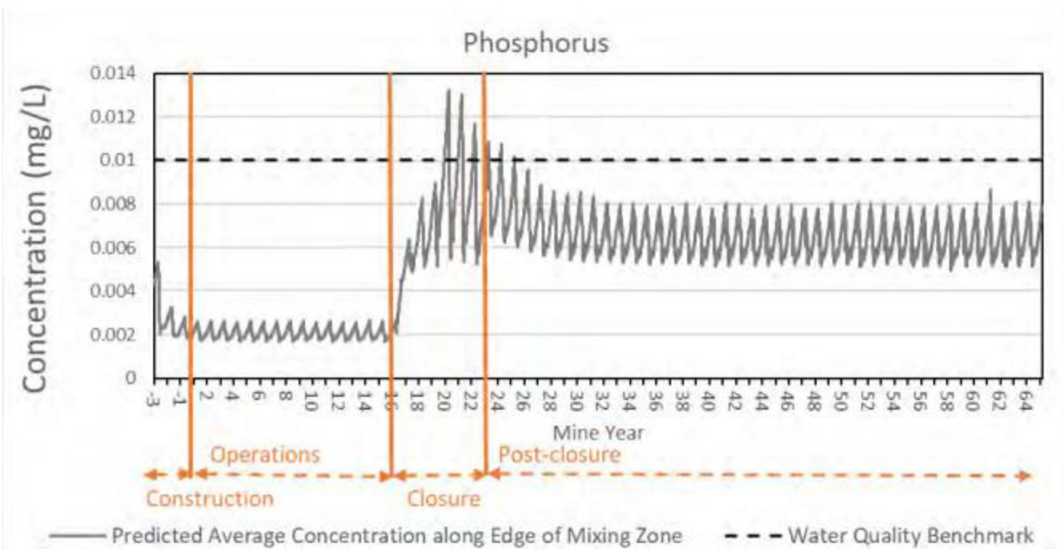


Figure B2: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at the Edge of Mixing Zone for PN05 over the Construction, Operations, Closure and Post-closure Periods

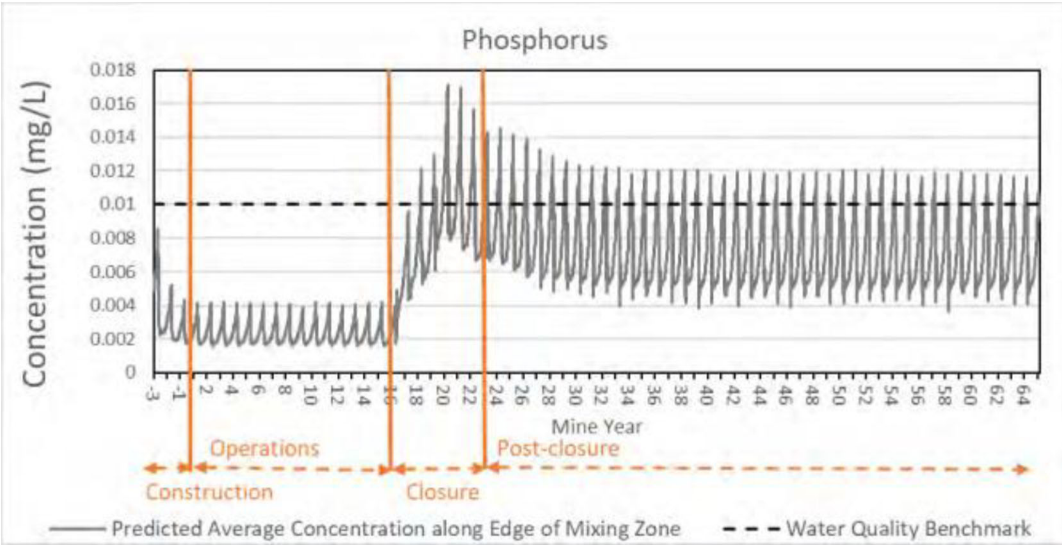


Figure B3: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at the Edge of Mixing Zone for PN08 over the Construction, Operations, Closure and Post-closure Periods

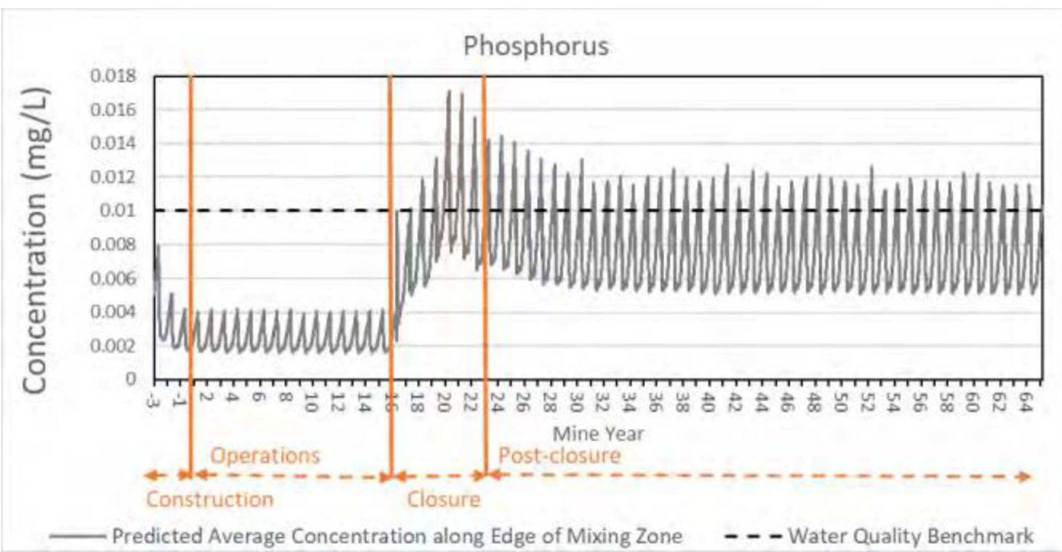


Figure C1: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at GLCB over the Construction, Operations, Closure and Post-closure Periods

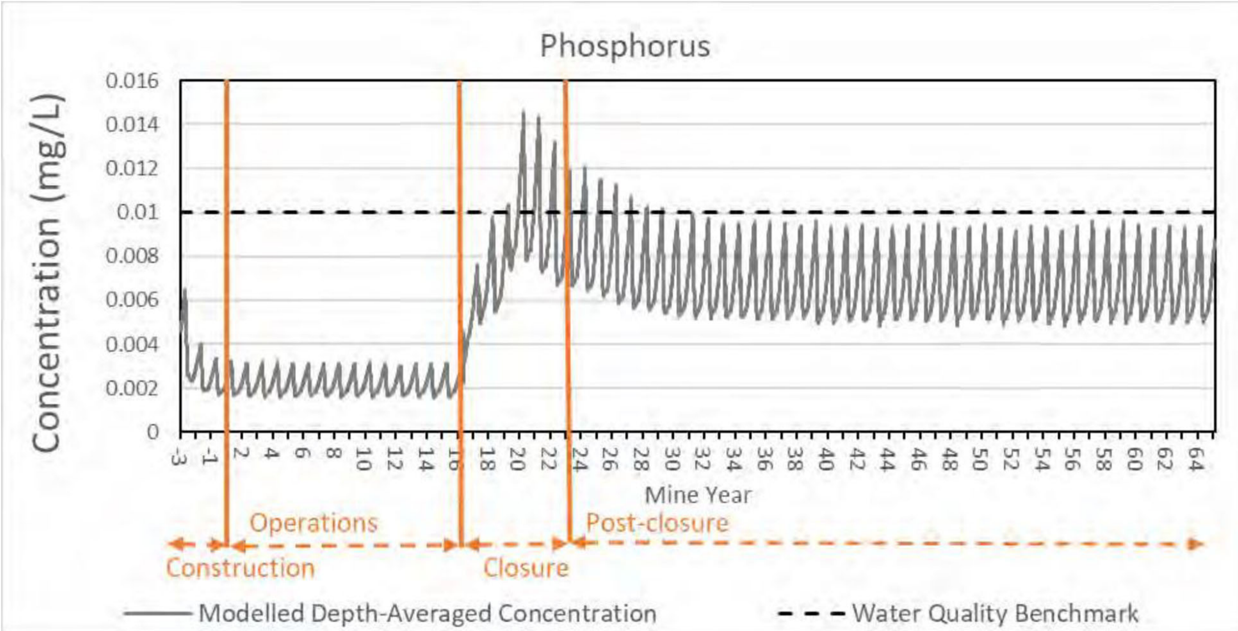


Figure C2: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at GLTL over the Construction, Operations, Closure and Post-closure Periods

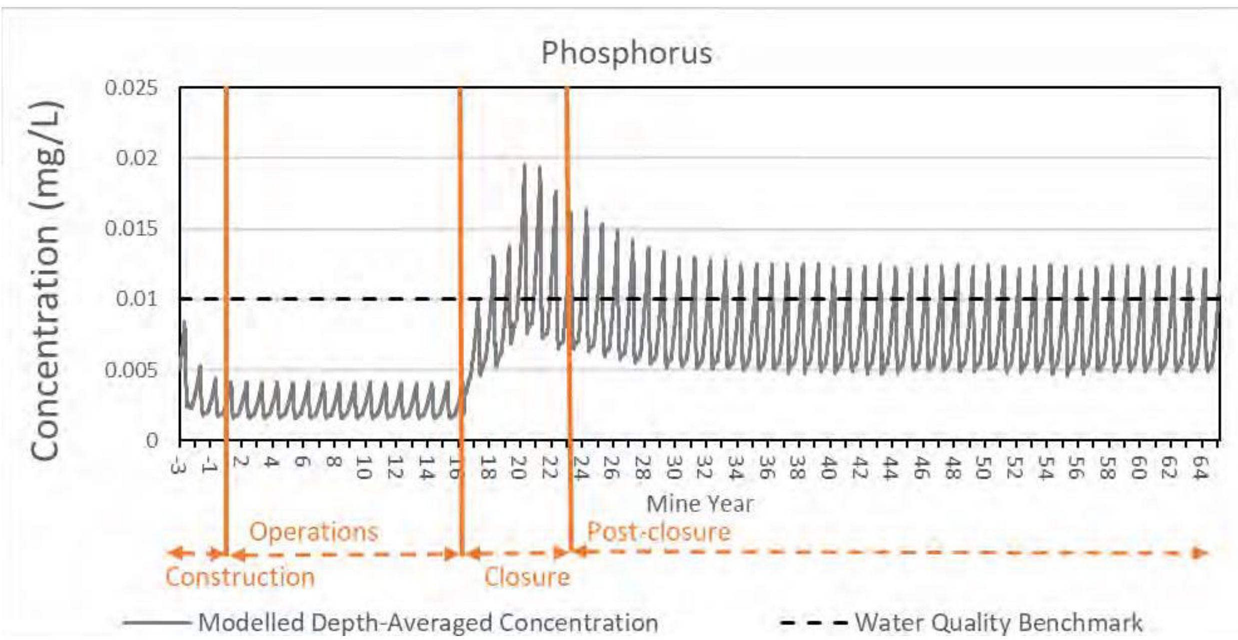
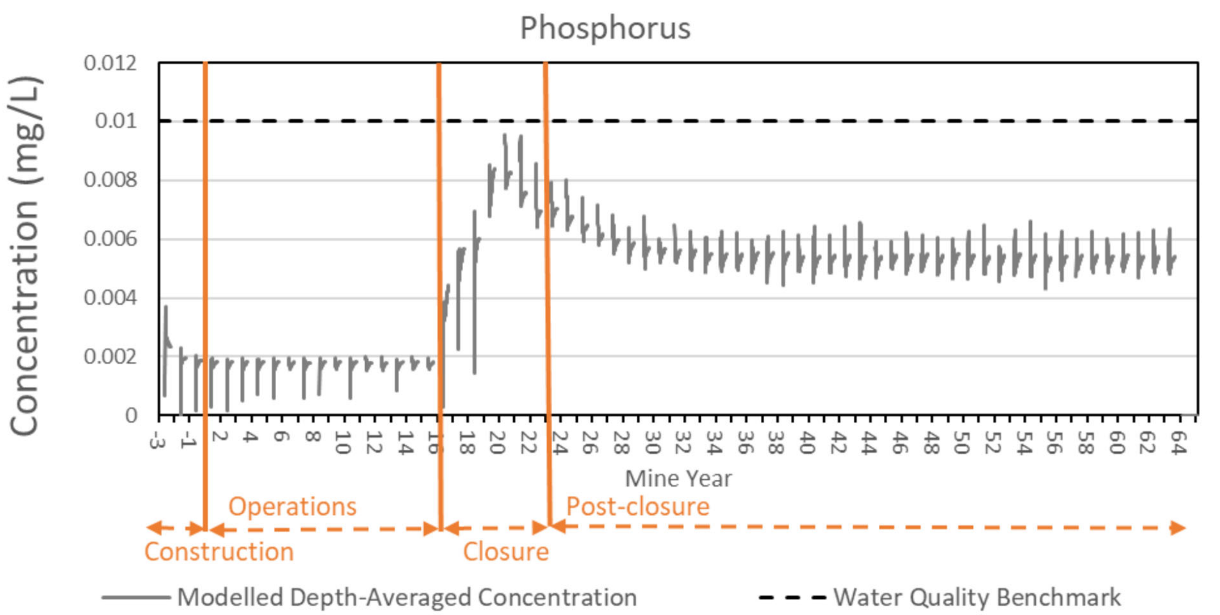


Figure C3: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake Outflow over the Construction, Operations, Closure and Post-closure Periods



Recommendation/Request:

A shift in trophic status from ultra-oligotrophic to oligotrophic is predicted for Goose Lake. This could have a significant impact on the phytoplankton and macrophyte community including increases or shifts in composition which may subsequently impact higher trophic levels. It is recommended that Sabina propose treatment for mine-affected inflows to Goose Lake as necessary to maintain the current trophic status of the lake. Sabina may also investigate the potential impact increases in phosphorus could have on Goose Lake including changes in phytoplankton community composition and biomass to demonstrate whether minimal impacts may be expected should they wish to maintain the current modeled phosphorus increases.

Sabina Response:

Sabina clarifies that the trophic status for Goose Lake during open-water conditions is oligotrophic (see IR response KIA-NWB-04) and confirms the predicted changes in total phosphorus concentrations in Goose Lake do not indicate a change in tropic status of Goose Lake. In addition, the predicted concentrations are a conservative estimate of future phosphorus concentrations in Goose Lake because the model does not account for processes that may remove phosphorus from the water column, such as biological uptake. Sabina has committed to monitoring phosphorus and chlorophyll annually in Goose Lake through the Aquatic Effects Management Plan (AEMP; Sabina 2017) as well as applying nutrient enrichment Action Levels in the AEMP Response Framework. If Action Levels are triggered for nutrient enrichment, then additional follow-up activities, such as plankton monitoring, will be considered.

References:

Sabina (Sabina Gold and Silver Corp.). 2017. Back River Project. Aquatic Effects Management Plan. October 2017.

KIA-NWB-06: Only open water dissolved organic carbon concentrations used in benchmark development

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 2.3 Modelled Constituents and Screening Criteria

Table 1: Modelled Constituents and Surface Water Quality Effects Benchmarks for the Protection of Aquatic Life

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Detailed Review Comment

For benchmark development Sabina notes, *"Values of pH and DOC used to calculate pH and DOC-dependent guidelines were based on data collected in Goose Lake during open water conditions (Golder 2019, 2022)."* The reviewer finds this method acceptable for pH, however lower concentrations of dissolved organic carbon (DOC) may be observed during the ice-covered season which would result in lower benchmark concentrations as DOC has an ameliorating effect on several parameters of concern (e.g., zinc). Therefore, DOC concentrations from the ice-covered season should be included in benchmark development.

Recommendation/Request:

It is recommended Sabina include dissolved organic carbon (DOC) concentrations measured during the ice-covered season in benchmark development to produce conservative benchmarks that reduce the ameliorative effects of DOC or provide both open-water and ice-covered dissolved organic carbon values and justification for the use of only the open-water season.

Sabina Response:

Based on baseline data collected during the ice-covered season (Golder 2019, 2022), the minimum measured dissolved organic carbon (DOC) concentration in Goose Lake was 4.6 mg/L, which is greater than the minimum concentration of 3.5 mg/L used to calculate DOC-dependent water quality benchmarks in Table 1 of the Hydrodynamic and Water Quality Modelling of Goose Lake Report. The calculated values of water quality benchmarks that vary with DOC decrease as DOC concentrations decrease (e.g., water quality benchmarks for manganese and zinc, which are based on DOC concentrations, are lower and more conservative with lower DOC concentrations); therefore, the selected value of 3.5 mg/L for DOC results in the most conservative DOC-dependent water quality benchmarks based on measured DOC concentrations in Goose Lake.

Sabina also highlights that the Note in Table 1: Modelled Constituents and Surface Water Quality Effects Benchmarks for the Protection of Aquatic Life should be revised to include under-ice conditions: *"Values of pH and DOC used to calculate pH and DOC-dependent guidelines were based on data collected in Goose Lake during open-water and under-ice conditions (Golder 2019, 2022)."*.

References:

Golder (Golder Associates Ltd). 2019. Sabina Gold & Silver Corp. Back River Project – Aquatic Baseline Synthesis Report. Appendix A to the Aquatic Effects Management Plan. Submitted to Sabina Gold & Silver Corp. July 2019. Ref No. 18114181-047-RPT-Rev0.

Golder. 2022. Sabina Back River Project – 2021 Aquatic Baseline Report. Draft completed in June 2022.

KIA-NWB-07: Climate change consideration

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 3.2 Meteorological Data

Page: 13 of 105

Document: Back River Project Water and Load Balance Report

Section: 3.2.2 Climate Change

Page: 18 of 110

Detailed Review Comment

Climate change does not appear to be taken into consideration within the hydrodynamic and water quality model. Sabina states, *"The precipitation data were extracted from Lupin station. An estimated under-catch factor was applied to the observed precipitation data based on the under-catch adjustment analysis completed by SRK (2015). For years with large gaps in precipitation data, monthly precipitation data for an average climate year were obtained from the Water and Load Balance (WLB) Model (WSP Golder 2022)."*

In the load and water balance model Sabina states, *"A climate change analysis was completed for the Project in 2015 (SRK 2015b) which projected the rate of change in precipitation and temperature in the future on an annual basis. While most surface water management infrastructure will have short lifespans and be breached at Closure, open pits filled with tailings and saline water, and waste rock storage areas will remain in perpetuity and long-term climate change effects were considered. The long-term air temperature and precipitation projections used as inputs to the Model are provided in Table 4, based on trends from 1979 to 2005. Temperature and precipitation projections in the Model were linearly interpolated and centered for 2025, 2055, and 2085, with climate projections beyond 2085 assumed to remain constant."* Climate change models and predictions change as more information becomes available. It is important to include recent projections in climate analysis.

Recommendation/Request:

Therefore, it is recommended that Sabina clarify if the precipitation data used in the models includes the greater variability in precipitation values that may result from climate change as in described Bush and Lemmen, 2019[7].

Sabina Response:

The precipitation rates applied in the hydrodynamic and water quality modelling of Goose Lake during the calibration period (2010 to 2021) were obtained from Environment Canada's Lupin station. The precipitation data applied in the Hydrodynamic and Water Quality Model for the forecast period (i.e., Construction, Operations, Closure, and Post-closure) were based on the monthly precipitation for the average climate year (Golder 2022a; Table 2; annual precipitation of 427 mm).

As stated in the Water and Load Balance (WLB) Report, climate change was considered in the WLB model and the long-term air temperature and precipitation projections were used as inputs to the model based on trends from 1979 to 2005 to predict inflows.

[7] *Bush, E. and Lemmen, D.S., editors (2019): Canada's Changing Climate Report; Government of Canada, Ottawa, ON. 444 p.*

As presented in Bush and Lemmen (2019), there is low confidence in quantifying regional amounts of total precipitation given insufficient station density; thus, the assessment of regional changes in precipitation is recommended to be based on locally normalized precipitation and expressed as a percentage change.

Sabina confirms that the precipitation projections applied in the WLB model were based on SRK (2015a and b). These projections estimated increases of 6%, 11%, and 16% over the baseline period (1979 to 2005) for the 2020s, 2050s, and 2080s, respectively (SRK 2015b). Those estimates were compared to projections available at the time the study was completed including the IPCC (2007), which projected an increase in annual mean precipitation in northern regions of up to 20% by 2100. Lenman et al. (2008) predicted that total annual precipitation could increase from 5% to 8% (2010 to 2030), and 15% to 30% (2070 to 2100), relative to 1961 to 1990.

Sabina also confirms that in the Goose Lake Hydrodynamic and Water Quality Model, the effects of climate change on precipitation rate, inflow rates, and inflow chemistries on model's predictions were evaluated as part of the sensitivity analysis (Golder 2022b, Appendix D). Sensitivity scenarios A and B assessed the effects of increased/decreased precipitation rates and variability from year-to-year on predicted constituent concentrations in Goose Lake. For the sensitivities A and B, the annual precipitation input was extracted from the stochastic WLB model for the realizations that were representative of the 96th and 4th percentile of historical precipitation conditions, representing (on average) an annual precipitation of 504 mm and 406 mm, respectively. When compared to the Base Case (i.e., annual precipitation of 427 mm), sensitivity A represents an increase of approximately 18% in average annual precipitation, which is within the expected range of long-term precipitation projections for change in climate as described in Bush and Lemmen (2019), IPCC (2007), Lenman et al. (2008) for the majority of the emission scenarios and future periods evaluated, noting that the baseline period to which the precipitation increases are referred to differs across studies.

Sabina also highlights that direct precipitation to Goose Lake comprises only a small portion of total inflows to the lake. Direct precipitation to the lake surface represents, on average, about 8% of total annual inflows to the lake for the forecast period (see Golder 2022b, Table 2).

Future versions of the WLB model may incorporate more recent precipitation projections as more data becomes available. If the more recent precipitation projections fall outside of the range considered in the Hydrodynamic and Water Quality Model, an updated sensitivity analysis may also be completed for the Hydrodynamic and Water Quality Model.

References:

Bush, E. and Lemmen, D.S., editors (2019): Canada's Changing Climate Report; Government of Canada, Ottawa, ON. 444 p.

Intergovernmental Panel on Climate Change (IPCC). 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

Golder 2022a. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

Golder 2022b. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-15000

Lenman, D. S., Warren, F. J., Lacroiz, J. and Bush, E., editors. 2008. From Impacts to Adaptation: Canada in a Changing Climate 2007. Government of Canada, Ottawa, ON.

SRK Consulting (Canada) Inc. (SRK). 2015a. Standardized Procedure for Climate Change Integration into Engineering Design. Memo prepared for Sabina Gold & Silver Corp. Project No. 1CS020.008, September 2015.

SRK Consulting (Canada) Inc. 2015b. Back River Project – Hydrology Report. Report prepared for Sabina Gold and Silver Corp in Support of the Final Environmental Impact Assessment. April 2015.

KIA-NWB-08: Use of temperature data from Snap Lake

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: 3.5 Water Quality Inputs

Page: 9 of 105

Detailed Review Comment

For water quality inputs that pertain specifically to temperature Sabina states, *“Continuous measurements of stream water temperature were not available for inflows from natural tributaries; thus, temperature timeseries were developed using data collected at streams draining into Snap Lake collected from 2009 and 2016 (De Beers 2017) and were applied to all tributary inflows to Goose Lake.”* The use of temperature data collected at Snap Lake is not appropriate for Goose Lake for several reasons:

1. Goose Lake is substantially further north than Snap Lake. Goose Lake has a latitude of 65°33’ and Snap Lake has a latitude of 63°53’.

2. Snap Lake is in an area with a greater coverage of pooling water relative to Goose Lake which would impact thermal regimes in ephemeral flow paths.

3. Snap Lake is close to the tree line compared to Goose Lake which is well above the tree line.

Therefore, it is recommended the Sabina collect local thermal data from the natural tributaries or find data from a more appropriate source.

Recommendation/Request:

The use of Snap Lake temperature data is inappropriate for input in the hydrodynamic model for Goose Lake due to difference in latitude, surrounding ephemeral flow paths and proximity to the tree line. Therefore, it is recommended that Sabina collect and use local data from natural tributaries or obtain data from a more appropriate source.

Sabina Response:

Please note that in the heat budget regulating the temperature of streams, air temperature typically has a large influence on stream temperature (Preud’homme and Stefan 1992). There have been several studies conducted to develop a relationship between air temperature and water temperature in rivers. Overall, the findings have shown that stream temperature is a function of air temperature (Yang and Peterson 2017; Liu et al. 2005) and generally follows the air temperature on a seasonal time scale (Sinokrot and Stefan 1993).

Figure KIA-NWB-8-1 compares the observed average monthly air temperature from June to October (i.e., the period with inflows to Goose Lake) at Snap Lake and Goose Lake. As shown on the figure, Goose Lake is, on average, approximately 1 to 2 degree Celsius (^{o}C) colder than Snap Lake. Because air temperatures are similar between the two sites and water temperatures are primarily based on air temperatures, water temperatures are expected to be similar between the two sites. Therefore, Sabina believes applying the observed water temperature collected at the streams draining into Snap Lake to the streams draining into Goose Lake is a reasonable assumption. However, During Operations, Sabina will monitor water temperature in the streams draining to Goose Lake and data will be compared with the data used in the model in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Schedule I; NWB 2021).

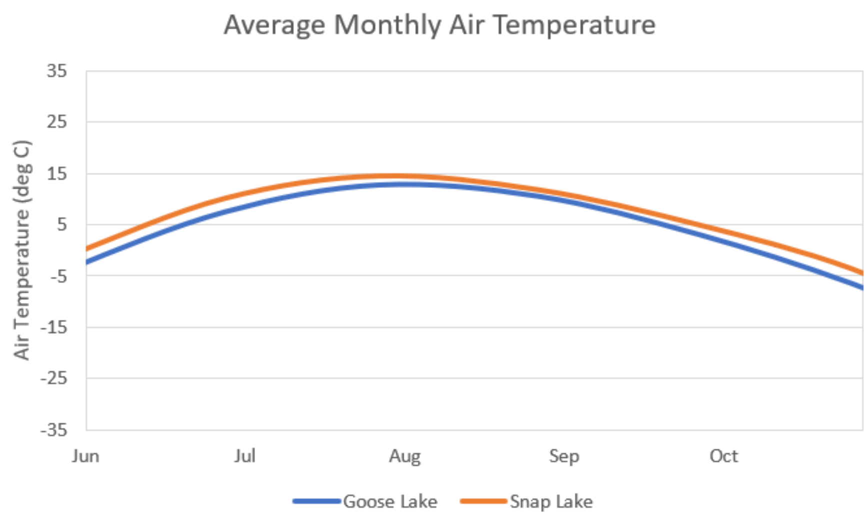

Figure KIA-NWB-8-1: Observed Average Monthly Air Temperature at Snap Lake and Goose Lake During the Period of the Year That There are Inflows to the Lakes (i.e., streams are not frozen)

References:

Liu, B., Yang, D., Ye, B., and Berezovskaya, S. 2005. Long-term open-water season stream temperature variations and changes over Lena River basin in Siberia. Global and Planetary Change 48(1-3):96 – 111.

NWB (Nunavut Water Board). 2021. Water Licence 2AM-BRP1831 (Amendment No. 1) for Sabina Gold and Silver Corp.'s Back River Project. Issued August 31, 2021.

Preud'homme E.B. and Stefan H.G. 1992. Relationship Between Water Temperatures and Air Temperatures for Central US Streams. University of Minnesota. St. Anthony Falls Hydraulic Laboratory. Project Report No. 333.

Yang D. and Peterson A. 2017. River Water Temperature in Relation to Local Air Temperature in the Mackenzie and Yukon Basins. Arctic. VOL. 70, NO. 1 (MARCH 2017) P. 47 – 58.

Sinokrot, B.A., and Stefan, H.G. 1993. Stream temperature dynamics: Measurement and modeling. Water Resources Research 29(7):2299 – 2312.

KIA-NWB-09: Thermal stratification

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: Appendix A Goose Lake Model – Calibration Results – Profile Plots

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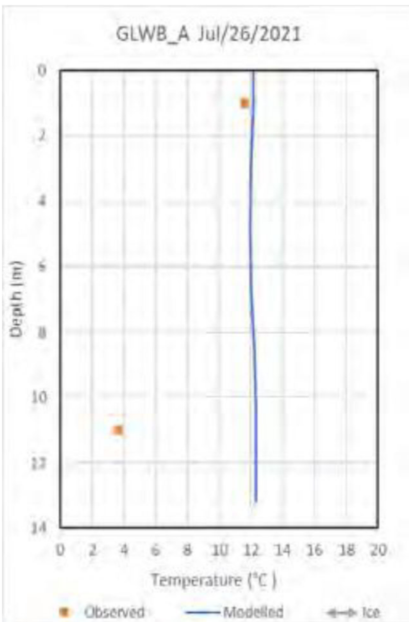
Detailed Review Comment

On July 26, 2021 from station GLWB_A thermal stratification was observed (evidenced by the orange data points) but was not modelled (blue line). Thermal stratification can be an indicator of potential changes in dissolved oxygen and the release of nutrients and metals from the lake sediment. Therefore, it is important to ensure that modeled thermal changes reflect observed.



Recommendation/Request:

It is recommended that Sabina provide an explanation why the model did not capture observed thermal stratification.

Sabina Response:

Sabina provides the following explanation for consideration:

1. Goose Lake is a relatively shallow lake with an average depth of 3 m. There are a few deeper pockets in the lake which overall comprise a small surface area and volume of the lake; based on the bathymetric data for Goose Lake, approximately 4% of the total volume and 5% of the total surface area is deeper than 8 meters. In consideration Goose Lake’s shallowness and the presence of very small areas of deep pockets, the primary objective of model calibration was to achieve good overall water temperature performance throughout the lake, recognizing that not all localities may necessarily be perfectly represented under all conditions. Overall, the calibrated model is predicting water temperature reasonably well throughout the vertical and lateral extent of the lake (refer to timeseries of the surface layer temperature and profile plots presented in Figure 5 and Appendix A of the Hydrodynamic and Water Quality Modelling of the Goose Lake Report [Golder 2022],

respectively). Figure KIA-NWB-9-1 compares the temperature profile plots for all monitoring stations across Goose Lake on July 26, 2021. As shown on the figure, Sabina believes that overall, the modelled and observed data shows a lack of thermal stratification across the lake, except for GLWB_A (i.e., the deep pocket with a small surface area).

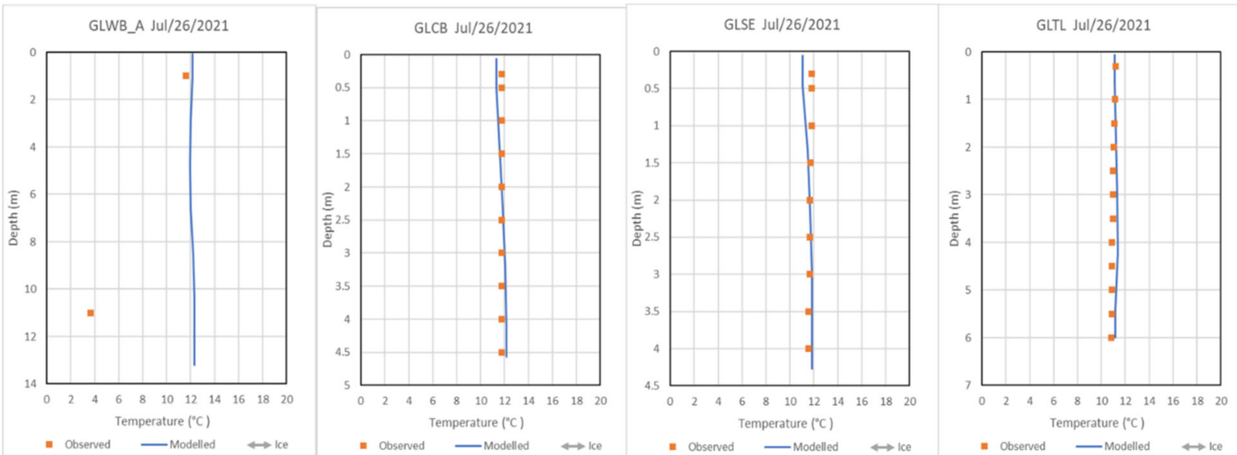


Figure KIA-NWB-9-1: Observed and Predicted Temperature Profiles in Goose Lake on July 26, 2021

2. As shown on Figure A1 of Appendix A [Golder 2022] and also presented on Figure KIA-NWB-9-2, the observed temperature data shows that Goose Lake has a relatively similar temperature from surface to bottom on September 3, 2021 at location GLWB_A. Sabina affirms that temporary periods of thermal stratification in local deep pockets, which compromise less than 4% of Goose Lake's total volume, in the early summer when ice is regressing from the lake is not expected to have a material effect on model conclusions.

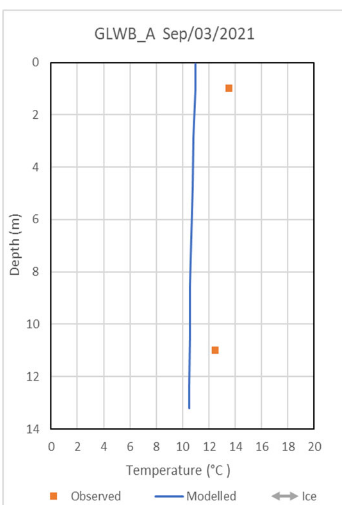


Figure KIA-NWB-9-2: Observed and Predicted Temperature Profiles in Deep Station GLWB-A on September 3, 2021

3. Sabina also notes that a material model assumption included in the assessment is that ice vanishes from the lake at the end of June each year. Given that real conditions can have slight variations across years, it is reasonable to assume that a difference in the timing of ice melt in 2021 could explain the discrepancy identified in this review comment.

Sabina will continue to monitor the temperate across the vertical and lateral extend of Goose Lake and in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Schedule I; NWB 2021) and will consider this information in the next update of the Hydrodynamic model.

References:

Golder 2022. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-1500.

NWB (Nunavut Water Board). 2021. Water Licence 2AM-BRP1831 (Amendment No. 1) for Sabina Gold and Silver Corp.'s Back River Project. Issued August 31, 2021.

KIA-NWB-10: Multiyear exceedances of nickel, chloride, iron and selenium

References:

Document: Hydrodynamic and Water Quality Modelling of Goose Lake

Section: Appendix C Goose Lake Model – Timeseries of Predicted Constituent Concentrations at the Assessment Stations during the Forecast Period

Page:

Detailed Review Comment

The predicted timeseries concentrations for nickel, chloride, iron and selenium at the central basin and tail of Goose Lake indicate multiyear exceedance of chronic guideline of the entire lake, indicating the potential for prolonged deleterious effects to aquatic life. It is recommended that Sabina either prove that the guidelines are overprotective for this particular site or provide mitigation efforts to reduce impacts. While exceedances are acceptable within the mixing zone, whole lake exceedances are not.

Figure C1: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at GLCB over the Construction, Operations, Closure and Post-closure Periods

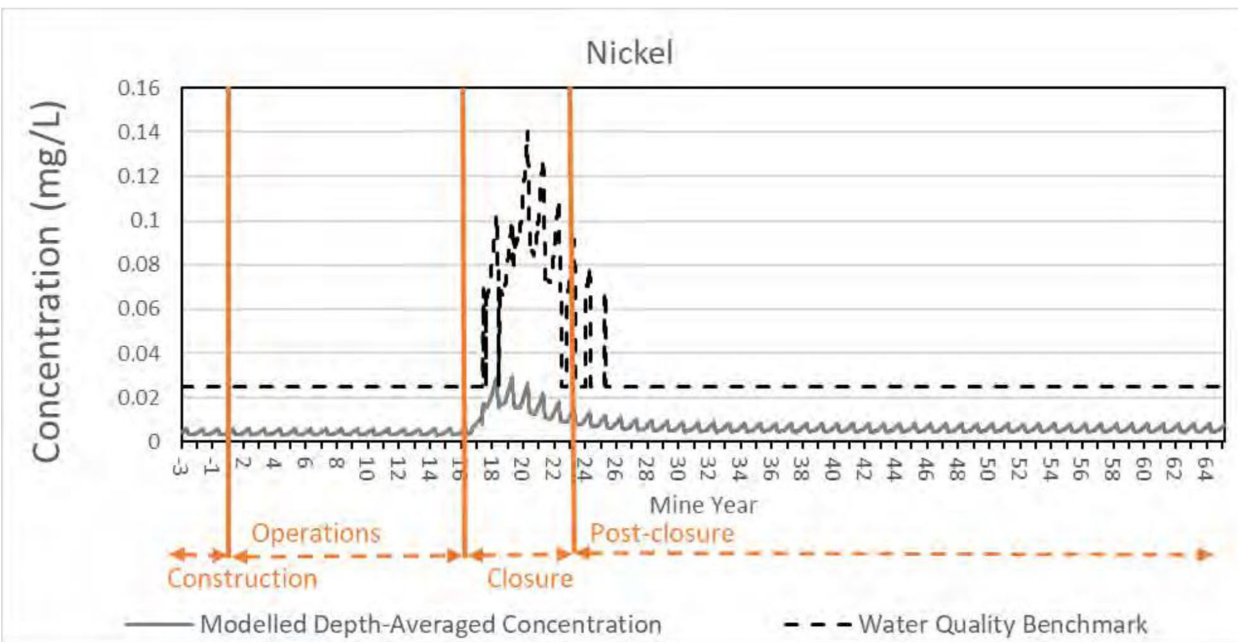
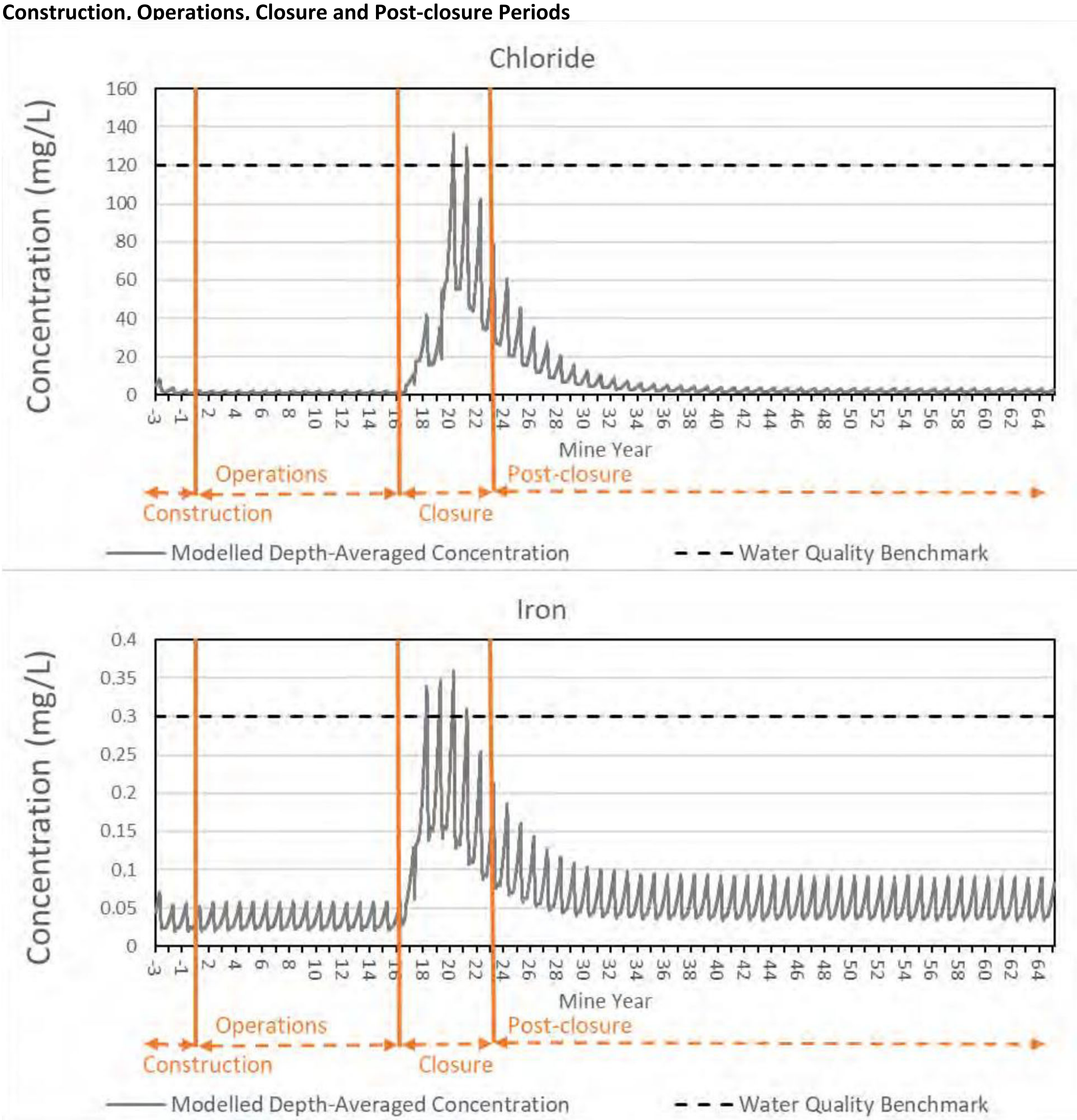
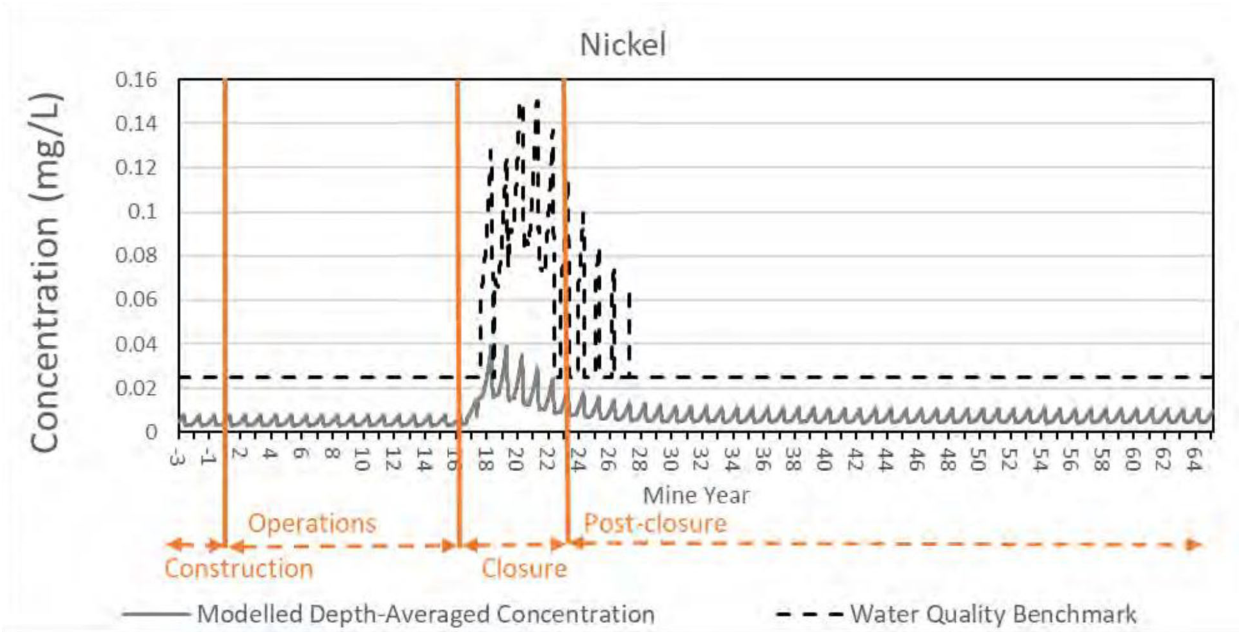
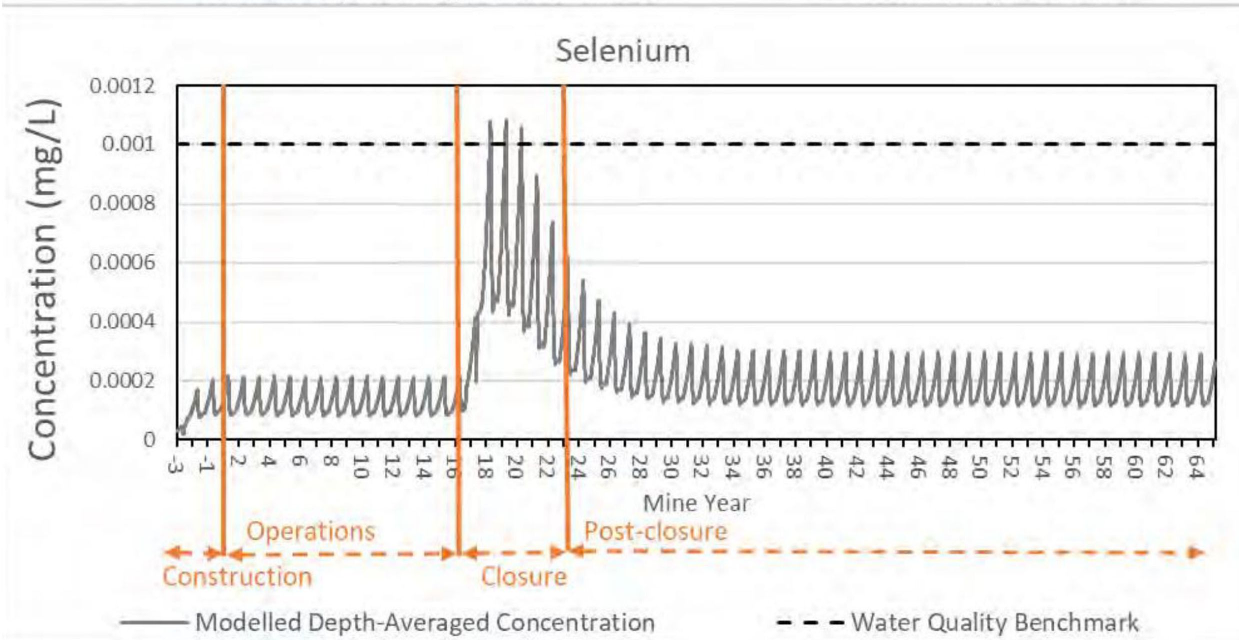


Figure C2: Predicted Timeseries Concentrations of Water Quality Constituents in Goose Lake at GLTL over the Construction, Operations, Closure and Post-closure Periods







Recommendation/Request:

It is recommended that Sabina either demonstrate that the generic guidelines for nickel, chloride, iron and selenium are overprotective for this particular site (e.g., derive a site-specific water quality objective) or provide mitigation efforts to reduce potential impacts to aquatic life due to multiyear exceedances of chronic guidelines (e.g., provide water treatment when contact water is predicted to result in lake wide exceedances).

Sabina Response:

Sabina confirms the predicted concentrations of nickel in the central basin and tail of Goose Lake are below the water quality benchmark (Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report), and as per response to KIA-NWB-2, acknowledges that the scale of plots in the Hydrodynamic and Water Quality Modelling of Goose Lake Report make this information difficult to confirm. Figures KIA-NWB-10-1 and KIA-NWB-10-2 provide a finer scale of the predicted nickel concentrations in the central basin and tail, respectively.

Sabina confirms that predicted concentrations of chloride, iron, and selenium remained below water quality benchmarks (Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report) in the central basin of Goose Lake (see Figure C1 in report). Per response to KIA-NWB-2, the predicted infrequent (i.e., less than 5% of predictions), localized (i.e., in the tail of Goose Lake) and temporary (i.e., occurring 2 to 4 years in Closure) exceedances of chronic guidelines for chloride, iron and selenium are not expected to result in harmful effects to aquatic life in Goose Lake. Finally, per response KIA-NWB-2, predicted iron concentrations in the tail of Goose Lake are below the draft Federal Environmental Quality Guideline (FEQG) suggested to be used by ECCC (see IR response ECCC-01). Sabina has proposed mitigation to treat discharge to Goose Lake so that the resulting concentrations in Goose Lake are not expected to be harmful for aquatic life.

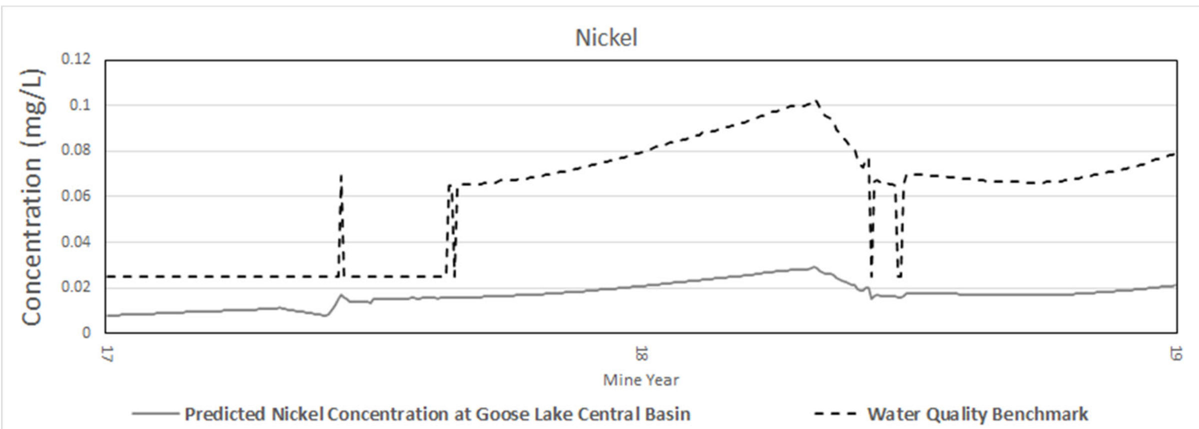


Figure KIA-NWB-10-1: Predicted Nickel Concentrations in Goose Lake at GLCB (i.e., central basin), Year 17 and 18

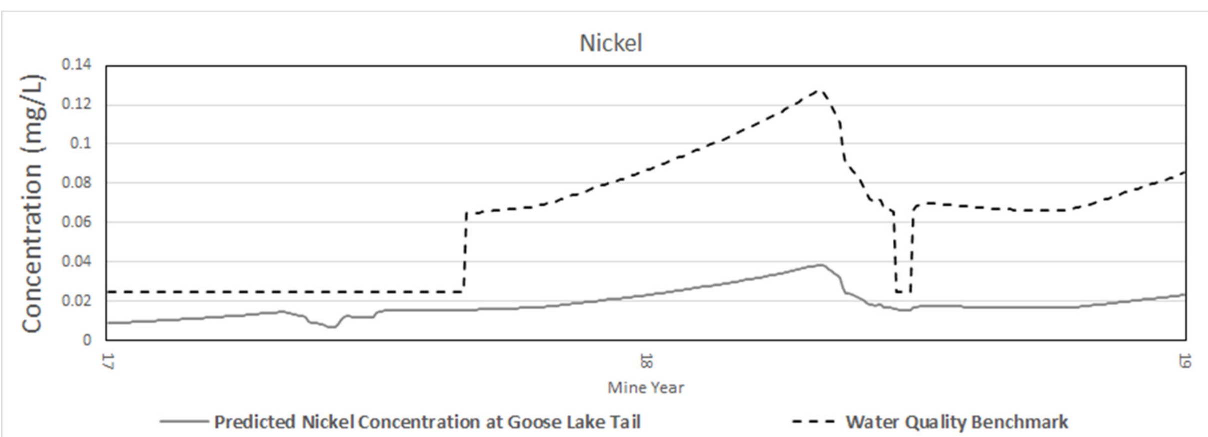


Figure KIA-NWB-10-2: Predicted Nickel Concentrations in Goose Lake at GLTL (i.e., the tail), Year 17 and 18

KIA-NWB-11: Inconsistences in analysis of values below the detection limit

References:

Document: Back River Project Water and Load Balance Report

Section: 4.2.1 Background Surface Water Quality and Lake Initial Water Quality

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Detailed Review Comment

Sabina states, *"Golder compiled and analyzed water quality data collected at the Project Site from 2011 to 2018 (Golder 2019). Stream water samples were collected and analyzed during freshet and the remaining open water season. The median concentrations were used as inputs in the load balance component of the Model (APPENDIX D). Measurements below the detection limit were conservatively assumed to be equal to the detection limit, with the exception of mercury which was treated as half the detection limit. Initial concentrations were assigned to Llama and Umwelt lakes in the model based on data collected in 2011 by Rescan (Rescan 2012) (APPENDIX E)."* Sabina does not explain why half the detection limit was used for mercury and not the other parameters. Using half, the detection limit will decrease predicted concentrations of mercury and is not consider a conservative approach to modeling.

Recommendation/Request:

It is recommended that Sabina either use the detection limit for mercury values below detection or provide an explanation for the inconsistencies in data analysis.

Sabina Response:

In the Water and Load Balance Model, the use of the detection limit concentration for mercury measurements below the detection limit overestimated mercury concentrations in the lake and resulted in artificially predicted exceedances of the water quality benchmark for mercury during early model runs. However, Sabina does not expect increased mercury concentrations from the mine-affected inflows based on the geochemical characterization for the Project and the results of humidity cell testing program; mercury concentrations were below the analytical detection limit of 0.002 mg/L for 97% of all the geochemical humidity cell test results (i.e., of 3,409 mercury measurements from the humidity cell testing program, only 96 samples were above the detection limit). The Water and Load Balance Model uses a mass balance approach for mine features; the use of the detection limit, especially for lab-based results which are used to develop source terms, can result in an overestimate of loads, such as those observed in the early runs for mercury, which are artefacts of the detection limit rather than actual geochemical processes.

Given the very low detected rate of mercury concentrations (i.e., 3% at the current detection limit), using an estimate of half the current detection limit, which is a less conservative approach than using the detection limit as was done for other parameters, is a reasonable assumption and a standard approach for characterizing concentrations of constituents that are typically below detection limits.

KIA-NWB-12: Use of dissolves source concentrations

References:

Document: Back River Project Water and Load Balance Report

Section: 4.2.3 Background Surface Water Quality and Lake Initial Water Quality

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Detailed Review Comment

Sabina states, *"Dissolved source concentrations for water in contact with the WRSAs and the Ore Stockpile were developed by SRK (2015), revised by Golder (2020), and further refined by WSP Golder for use in the geochemical modelling used for the load balance component of this model. The approach used to predict the source concentrations used HCT results and included the application of correction factors (i.e., temperature, coarseness, and flow channeling), geochemical modelling, and extrapolation of monitoring data from geologically similar sites in the area."* The use of dissolved concentrations underpredicts concentrations in contact water and therefore total concentrations of parameters in inflow water to Goose Lake should be used. Depending on the parameter particulate fractions can cause greater impact to aquatic biota than the dissolved fraction therefore, it is important to take both fractions into consideration when predicting parameter concentrations. Sabina also does not clearly state if predicted concentrations are for the total fraction or dissolved. Predicted concentrations could be misleading if these values represent the dissolved fraction and not the total fraction.

Recommendation/Request:

It is recommended that Sabina use total source concentrations in future modeling or provide an explanation why dissolved source concentrations are appropriate for use at this site. It is also recommended that Sabina clarify that all output parameters represent total parameter concentrations and not the dissolved fraction.

Sabina Response:

Total concentrations account for metals that are adsorbed or attached to suspended particulate matter in flows (i.e., total suspended solids [TSS]). However, Sabina would like to highlight that the main flow mechanism for mine features like the Waste Rock Storage Areas (WRSAs) and Ore Stockpile is expected to be seepage, which travels at a slower rate and therefore typically contains lower TSS than water flowing at higher velocities (e.g., higher velocities can disturb sediment and/or cause erosion). The dissolved and total fractions of constituents are expected to be similar in these types of slower moving flows. Additionally, the presence of ponds and other water management infrastructure also reduces particulate content, which will result in the total concentrations to be primarily made of dissolved constituents (i.e., minimal constituents in particulate form).

For the mine features like the WRSAs and Ore stockpile, the lab-based geochemical characterization tests used for the development of source terms (i.e., humidity cell tests) only measure the dissolved metal fraction. Total metal concentrations are not measured or reported for these tests. It is common that, in the absence of the total metals, the source terms for mine features assume the total concentrations are the same as the dissolved fraction. The approach used in this model mirrors the development of source terms in SRK (2015) that was submitted and approved as part of the 2017 Type A Water Licence application.

In the Water and Load Balance model, the process water effluent source term was based on total metal concentrations and rest of source terms were based on dissolved metal concentrations.

References:

SRK Consulting (Canada) Inc. 2015. Back River Project water and load Balance Report. April 2015.

KIA-NWB-13: Values only compared to MDMER

References:

Document: Back River Project Water and Load Balance Report

Section: 5.2 Modelled Constituents and Discharge Limits

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Section: 7.1 Prediction Nodes

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Detailed Review Comment

Sabina states, *"Water quality constituents included in the load balance component of the Model are listed in Table 18. Results of the load balance component of the Model were screened against the Metal and Diamond Mining Effluent Regulations (MDMER) discharge limits (Government of Canada 2002) (Table 19). It is acknowledged that additional requirements for discharge limits may be applicable (e.g., Water Licence discharge limits) to meet intake (i.e., Goose Lake) water quality objectives."* Discharges must meet all discharge limits including MDMER, licence criteria and acute guidelines (site specific or generic), however Sabina has only compared discharges to MDMER. Therefore, it is recommended that Sabina compare results of the load balance to MDMER, licence criteria and acute guidelines (site specific or generic).

Sabina also states, *"Timeseries plots of the predicted monthly average constituent concentrations (i.e., under average climate conditions; Section 5.1.3) (APPENDIX F). These plots are presented for the constituents with MDMER discharge limits and those that were included in the Goose Lake Hydrodynamic Model (WSP Golder 2022)."* Given that other additional discharge limits are applicable timeseries plots should be updated to include all constituents with licence criteria and acute guidelines.

Recommendation/Request:

It is recommended that Sabina compare results of the load balance to all applicable criteria including MDMER, licence criteria and acute guidelines to provide confidence discharge will be compliant and provide timeseries plots for all constituents with discharge limits.

Sabina Response:

Sabina clarifies that the approved Water License discharge limits (Water License 2AM-BRP1831) were developed based on Effluent Quality Criteria (EQC) (Golder 2021, Sabina 2021); these EQC are applicable to one discharge location of effluent for Goose Lake, which is Location B in the modelling, and to adopt one discharge rate of 1,900 m^3/day (Water License 2AM-BRP1831). Thus, these limits (i.e., EQC) cannot be applied to prediction nodes PN04, PN05, and PN08; only acute guidelines for aquatic life and Metal and Diamond Mining Effluent Regulations (MDMER) discharge limits are applicable to these prediction nodes. Although the currently approved EQC are not applicable at these prediction nodes, Sabina highlights that the discharge concentrations are predicted to be below the approved EQC (Water License 2AM-BRP1831).

Sabina has completed a comparison of predicted concentrations at prediction nodes (i.e., discharges to Goose Lake) to Canadian Council of Ministers of the Environment (CCME) acute guidelines for the protection of aquatic life. Please see Attachment KIA-A which includes timeseries plots of predicted concentrations with the acute guideline included, where applicable. The plots are presented for all modelled constituents with CCME acute guidelines, MDMER discharge limits, and also include the full suite of plots that were included in the Goose Lake Hydrodynamic and Water Quality Model (see Golder 2022a, Section 2.3). The plots include predicted discharge concentrations, applicable CCME acute guidelines for the protection of aquatic life, and MDMER maximum monthly mean concentration discharge limits, if applicable. For the constituents with no CCME acute guideline, plots are identical to the ones presented in Golder (2022b), Appendix F.

References:

Golder 2021. Sabina Gold & Silver Corporation Back River Project, Effluent Quality Criteria Report for Effluent Discharged from Tailings Facilities, Tailings Storage Facilities, or Reservoirs - Version 1. Submitted to Sabina Gold & Silver on 27 May 2021. Reference No. 20412211-081-R-Rev0-2400

Golder 2022a. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-15000

Golder 2022b. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

Sabina (Sabina Gold and Silver Corp.). 2021. Response to Information Request from Kitikmeot Inuit Association (KIA-TC-02). June 25, 2021.

KIA-NWB-14: Discharge of treated contact water at north side of Goose Neck

References:

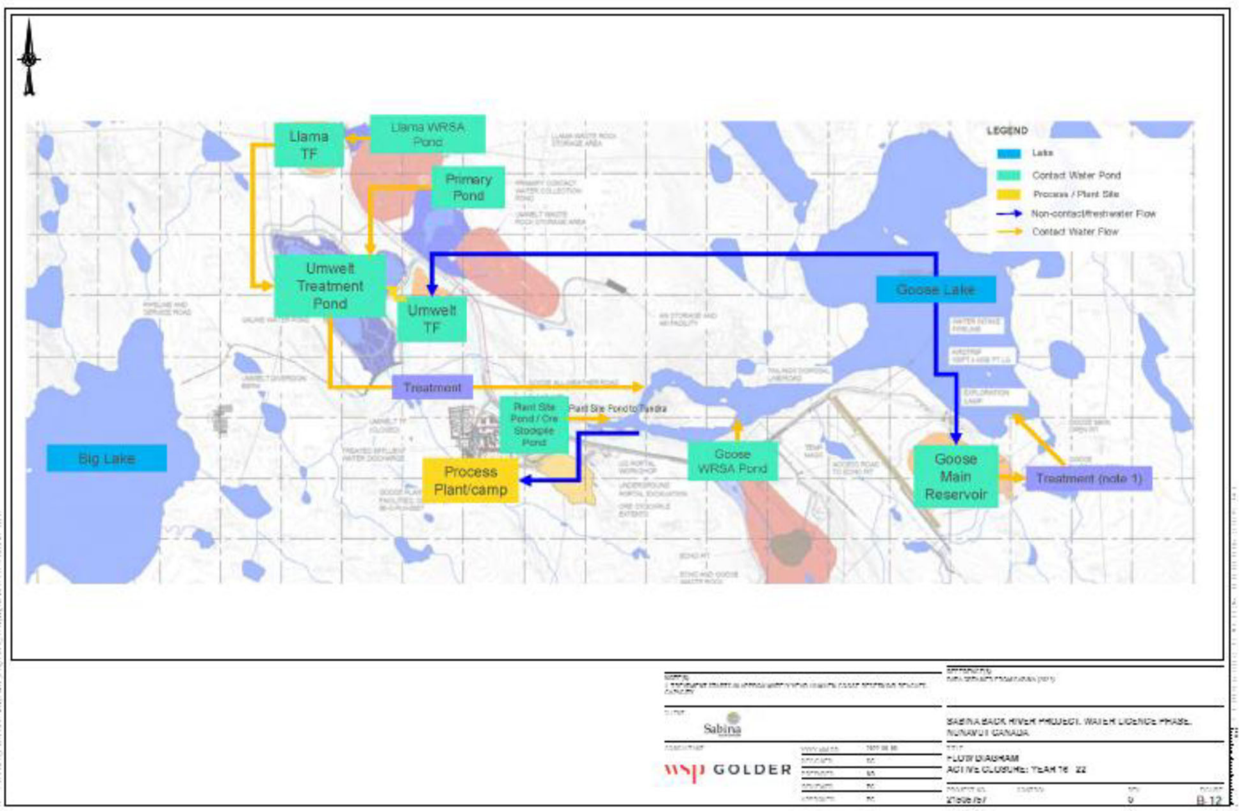
Document: Back River Project Water and Load Balance Report

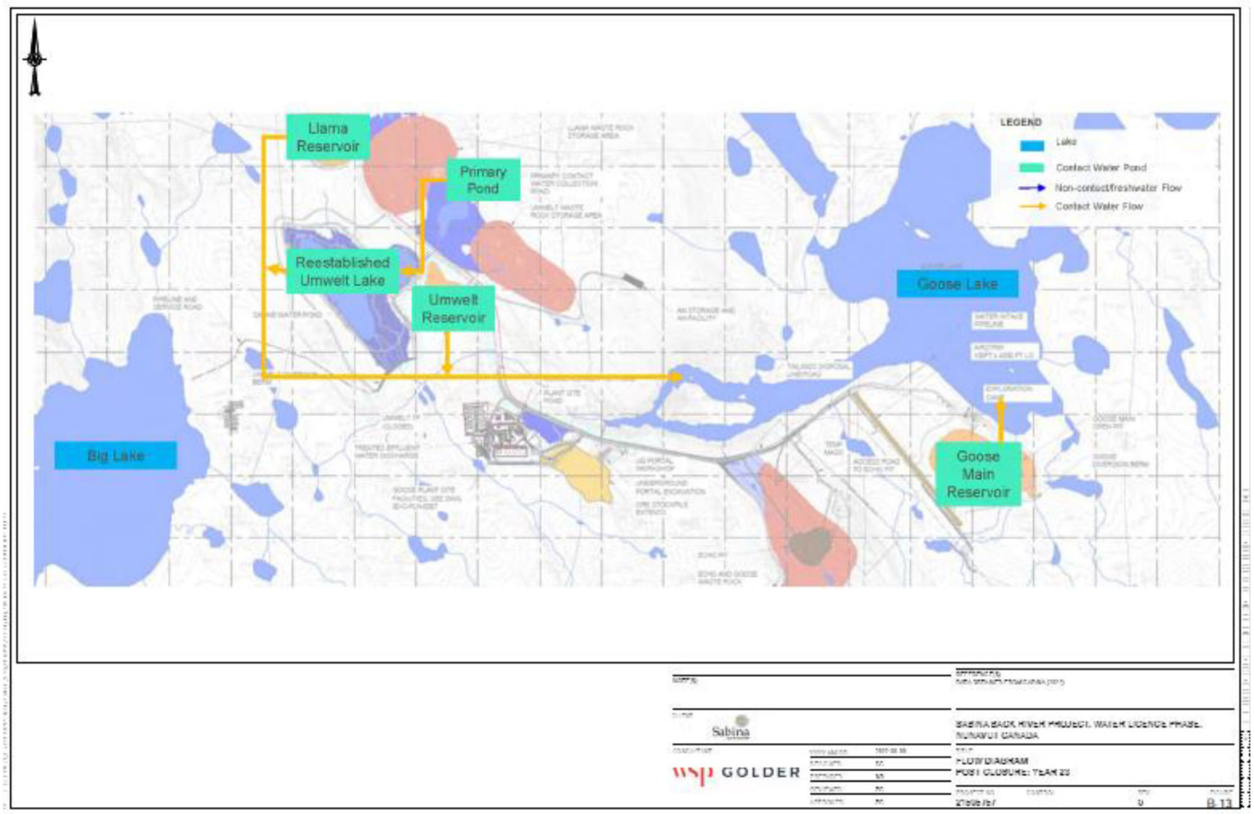
Section: Appendix B

Page: 69 and 70 of 110

Detailed Review Comment

Figure B12 and B13 show treated contact water being discharge to the northern arm of Goose neck in Goose Lake. This Location does not have a node that was accessed. To determine the impact of treated discharge water being discharge to this location of the lake modeling should be complete and outputs compared to MDMER and all discharge limits specific to the Back River project.





Recommendation/Request:

It is recommended that Sabina include a modeled node at the northern arm of Goose Neck in Goose Lake in the Load and Water Balance Model and Hydrodynamic model and compare the results to all applicable discharge and benchmark to determine the impact of treated discharge water to this location as or clarify if treated contact water will actually be discharge to this location as indicated in Figures B-12 and B-13. Alternatively, Sabina may provide evidence that this area is non fish bearing / not considered aquatic habitat.

Sabina Response:

Sabina clarifies that the arrow for treated contact water in the Figure B-12 and B-13 of the Water and Load Balance Report (Appendix B) is misleading of the discharge location and confirms that all flows represented by this arrow will discharge at PN04. Sabina confirms there are no additional discharge locations or nodes to Goose Lake beside the ones considered in the Water and Load Balance Report (Golder 2022a) and Hydrodynamic and Water Quality Modelling of Goose Lake Report (Golder 2022b).

References:

Golder 2022a. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

Golder 2022b. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-15000

KIA-NWB-15: Nitrate missing from timeseries plots

References:

Document: Back River Project Water and Load Balance Report

Section: Appendix F Timeseries of Predicted Monthly Average Constituent Concentrations at the Prediction Nodes Under Average Hydrological Conditions

Page: 84 to 104 of 110

Detailed Review Comment

Nitrate was not included in the timeseries plots. Nitrate is a parameter of concern with an associated site-specific water quality objective. Therefore, it is important to understand how nitrate concentrations are predicted to change over the life of the mine.

Recommendation/Request:

It is recommended that Sabina include nitrate in their timeseries plots as it is a parameter of concern with an associated site-specific water quality objective.

Sabina Response:

Sabina highlights that the plot for timeseries of nitrate concentrations was included in the Appendix F of the Water and Load Balance Model Report (Golder 2022, Appendix F). Please see Attachment KIA-A, which is an updated version of Appendix F in response to KIA-NWB-13, that includes timeseries plots of predicted monthly average nitrate concentrations at the prediction nodes (i.e., PN04 to PN09) with the addition of Canadian Council of Ministers of the Environment (CCME) acute guidelines for the protection of aquatic life, where applicable.

References:

Golder 2022. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

KIA-NWB-16: Compare maximum monthly average concentrations to MDMER

References:

Document: Back River Project Water and Load Balance Report

Section: Appendix G Predicted Maximum Monthly Average Concentrations per Mine Phase at Each Prediction Node for Average Hydrological Conditions

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Detailed Review Comment

Maximum monthly average concentrations are provided in appendix G however these values are not compared to MDMER. To provide context and to ensure concentrations are complying it is recommended that Sabina compare values to MDMER and all applicable discharge limits.

Recommendation/Request:

It is recommended that Sabina compare maximum monthly average concentrations to MDMER and all applicable discharge limits.

Sabina Response:

Please refer to Tables 23, 25, and 27 of the Water and Load Balance Model Report (Golder 2022) for comparison of the maximum monthly average concentrations to Metal and Diamond Mining Effluent Regulations (MDMER) discharge limits for all the prediction nodes affected by the Project activities. For comparison to the Canadian Council of Ministers of the Environment (CCME) acute guidelines for the protection of aquatic life, please see Attachments KIA-B (updated version of Appendix G of Golder 2022) and KIA-C (updated version of Appendix H of Golder 2022) which include comparison against both MDMER discharge limits and CCME acute guidelines.

References:

Golder 2022. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

2.2 RESPONSE TO CROWN-INDIGENOUS RELATIONS AND NORTHERN AFFAIRS CANADA

CIRNAC-R-01: Tailings Management Facilities as Chemical Load Source Term

Comment:

Section 2.1 of the Water and Load Balance Report summarized the major infrastructure at the Goose Property mine site, including three tailings management facilities (i.e., Echo Open Pit as Echo Tailings Management Facility (TMF), Umwelt Open Pit as Umwelt TMF, and Llama Open Pit as Llama TMF).

Table 11 of the Water and Load Balance Report listed all the source terms applied in the model for load balance calculation. It seems, however, that the three TMFs are not included as source term in the model. It is well established that tailings management facilities could be important chemical load sources for the quality of tailings porewater, overlying surface water, and groundwater.

Recommendation:

(R-01) CIRNAC recommends that the licensee clarify and justify if and how tailings management facilities are treated as chemical load source term in the model.

Sabina Response:

Tailings generated from the Project will be managed in the mined-out open pits (called Tailings Facilities [TFs]). The Tailings Management Plan outlines that tailing will be subaqueously (i.e., under water) deposited during the operation of the TFs. The water cap limits the geochemical reactivity of the tailings by limiting the amount of oxygen that can oxidize the tailings materials to the small amount of dissolved oxygen in the water cover.

Within the Water and Load Balance Model (model), the process water effluent source term is used to represent water in contact with the tailings because it is slurried to the TFs during Operations. Table 11 of the Water and Load Balance report specifies that the process water effluent source term is applied to the tailings slurry supernatant (i.e., the liquid fraction of the tailings slurry) in the TFs in the model, which contributes to the quality of the water cap and the final reservoir.

Consistent with the previous version of model (SRK 2020), it was assumed that the porewater loading from the submerged tailings would have negligible effects on the quality of the water cap. During Operations, Sabina will monitor water quality in TFs in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Schedule I; NWB 2021). If assumptions around tailings pore water loading need to be modified, additional water treatment or other measures will be applied to meet discharge limits and protect water quality in the Goose Lake (i.e., concentrations are below CCME guidelines and SSWQOs at the edge of mixing zones).

References:

NWB (Nunavut Water Board). 2021. Water Licence 2AM-BRP1831 (Amendment No. 1) for Sabina Gold and Silver Corp.'s Back River Project. Issued August 31, 2021.

CIRNAC-R-02: Chemical Load Source Term in Closure and Post-closure Phases

Comment:

The Project has four open pits (i.e., Echo, Umwelt, Llama, and Goose). Waste rock on the walls of the open pits could be important chemical load sources during the operation phase, as well as in the closure and post-closure phases of the project.

Based on information provided in Table 11 of the Water and Load Balance Report, it seems, however, that the pit walls are considered as chemical load sources for the operation phase of the project only.

Recommendation:

(R-02) CIRNAC recommends that the licensee clarify and justify if and why pit walls are not considered as chemical load source term in the closure and post-closure phases of the project.

Sabina Response:

Sabina clarifies that once the pits are filled to the overflow elevation, the Pit Wall source term switches to High Wall source term for Closure and through Post-Closure (Water and Load Balance Report [Golder 2022] Table 11). Sabina also notes that the last column of Table 11 for the High Wall source term should be revised to include both Closure and Post-Closure to accurately reflect the source term applicable in the model.

References:

Golder 2022. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

CIRNAC-R-03: Waste Rock or Tailings Buried below Thermal Active Layer or under Water Cover as Chemical Load Source Term

Comment:

Section 8.2 of the Water and Load Balance Report summarized the key assumptions and uncertainties of the load balance component of the Model.

Although it appears that waste rock or tailings that are buried below the thermal active layer or under permanent water cover are not considered as chemical load source term in the model, this assumption is not discussed in Section 8.2 of the report.

CIRNAC notes that thermal monitoring of waste rock management facilities at a number of mining project sites in Nunavut in recent years has shown that part of the waste rock or tailings that are encapsulated below the thermal active layer may remain unfrozen or undergo the annual freeze-thaw cycle. Furthermore, submerging waste rock or tailings in water may reduce the rate of sulfide mineral oxidation; it would not, however, prevent metal leaching from waste rock and tailings.

Recommendation:

(R-03) CIRNAC recommends that the licensee clarify and justify if and why waste rock or tailings that are buried below the thermal active layer or under permanent water cover are not considered as chemical load source term in the model.

Sabina Response:

Sabina confirms that the water quality model assumed a thermal active layer with 5 meter thickness for all Waste Rock Storage Areas (WRSAs). A thermal active layer refers only to the material that undergoes annual freezing and thawing, and therefore has the potential to contribute mass loading to the contact water management system. Material below the thermal active layer remains frozen year-round, has limited potential to interact with water, and as such, does not contribute mass loading. The uncertainty associated with thermal active layer is not whether the material under it will contribute mass loading; rather, uncertainty is associated with how deep the thermal active layer will be, and the associated amount of material potentially contributing mass loading.

The thickness of the thermal active layer assumed in the model is based on a thermal modeling analysis completed by SRK (2015) that was submitted and approved as part of the 2017 Type A Water Licence application. It is recognized that the thickness of the thermal active layer and its potential effects on mass loadings will require confirmation during WRSA development, and Sabina has operational measures in place to monitor active layer thickness during Operations.

During Operations, Sabina will monitor WRSA thermal and moisture conditions, as well as WRSA seepage and runoff water quality and quantity during the WRSA freeze-back period, as outlined in the Waste Rock Management Plan (Sabina 2022a) and the Water Management Plan (Sabina 2022b). In addition, Sabina has identified adaptive management measures in the event monitoring information verifies that WRSA pile freeze-back takes longer than anticipated. If appropriate, Sabina will update the water quality model to reflect additional data and updated field conditions.

Consistent with the previous version of model (SRK 2020), it was assumed in the water and load balance model that the porewater loading from the submerged tailings would have negligible effects on the quality of the water cover and was therefore not considered in the water quality model. Water covers have proven highly effective in preventing oxidation of the submerged mine waste and eliminating acid drainage and metal leaching issues in the long term. As noted in the Global Acid Rock Drainage Guide (GARD 2014), "While only shallow water covers are needed to effectively prevent oxygen diffusion, a thicker cover (typically from 1 to 3 metres deep) is needed if preventing resuspension of fine tailings due to water action is a consideration." During Operations, Sabina will monitor water quality in TFs in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Schedule I; NWB 2021).

During Operations, Sabina commits to adapt water management and water treatment strategies at the Project such that relevant water quality discharge limits (e.g., Metal and Diamond Mining Effluent Regulations) are met, water quality in Goose Lake is protected (i.e., concentrations are below Canadian Council of Ministers of the Environment [CCME] guidelines and Site-Specific Water Quality Objectives [SSWQOs] at the edge of mixing zones), and long-term closure objectives are met.

References:

GARD. 2014. GARD Guide: http://gardguide.com/index.php?title=Main_Page.

NWB (Nunavut Water Board). 2021. Water Licence 2AM-BRP1831 for Sabina Gold and Silver Corp.'s Back River Project. Issued August 31, 2021.

SRK. 2015. Back River Property: Waste Rock Storage Area Management Approach and Associated Design Criteria – Final. Prepared for Sabina Gold & Silver Corp. November 2015. Ref No, 1CS020.008.

SRK. 2020. Back River Project Water and Load Balance Report. Prepared for Sabina Gold & Silver Corp. June 2020. Ref No, 1CS020.018.

Sabina (Sabina Gold and Silver Corp.). 2022a. Back River Project. Waste Rock Management Plan. April 2022.

Sabina (Sabina Gold and Silver Corp.). 2022b. Back River Project. Water Management Plan. April 2022.

CIRNAC-R-04: Predicted Concentrations at Prediction Nodes in Winter Months

Comment:

Appendix F of the Water and Load Balance Report presented the Timeseries of Predicted Monthly Average Constituent Concentrations at the Prediction Nodes Under Average Hydrological Conditions.

It seems that the predicted monthly average concentrations of all the modeled constituents exhibit an annual cycle: increasing to a maximum in the summer and decreasing to a concentration of zero in the winter months.

Although it is expected that constituent concentrations would change as a function of time or season due to changes in hydrology, geochemical reactions, and mining activities, etc., it would be difficult, if not impossible, to expect that concentrations of all constituents would decrease to zero in the winter months.

Recommendation:

(R-04) CIRNAC recommends that the licensee clarify and explain if and how the concentrations of all constituents decrease to zero in the winter months.

Sabina Response:

Sabina highlights that the streams flowing into Goose Lake (i.e., PN04 to PN09) are expected to freeze during the winter months as observed by the baseline/historical data (Rescan 2011, 2012, and 2013); therefore, no inflows to the lake are expected during the annual ice-covered season. The same pattern is expected to occur during all Project phases since there are no natural nor mine-affected inflows from the Project site during this season. For this reason, constituent concentrations are shown as zero on the Timeseries plots to indicate that no constituent load from these inflows are attributed to the prediction nodes during the annual ice-covered season.

CIRNAC-R-05: Predicted Concentrations at Prediction Nodes during Operation Phase

References:

2021 Annual Report for Water Licence 2AM-BRP1831, Page 2-11 (Sabina, March 2022)

Comment:

Appendix F of the Water and Load Balance Report presented the Timeseries of Predicted Monthly Average Constituent Concentrations at the Prediction Nodes Under Average Hydrological Conditions.

It seems that the predicted monthly average concentrations of all the modeled constituents repeat themselves from one year to another at all the Prediction Nodes during the operation phase of the project.

Although the average hydrological conditions (i.e., monthly distributed precipitation, evaporation, and air temperature) were assumed to be repeating from one year to another in the model, other factors that would impact water quality, such as mining footprints and mining activities, quantities of waste rock and tailings, and mine site water management, would change from one year to another during the operation phase of the project. It is therefore hard to make sense of the year-to-year repetitions of the predicted monthly average constituent concentrations at the Prediction Nodes during the operation phase of the project.

Recommendation:

(R-05) CIRNAC recommends that the licensee clarify why there is a yearly repetition of the predicted monthly average concentrations of all constituents at the Prediction Nodes during the operation phase of the project.

Sabina Response:

Sabina clarifies that the prediction nodes during the Operations Phase are only affected by a fixed proportion of mass loading sources (i.e., background surface water runoff versus industrial pad runoff). Contact water is managed on-site within ponds and mined-out open pits during Operations and no treated effluent is released to the environment until the Closure Phase. Therefore, Sabina confirms that these prediction nodes are not affected by potential annual changes in the mine facilities (e.g., mining footprints and activities) until closure activities commences.

CIRNAC-R-06: Goose Lake Bathymetry

Comment:

Figure 1 in Section 3.1 of the Hydrodynamic and Water Quality Modelling of Goose Lake Report presented the bathymetry and model mesh of Goose Lake.

CIRNAC notes that there is an apparent increase in areas of Goose Lake with depth greater than 14 meters when compared to data presented in Figure 1 of the 27 May 2021 Effluent Quality Criteria Report for Effluent Discharged from Tailings Facilities, Tailings Storage Facilities, or Reservoirs (Version 1). However, no discussion is provided on this apparent change in Goose Lake bathymetry.

Recommendation:

(R-06) CIRNAC recommends that the licensee explain the changes in Goose Lake bathymetry presented in this report vs. data from the previous reports.

Sabina Response:

Sabina confirms that the hydrodynamic model mesh presented in the Hydrodynamic and Water Quality Modelling of Goose Lake Report (Golder 2022; Figure 1) is correct. There are two reasons for the observed difference between the figure presented in the Golder (2022) and the Effluent Quality Criteria (EQC) Report (Golder 2021):

1. Sabina clarifies that, unfortunately, the legend included on Figure 1 of Golder (2021) report is incorrect and does not belong to the presented color scale. The model mesh applied in the Golder (2021) is presented in Figure CIRNAC-R-06-1 with an updated color scale.
2. As part of the 2022 hydrodynamic model update (Golder 2022), minor edits were made to the model mesh. The mesh was re-evaluated against the bathymetric data to identify the areas that the mesh resolution could be improved. Thus, the mesh cells around certain localized areas in the lake were deepened to better match the bathymetric data.

Sabina further confirms that the analysis and findings of the Effluent Quality Criteria (EQC) Report (Golder 2021) remain valid.

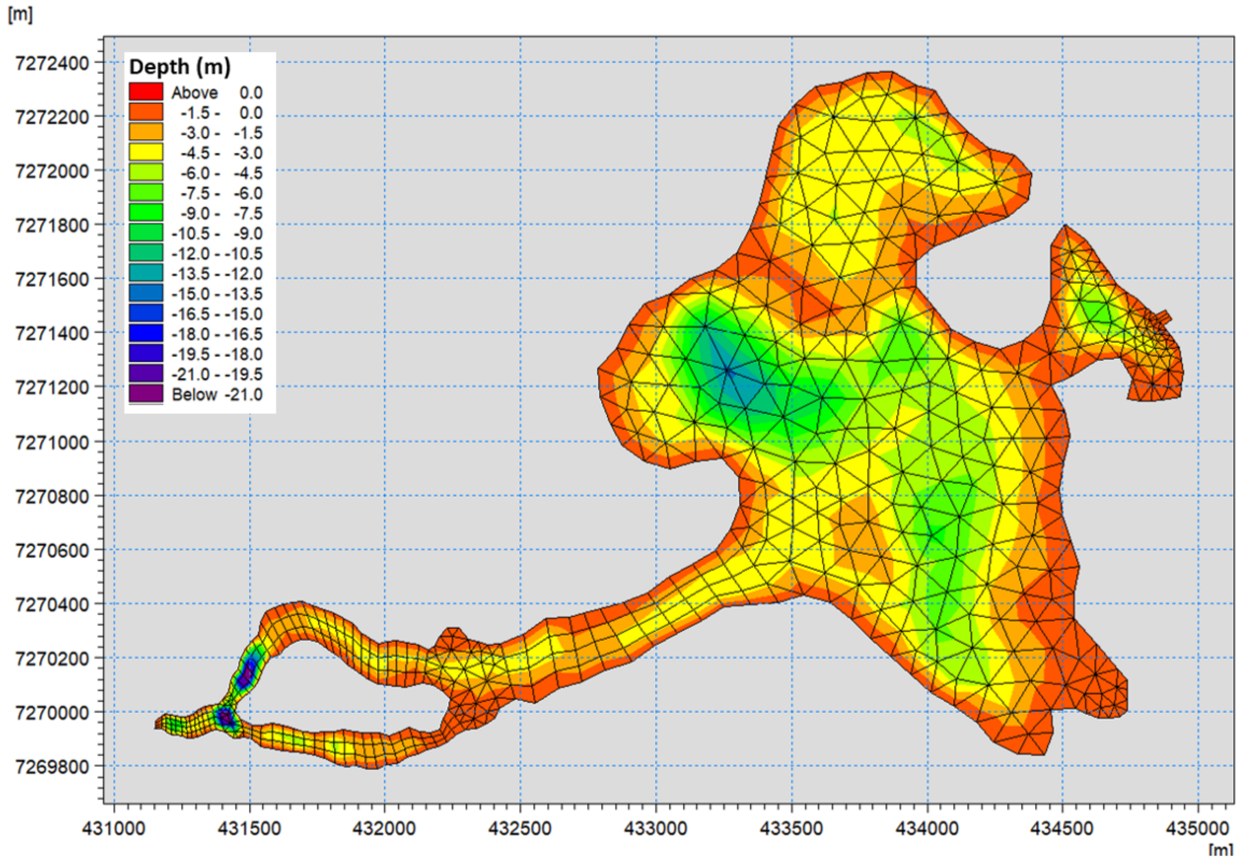


Figure CIRNAC-R-06-1: Model Mesh Applied in the EQC Report with Updated Color Scale

References:

Golder 2022. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-15000

Golder 2021. Sabina Gold & Silver Corporation Back River Project, Effluent Quality Criteria Report for Effluent Discharged from Tailings Facilities, Tailings Storage Facilities, or Reservoirs - Version 1. Submitted to Sabina Gold & Silver on 27 May 2021. Reference No. 20412211-081-R-Rev0-2400

CIRNAC-R-07: Predicted Selenium Concentrations in Goose Lake

Comment:

Appendix B and Appendix C of the Hydrodynamic and Water Quality Modelling of Goose Lake Report presented the timeseries of model predicted constituent concentrations at the edges of the mixing zones and at the assessment stations, respectively. CIRNAC notes that the predicted concentrations for iron, phosphorous, and selenium would sometimes be above the applicable water quality benchmarks at PN04, PN05, and/or GLTL during the closure phase of the project.

While in Section 7.1 of the Hydrodynamic and Water Quality Modelling of Goose Lake Report, the licensee provided discussions on the subject of the predicted concentrations of iron and phosphorous being above the water quality guidelines in the report, no such discussion is given on the predicted concentrations of selenium, which is also above the applicable water quality guideline sometime during the closure phase of the project. Given that selenium can be toxic to aquatic life at elevated concentrations, such a discussion is warranted.

Recommendation:

(R-07) CIRNAC recommends that the licensee provide a discussion on the predicted concentrations of selenium in Goose Lake and any appropriate mitigation measures.

Sabina Response:

Sabina confirms that infrequent exceedances of a chronic effects guideline, such as those predicted for selenium concentrations in Goose Lake, are not expected to result in chronic effects to aquatic life; Sabina's currently proposed mitigation of treating discharges to Goose Lake is expected to result in concentrations in Goose Lake that are not a concern for aquatic life. The predicted concentrations of selenium in Goose Lake are not expected to result in harmful effects to aquatic life because the exceedances of the water quality benchmark (Table 1 in the Hydrodynamic and Water Quality Modelling of Goose Lake Report), which is based on the CCME chronic guideline for the protection of aquatic life, occur infrequently (less than 5% of predictions), are localized (i.e., at the edge of a mixing zone or in the tail of Goose Lake) and are temporary (i.e., occur for 2 or 3 years during Closure). Also see IR responses KIA-NWB-2 and KIA-NWB-10.

CIRNAC-R-08: Predicted Phosphorous Concentrations in Goose Lake

Comment:

In discussing the subject of the predicted concentrations of phosphorus being above the applicable water quality guideline in Section 7.1 of the Hydrodynamic and Water Quality Modelling of Goose Lake Report, the licensee interpreted the model predictions as a result of overestimation because phosphorus was treated conservatively and no biological uptake of phosphorus was considered in the model.

Increases in biological uptake of phosphorous, however, are associated with increases in biological productivity in the lake and consequently, would result in changes in the trophic status of the lake. Such changes have been observed in other mining project sites in Nunavut.

Recommendation:

(R-08) CIRNAC recommends that the licensee quantify if the predicted increases in biological uptake of phosphorous would result in changes in the trophic status of Goose Lake.

Sabina Response:

A change in trophic status in Goose Lake is not expected to occur based on the predicted increase in phosphorus concentrations as discussed in response to KIA-NWB-5. Predicted concentrations of phosphorus during open-water conditions, when the effects of nutrient enrichment are most likely to occur, remained below the applicable water quality benchmark for phosphorus (Table 1 of Hydrodynamic and Water Quality Modelling of Goose Lake Report). If biological uptake of phosphorus did occur, it would result in lower than predicted concentrations of phosphorus in Goose Lake which means that future phosphorus concentrations would be more similar to existing concentrations. Sabina has committed to annual monitoring of phosphorus and chlorophyll in Goose Lake as part of the AEMP and developing nutrient enrichment Action Levels in the AEMP Response Framework to track and follow up on concerns related to nutrient enrichment in Goose Lake, per response to KIA-NWB-5.

2.3 RESPONSE TO ENVIRONMENT AND CLIMATE CHANGE CANADA

ECCC-01: New Federal Environmental Quality Guideline for Iron

References:

Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake, Table 1: Modelled Constituents and Surface Water Quality Effects Benchmarks for the Protection of Aquatic Life

Comment:

A Federal Environmental Quality Guideline for iron has been published in draft and may be useful for comparison purposes. Specifically, where there are seasonal exceedances of the Canadian Council of Ministers of the Environment (CCME) guideline, it may be useful to calculate and compare the Federal Environmental Quality Guideline (FEQG) value for iron, which takes into account pH and dissolved organic carbon, if that data is available.

Recommendation:

ECCC recommends that where there are seasonal exceedances of the CCME guideline, the Proponent calculate and compare the FEQG value for iron, which takes into account pH and dissolved organic carbon, if that data is available.

Sabina Response:

In response to ECCC's recommendation, a conservative value of the draft Federal Environmental Quality Guideline (FEQG) for iron was calculated to be 1.75 mg/L, based on minimum measured dissolved organic carbon (DOC) concentrations and pH value in Goose Lake in the baseline data (Golder 2019, 2021). Sabina confirms that the predicted iron concentrations at the edge of the mixing zones and within the assessed locations of Goose Lake are below this conservative estimate of the draft FEQG for iron (see IR Response KIA-NWB-02, Figure KIA-NWB-2-10 to Figure KIA-NWB-2-12).

References:

Golder. 2019. Sabina Gold & Silver Corp. Back River Project – Aquatic Baseline Synthesis Report. Appendix A to the Aquatic Effects Management Plan. Submitted to Sabina Gold & Silver Corp. July 2019. Ref No. 18114181-047-RPT-Rev0.

Golder. 2022. Sabina Back River Project – 2021 Aquatic Baseline Report. Draft completed in June 2022.

ECCC-02: Hydrologic Inputs

References:

Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake, Section 3.3 Hydrologic Inputs, Table 2: Annual Average Hydrological Inputs during Calibration and Forecast Periods

Comment:

Section 3.3 states that inflows to Goose Lake were based on four years of flow data collected between 2011 to 2021, with daily averages of these years applied to the years with no observed data (2014 to 2020). However, Table 2 only shows three years of data used for the calibration period.

Given the range in water levels and flows seen in other parts of the North between 2014 and 2020, it is not clear if the use of limited inflow data has biased the results.

Recommendation/Request:

ECCC requests:

- Clarification of the use of 2021 flow data; and
- Discussion of how representative the 3 years of inflow data (averaged) are for the full calibration period.

Sabina Response:

Sabina confirms that the inflow rates to Goose Lake in the Hydrodynamic and Water Quality Model were based on four years of observed data collected from 2011, 2012, 2013, and 2021. Sabina acknowledges that the 'Year/Month of Available Data' column of Table 2 from Golder (2022) is missing the reference to 2021 data. Please see Table ECCC-02-1 below with the updated 'Year/Month of Available Data' column.

Sabina applied the best available data for the model calibration and believes that the assumptions related to natural inflow rates to the Goose Lake were reasonable, because:

- Over the past 10 years, the natural hydrological regime for watersheds draining to Goose Lake are not expected to have changed to a degree that natural inflow rates to Goose Lake fall outside of the range of inflow rates collected between 2011 and 2013. Moreover, it was noted that the 2021 spot inflow rates measurements are in strong agreement with the data collected in 2011 to 2013.
- The model calibration results presented in Sections 4.1 (Water Levels and Outflows), 4.2 (Currents), 4.3 (Water Temperatures), and 4.4 (Total Dissolved Solids Concentrations) of Golder (2022) show that the model is capturing the magnitude and trend of observed data relatively well.

Sabina will continue to monitor inflow rates to Goose Lake during Operations to confirm that inflow conditions remain within the range modelled.

Table ECCC-02-1: Annual Average Hydrological Inputs during Calibration and Forecast Periods

Inflow Name	Inflow Rates (Mm³/yr)					
	Calibration Period		Forecast Period			
	Rate	Year/Month of Available Data	Construction	Operations	Closure	Post-closure
PN04	1.6	2011 (Jun to Sep)	2.5	2.1	3.3	3.6
		2012 (May to Sep)				
		2013 (May to Oct)				
		2021 (spot measurements in July & September)				
PN05	0.94	2011 (Jun to Sep)	5.6	5.5	3.1	5.3
		2012 (May, Jun, Jul, Sep)				
		2013 (May to Oct)				
		2021 (spot measurements in July & September))				
PN06	3.8	2011 (Jun to Oct)	3.6	4.5	4.2	4.4
		2012 (May to Sep)				
		2013 (May to Oct)				
		2021 (spot measurements in July & September))				
PN07	0.19	2011 (Jun to Sep)	4	4.5	Not active	
		2012 (May, Jun, Jul, Sep, Oct)				
		2013 (May to Oct)				
		2021 (spot measurements in July & September))				
PN08	3.4	2011 (Jun to Sep)	0.99	1.1	1.5	1.5
		2012 (May to Sep)				
		2013 (May to Oct)				
		2021 (spot measurements in July & September))				
PN09	0.7	2013 (May to Oct)	0.11	0.11	Not active	
		2021 (spot measurements in July & September))				
Precipitation	1.7	2010 - 2021	1.4	1.4	1.4	1.4
Evaporation	-0.75	Calculated by the model	-0.75	-0.75	-0.76	-0.75
Discharge from Water Treatment Plant (WTP) (dewatering of Umwelt and Llama Lakes)	Not active		1.2	Not active		
Road Runoff			0.011	0.012	0.012	0.013
Undisturbed Runoff			1.4	1.6	1.7	1.7
Withdrawal			-0.22	-0.46	-0.17	Not active

References:

Golder 2022. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-15000

ECCC-03: Sensitivity Analysis

References:

Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake, Section 8.0 Sensitivity Analysis

Comment:

Various sensitivity analyses were run to evaluate effects of changes to meteorological conditions, ice cover, and inflow quantity and quality for a 10-year period–extending five years into post-closure. As with the modeling completed, average climactic conditions were assumed, with the sensitivity analysis run for 96% and 4% of historical precipitation conditions. A longer ice cover period was also evaluated. It is not clear if these assumptions encompass conditions which would occur under a non-average set of climate conditions (i.e. would this be sufficiently representative of climate change scenarios which are potentially expected to affect conditions)?

Recommendation/Request:

ECCC recommends that a discussion of climate change effects on the forecasts be provided, which includes an evaluation of the various scenarios.

Sabina Response:

Sabina confirms that in the Hydrodynamic and Water Quality Model of Goose Lake, the effects of climate change on precipitation rate, inflow rates, and chemistry on water quality forecasts were evaluated as part of the sensitivity analysis (Golder 2022a, Appendix D). Sensitivity scenarios A and B assessed the effects of increased/decreased precipitation rates and inflow rates and chemistry variability from year-to-year on predicted constituent concentrations in Goose Lake. For the sensitivity scenarios A and B, the inflow rates, inflow chemistries, and annual precipitation inputs were provided by the stochastic Water and Load Balance (WLB) Model (Golder 2022b) for the realizations that were representative of the 96th and 4th percentile of historical precipitation conditions. The 96th and 4th percentile realizations represent (on average) an annual precipitation of 504 mm and 406 mm, respectively. When compared to the Base Case, sensitivity A represents an increase of approximately 18% in average annual precipitation, which is within the expected range of long-term precipitation projections for climate change as described in Bush and Lemmen (2019), IPCC (2007), and Lenman et al. (2008) for the majority of the emission scenarios and future periods evaluated.

Inputs to the Hydrodynamic and Water Quality Model of Goose Lake for sensitivities A and B (i.e., precipitation rates, inflows rates, and inflow chemistries) varied monthly and annually, and were different than the ones applied in model for the Base Case (i.e., average climate conditions).

Sabina believes that Sensitivity Scenario A and B (i.e., wet and dry conditions) captures the range of expected in-lake concentrations as a result of future climate change conditions.

Future versions of the WLB model may incorporate more recent precipitation projections as more data becomes available. If the more recent precipitation projections fall outside of the range considered in the Hydrodynamic and Water Quality Model, an updated sensitivity analysis may also be completed for the Hydrodynamic and Water Quality Model.

References:

Bush, E. and Lemmen, D.S., editors (2019): Canada's Changing Climate Report; Government of Canada, Ottawa, ON. 444 p.

Lenman, D. S., Warren, F. J., Lacroiz, J. and Bush, E., editors. 2008. From Impacts to Adaptation: Canada in a Changing Climate 2007. Government of Canada, Ottawa, ON.

Golder 2022a. Sabina Back River Project, Hydrodynamic and Water Quality Modelling of Goose Lake. Submitted to Sabina Gold & Silver Corp. on 29 August 2022. Reference No. 21505757-118-R-Rev0-15000

Golder 2022b. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

ECCC-04: Contact Water Sources

References:

Back River Project, Water and Load Balance Report, Table 1: Summary of the Key Water Management Activities at the Goose Property

Comment:

It is stated in Phase 1: Construction, that "contact water from the Plant Site is collected in the Plant Site Pond, then released to the tundra."

Under the conditions of the Water Licence, there are land discharge limits for treated camp wastewater, as well as effluent from the Hazardous Waste Management Area, Land farm, and the Fuel Tank Farm.

ECCC notes that the Plant Site Pond is close to the drainage to Goose Lake, and adjacent tundra discharges would flow almost directly to the stream going into the lake.

It is not clear which contact water sources, if any, will be directed to the Plant Site Pond (other than runoff, which could include runoff from the ore stockpile), and whether effluent quality criteria should be applied to this discharge.

Recommendation/Request:

ECCC requests clarification on which contact water sources will report to the Plant Site Pond, and further discussion on whether effluent quality criteria are appropriate for this discharge.

Sabina Response:

Sabina clarifies that the Water and Load Balance Model includes one discharge to the tundra that occurs during the Construction Phase only, which is discharge from the sewage treatment plant. Concentrations in this discharge (source term concentrations presented in Appendix D, Golder 2022) are expected to be lower than the Water Licence limits for discharge to the tundra (2AM-BRP1831, Amendment No. 1). Table ECCC-04-1 presents the missing row from Table 11 of Golder (2022). Sabina will comply with all appropriate criteria associated to all discharges to the tundra.

The Plant Site Pond receives runoff from the Plant Site Pad. During Construction, Sabina clarifies that the contact water in the Ore Stockpile Pond is pumped to the Primary Pond, not the Plant Site Pond, and is not released to tundra nor directly released to Goose Lake.

Table ECCC-04-1 Summary of Sewage Treatment Plant Effluent Source Terms Applied in the Load Balance Component of the Model

Source Term	Units	Applies to	Associated Mine Component	Mining Phase
Sewage treatment plant effluent	mg/L	Discharge from the sewage treatment plant	Goose Lake, Umwelt Tailings Facility, Llama Tailings Facility, Echo Tailings Facility	Construction, Operations, Closure

References:

Golder 2022. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

ECCC-05: Contaminant Concentrations

References:

- Back River Project, Water and Load Balance Report, Section 5.3 Water Treatment
- Back River Project, Water and Load Balance Report, Appendix G
- Back River Project, Water and Load Balance Report, Appendix H
- Back River Project, Water Management Plan, Section 7.4.2 Goose Property Water Treatment Plant and Disposal
- Back River Project, Water Management Plan, Section 8.3.3 Open Pit Closure

Comment:

Section 7.4.2 of the Water Management Plan (WMP) states that "during the Closure Phase, overflow water from the Llama and Umwelt Reservoirs will be treated before arrival at PN04 to achieve MDMER limits at this location." Similarly, Section 5.3 of the Water and Load Balance Report (WLBR) notes that the Metal and Diamond Mining Effluent Regulations (MDMER) discharge limits are the basis for evaluating the treatment required for discharges to Goose Lake. This is to be achieved at the time of flooding. The long-term objective is to meet CCME guidelines or Site-Specific Water Quality Objectives (SSWQOs) as appropriate, with water treatment continuing into the closure phase until these are met. The updated Water and Load Balance Report water quality predictions (Appendices G and H) include Goose Lake PN04 levels at closure that are well below MDMER criteria.

Recommendation/Request

ECCC recommends that the Proponent provide further discussion on whether contaminant concentrations in discharges to Goose Lake could be achieved earlier, and at the lower levels already depicted, through all remaining phases of the project.

Recommendation/Request:

ECCC recommends that the Proponent provide further discussion on whether contaminant concentrations in discharges to Goose Lake could be achieved earlier, and at the lower levels already depicted, through all remaining phases of the project.

Sabina Response:

The current Water and Load Balance model and Hydrodynamic and Water Quality model reflect Sabina's strategy to reuse water during Operations and minimize the freshwater requirements from Goose Lake; as such, the discharge to the receiving environment does not start until late in the Operations Phase. During this phase, Sabina will collect on-site data to assess optimization opportunities for earlier discharge at concentrations that will be protective of Goose Lake (i.e., concentrations in Goose Lake that are below Canadian Council of Ministers of the Environment [CCME] or Site-Specific Water Quality Objectives [SSWQOs]) and meet Water License 2AM-BRP1831 Amendment No. 1 (Part F, Condition 21) and Metal and Diamond Mining Effluent Regulations (MDMER) discharge limits. Sabina will consider these potential optimization opportunities in future updates to the Water Management Plan.

ECCC-06: Increased Tailings Volumes

References:

- Back River Project, Water and Load Balance Report
- Back River Project, Water Management Plan, Section 8.2.6 Tailings Management Facilities

Comment:

Table 8.2-4 in section 8.2.6 provides the updated tailings volumes. There has been an increase in tailings storage up to 15.6M-m^3 (previously 10.3 M-m^3); Llama TF was previously to store only 6.8 M-m^3,and now is to store 8.14 M-m^3. It is unclear if these increases affect the depth and/or quality of water cover proposed.

Recommendation/Request:

ECCC requests clarification, including any consequences identified, that would be associated with the increase in tailings volume into the Llama TF.

Sabina Response:

Sabina notes that the main difference between the previous modelled scenario (SRK 2020) and the current Water and Load Balance (WLB) model scenario is that there is shallower depth of water cover over the tailings in Llama TF; however, Sabina reconfirms the commitment to maintain a minimum 5 m water cover for all Tailings Facilities (TFs) at Closure.

Sabina highlights that the closure strategy of 5 m water caps for TFs was provided as part of the Final Environmental Impact Statement (FEIS) submission and Type A Water Licence Application in the description of the Project, Tailings Management Plan (TMP), Water Management Plan, and Interim Closure and Reclamation Plan and Closure Cost Estimate. This closure information was thoroughly reviewed by all intervening parties during the prescribed processes, including during closure cost discussions, and deemed sufficient to meet the required regulatory applications.

The depth and quality of water cover in the Llama TF in the current WLB model is based on the expected tailings volume of 15.6 Mm^3. The WLB model currently includes the following source terms which affect the quality of water cover:

- pit wall/high wall runoff;
- process water effluent; and
- non-contact (i.e., natural) runoff.

Other processes included in the WLB model that affect the quality of the water cover are:

- inflows from water management ponds; and
- water treatment (Year 13 to Year 22).

Consistent with the previous version of model (SRK 2020), it was assumed in the WLB model that the porewater loading from the submerged tailings would have negligible effects on the quality of the water cover.

As detailed in FEIS Appendix V2-7G Section 8.2, a water cover of 5 m, in addition to the planned particle size distribution of the Project tailings (i.e., 80% finer than 50 µm; TMP), is deemed sufficient to prevent oxidation of tailings, prevent resuspension of tailings solids due to wave action, surge following storm events, and ice scour.

During Operations, Sabina will monitor water quality in TFs in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No. 1 (Schedule I; NWB 2021). If assumptions around tailings pore water loading need to be modified, additional water treatment or other measures will be applied to meet discharge limits and protect water quality in the Goose Lake (i.e., concentrations are below CCME guidelines and SSWQOs at the edge of mixing zones).

References:

SRK. 2020. Back River Project Water and Load Balance Report. Prepared for Sabina Gold & Silver Corp. June 2020. Ref No, 1CS020.018.

ECCC-07: Treatment Timeline

References:

- Back River Project, Water and Load Balance Report
- Back River Project, Water Management Plan, Section 8.3.9 Water Treatment Closure

Comment:

Section 8.3.9 of the Water Management Plan states that "year round recirculation water treatment in Umwelt and Llama TF for metals, phosphorus, nitrogen species and suspended solids will occur starting in year 13 and into closure until all water quality objectives are met".

Recommendation/Request:

ECCC requests an estimate of the duration of treatment that may be required in closure.

Sabina Response:

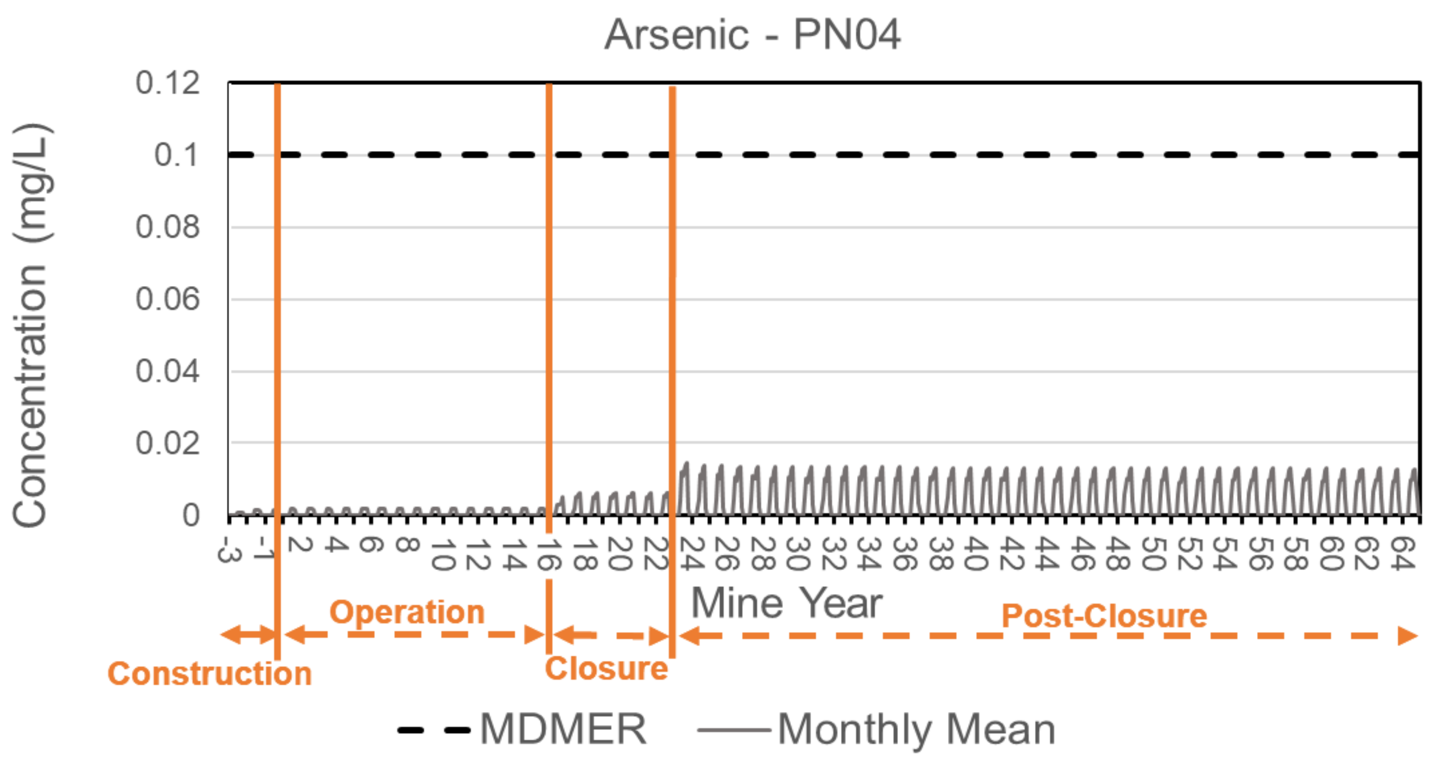
Based on the modelling results completed to-date, Sabina estimates the treatment duration of water in the Umwelt and Llama Tailings Facilities (TFs) to be approximately 9 years (i.e., Year 13 to 22).

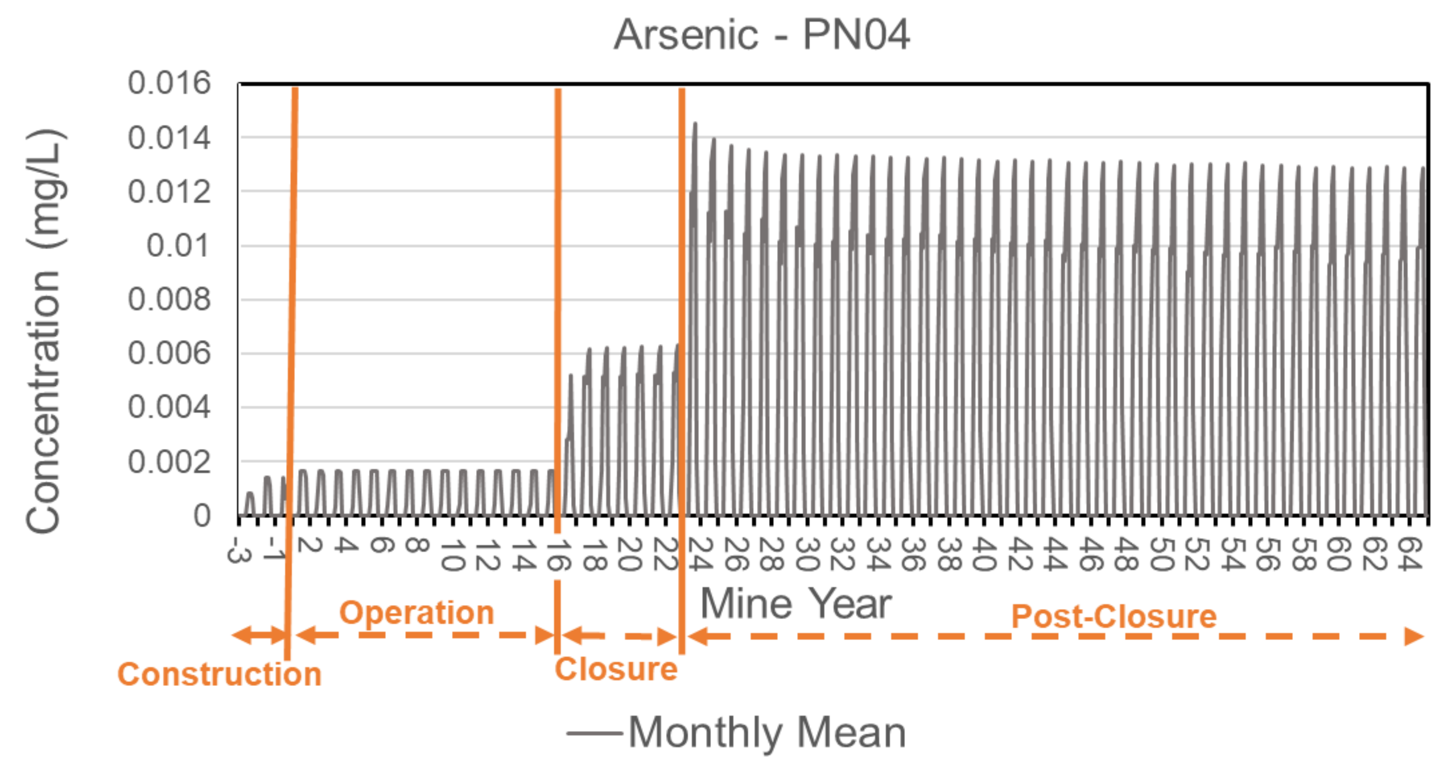
The Closure Phase is expected to occur between Year 16 to 22 (Golder 2022; Table 1); thus, 6 years of treatment is predicted to be required during Closure. The duration of treatment may vary for each constituent, but no treatment will be required beyond the Closure Phase.

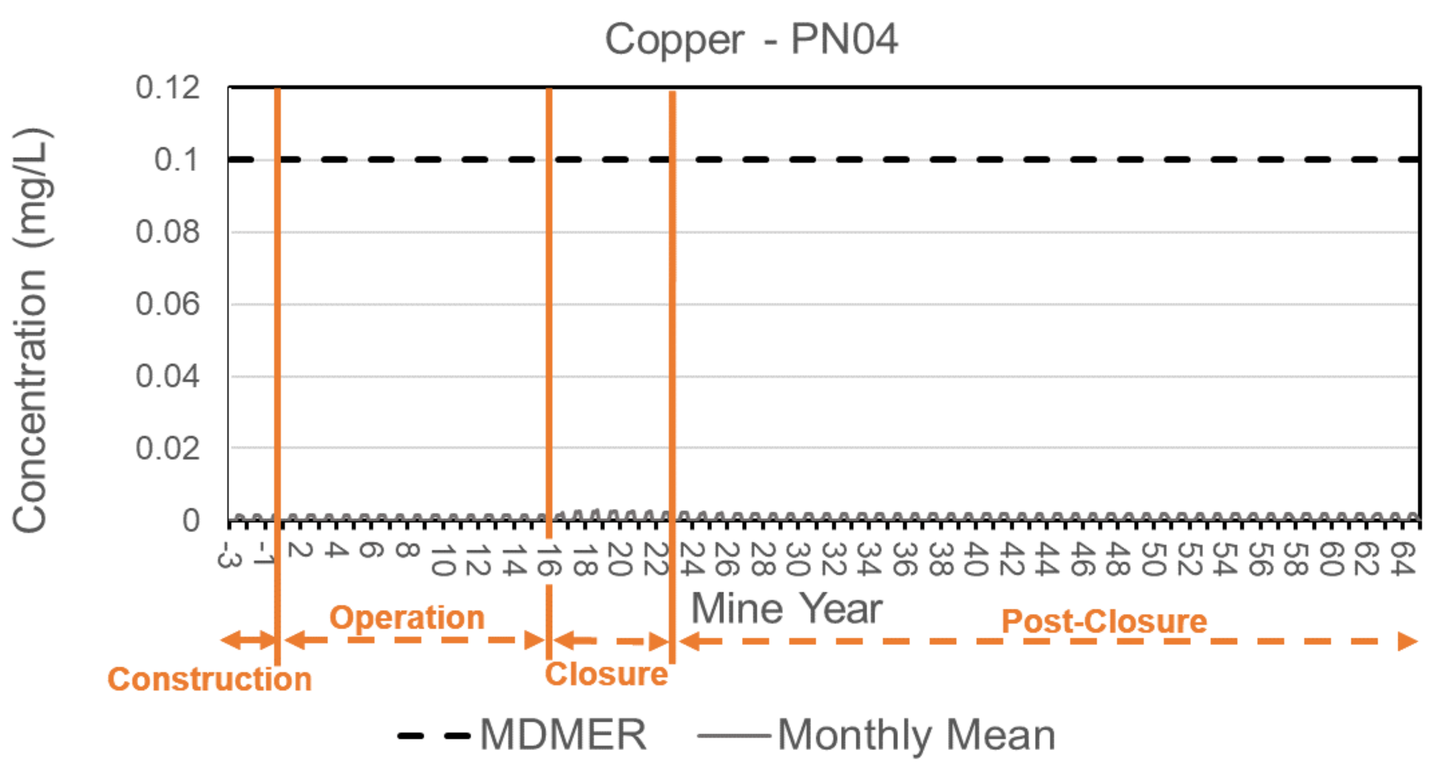
References:

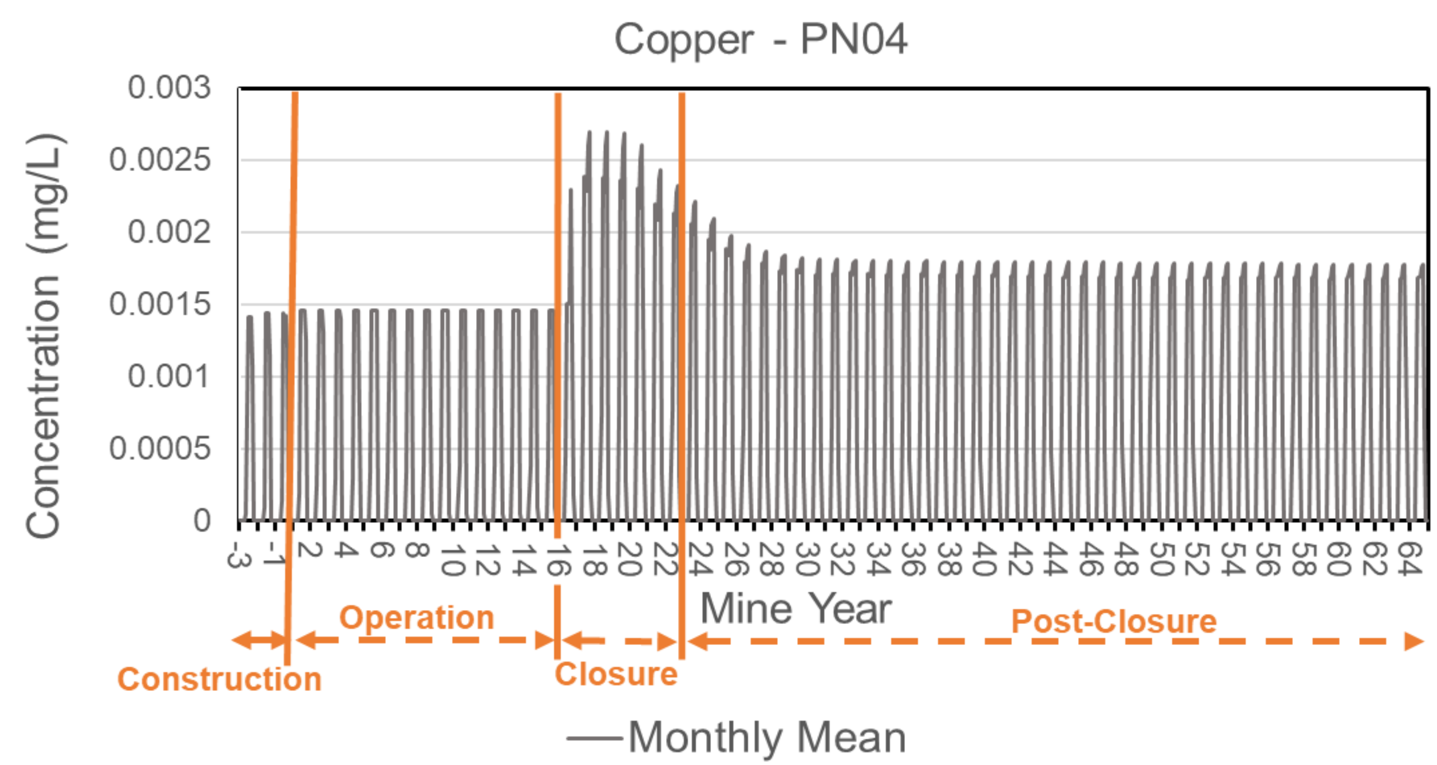
Golder 2022. Sabina Back River Project, Water and Load Balance Report. Submitted to Sabina Gold & Silver Corp. on 30 August 2022. Reference No. 21505757-122-R-Rev0-100

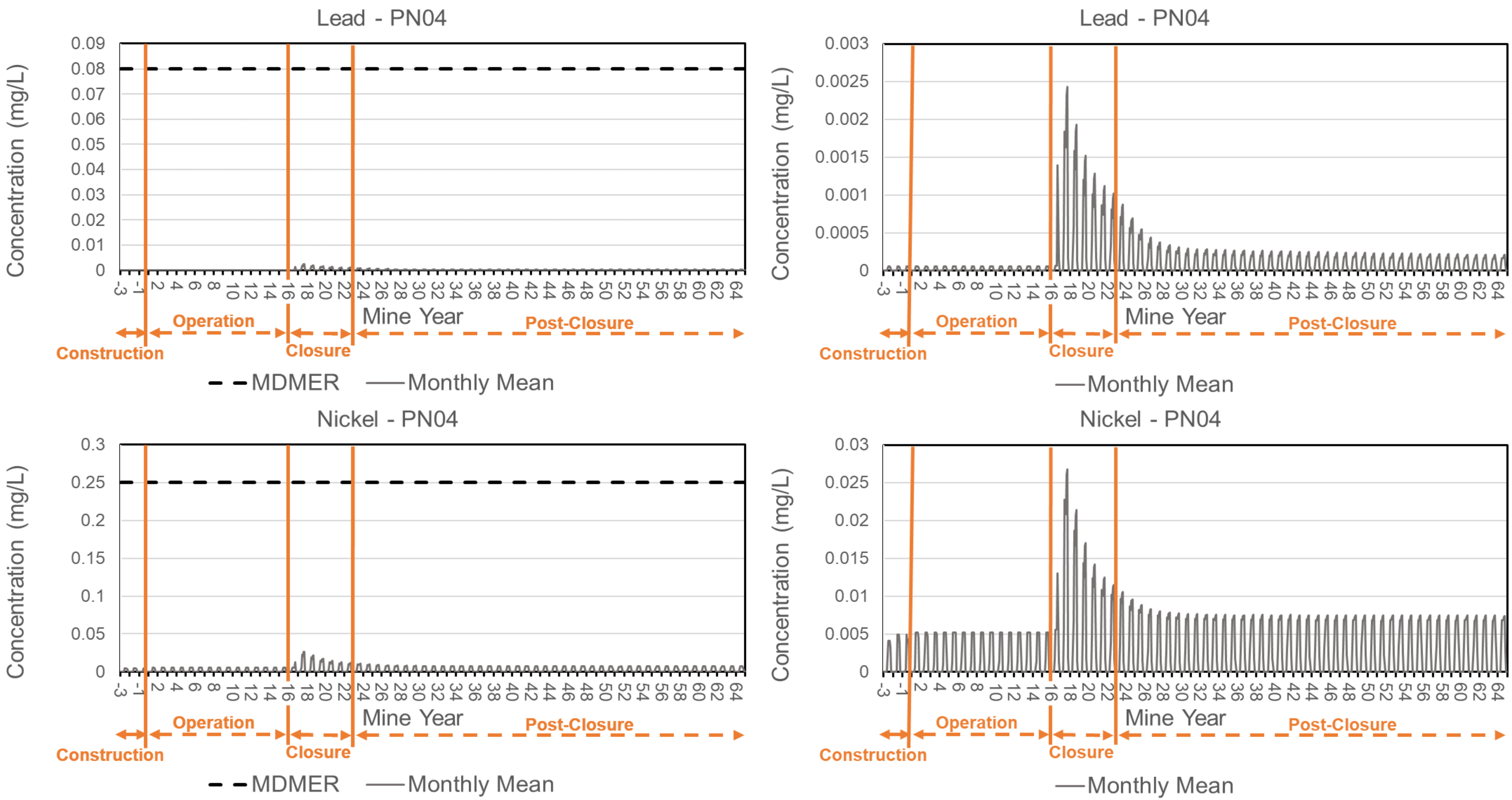
Attachment KIA-A: Updated Version of Appendix F of Golder 2022 (Sabina Back River Project, Water and Load Balance Report. Reference No. 21505757-122-R-Rev0-100)

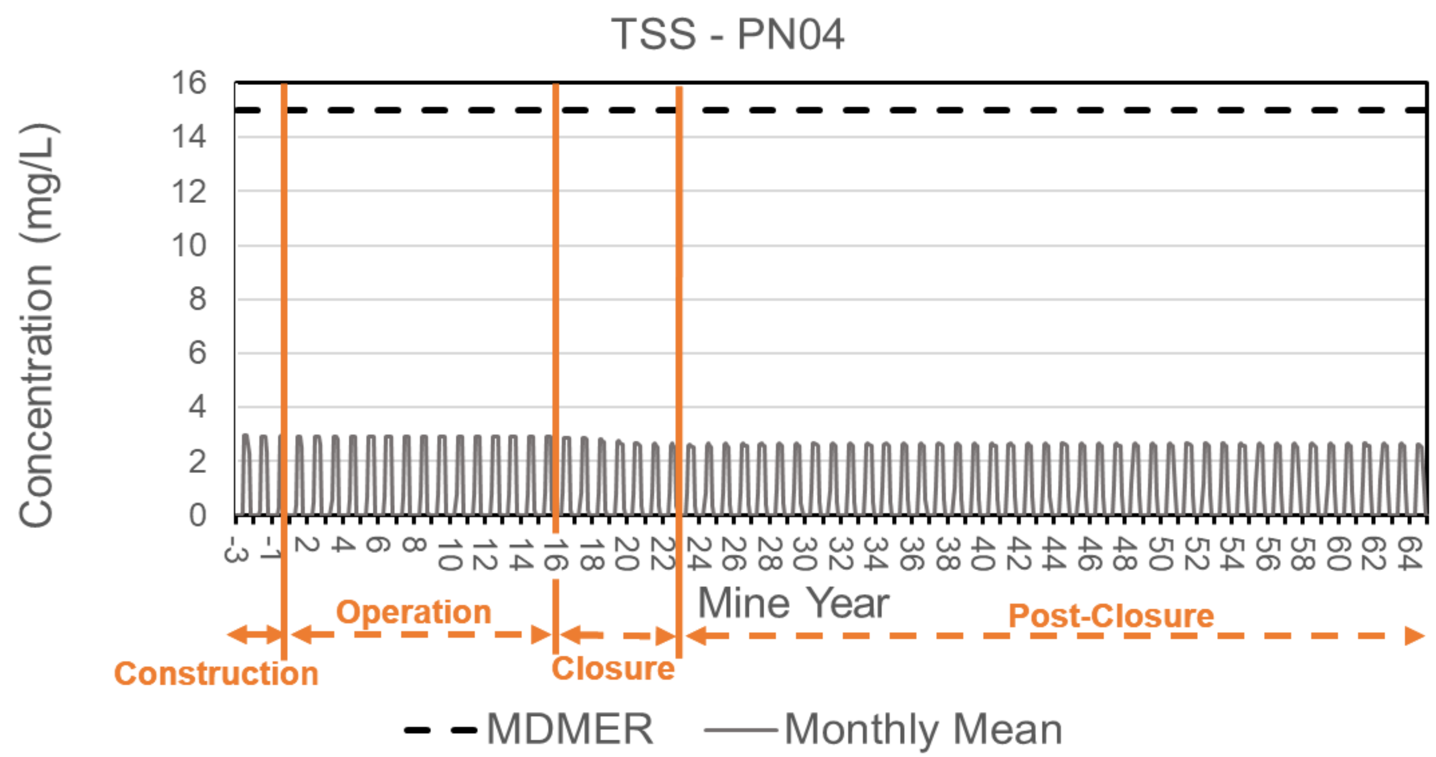

Arsenic - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

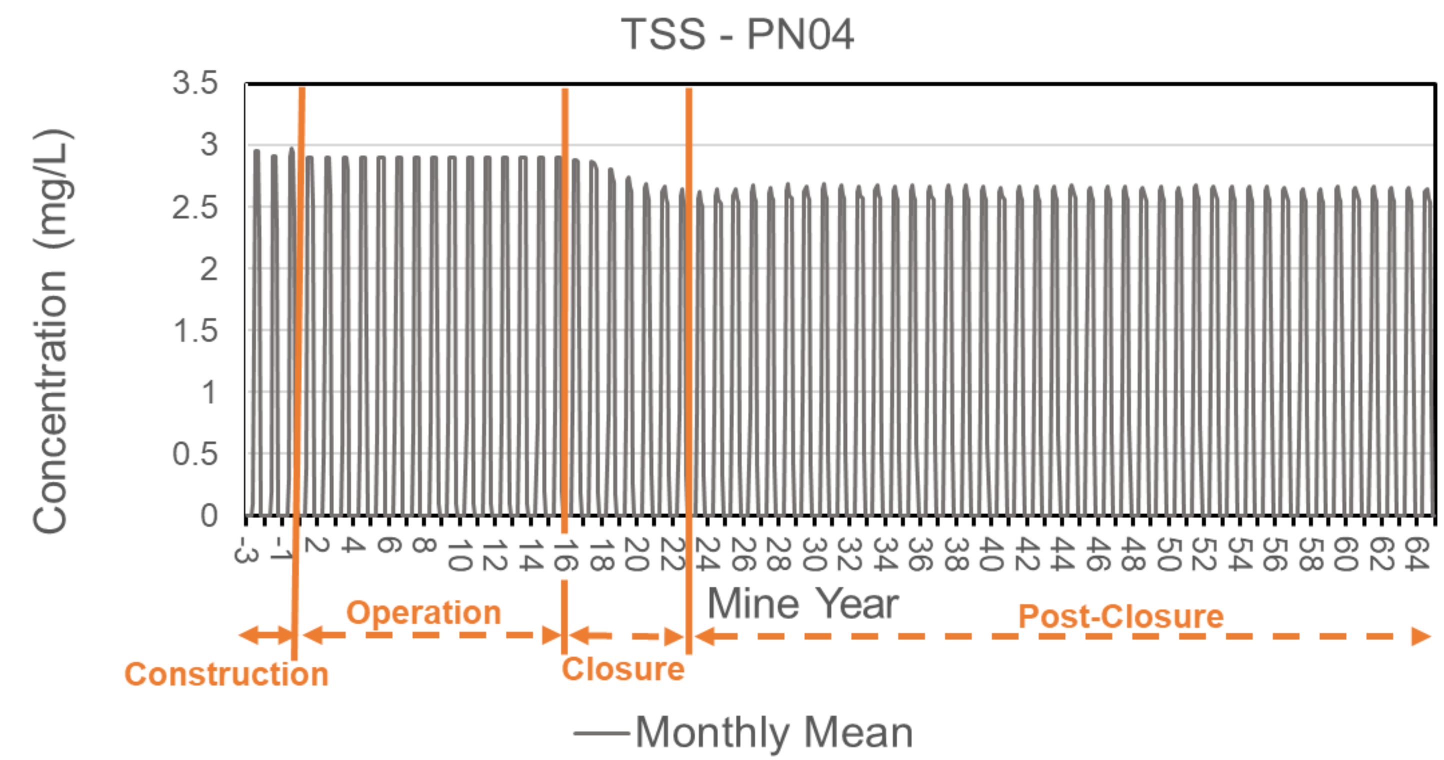

Arsenic - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

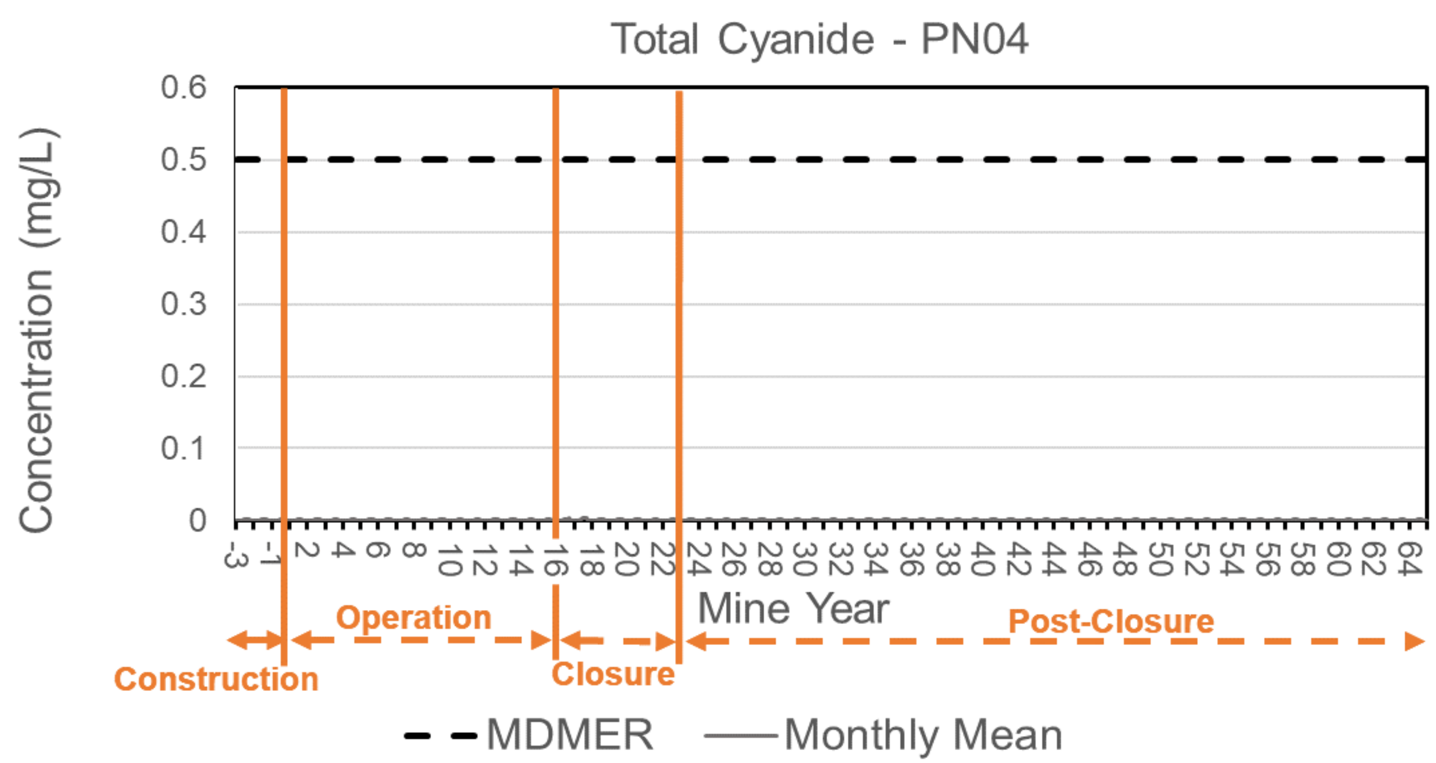

Copper - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

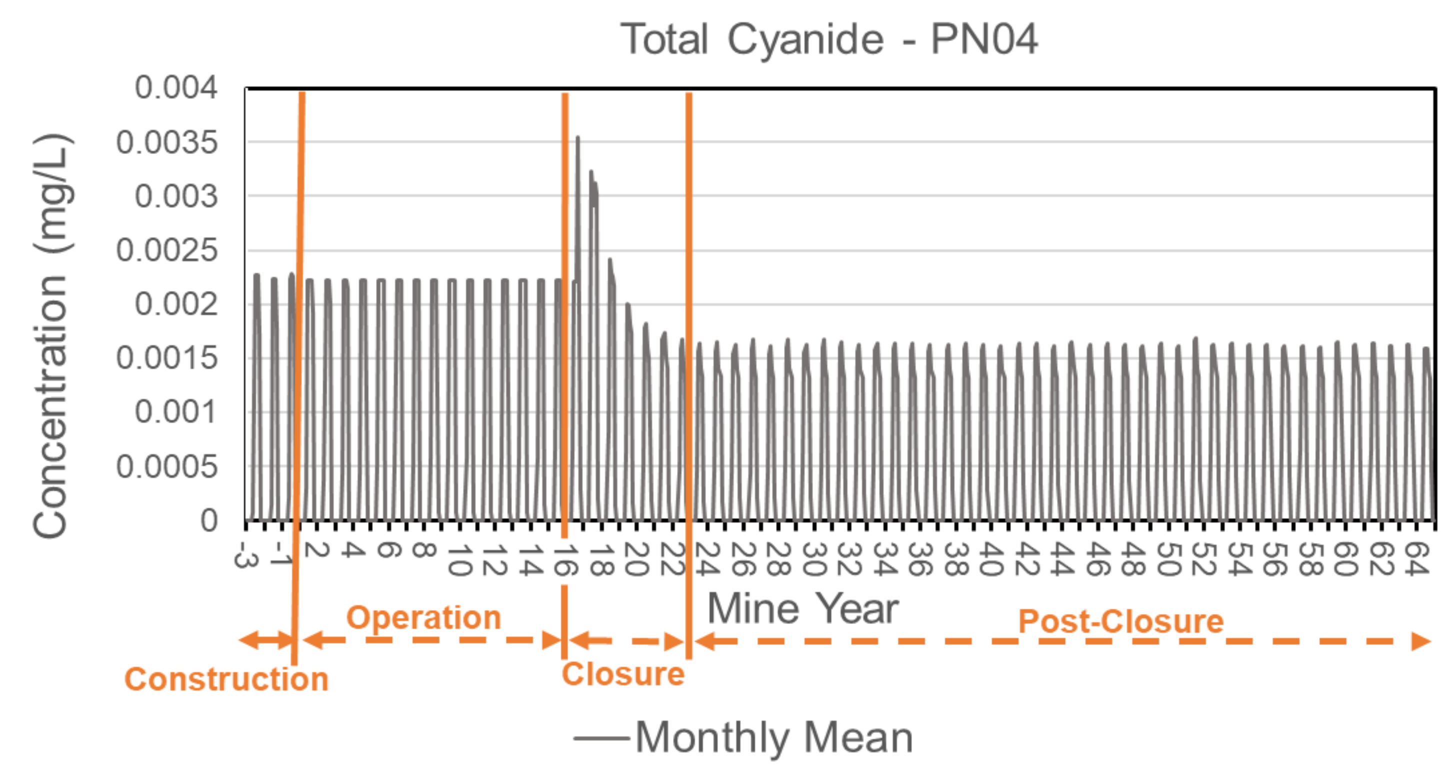

Copper - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

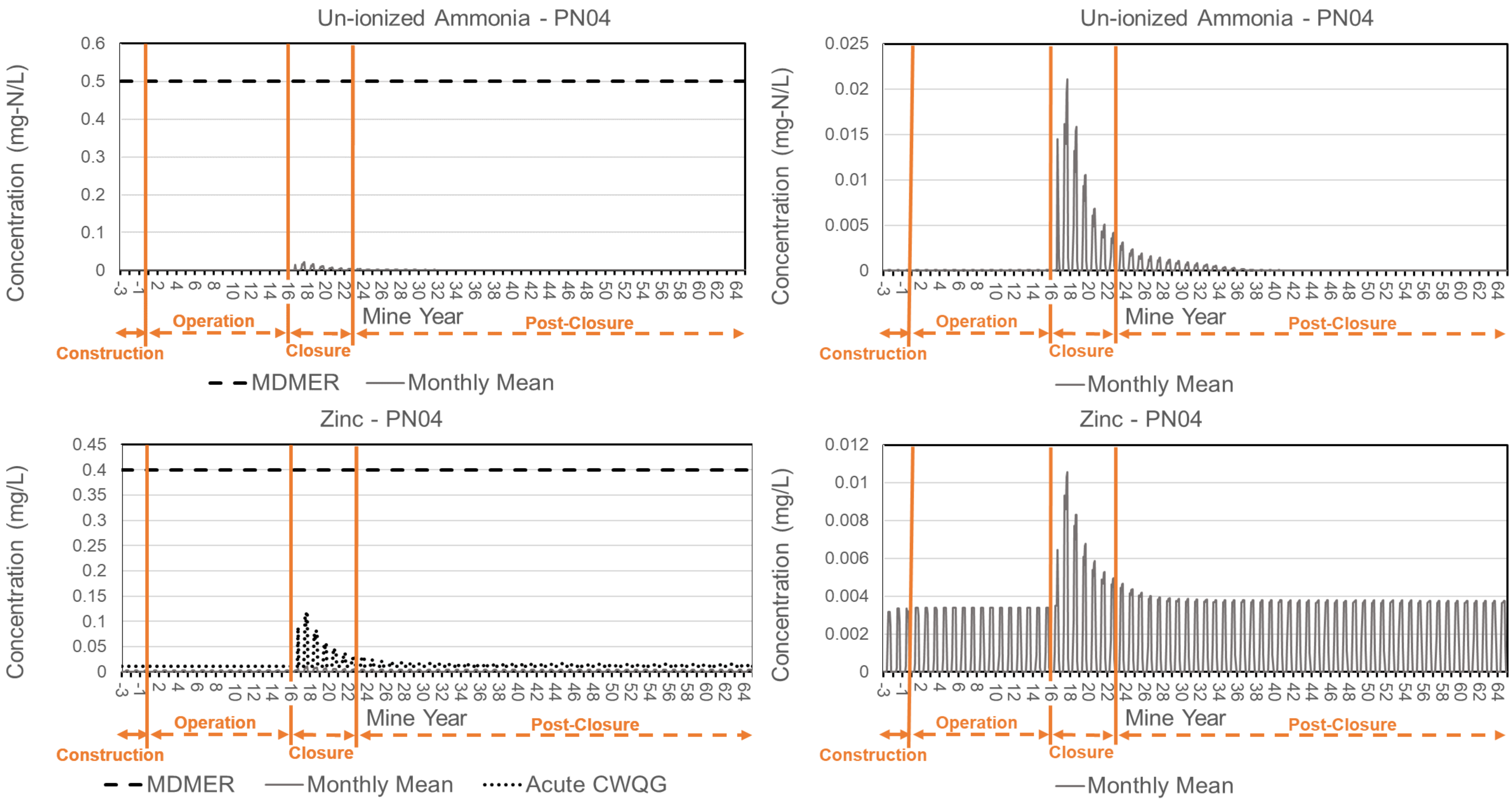

Lead - PN04
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Concentration (mg/L)
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Lead - PN04
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Concentration (mg/L)
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Nickel - PN04
0.3
0.25
0.2
0.15
0.1
0.05
0
Concentration (mg/L)
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Nickel - PN04
0.03
0.025
0.02
0.015
0.01
0.005
0
Concentration (mg/L)
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

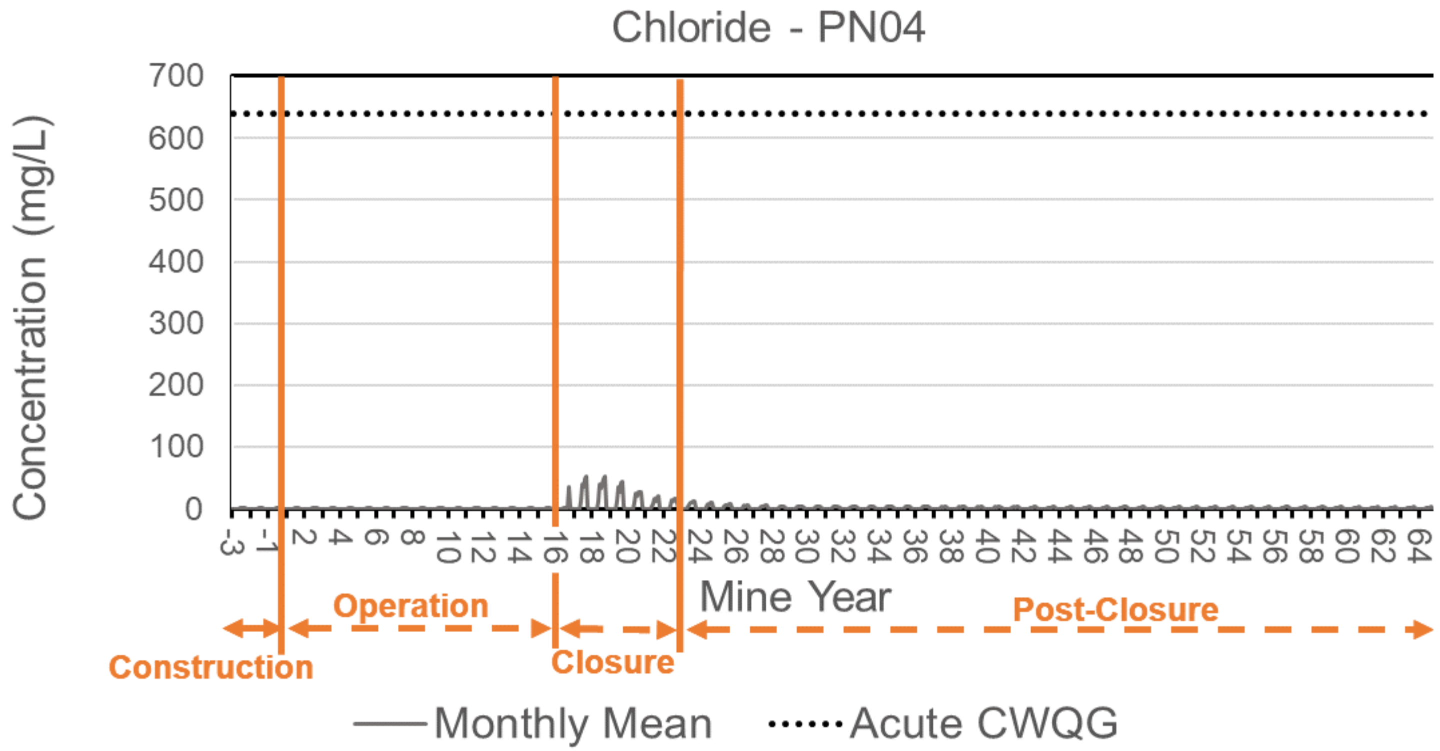

TSS - PN04
Concentration (mg/L)
16
14
12
10
8
6
4
2
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

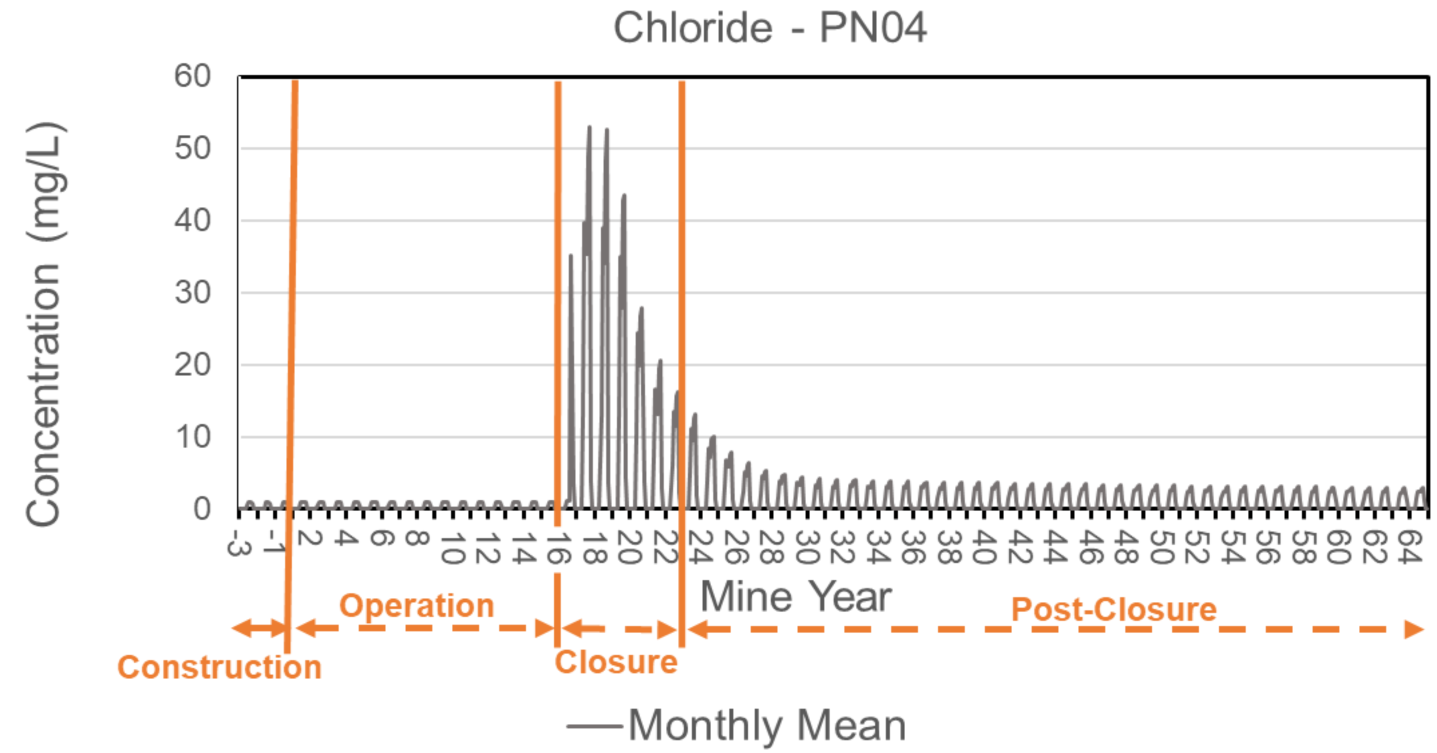

TSS - PN04
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

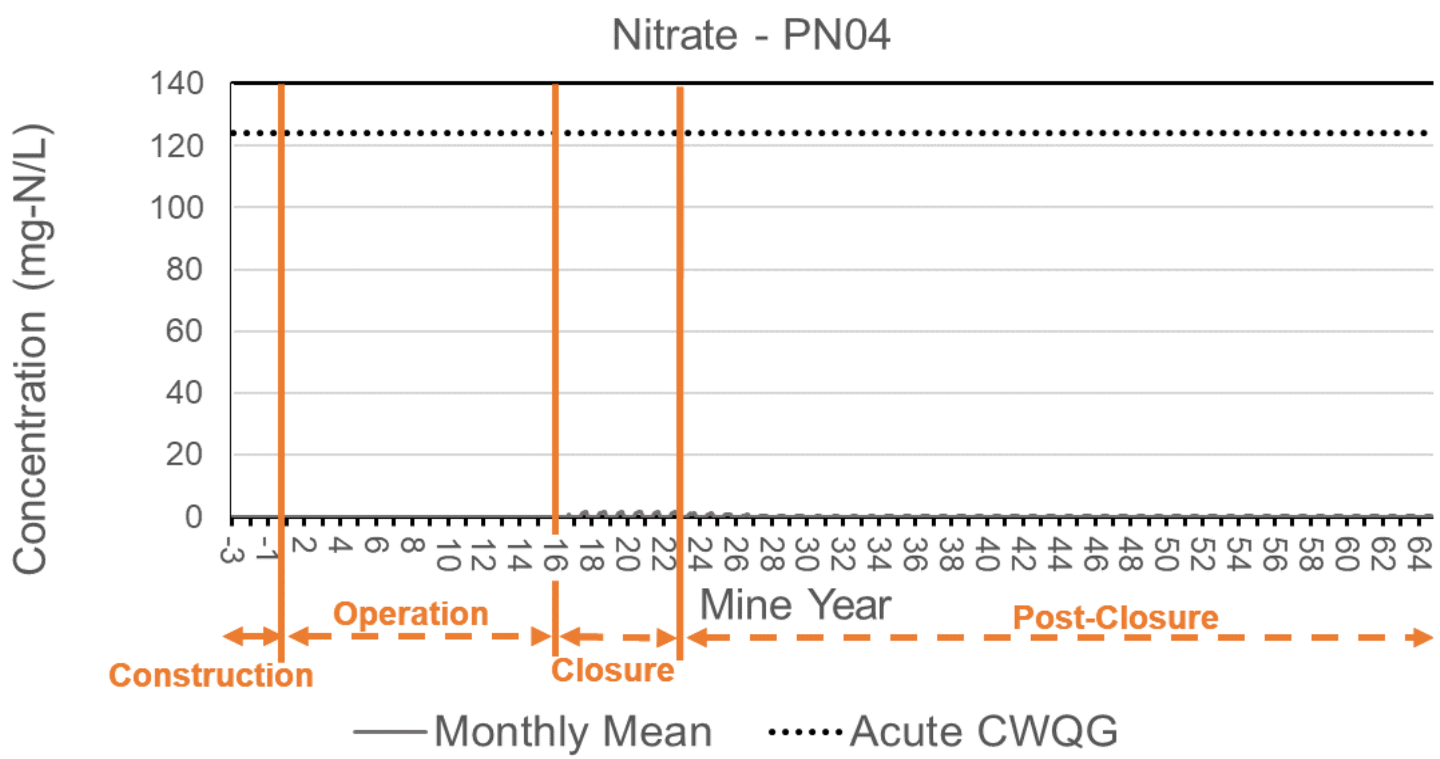

Total Cyanide - PN04
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

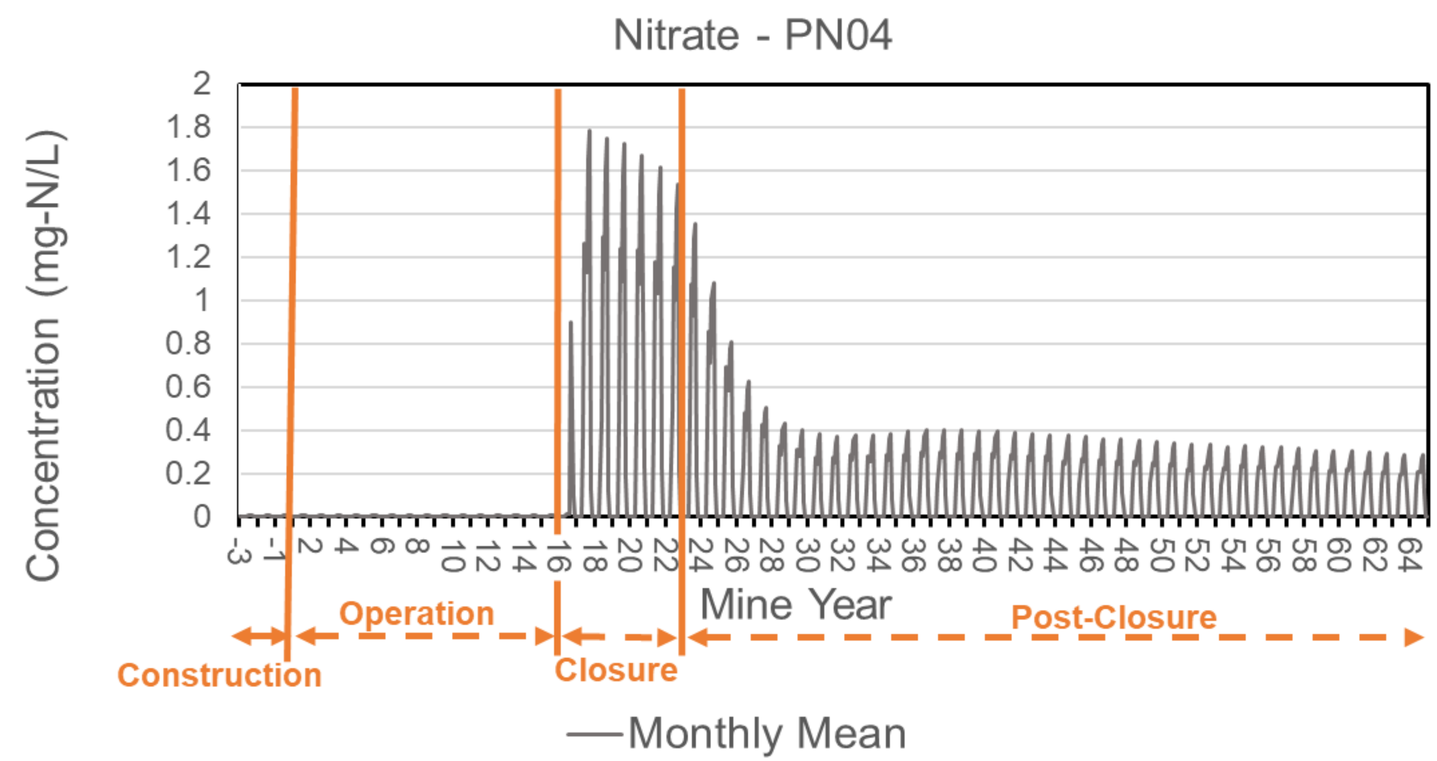

Total Cyanide - PN04
Concentration (mg/L)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

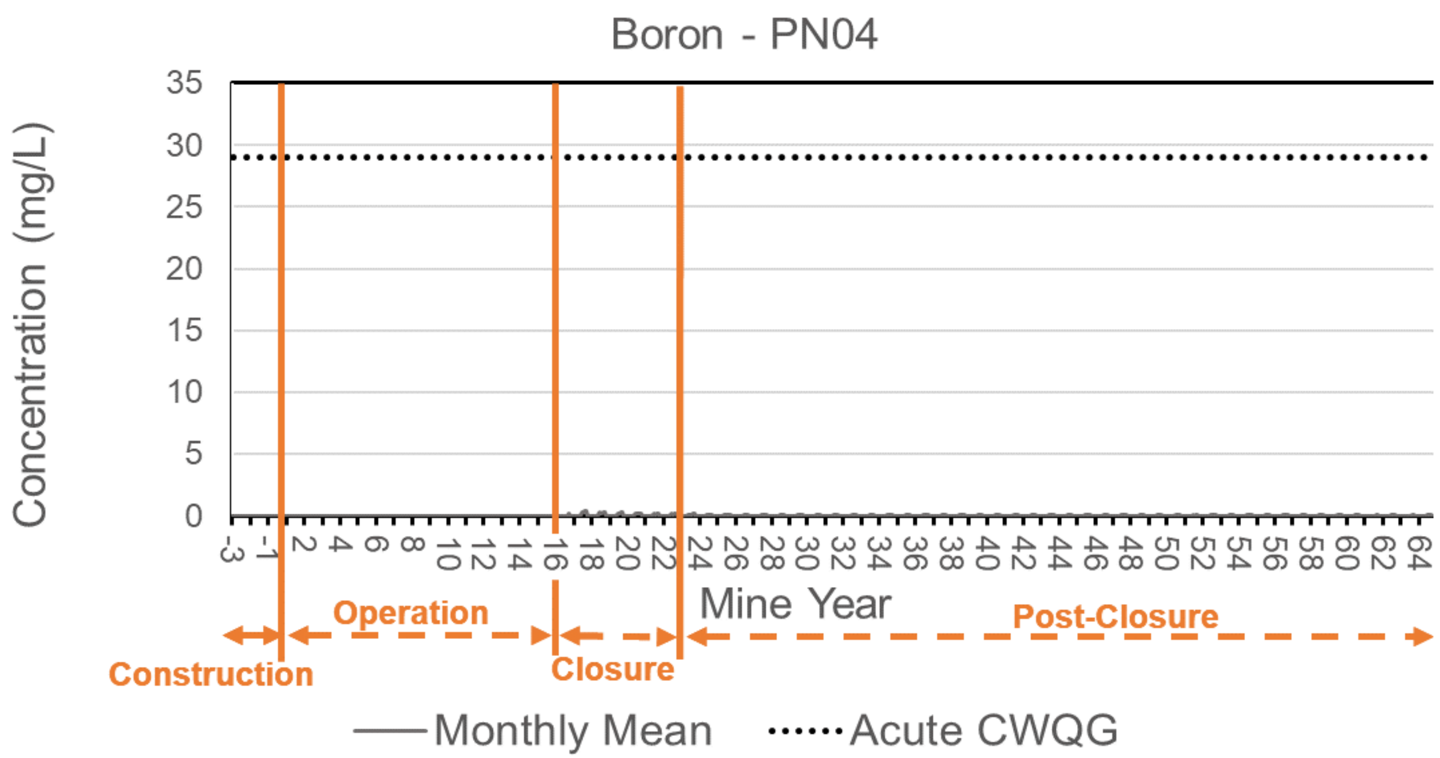

Un-ionized Ammonia - PN04
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Un-ionized Ammonia - PN04
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Zinc - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Acute CWQG
Zinc - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

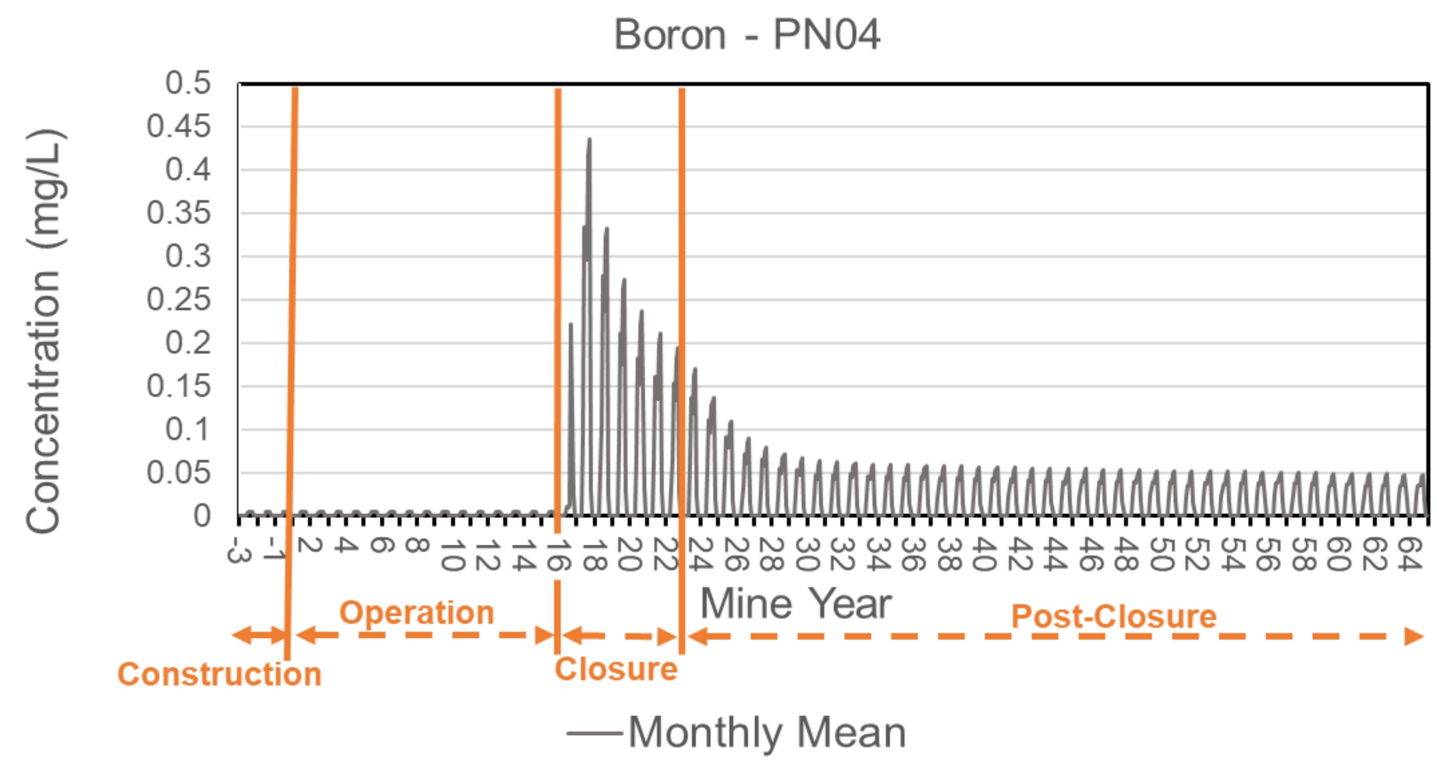

Chloride - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

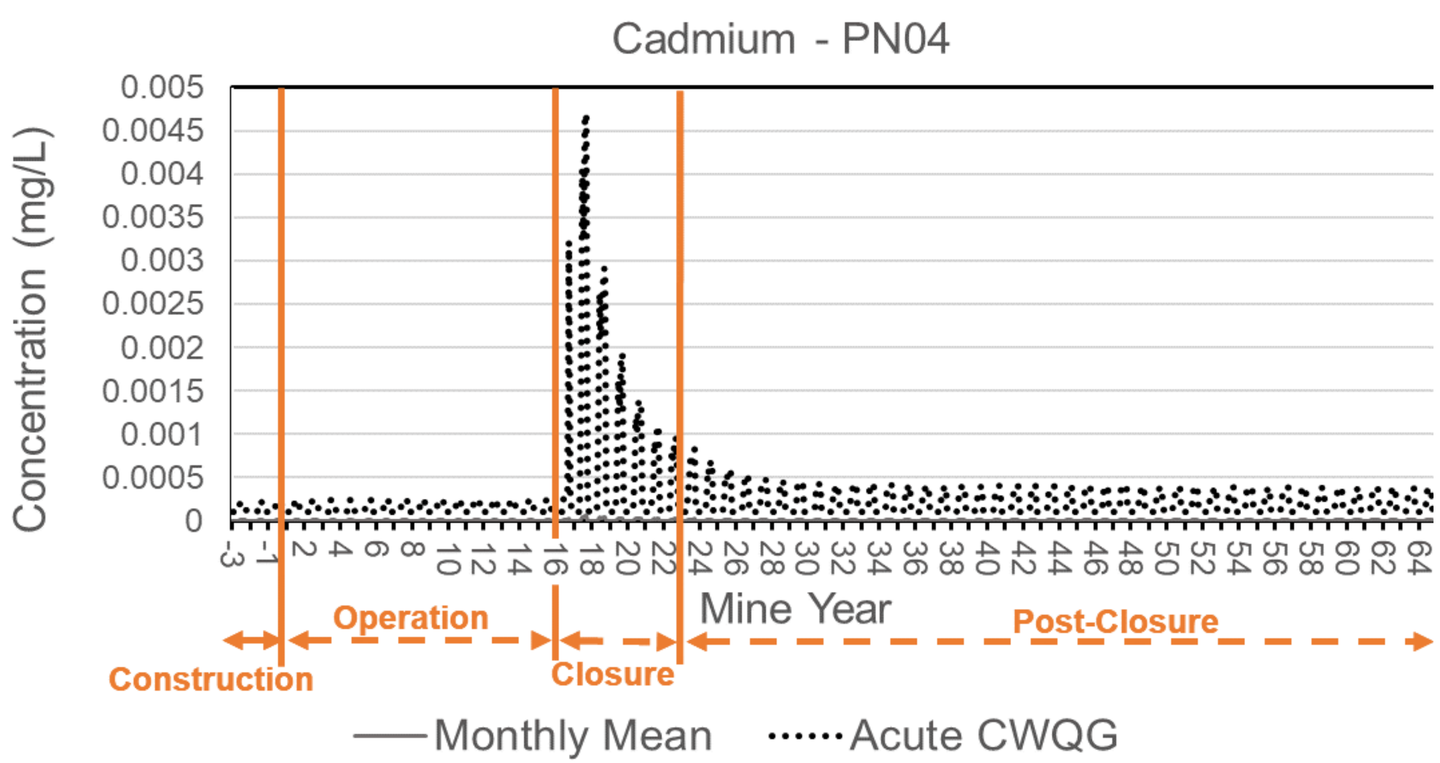

Chloride - PN04
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

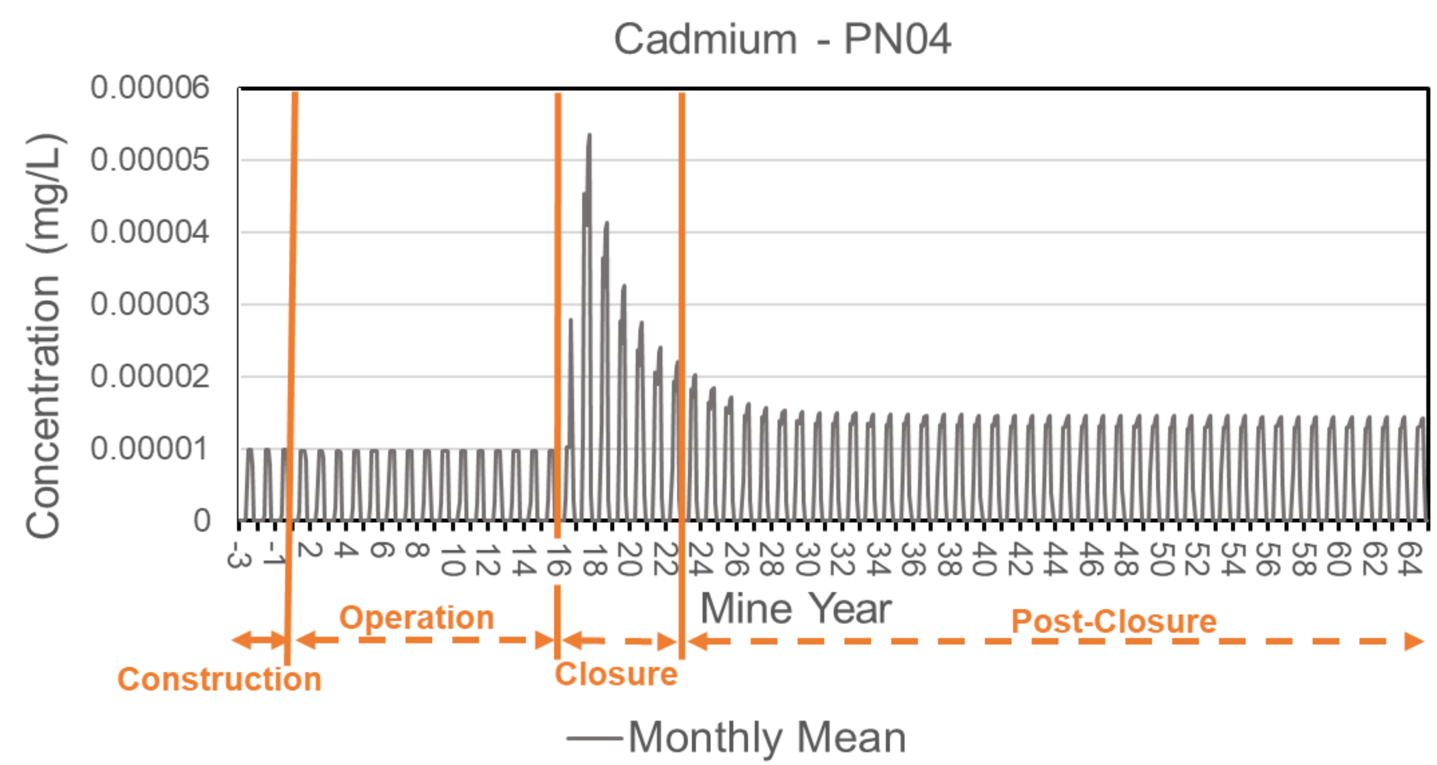

Nitrate - PN04
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

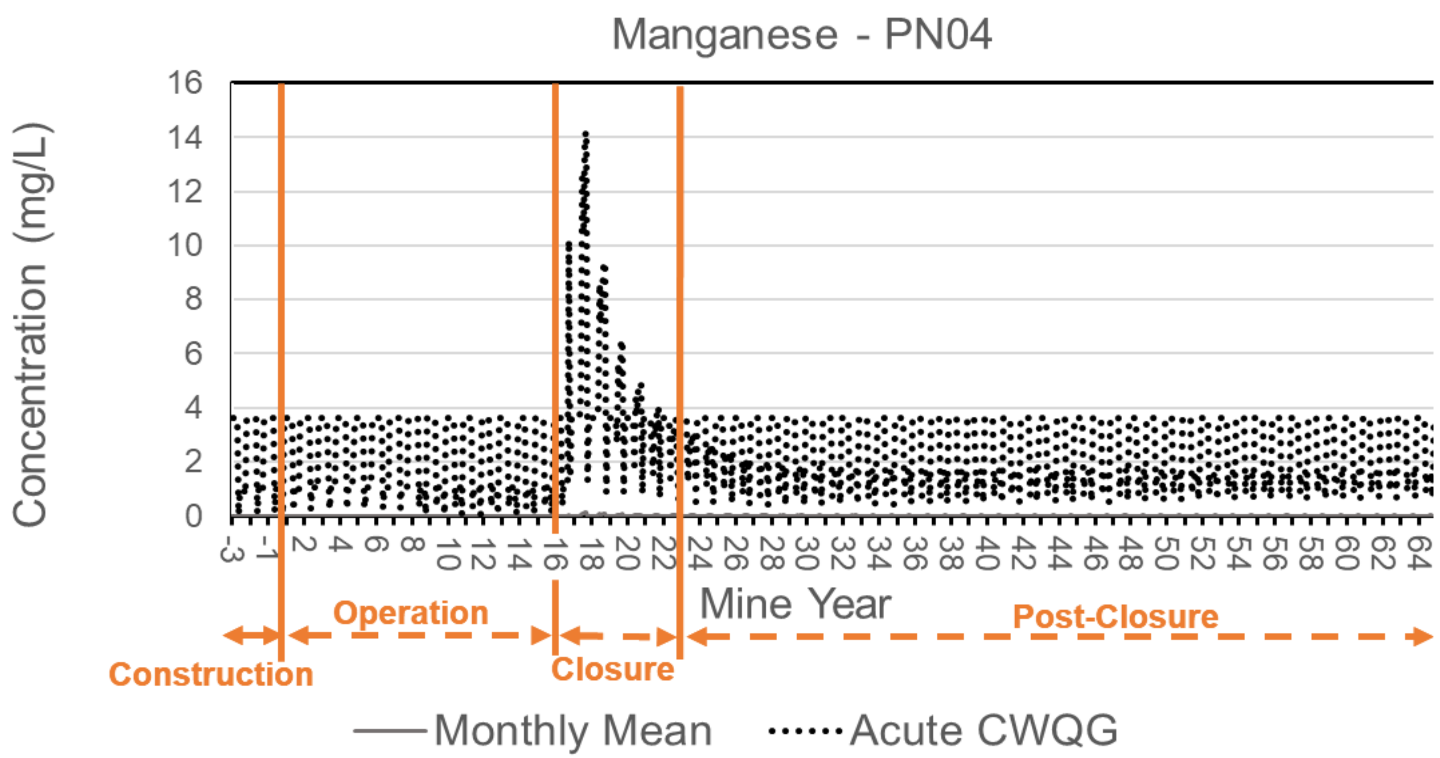

Nitrate - PN04
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

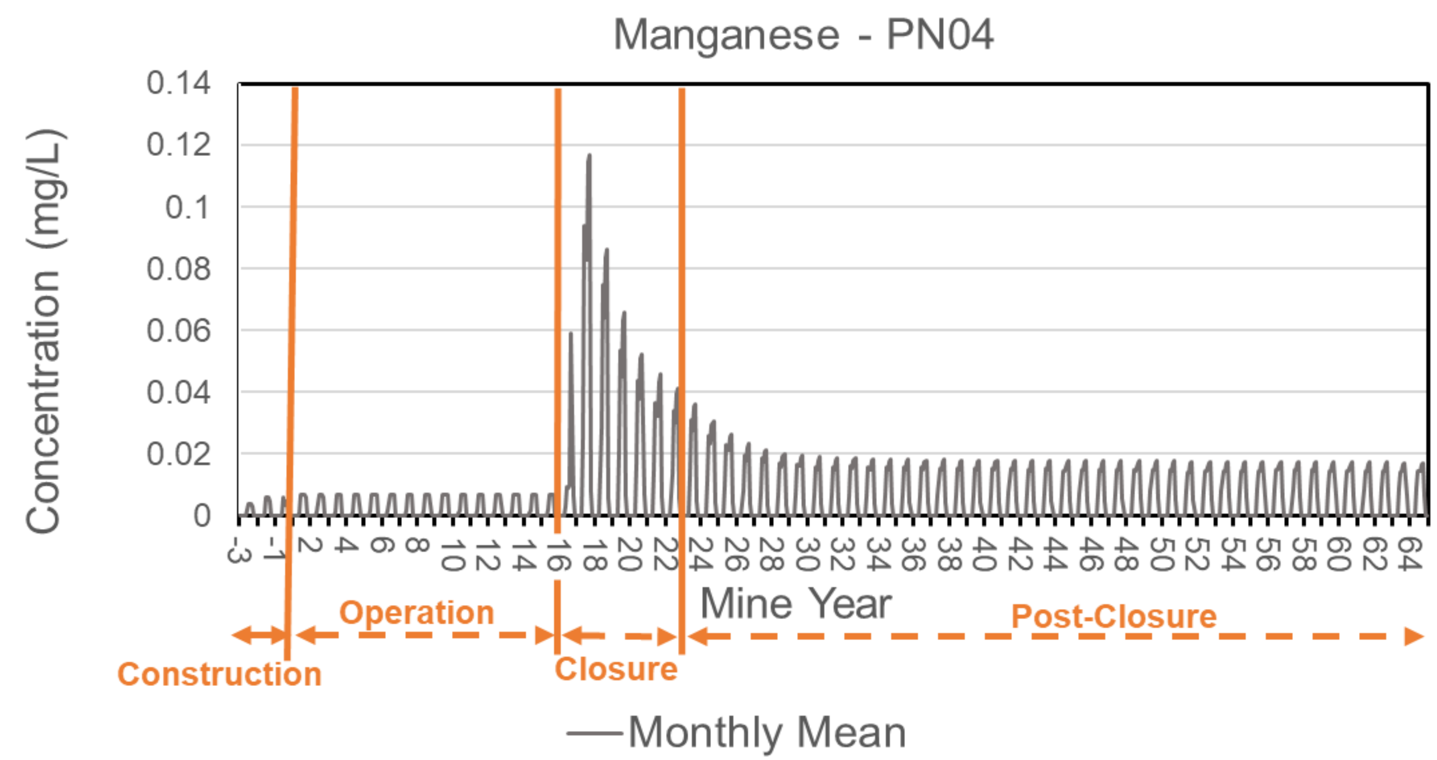

Boron - PN04
Concentration (mg/L)
35
30
25
20
15
10
5
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

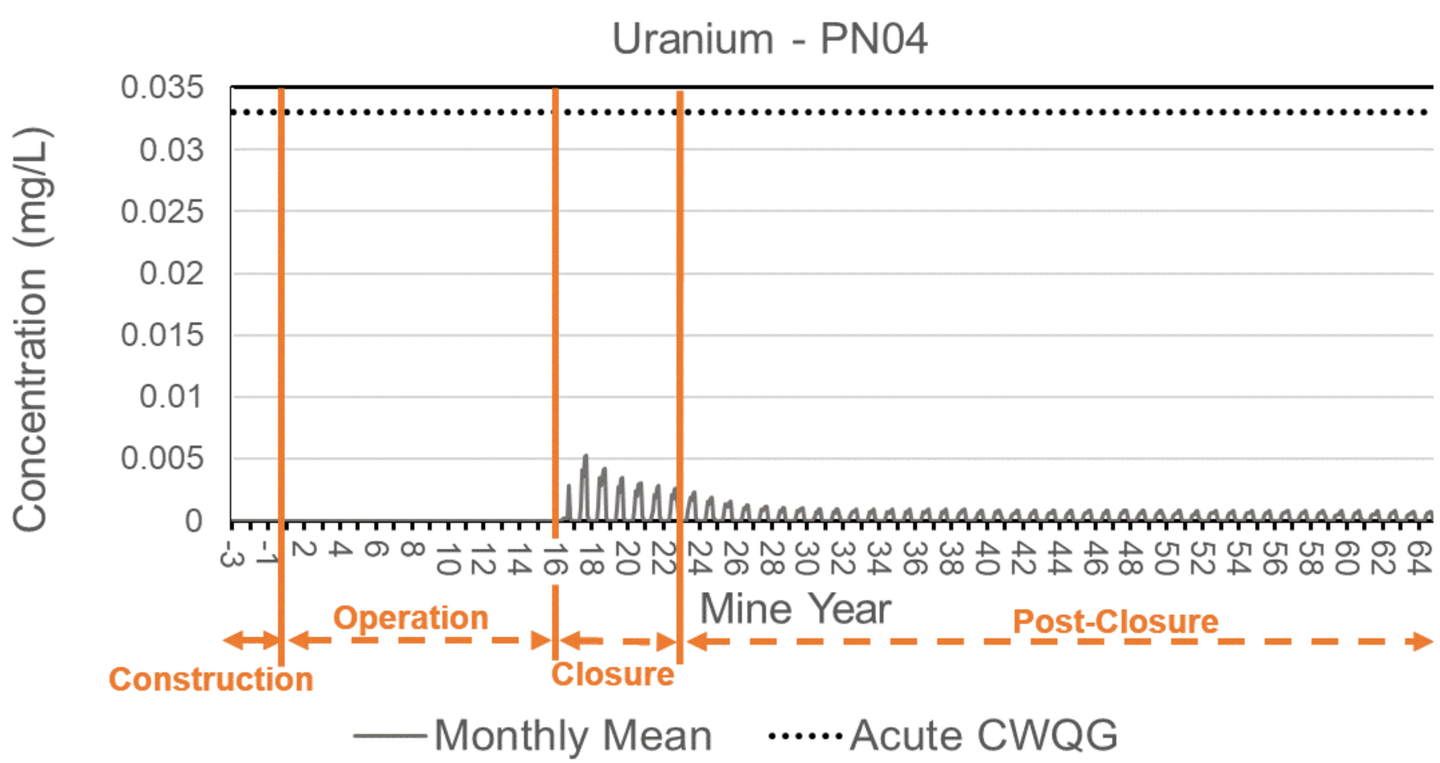

Boron - PN04
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

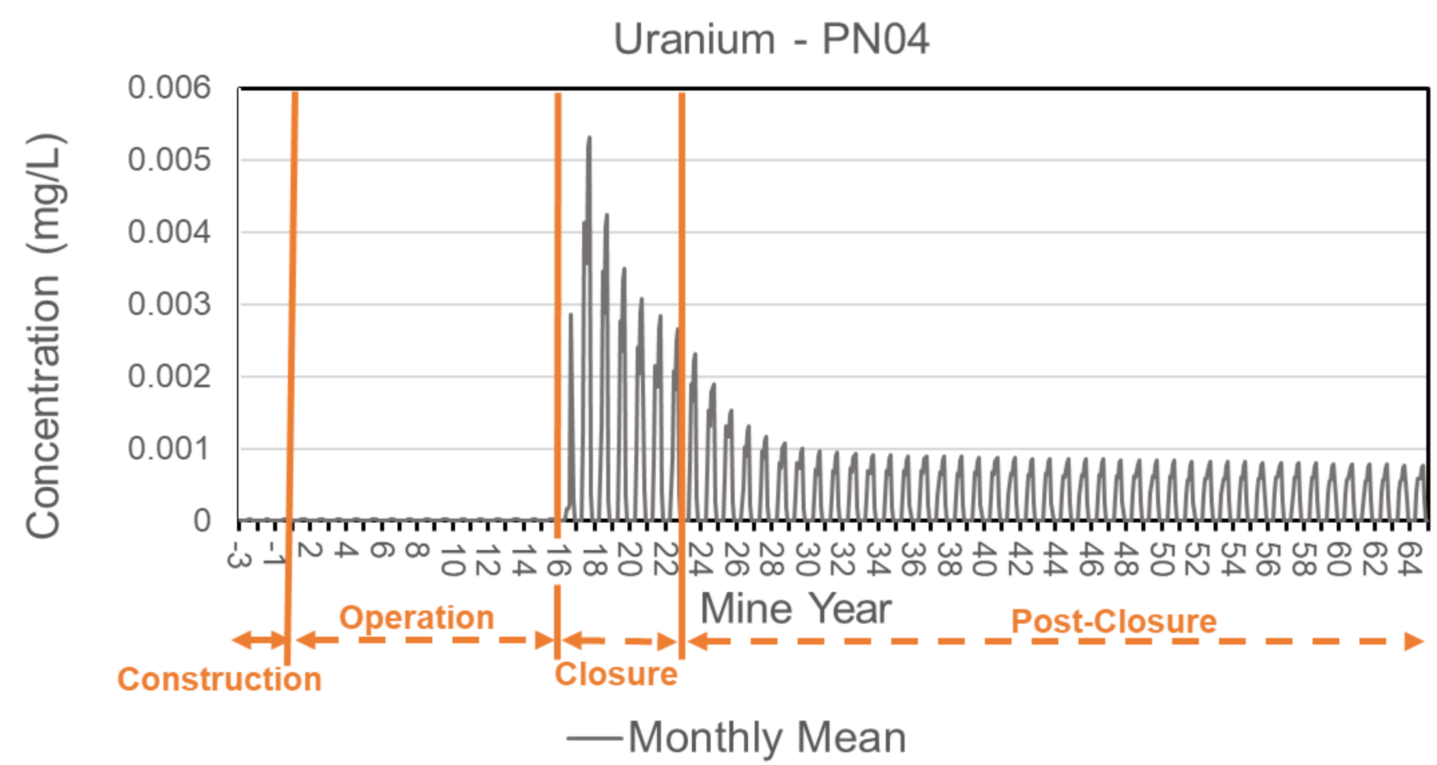

Cadmium - PN04
Concentration (mg/L)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

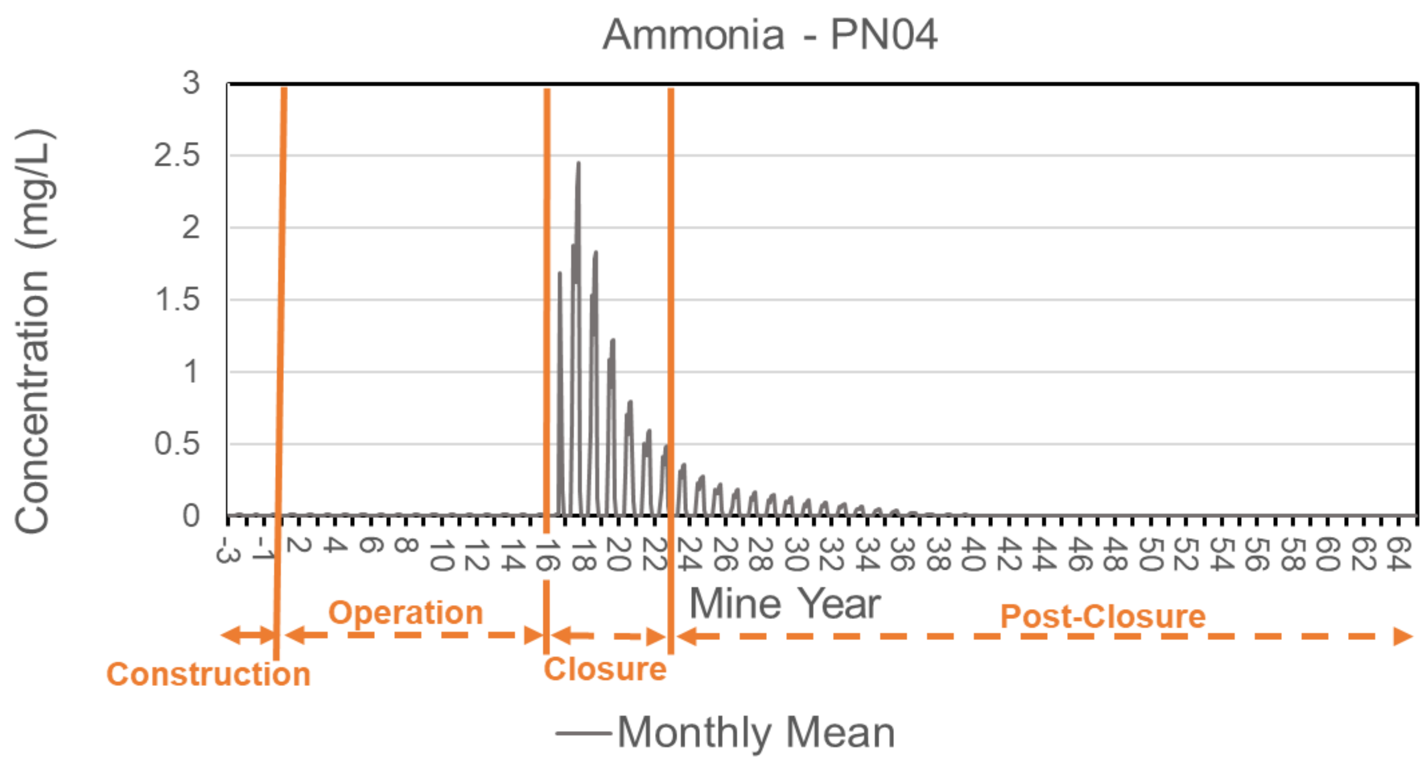

Cadmium - PN04
Concentration (mg/L)
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

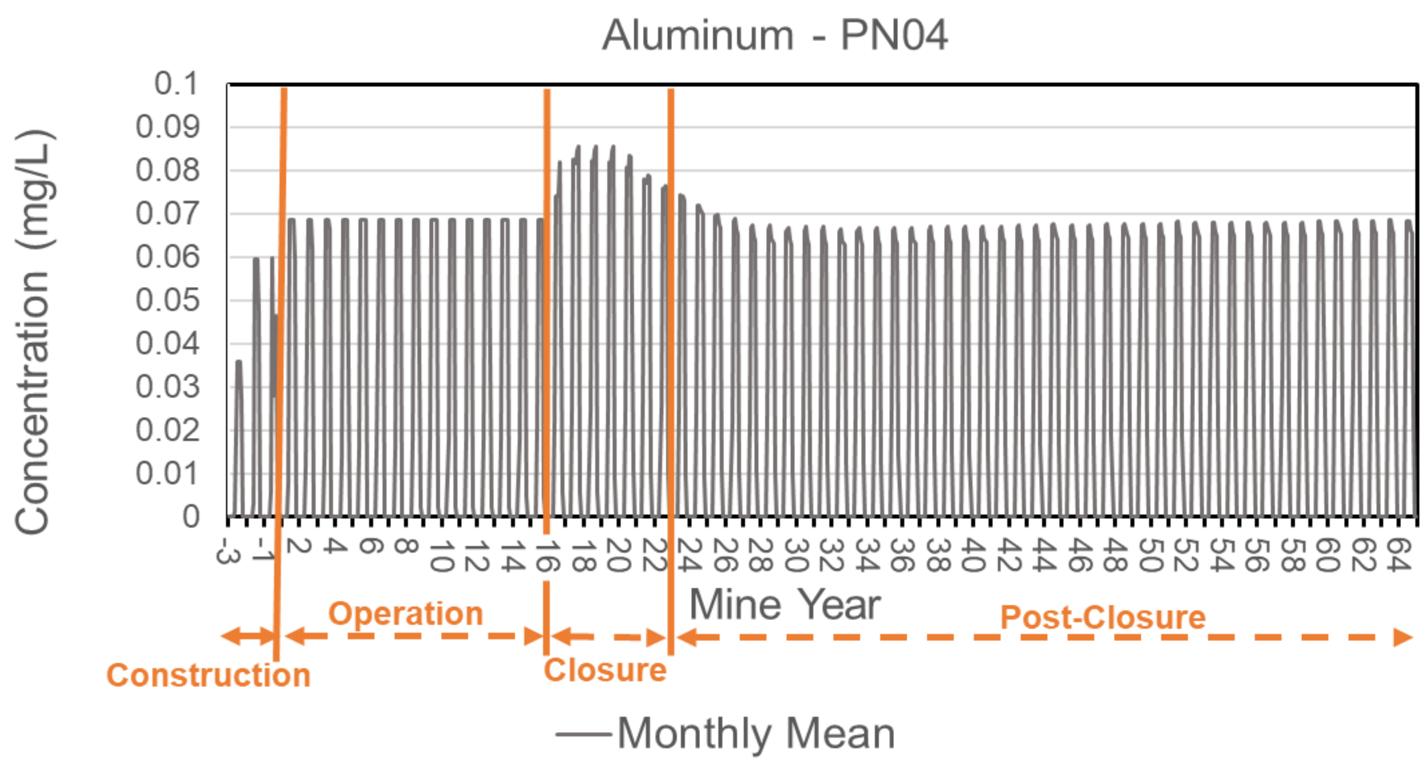

Manganese - PN04
Concentration (mg/L)
0
2
4
6
8
10
12
14
16
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

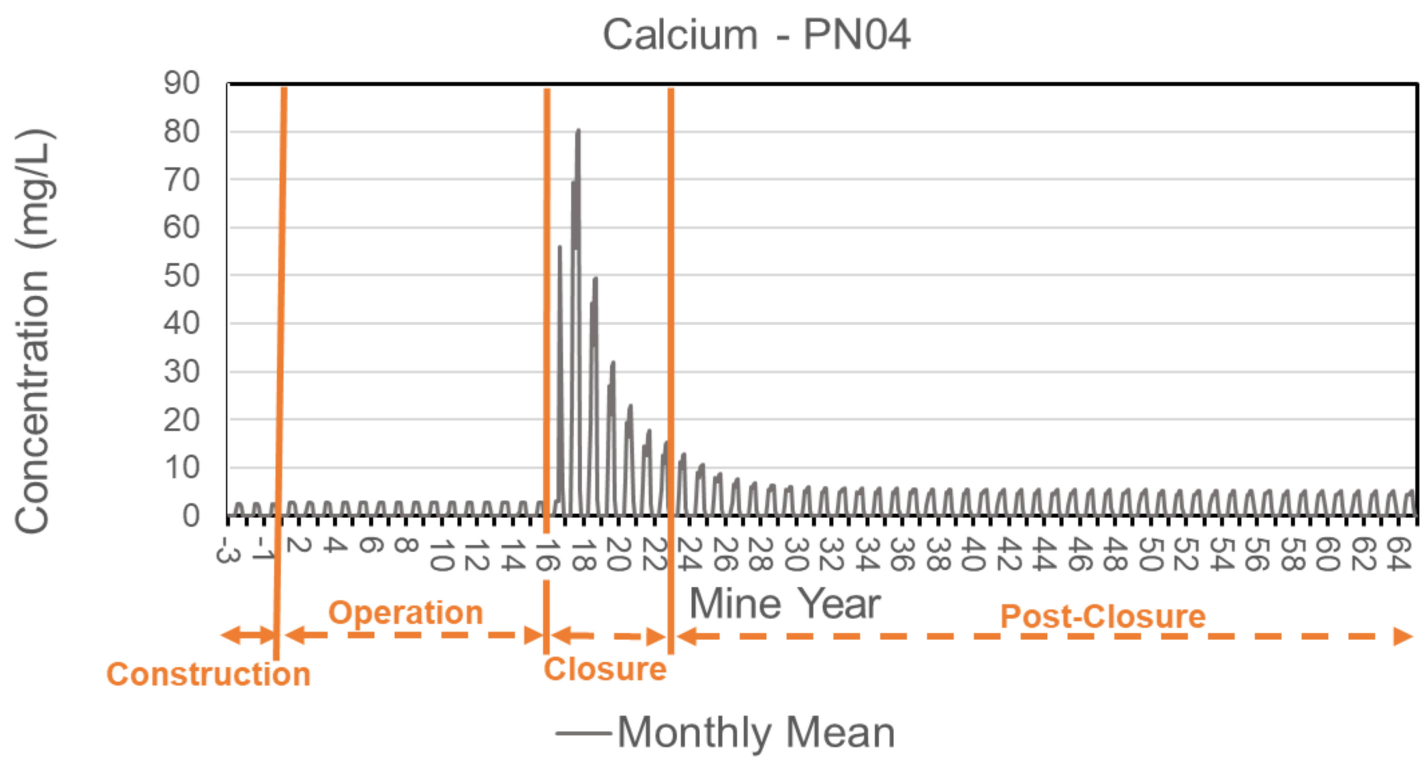

Manganese - PN04
Concentration (mg/L)
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

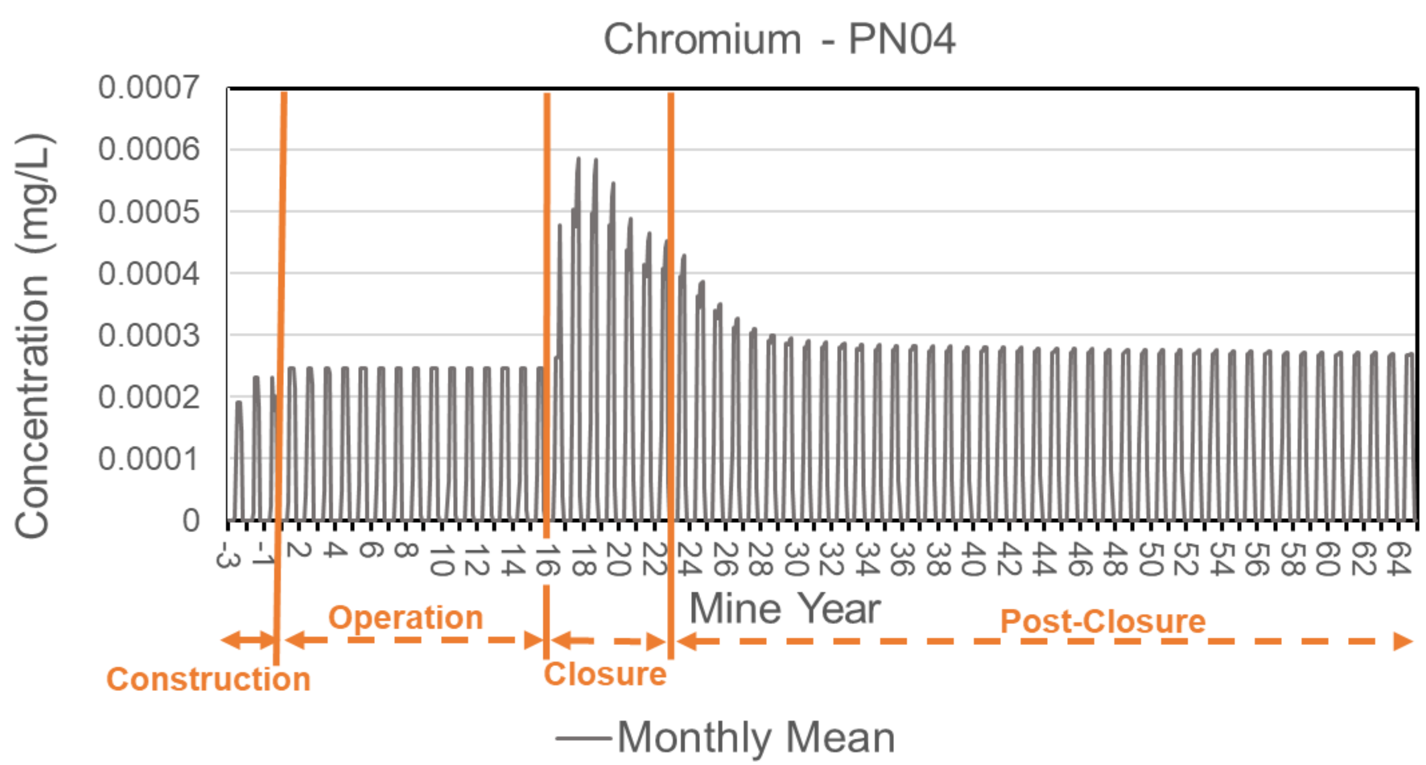

Uranium - PN04
Concentration (mg/L)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

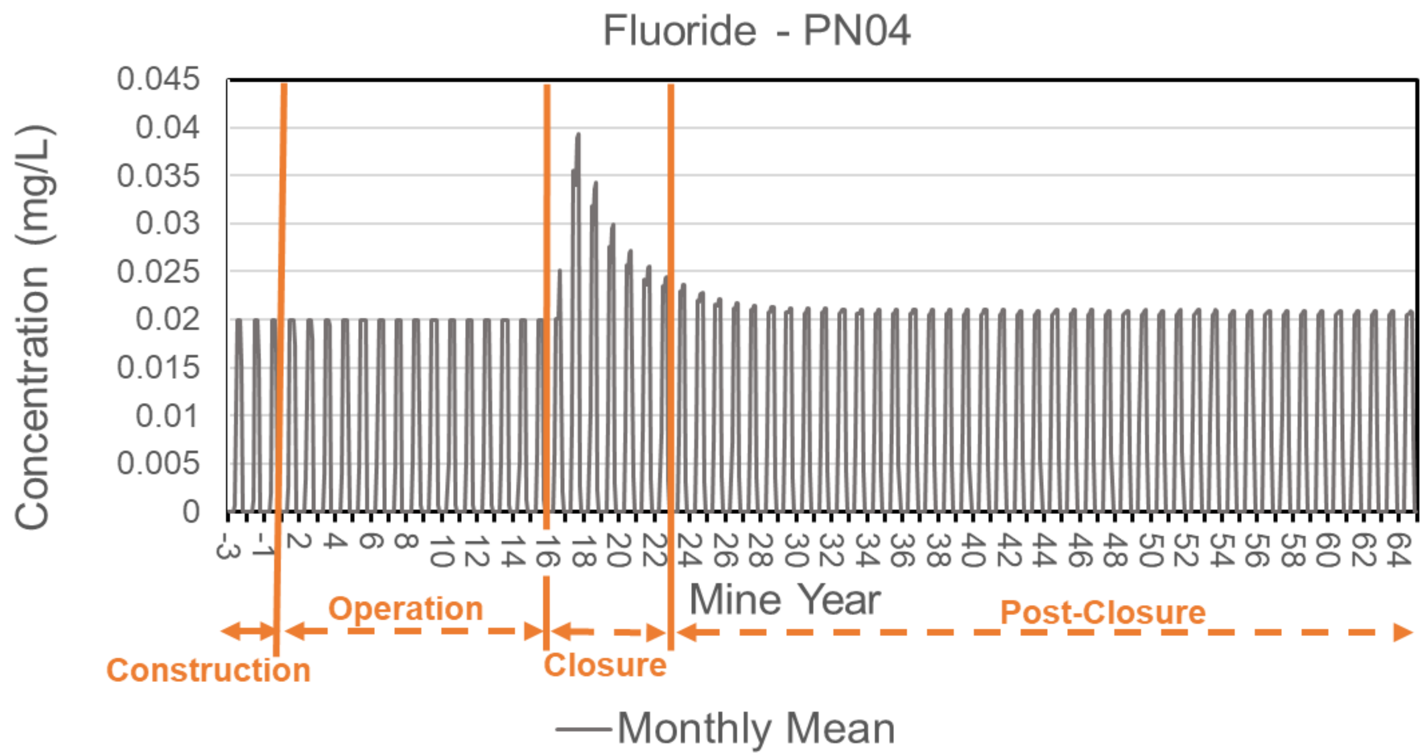

Uranium - PN04
Concentration (mg/L)
0
0.001
0.002
0.003
0.004
0.005
0.006
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Ammonia - PN04
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

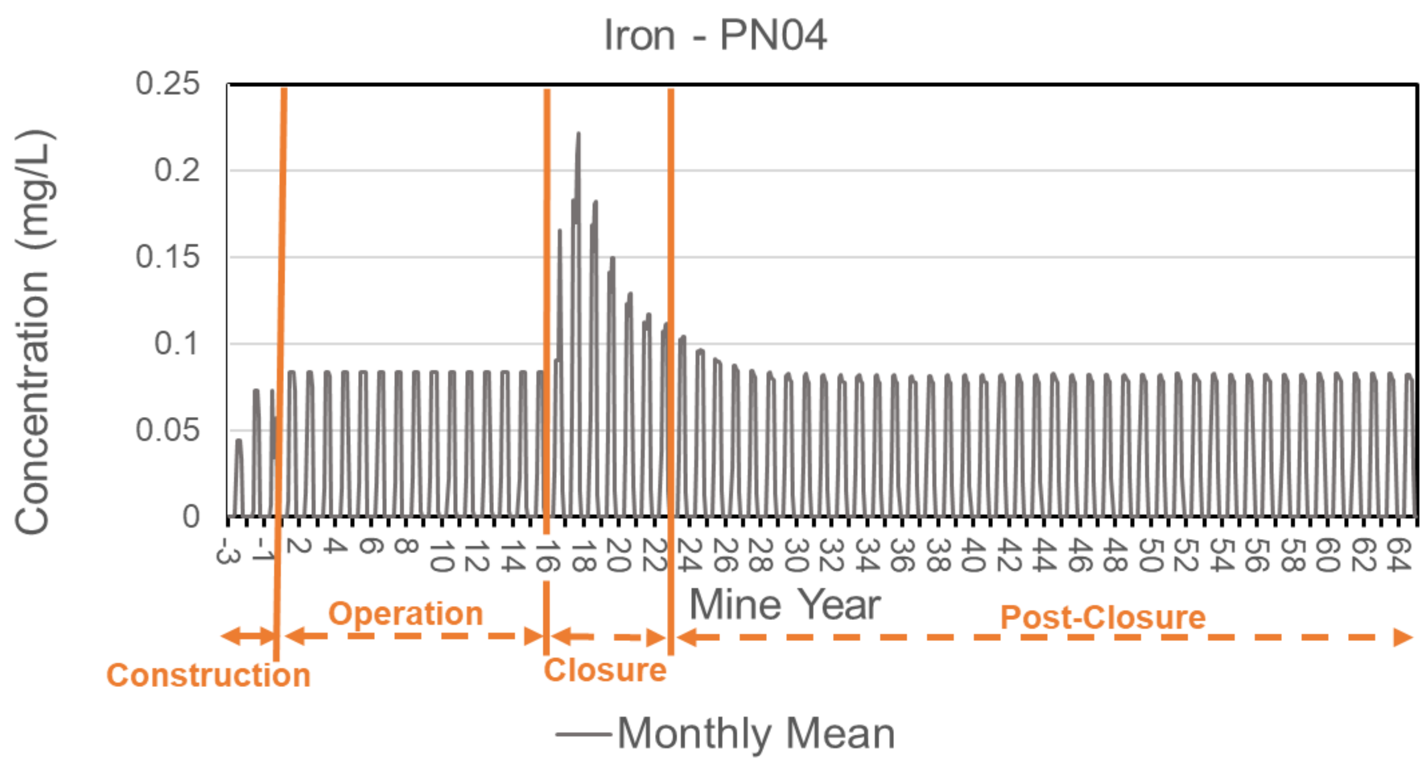

Aluminum - PN04
Concentration (mg/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Calcium - PN04
Concentration (mg/L)
90
80
70
60
50
40
30
20
10
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

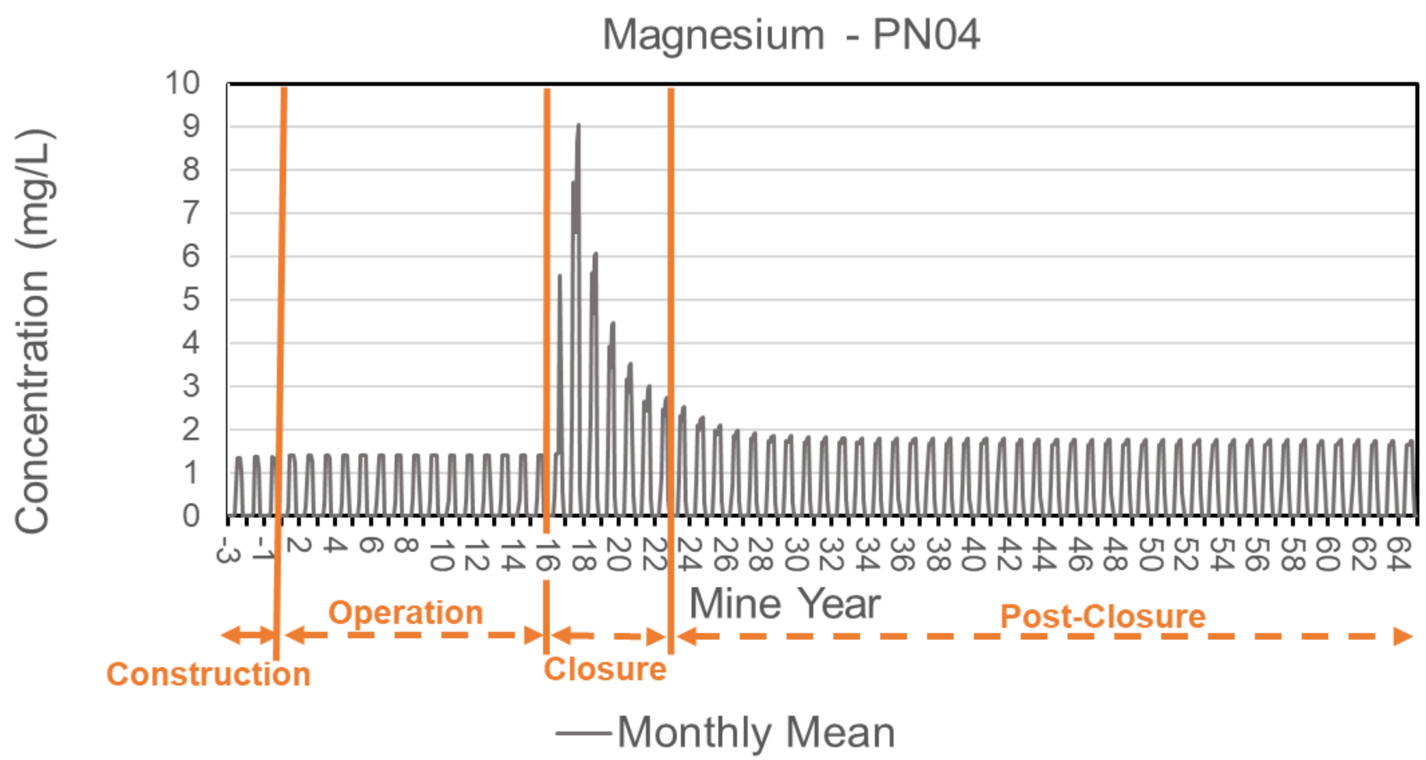

Chromium - PN04
Concentration (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

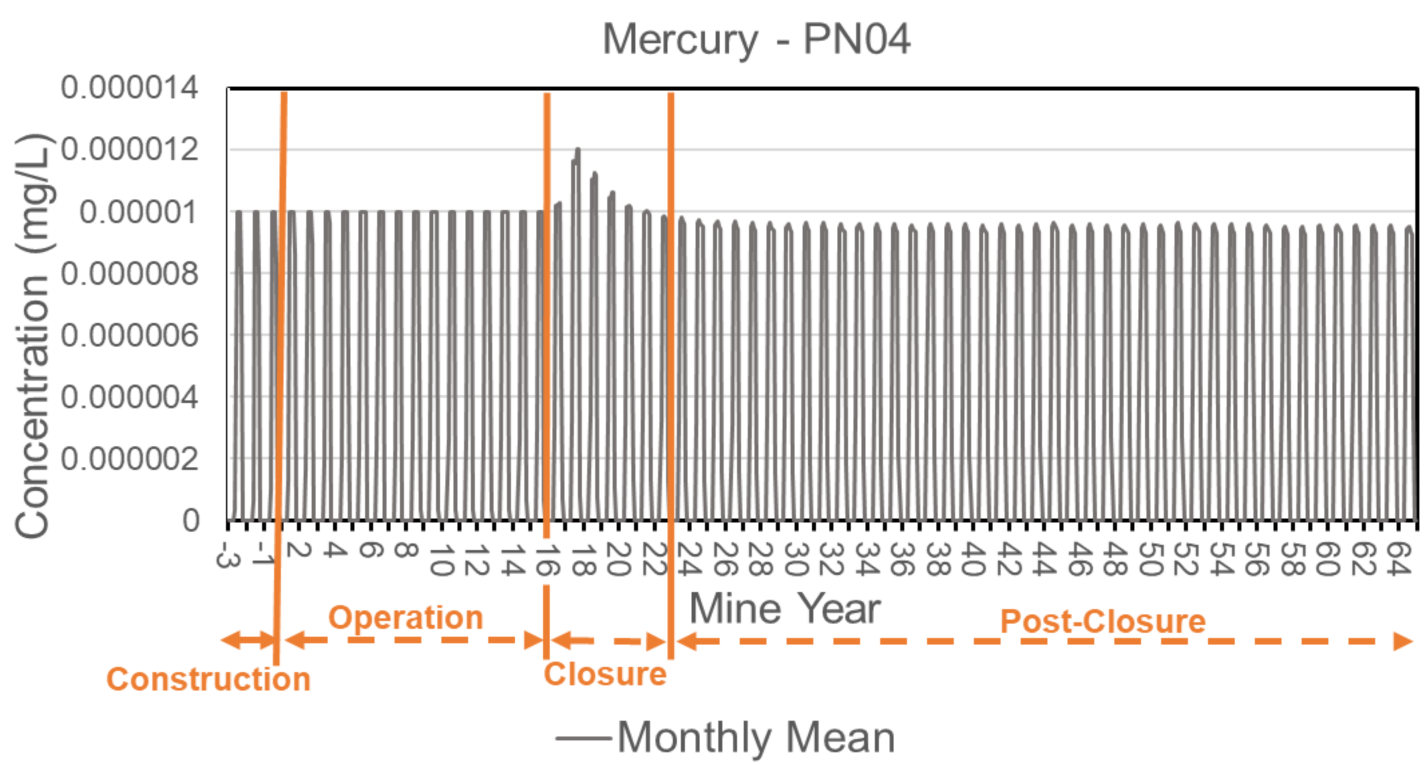


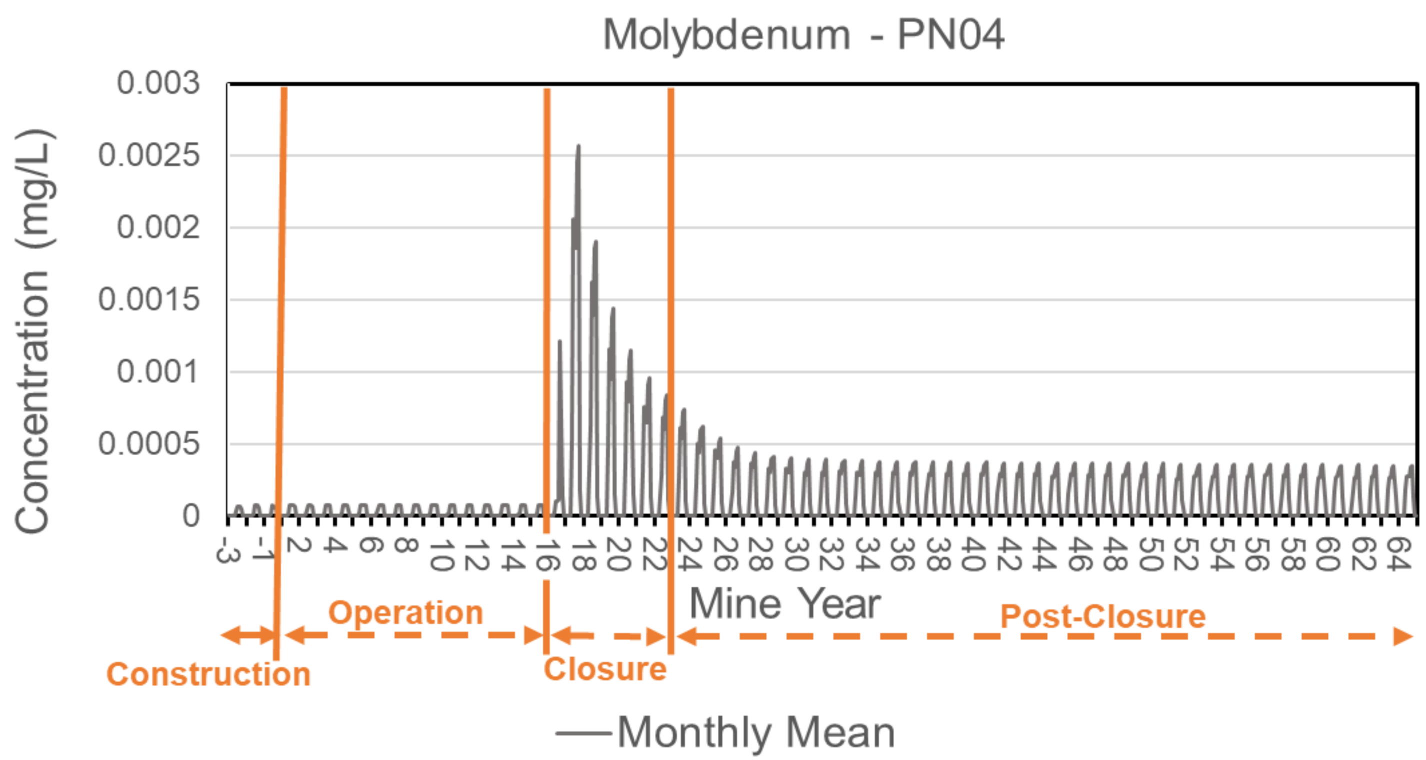
Fluoride - PN04
Concentration (mg/L)
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



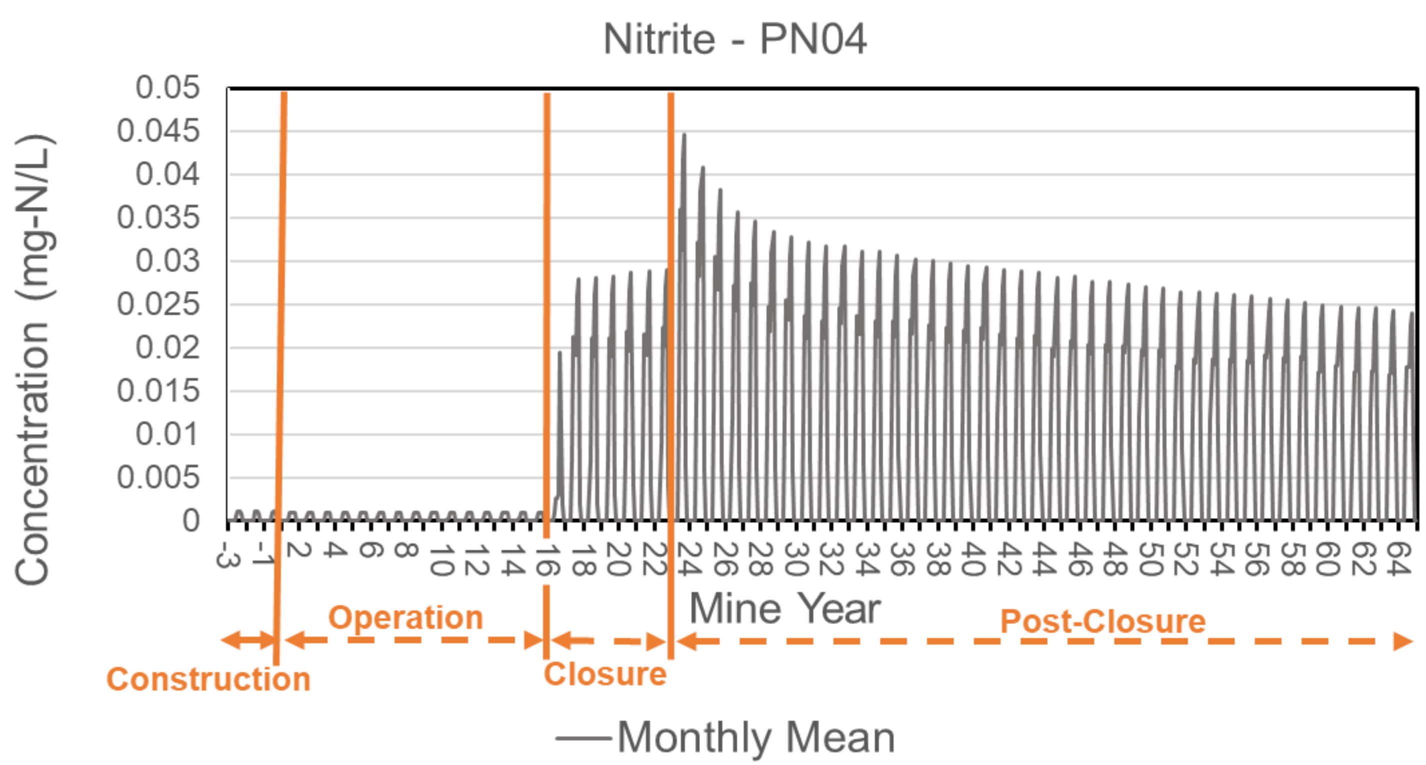
Iron - PN04
Concentration (mg/L)
0.25
0.2
0.15
0.1
0.05
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Magnesium - PN04
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

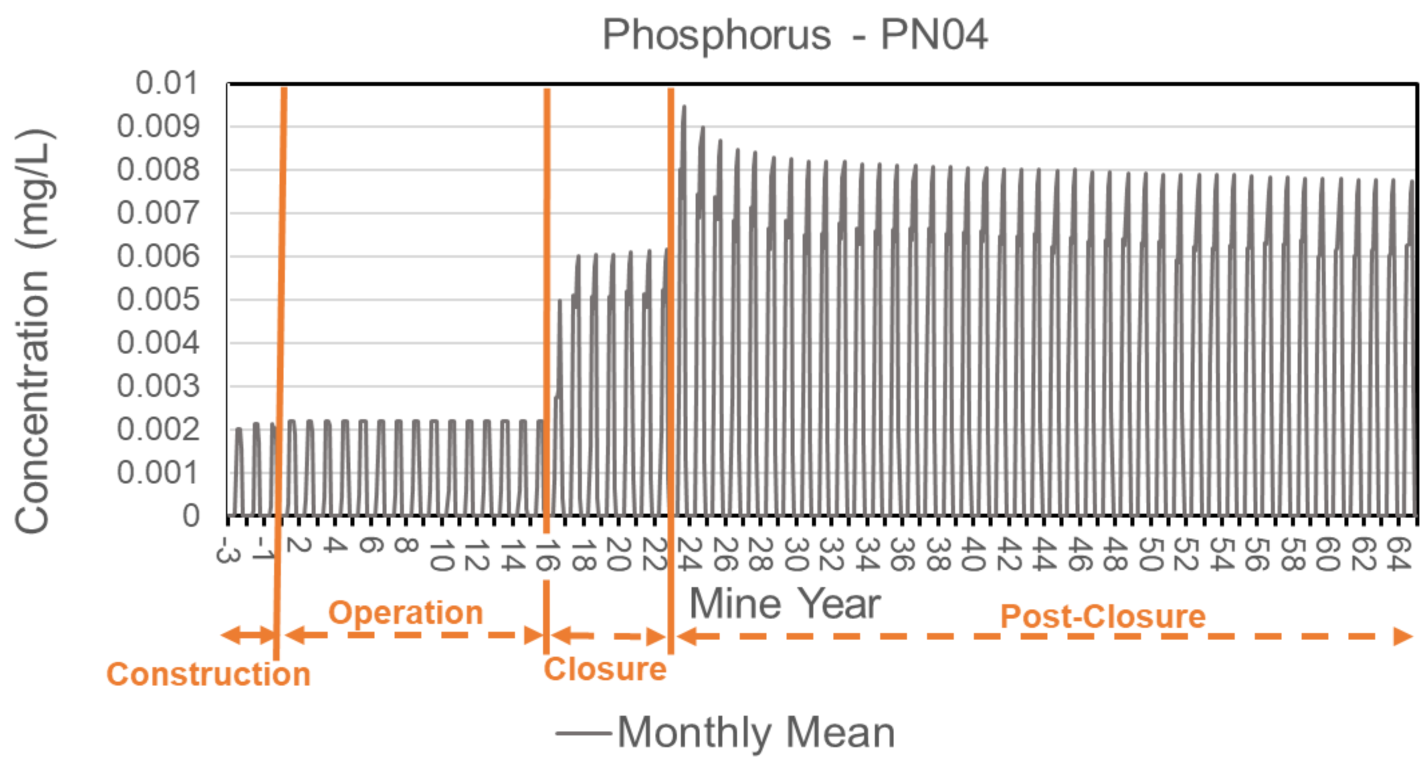

Mercury - PN04
Concentration (mg/L)
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

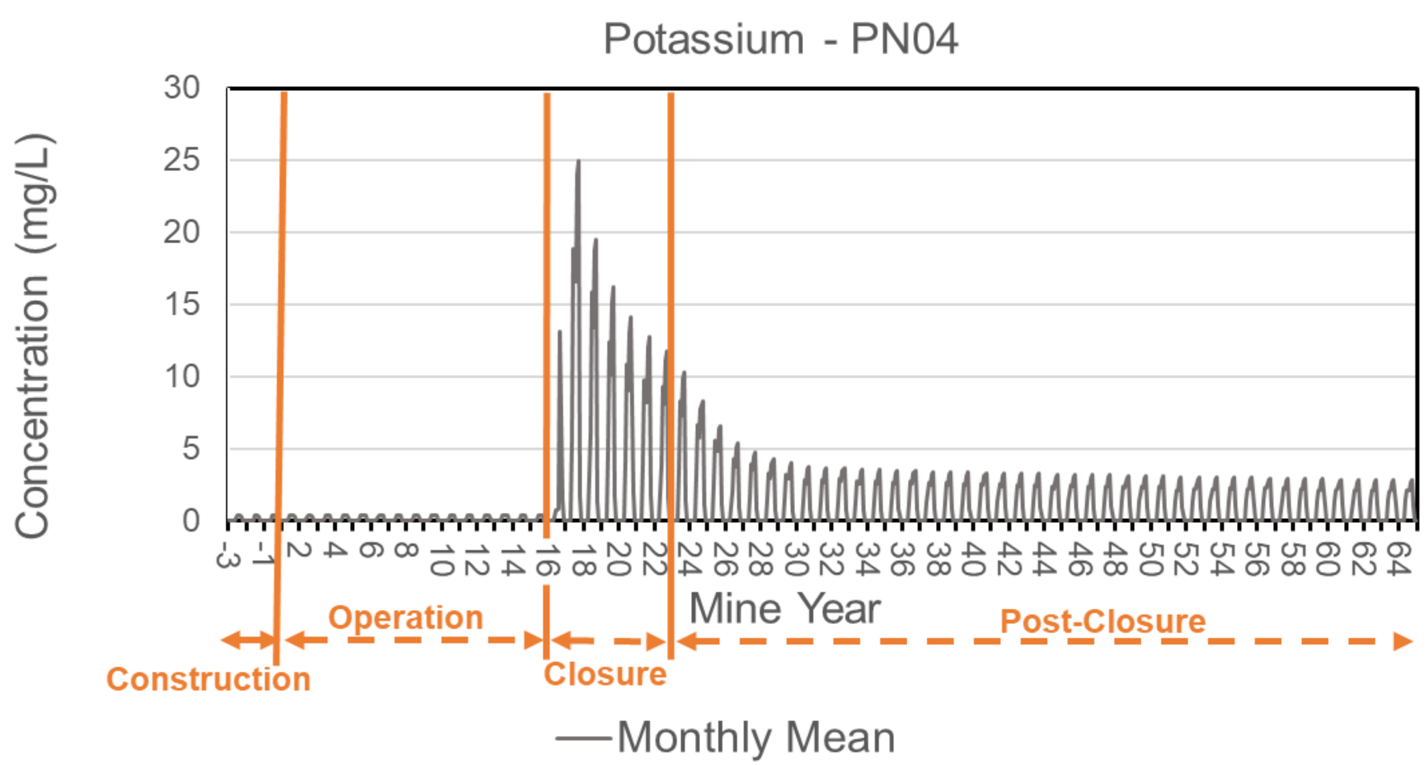


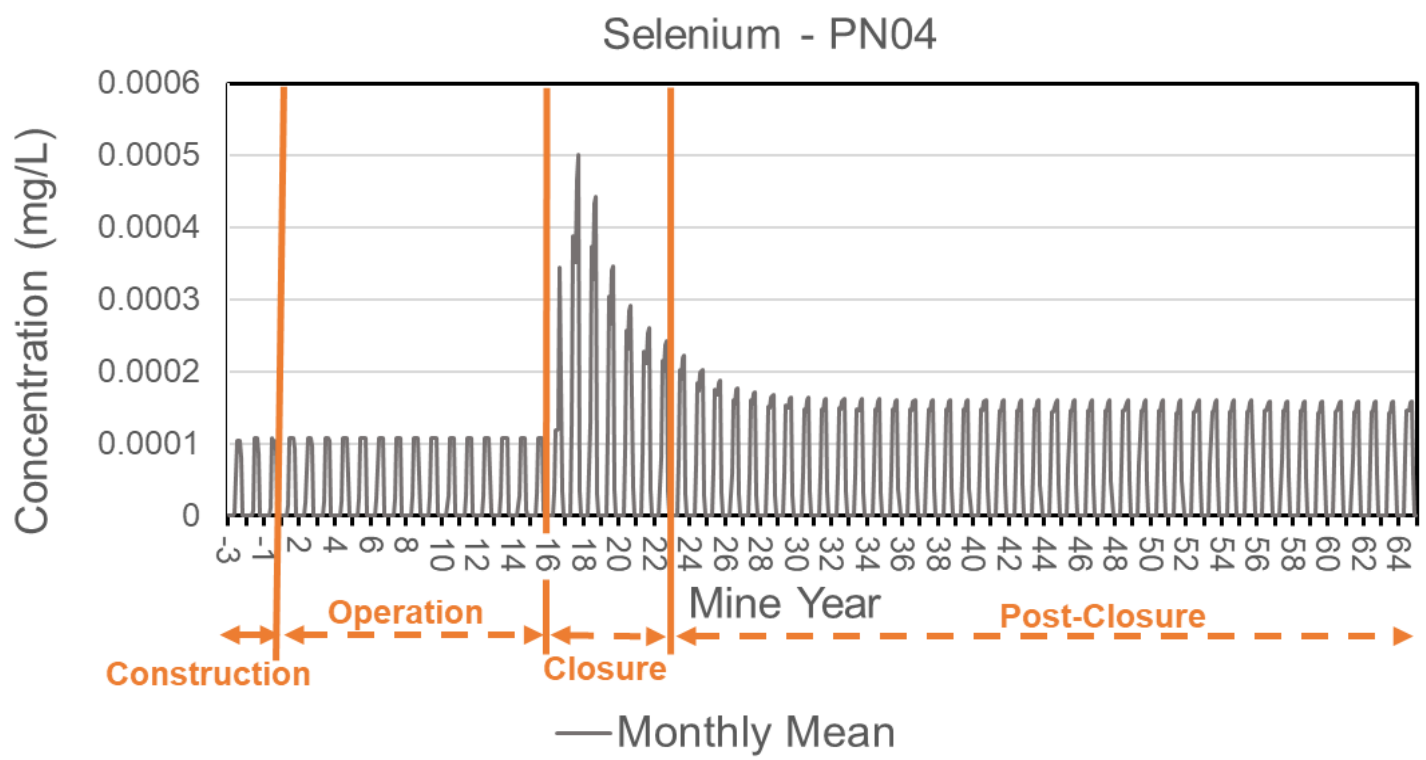
Molybdenum - PN04
Concentration (mg/L)
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



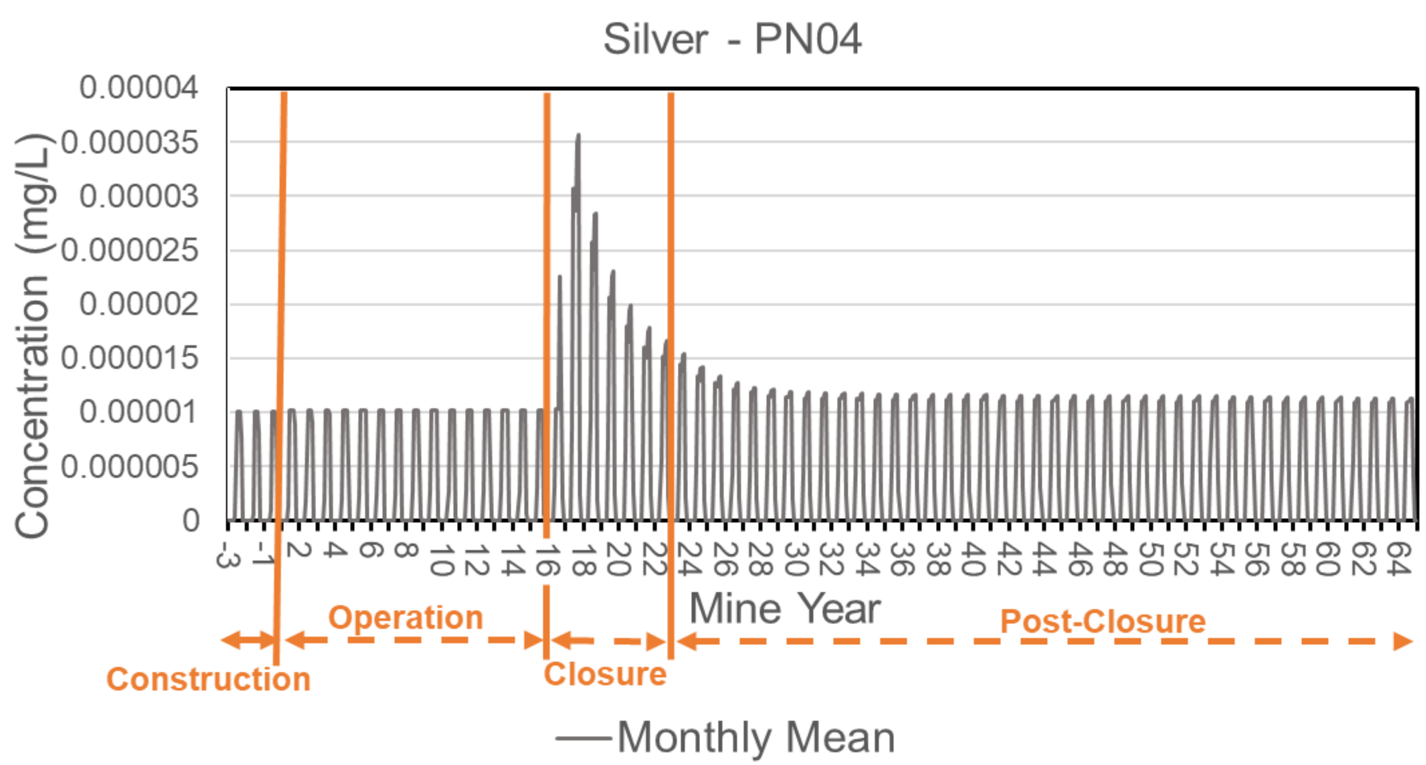
Nitrite - PN04
Concentration (mg-N/L)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Phosphorus - PN04
Concentration (mg/L)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

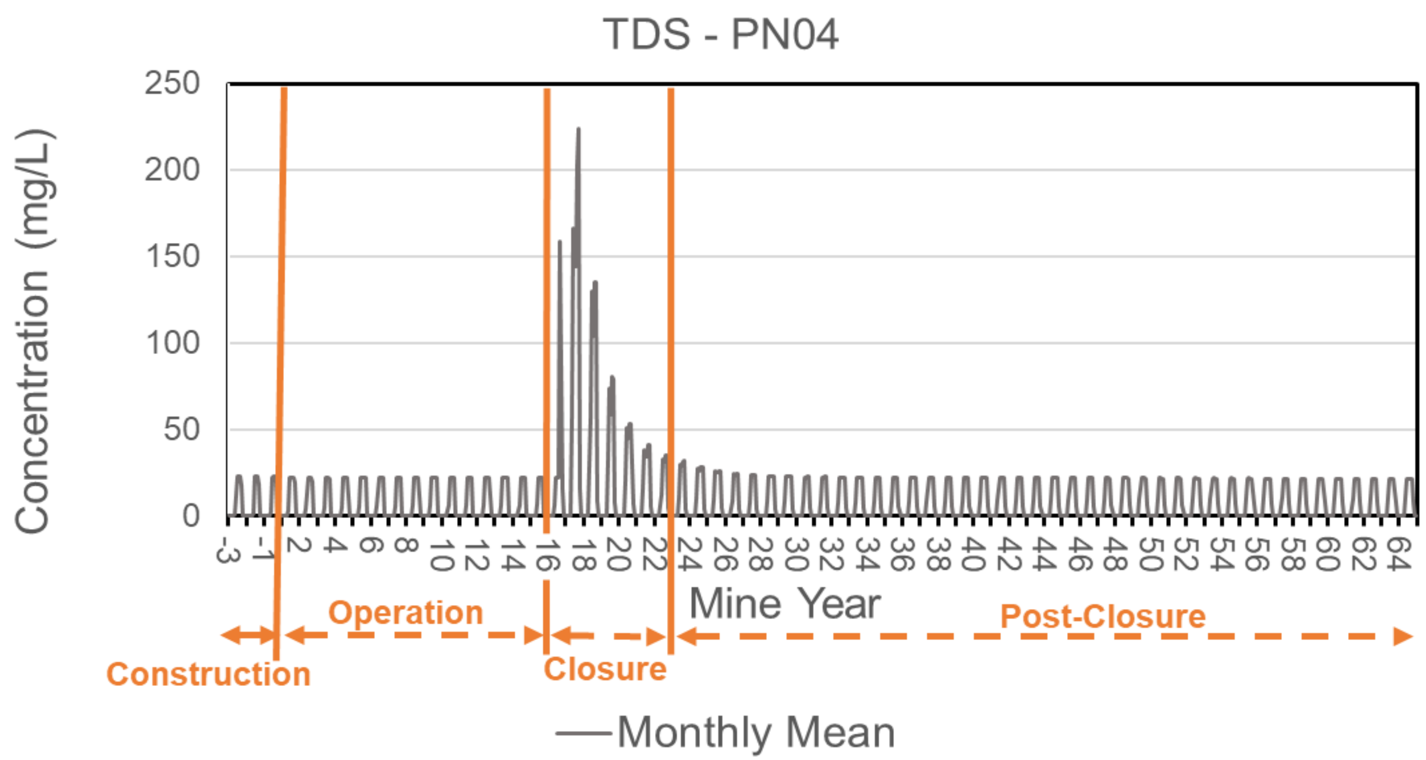

Potassium - PN04
Concentration (mg/L)
30
25
20
15
10
5
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

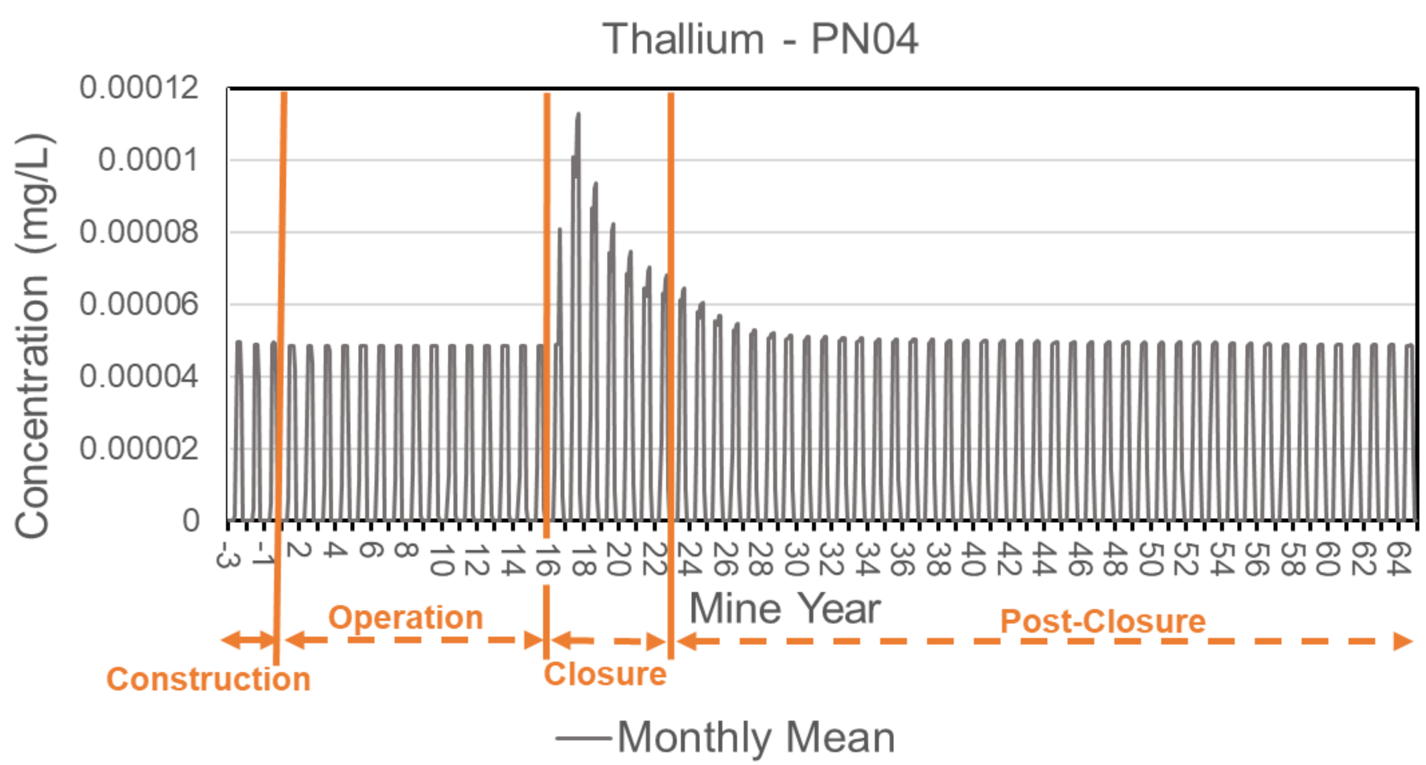


Selenium - PN04
Concentration (mg/L)
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



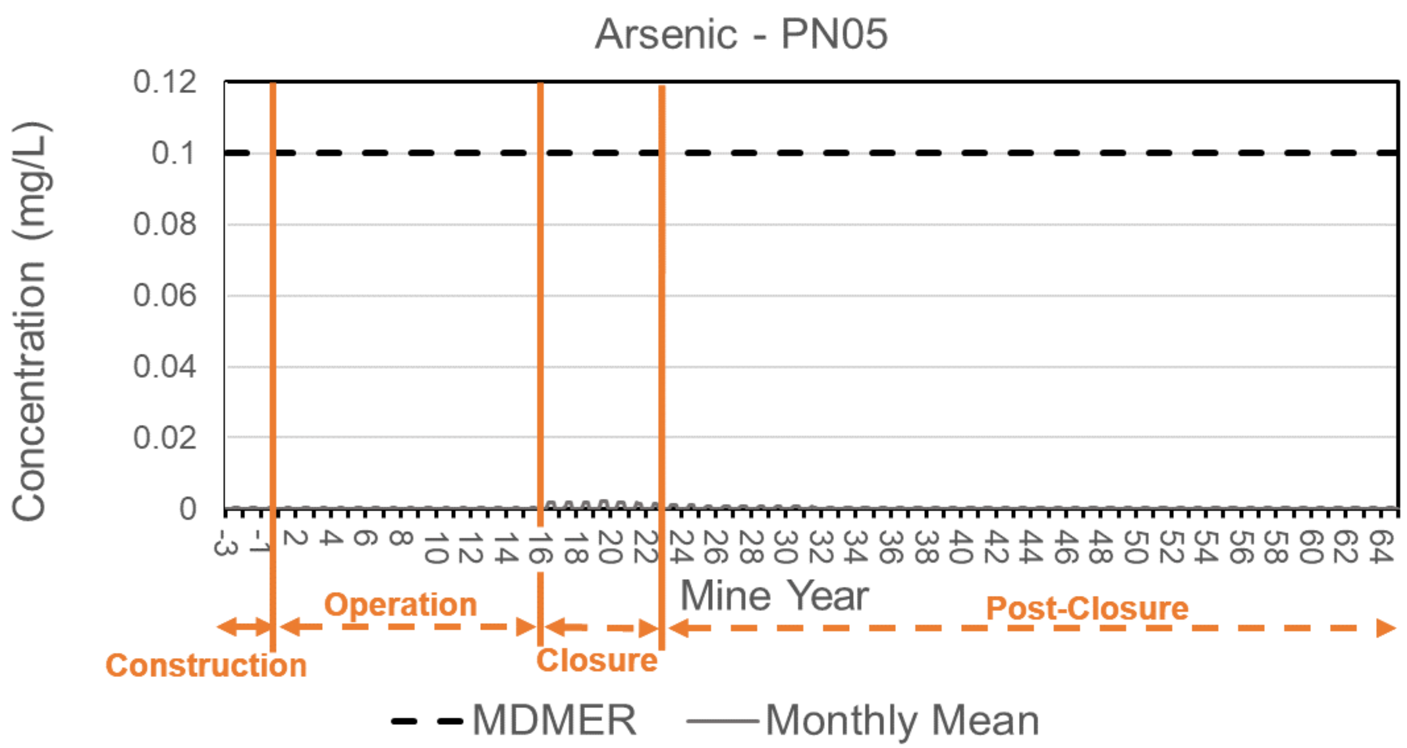
Silver - PN04
Concentration (mg/L)
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

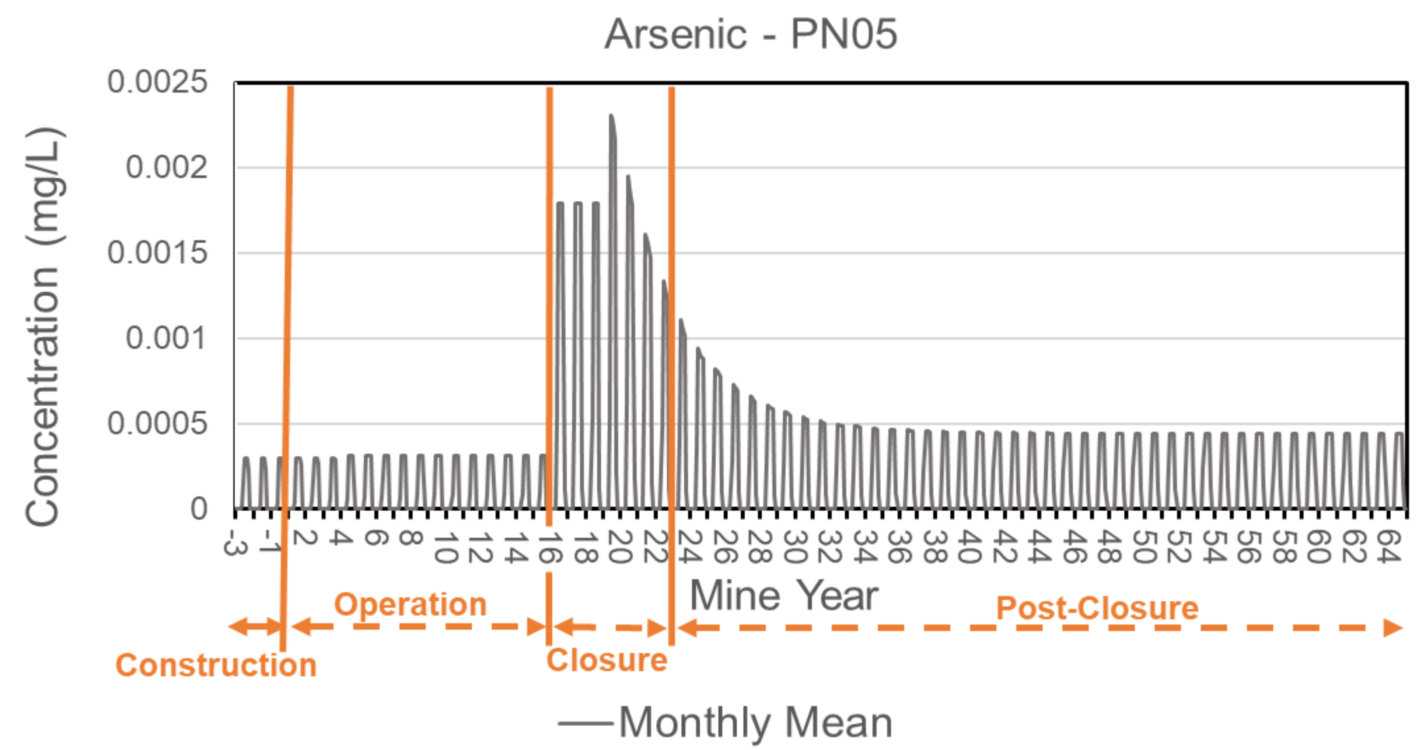


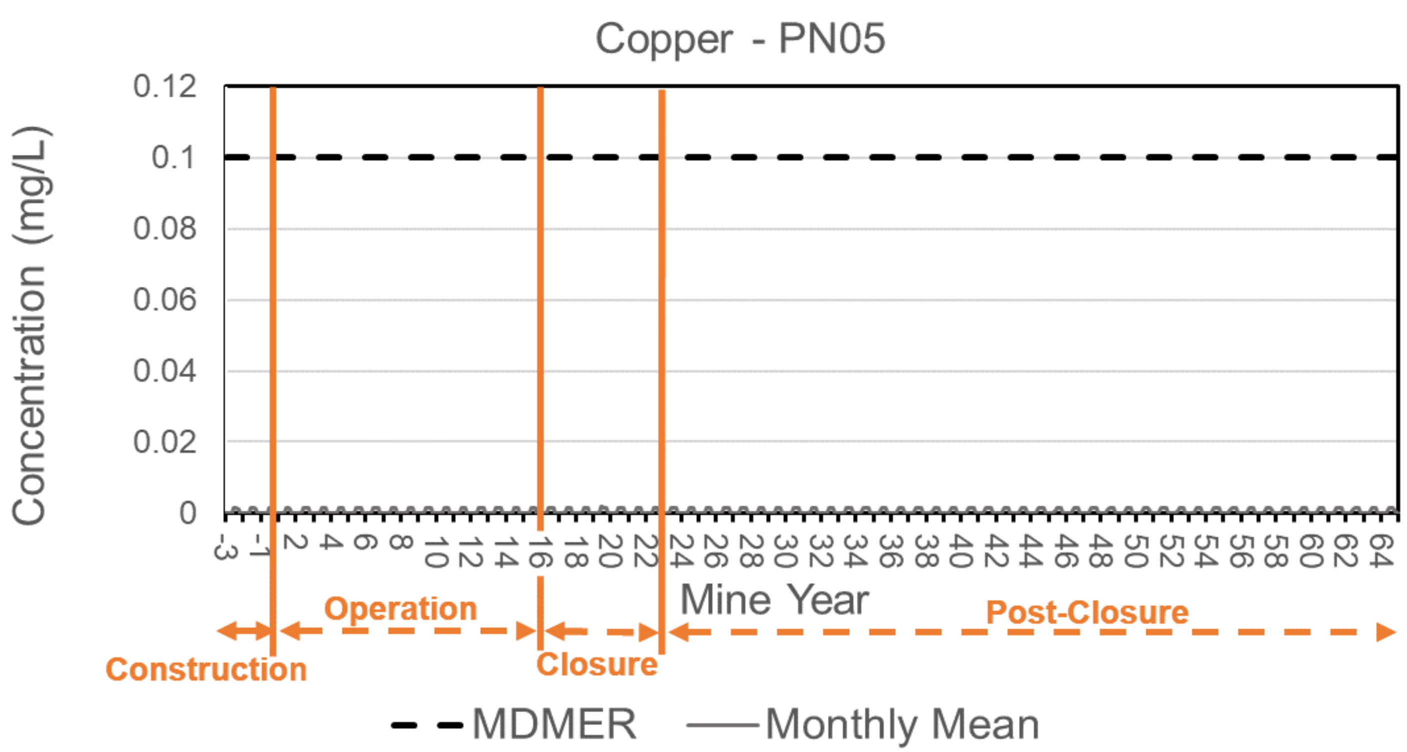


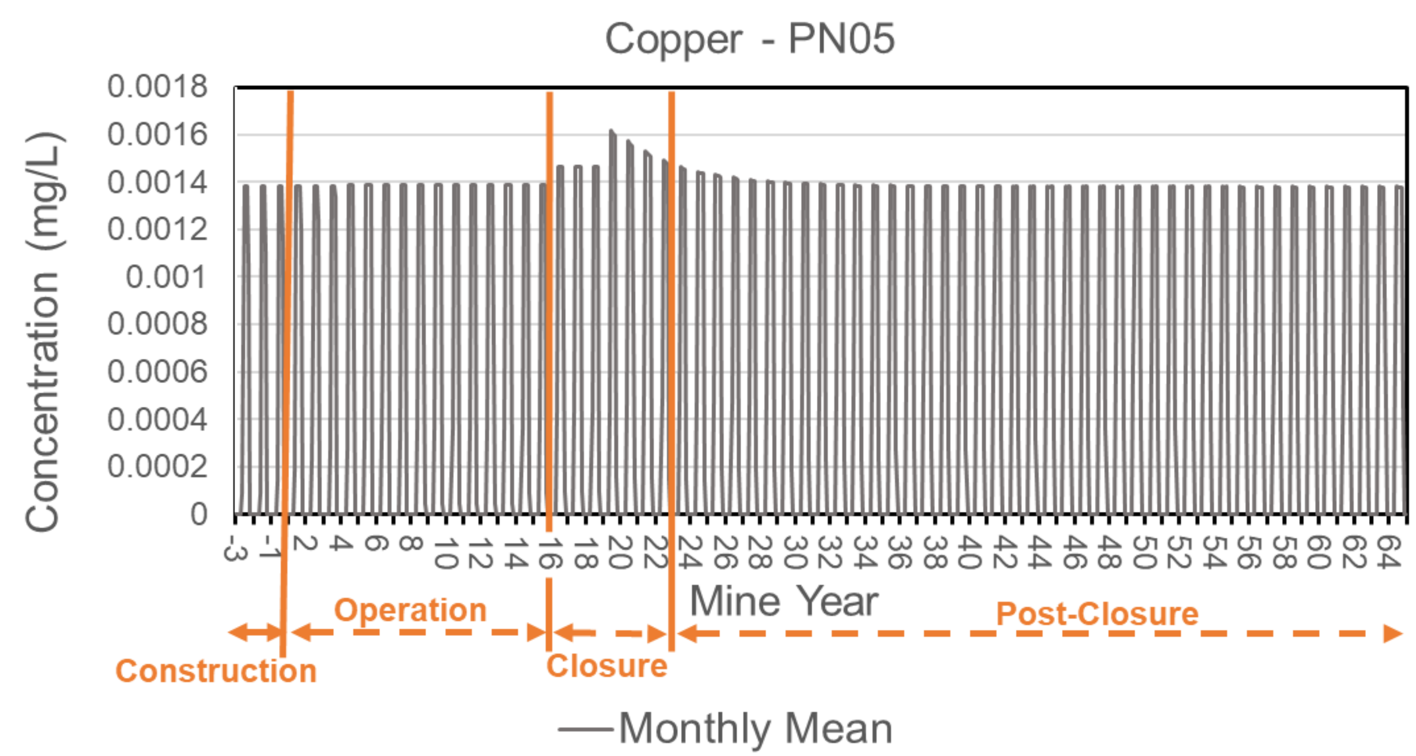
CWQG = Canadian Water Quality Guideline (from CCME 1999)

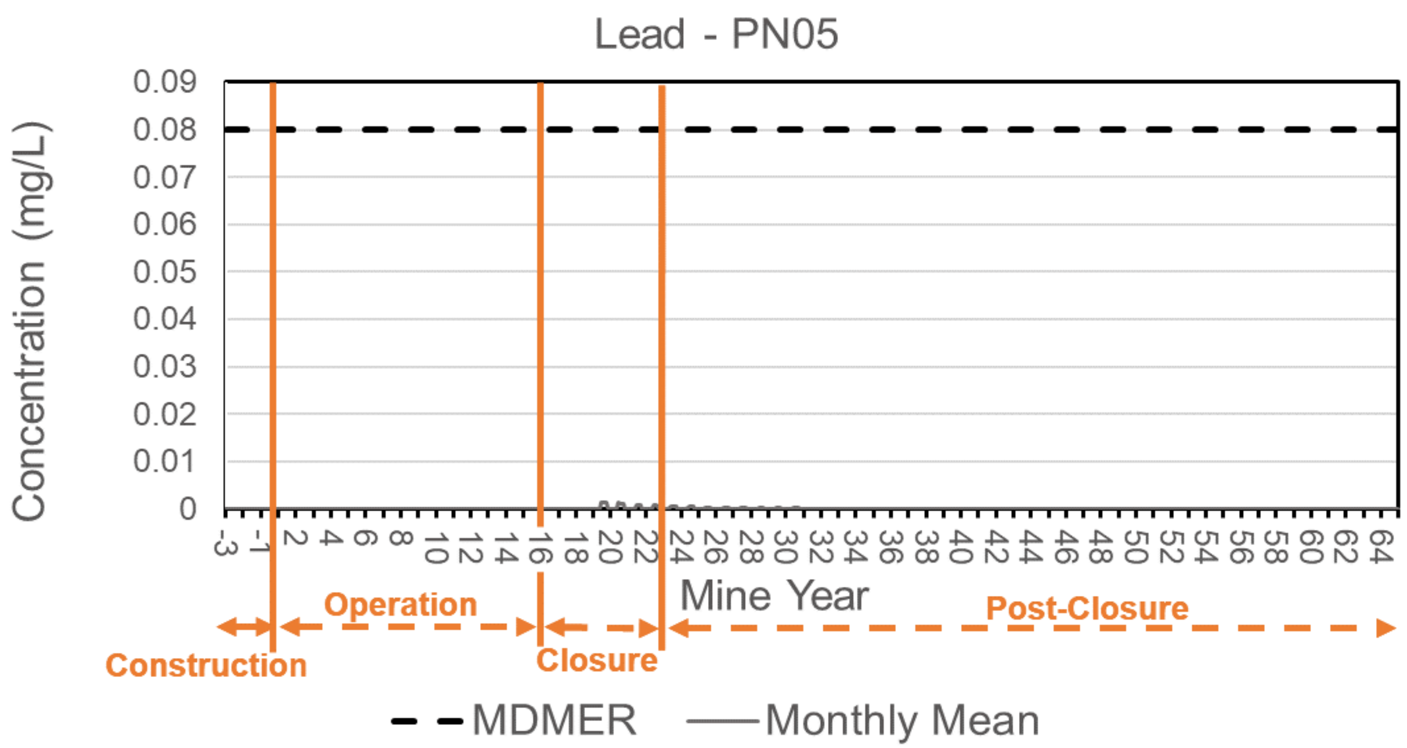
CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2019. Winnipeg, MB, Canada.

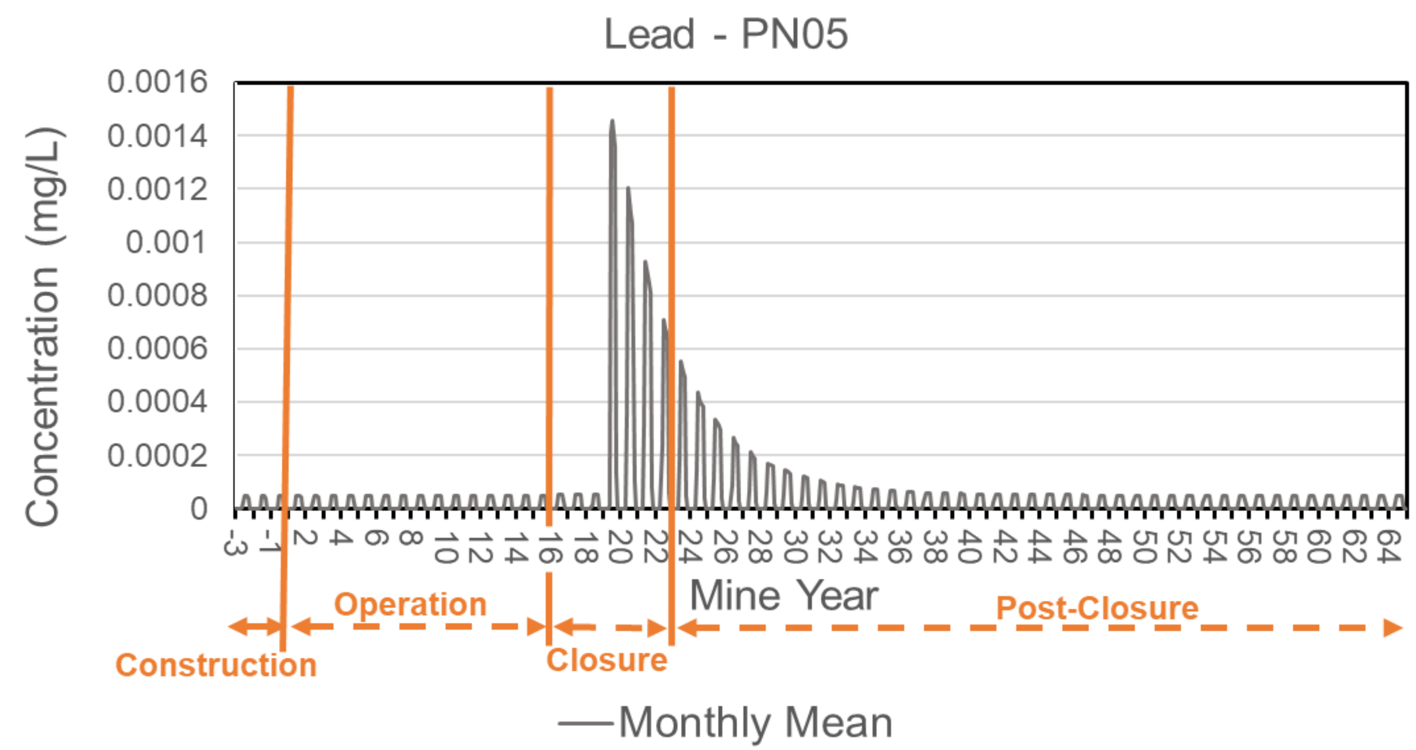

Arsenic - PN05
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

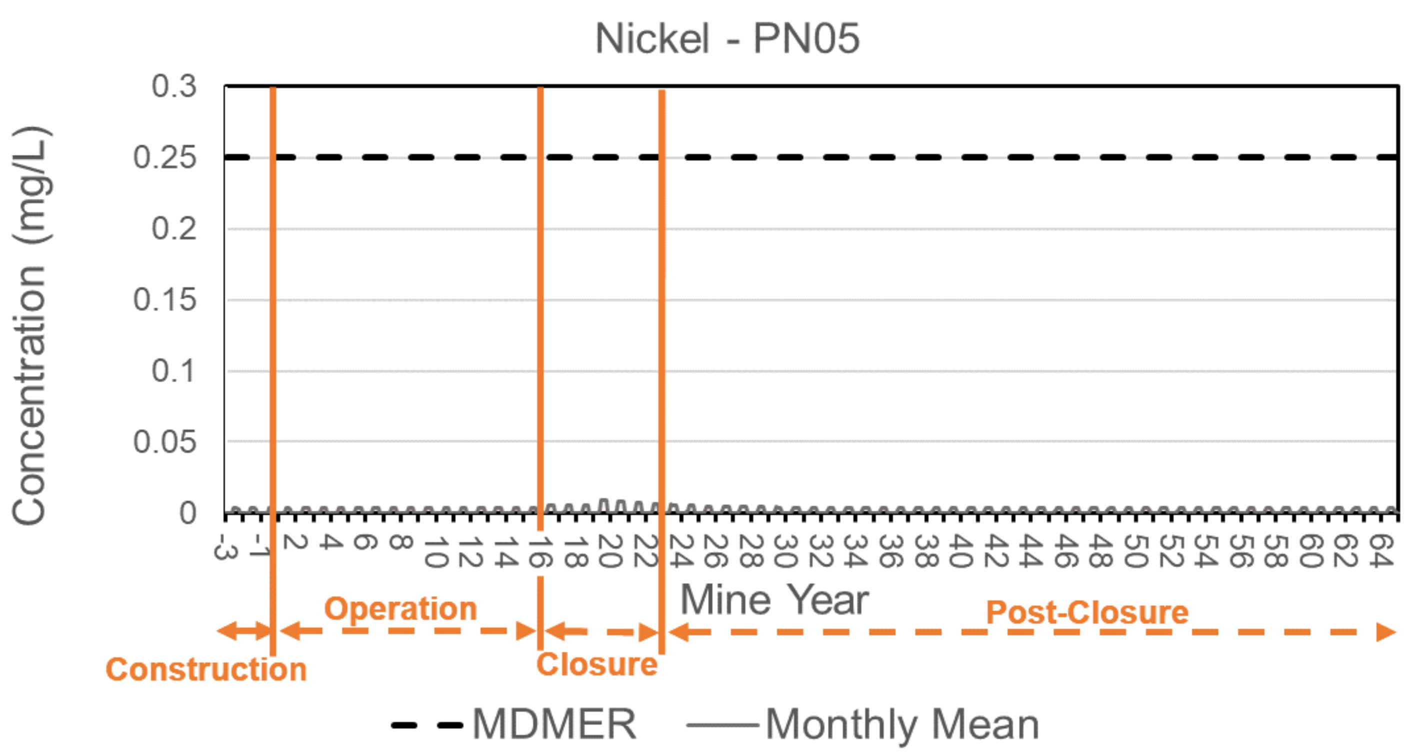

Arsenic - PN05
Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

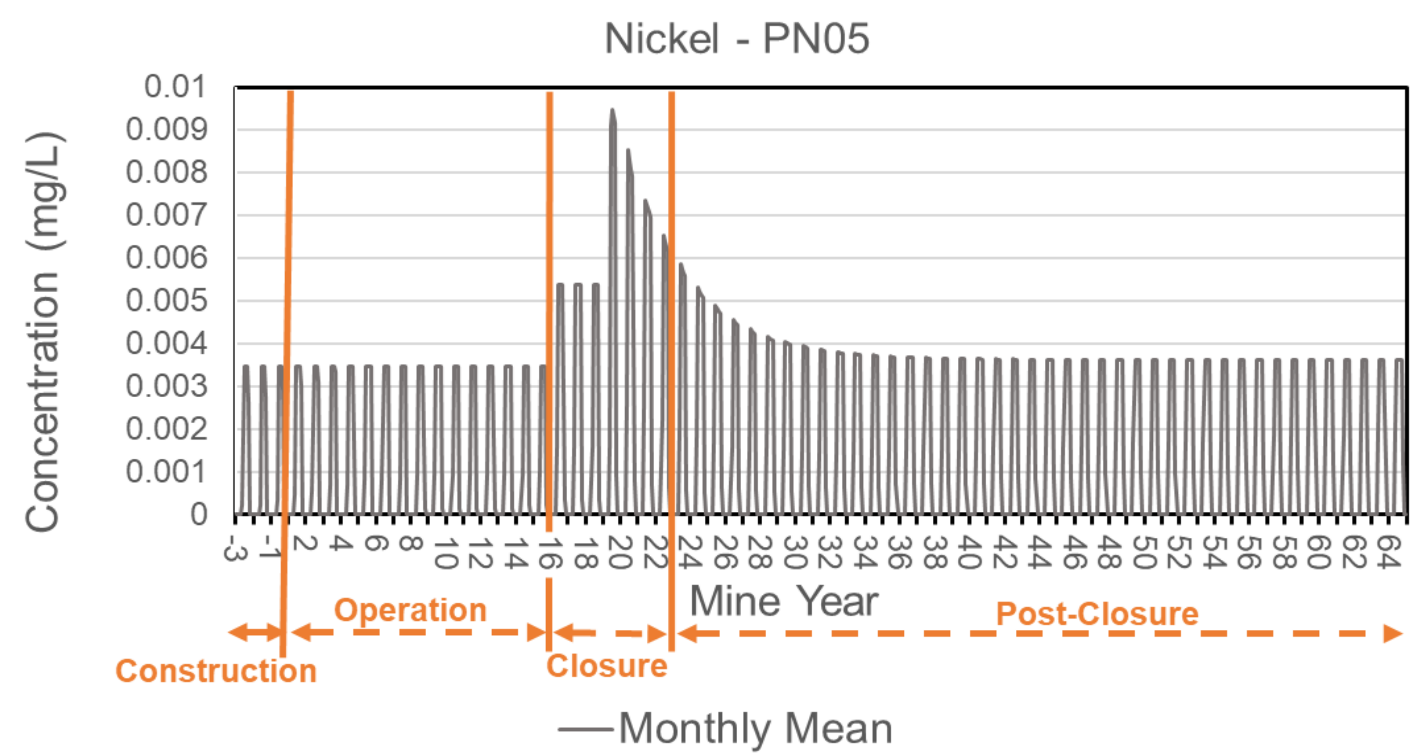

Copper - PN05
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

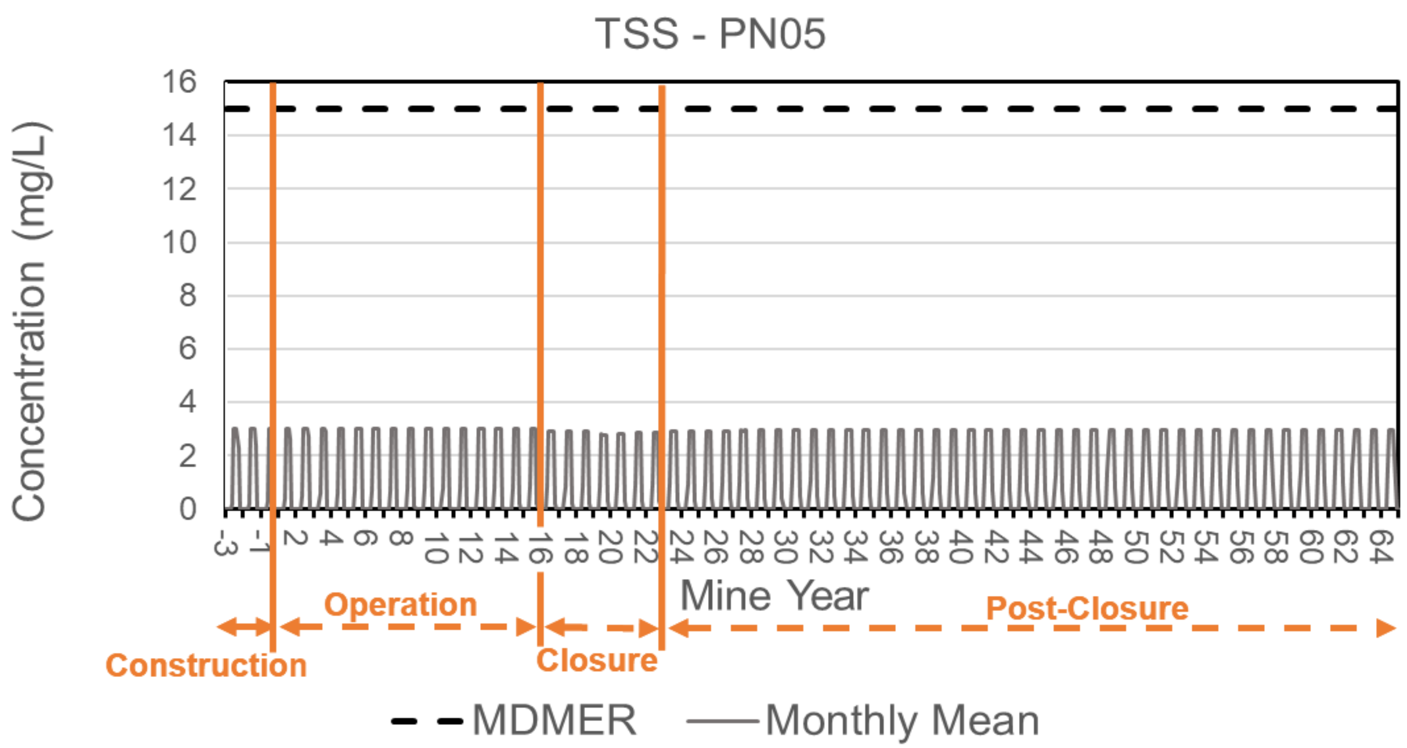

Copper - PN05
Concentration (mg/L)
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

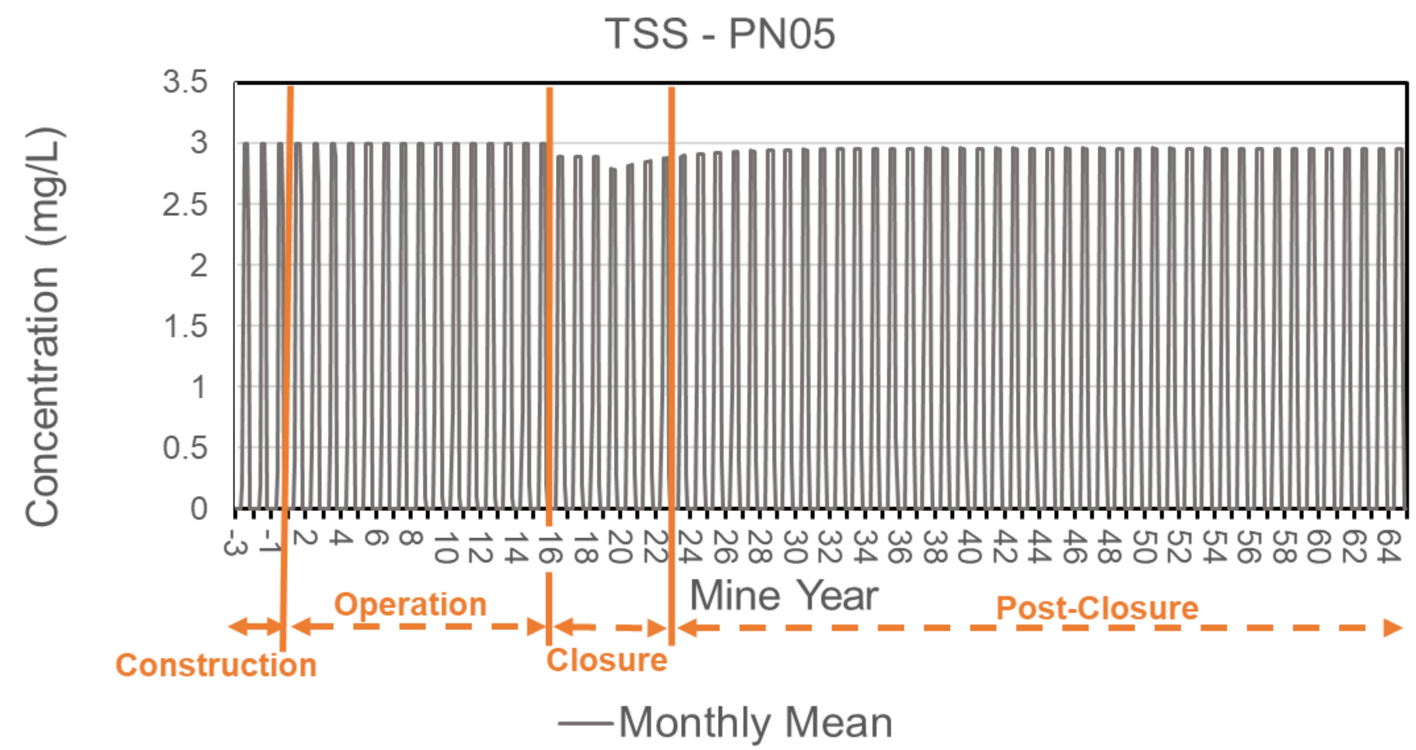

Lead - PN05
Concentration (mg/L)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

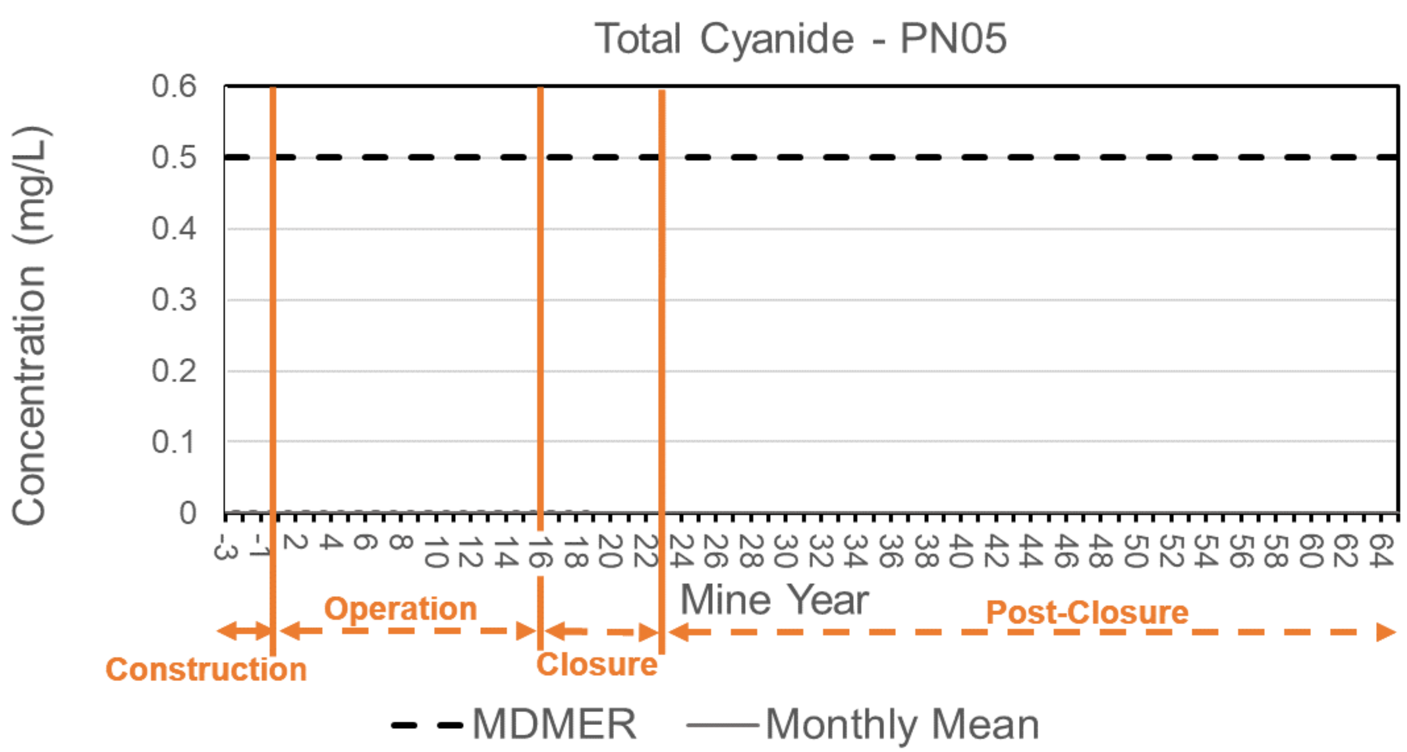

Lead - PN05
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

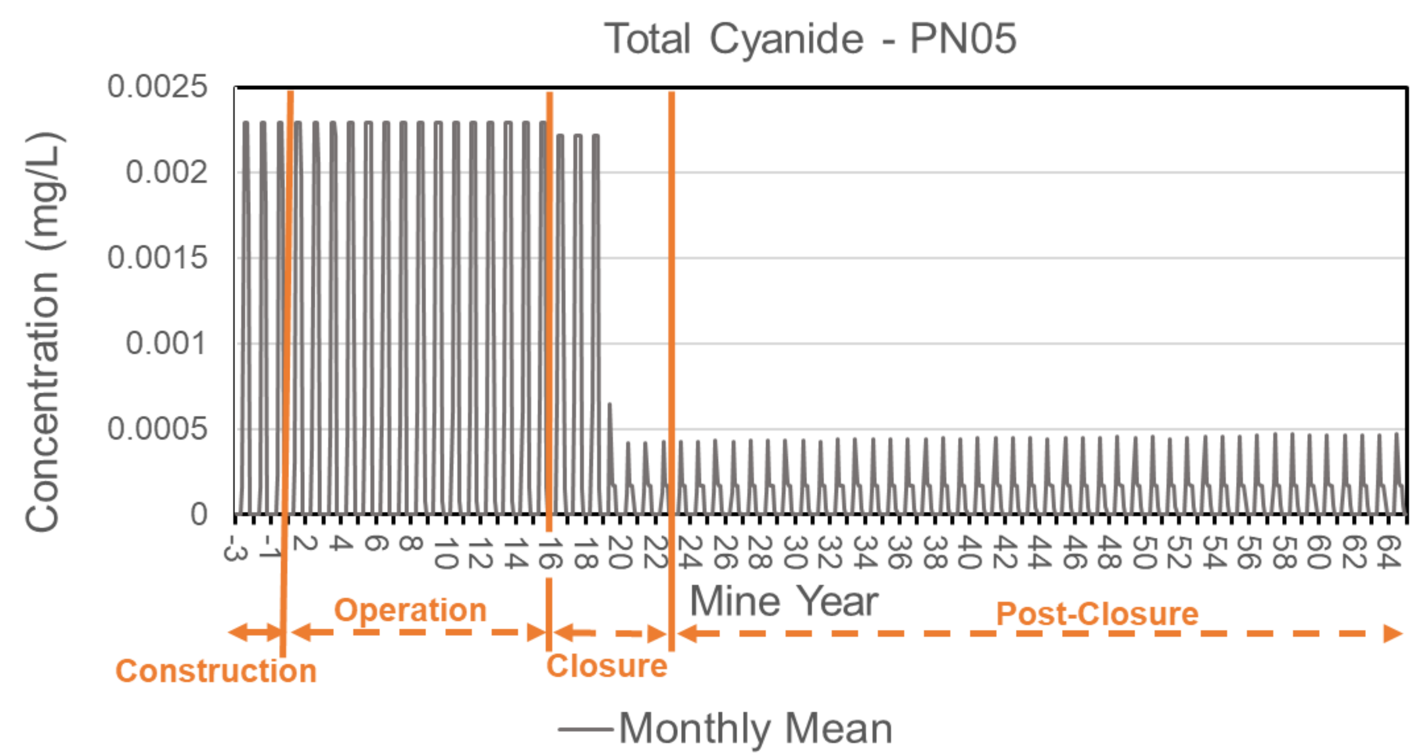

Nickel - PN05
Concentration (mg/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

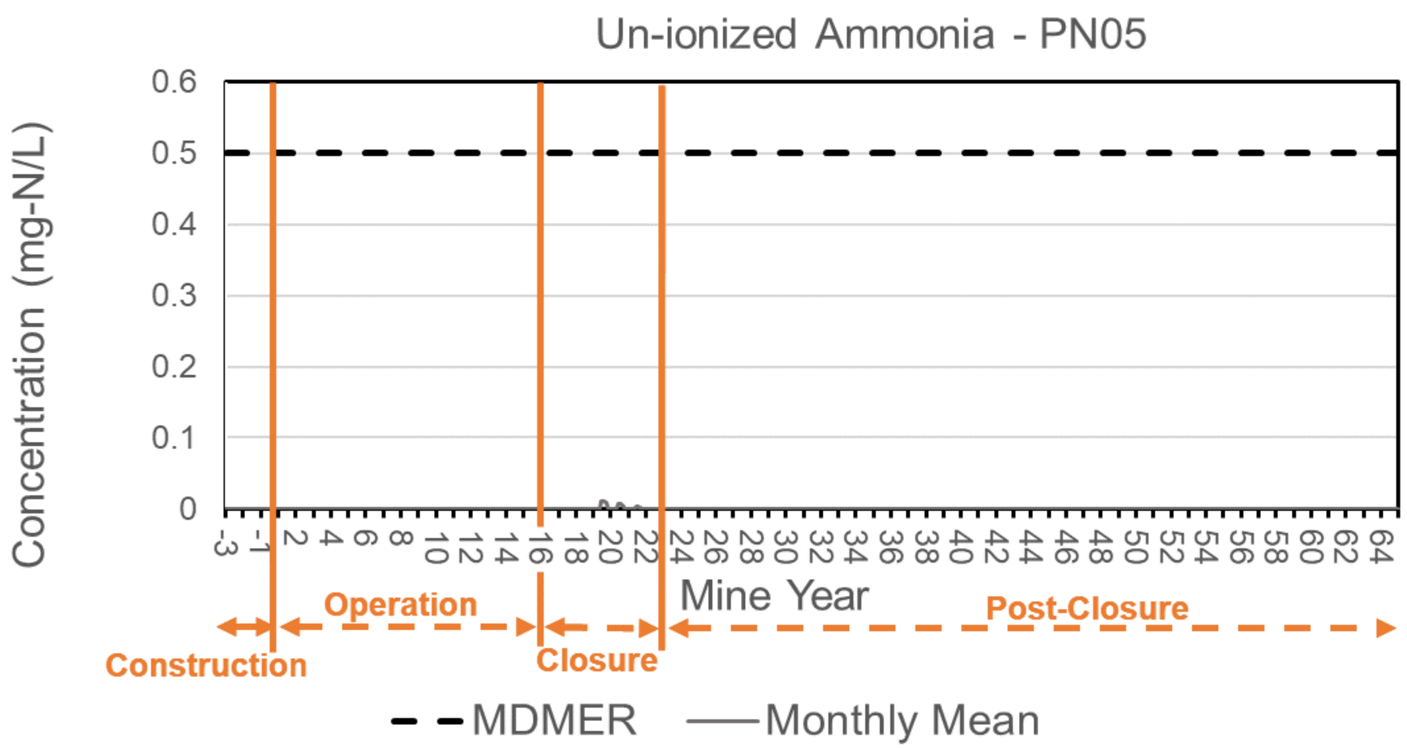

Nickel - PN05
Concentration (mg/L)
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

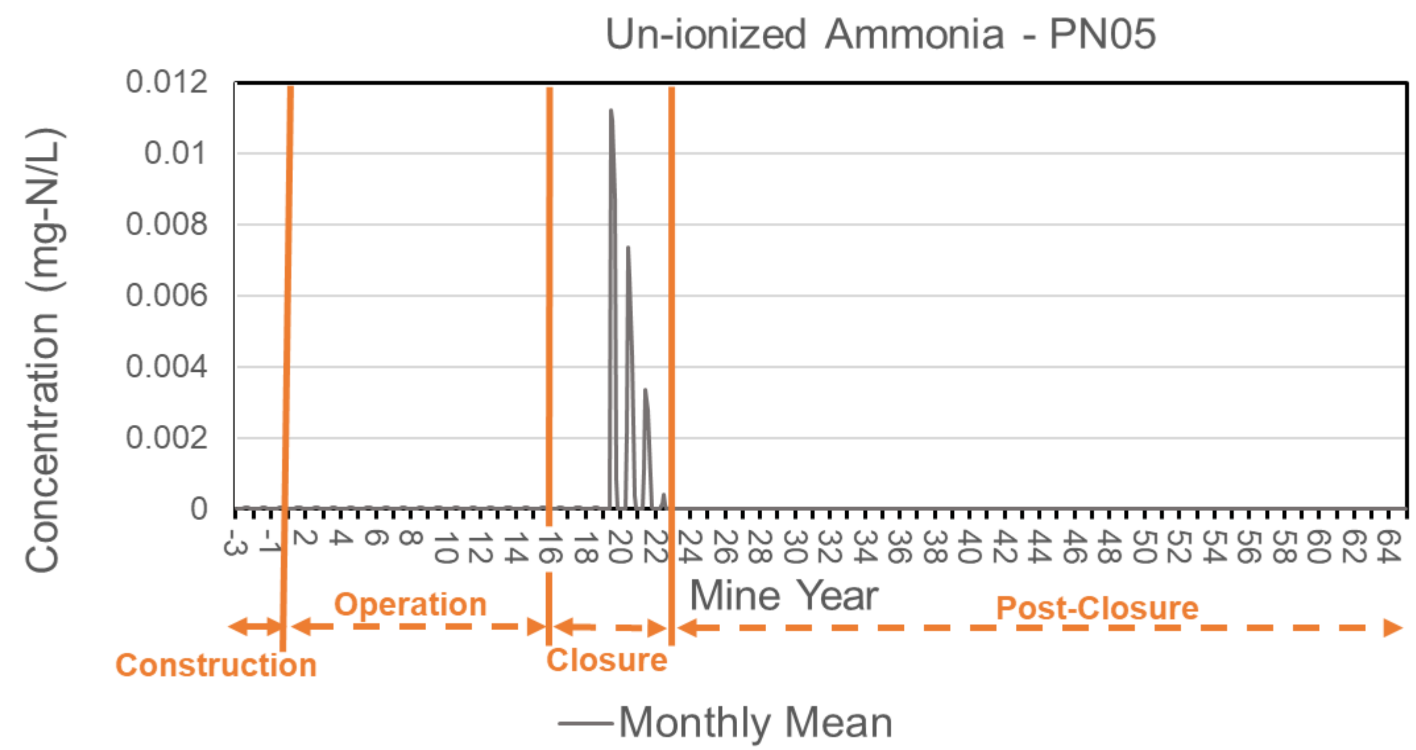

TSS - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

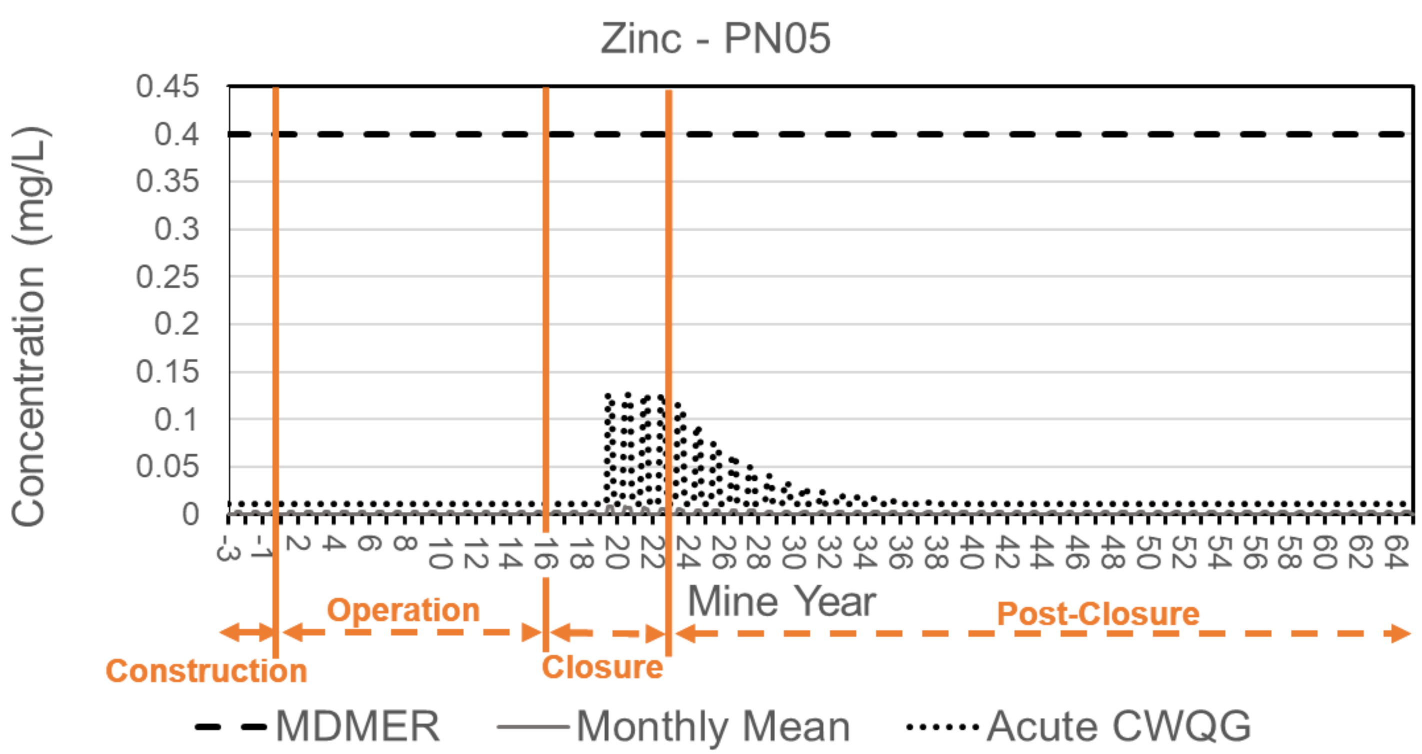

TSS - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

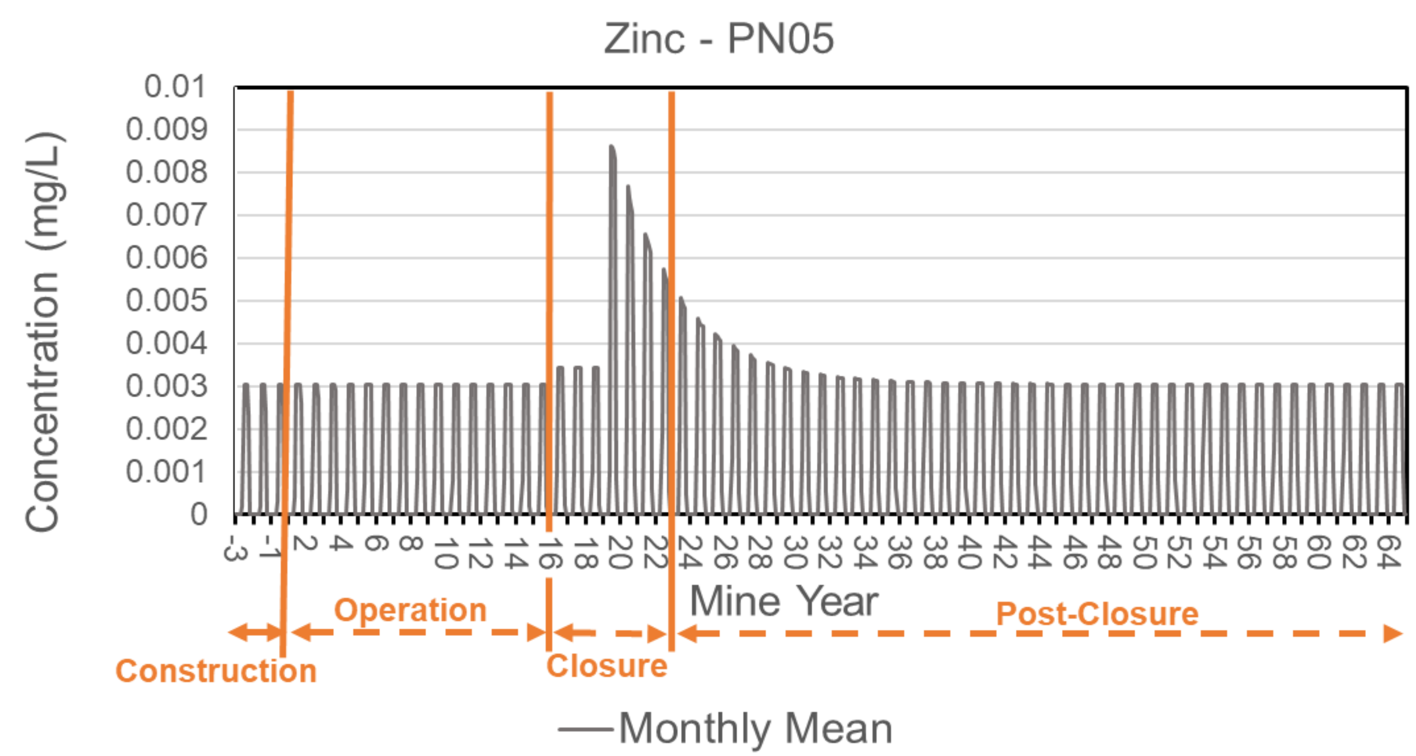

Total Cyanide - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

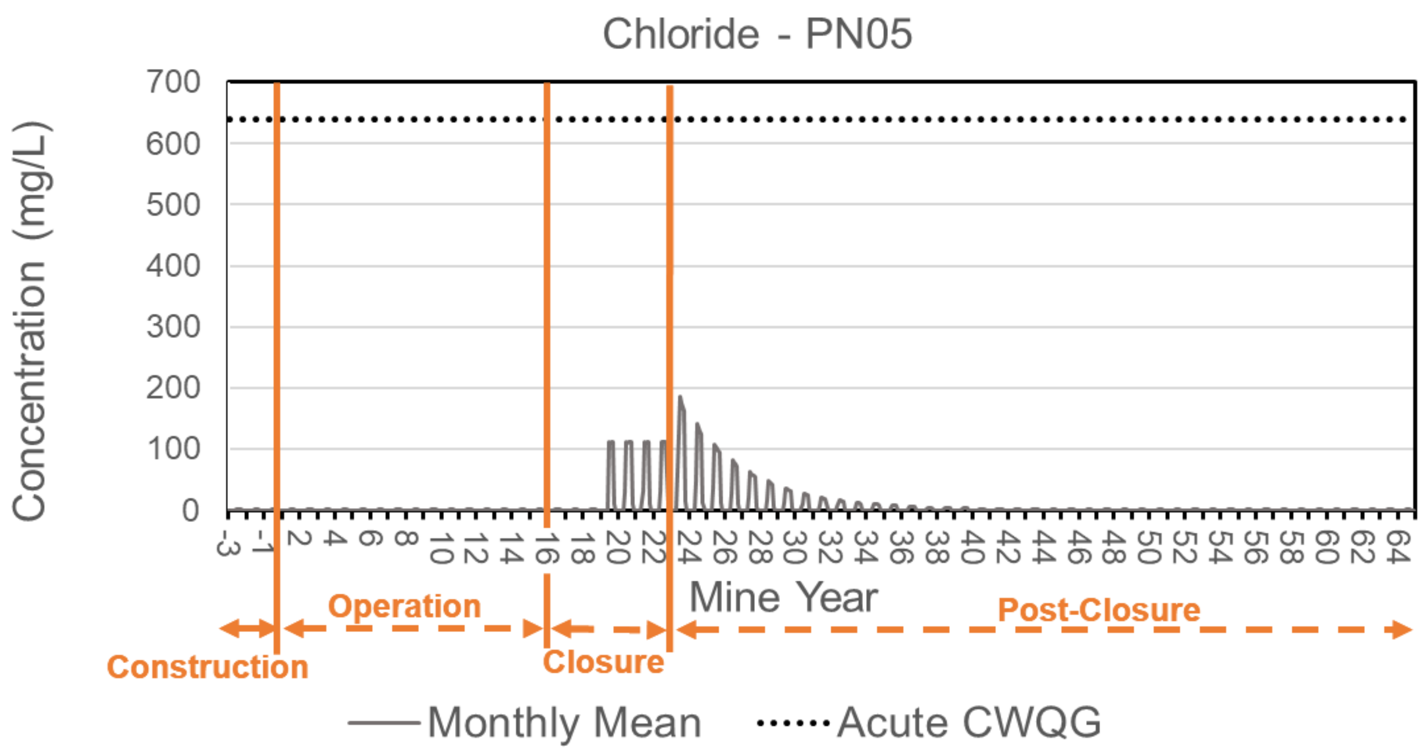

Total Cyanide - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

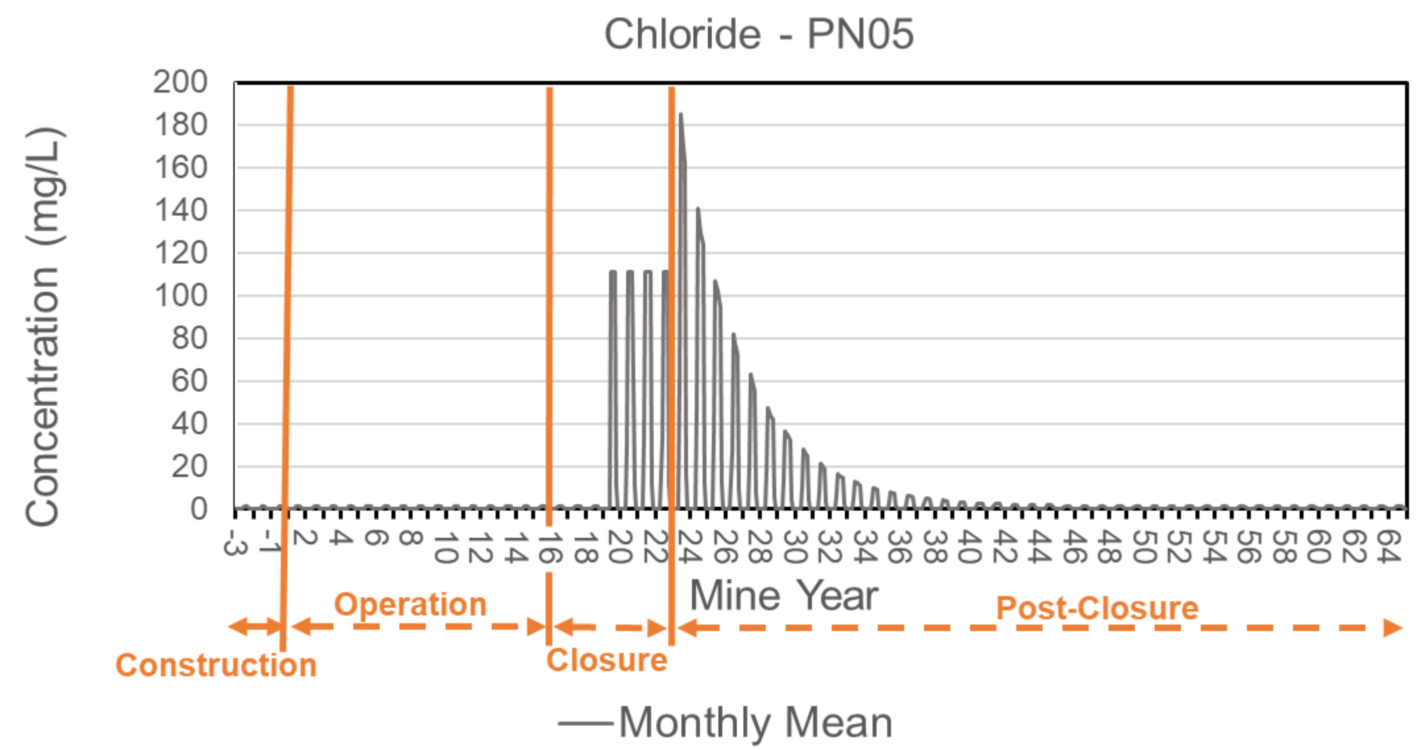

Un-ionized Ammonia - PN05
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

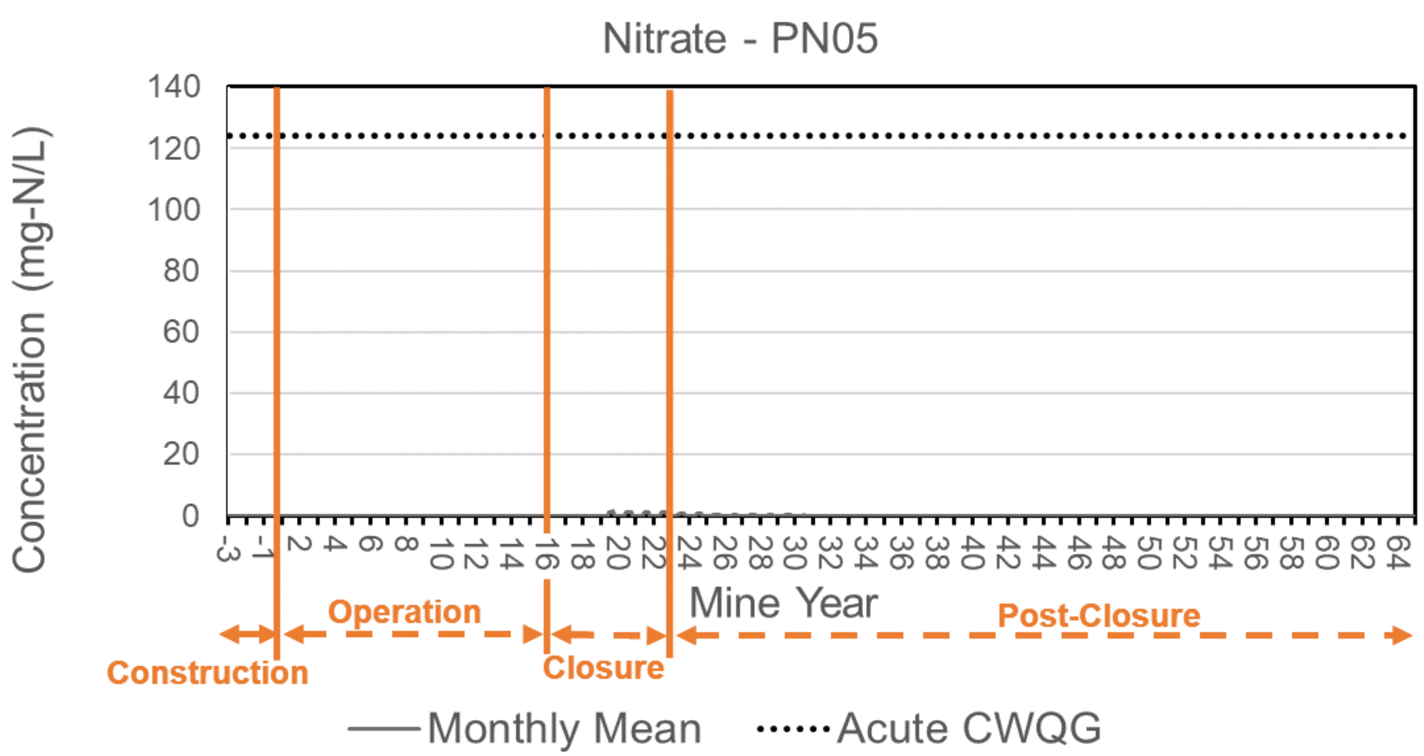

Un-ionized Ammonia - PN05
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

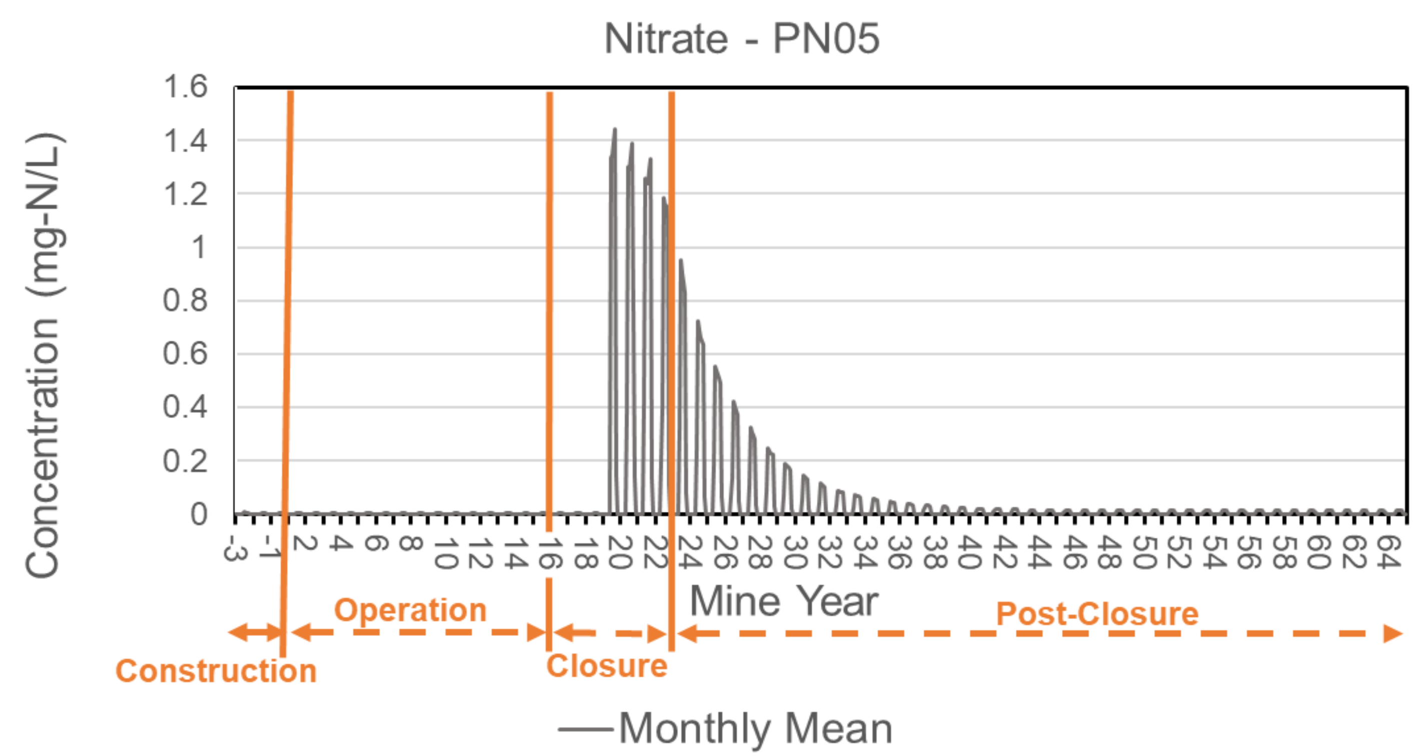

Zinc - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Acute CWQG

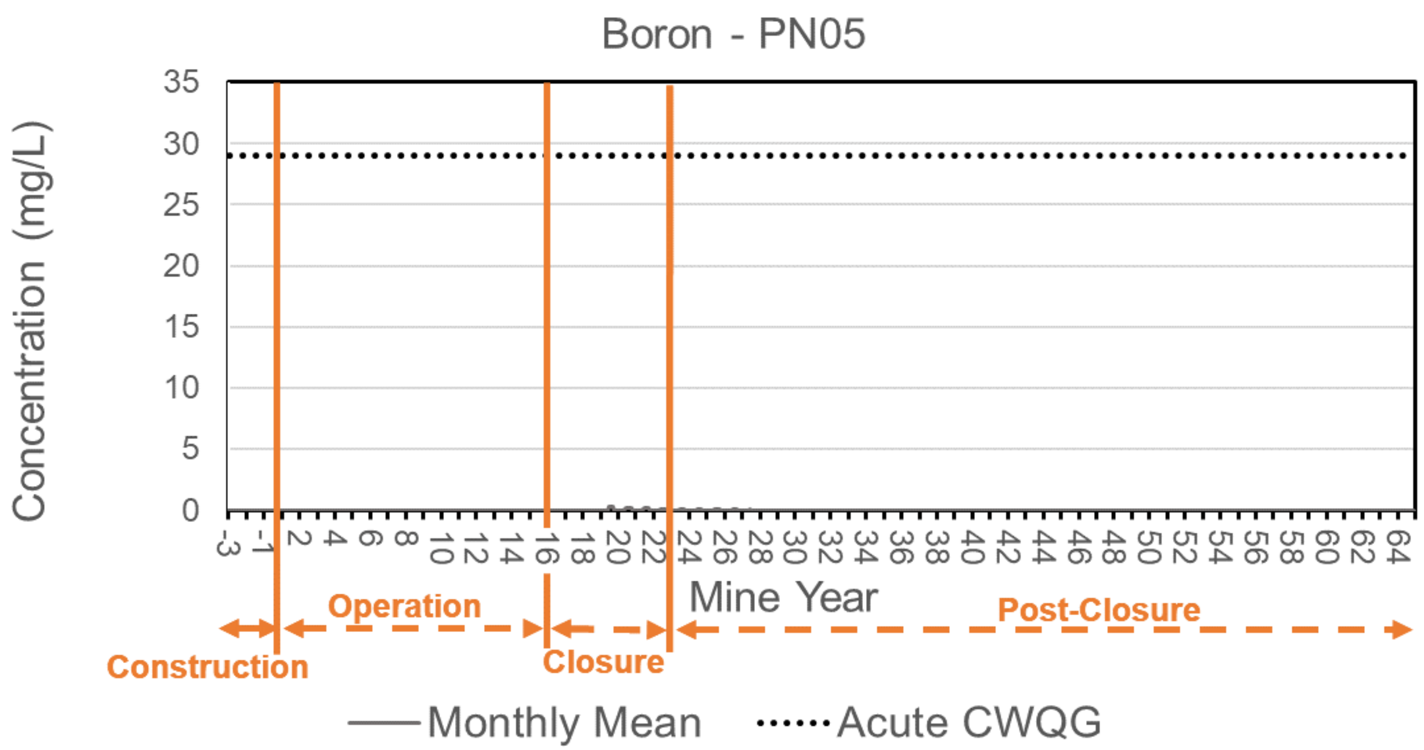

Zinc - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

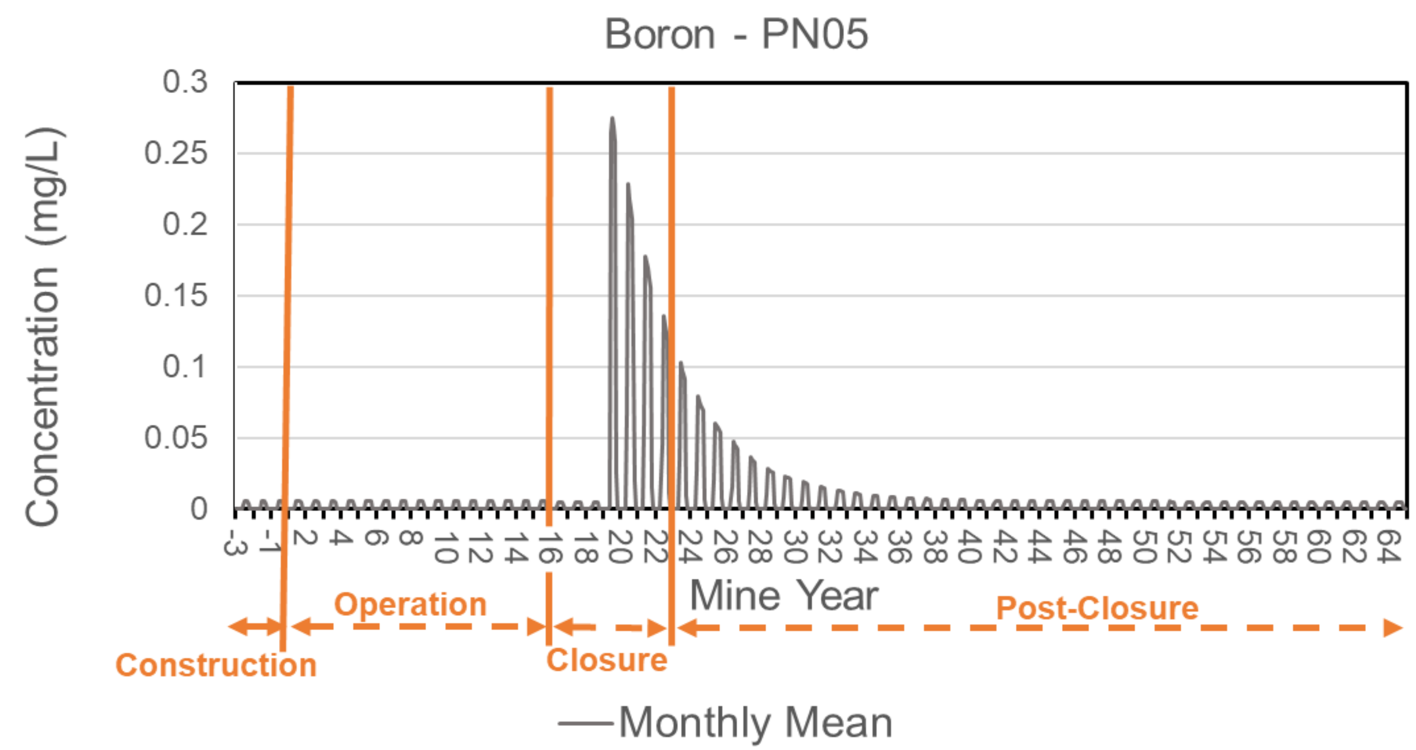

Chloride - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

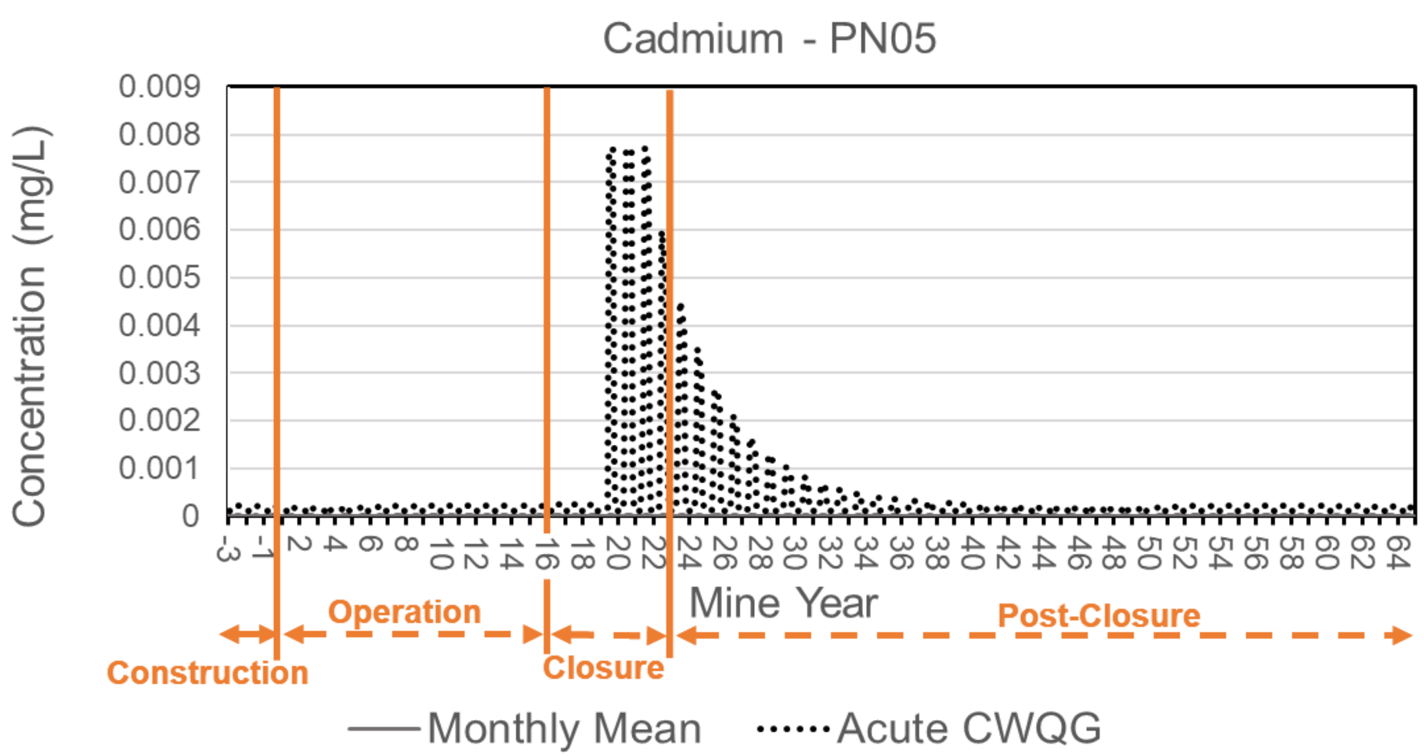

Chloride - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

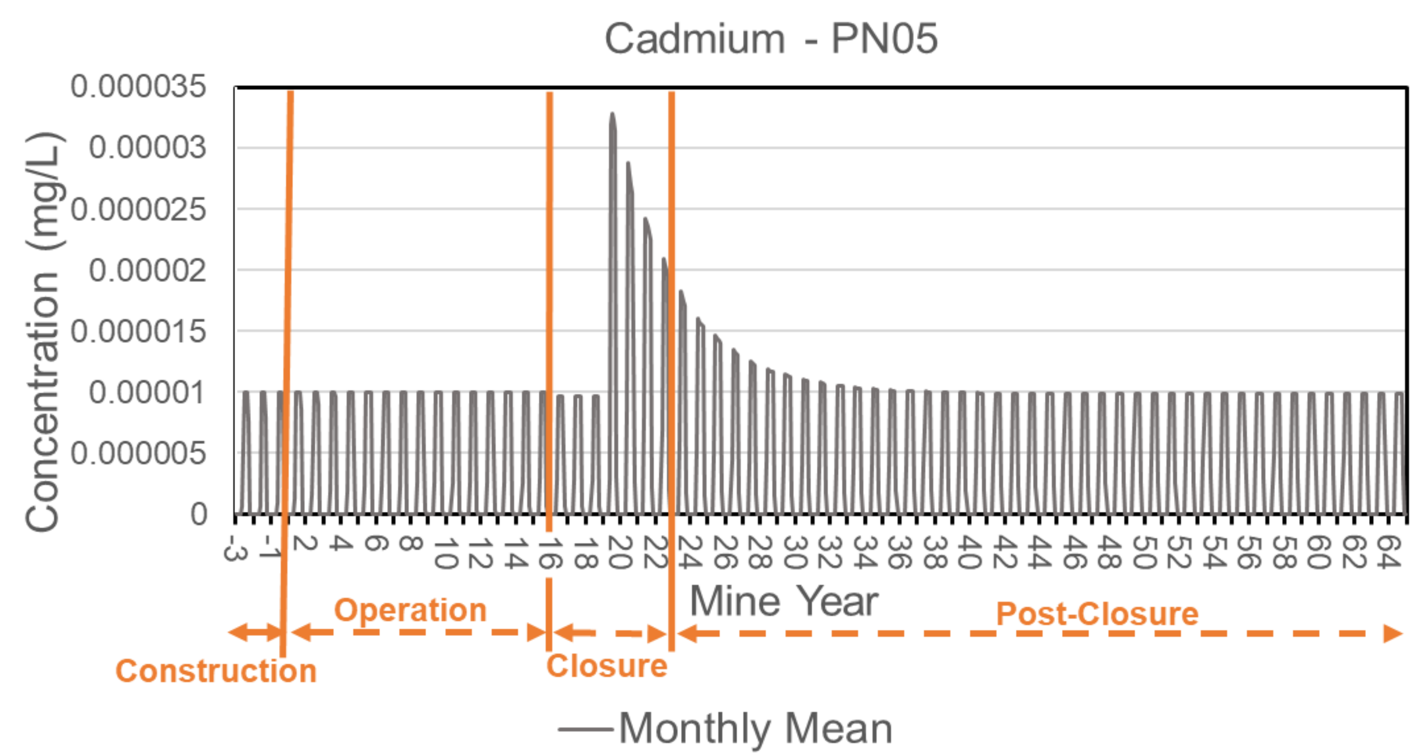

Nitrate - PN05
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

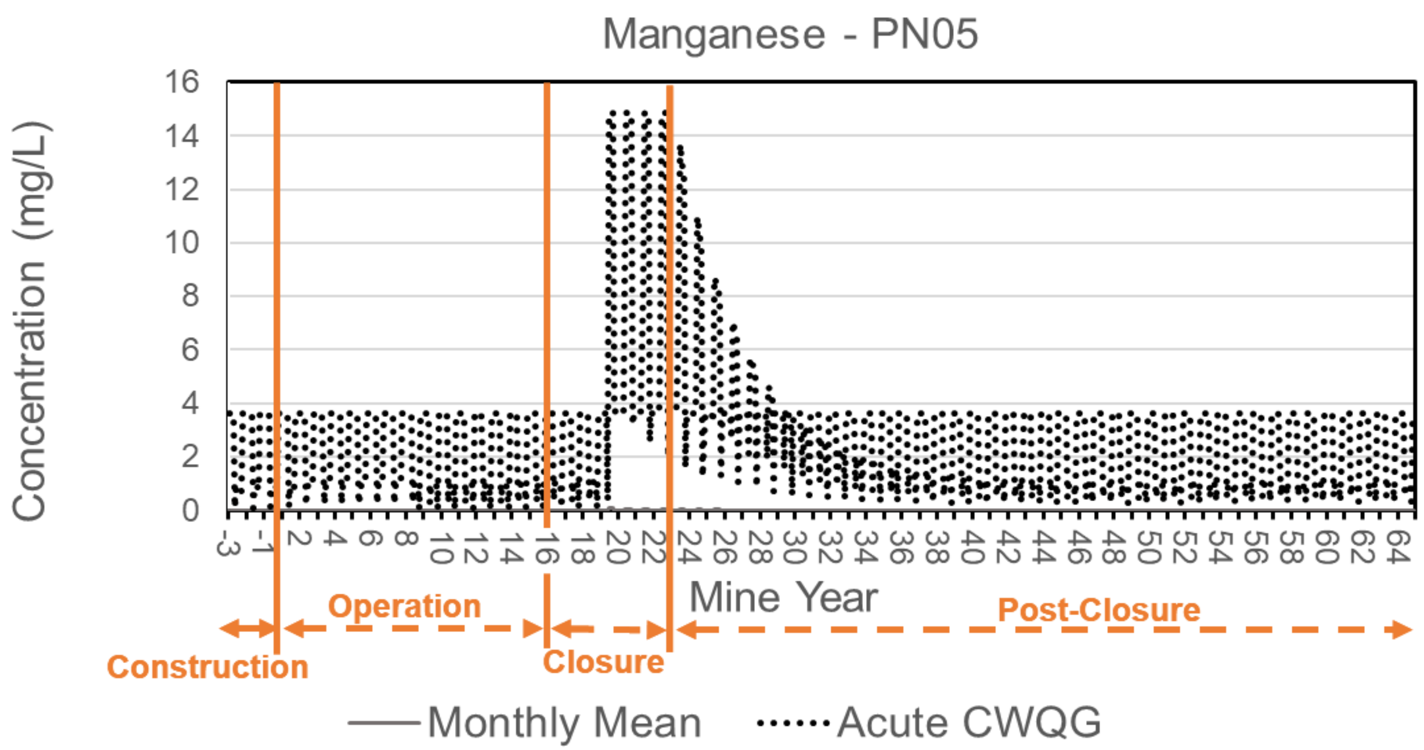

Nitrate - PN05
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Boron - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

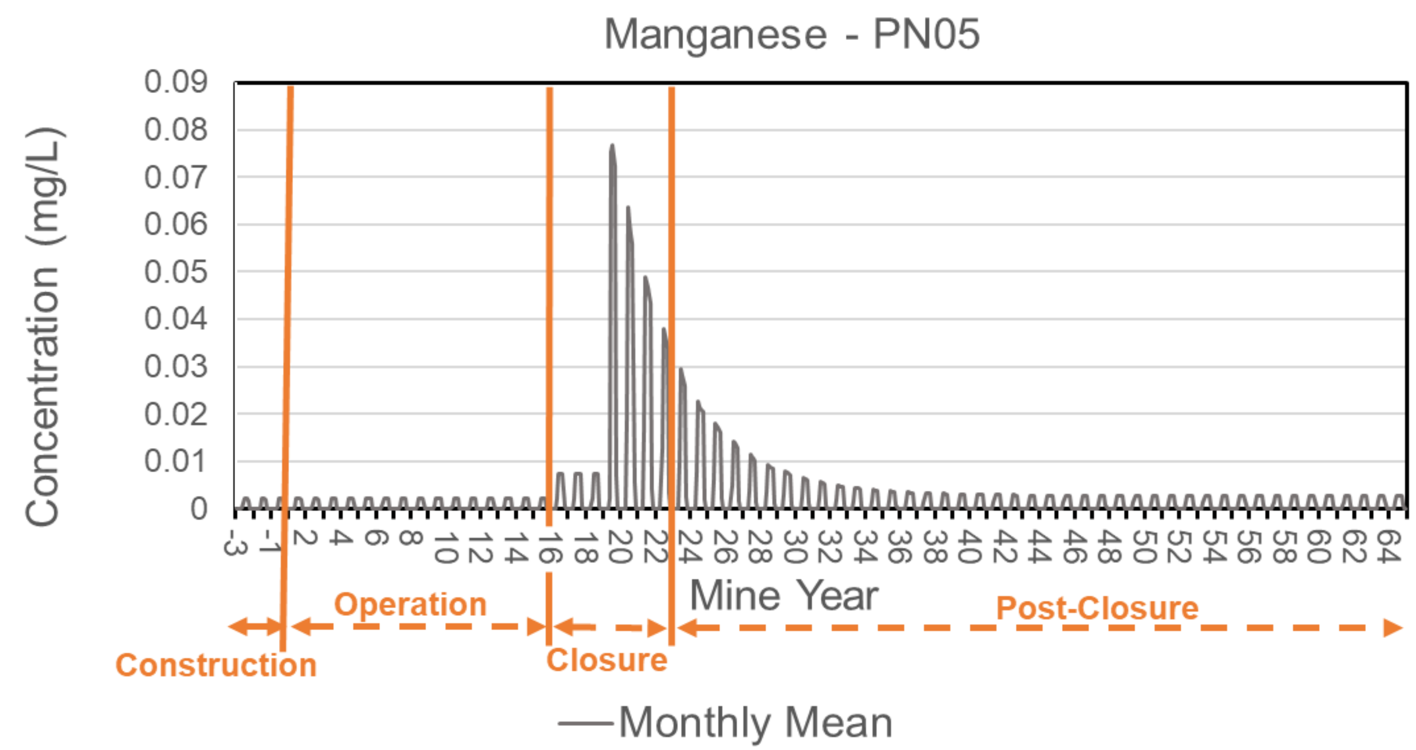

Boron - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Cadmium - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

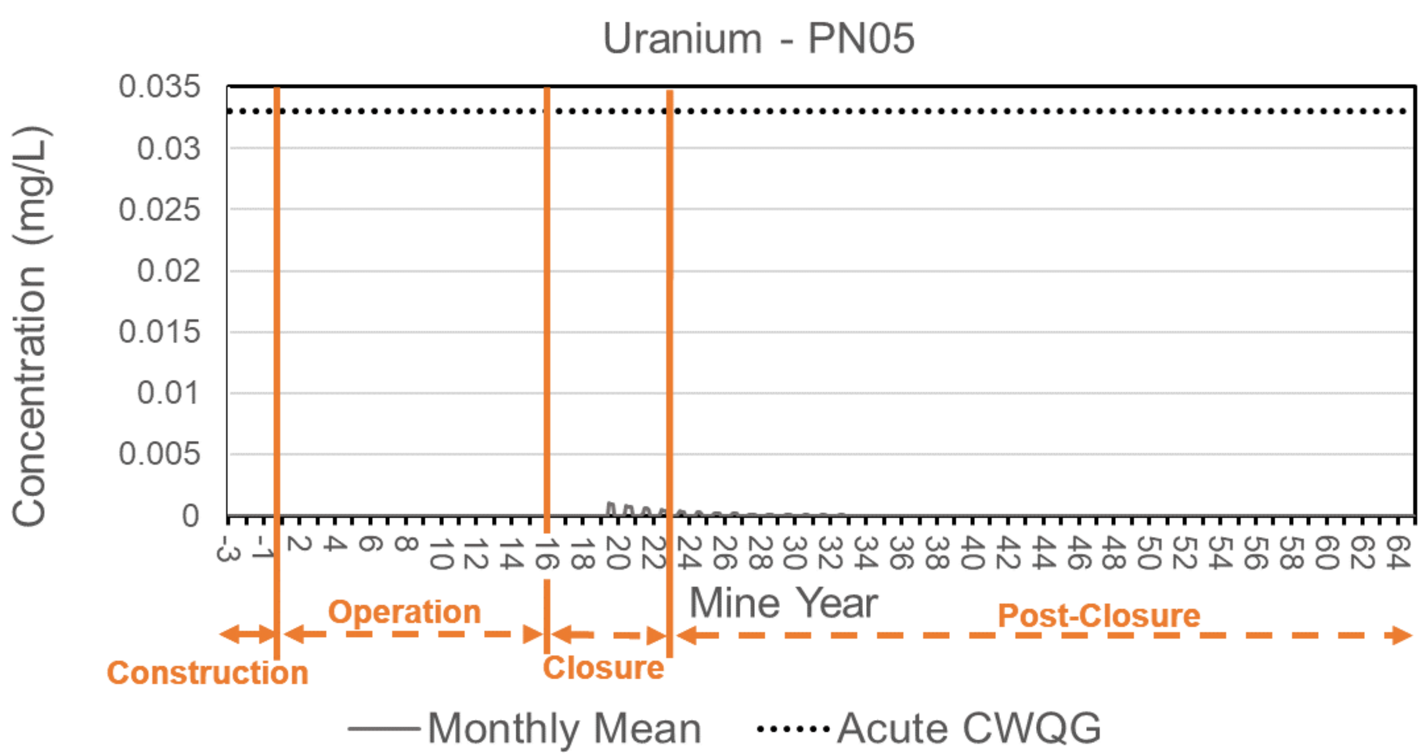

Cadmium - PN05
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



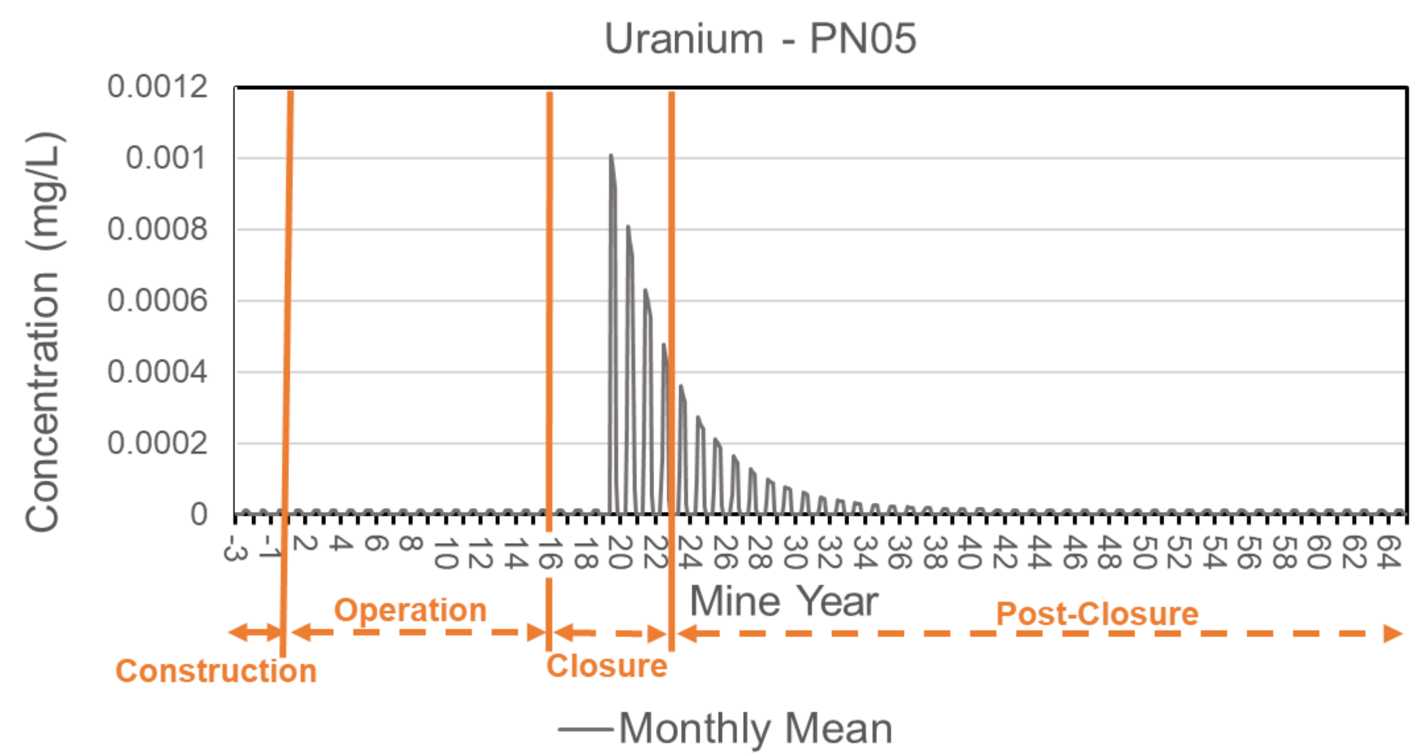
Manganese - PN05
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean
Acute CWQG



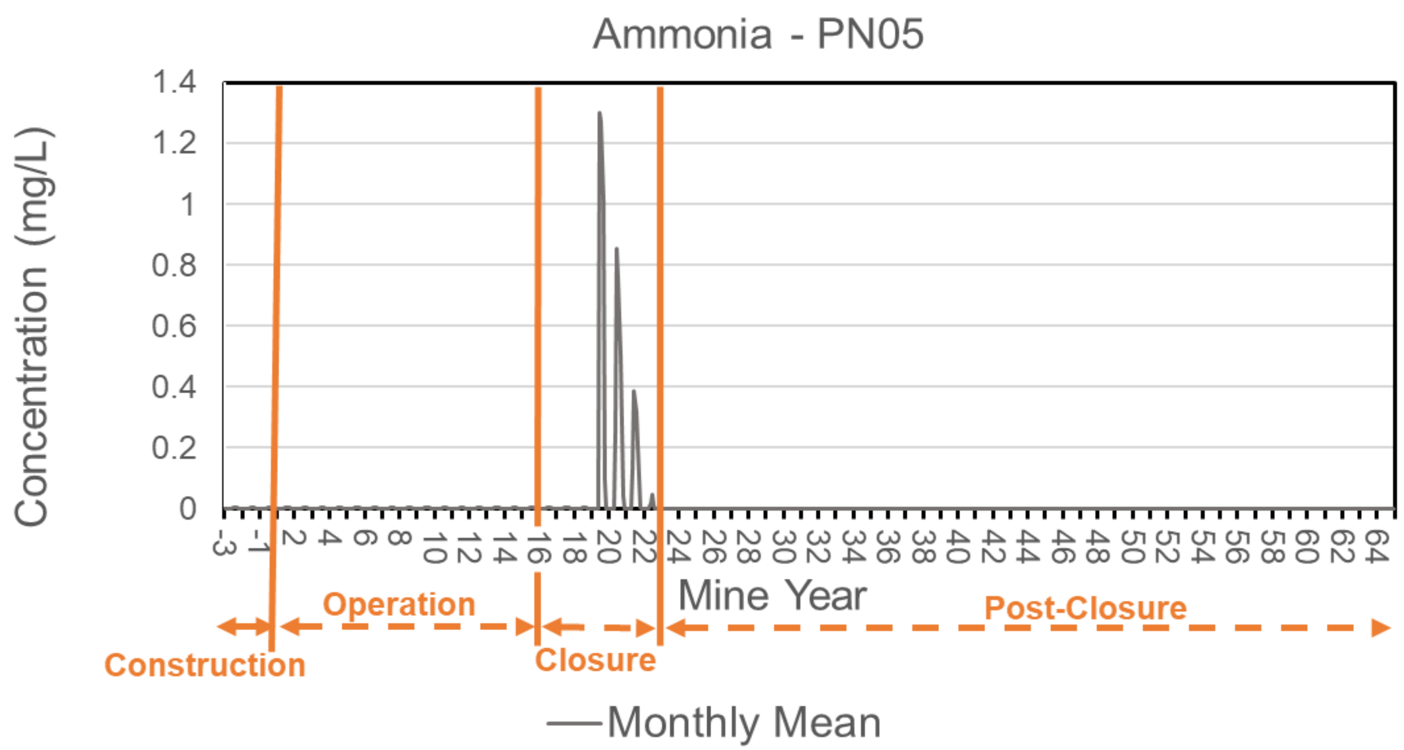
Manganese - PN05
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

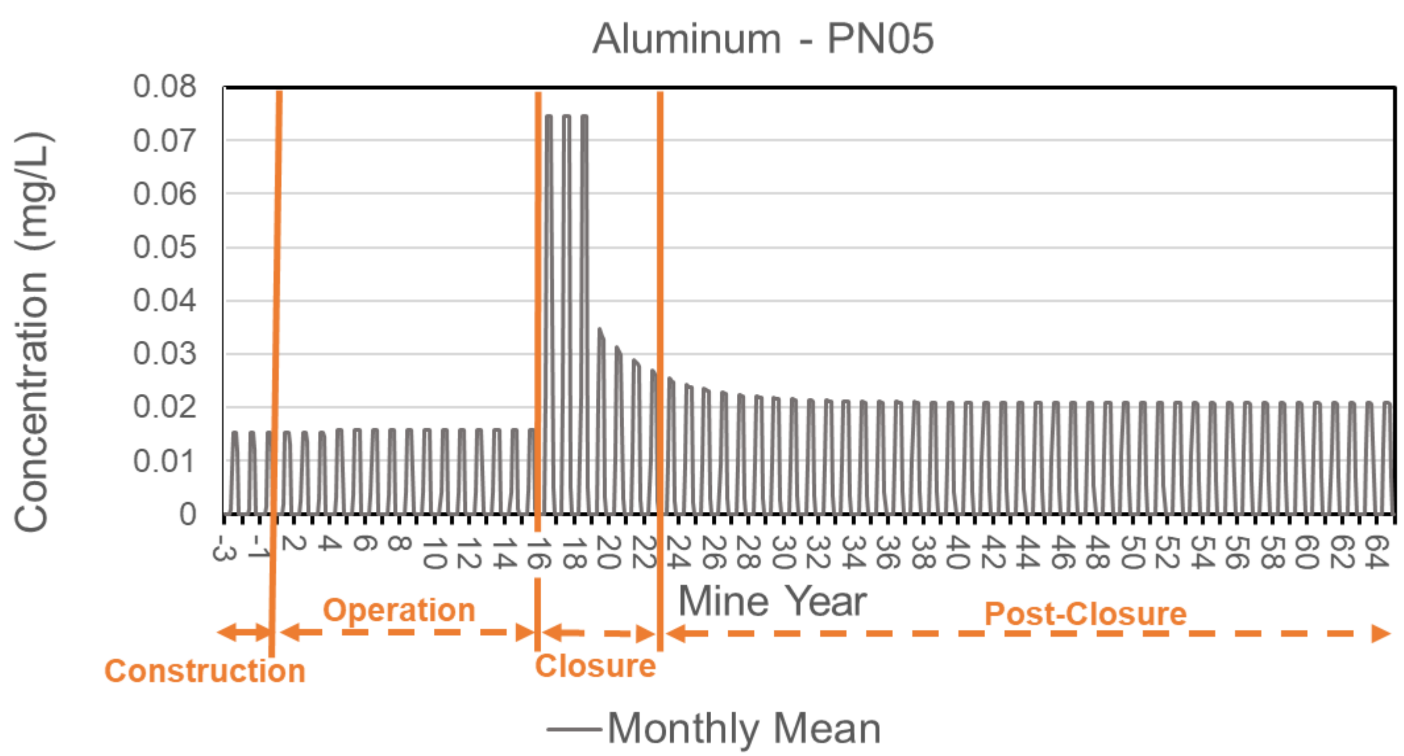


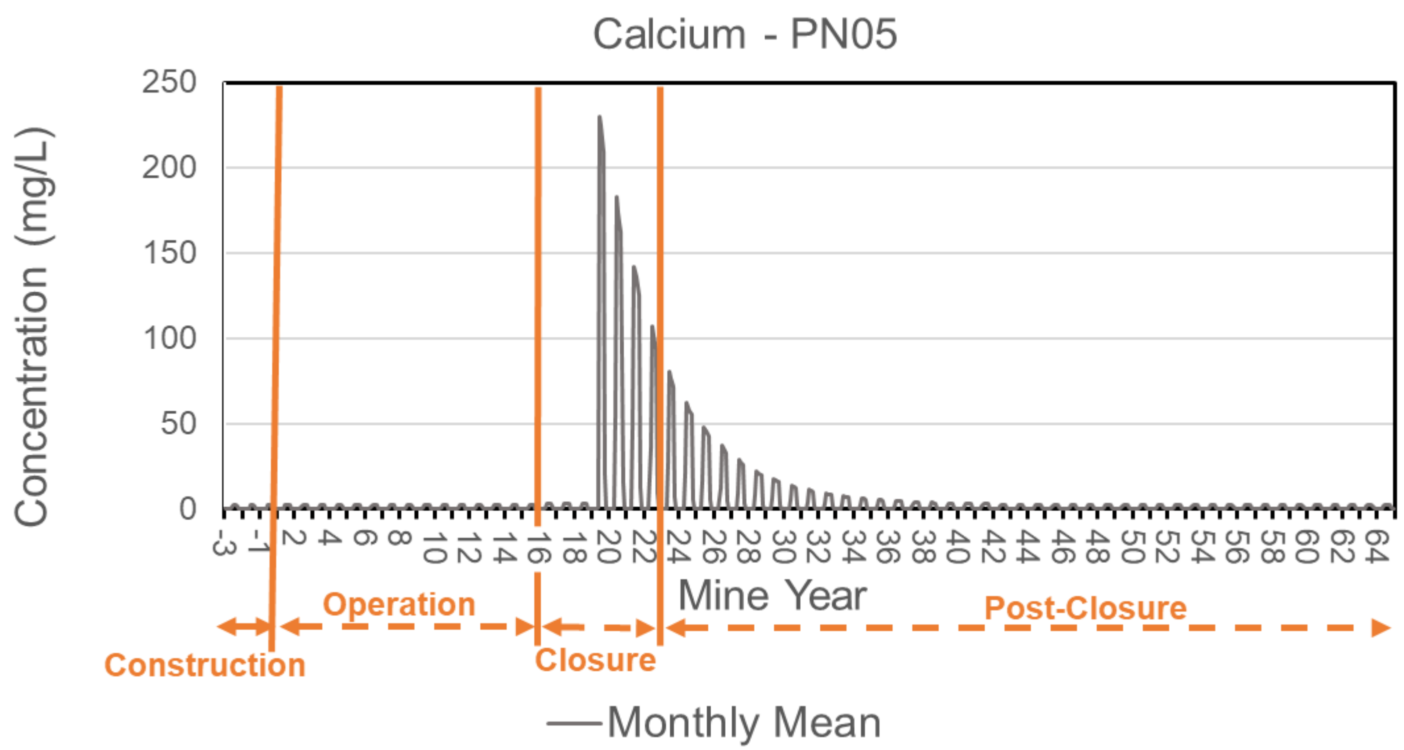
Uranium - PN05
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean
Acute CWQG

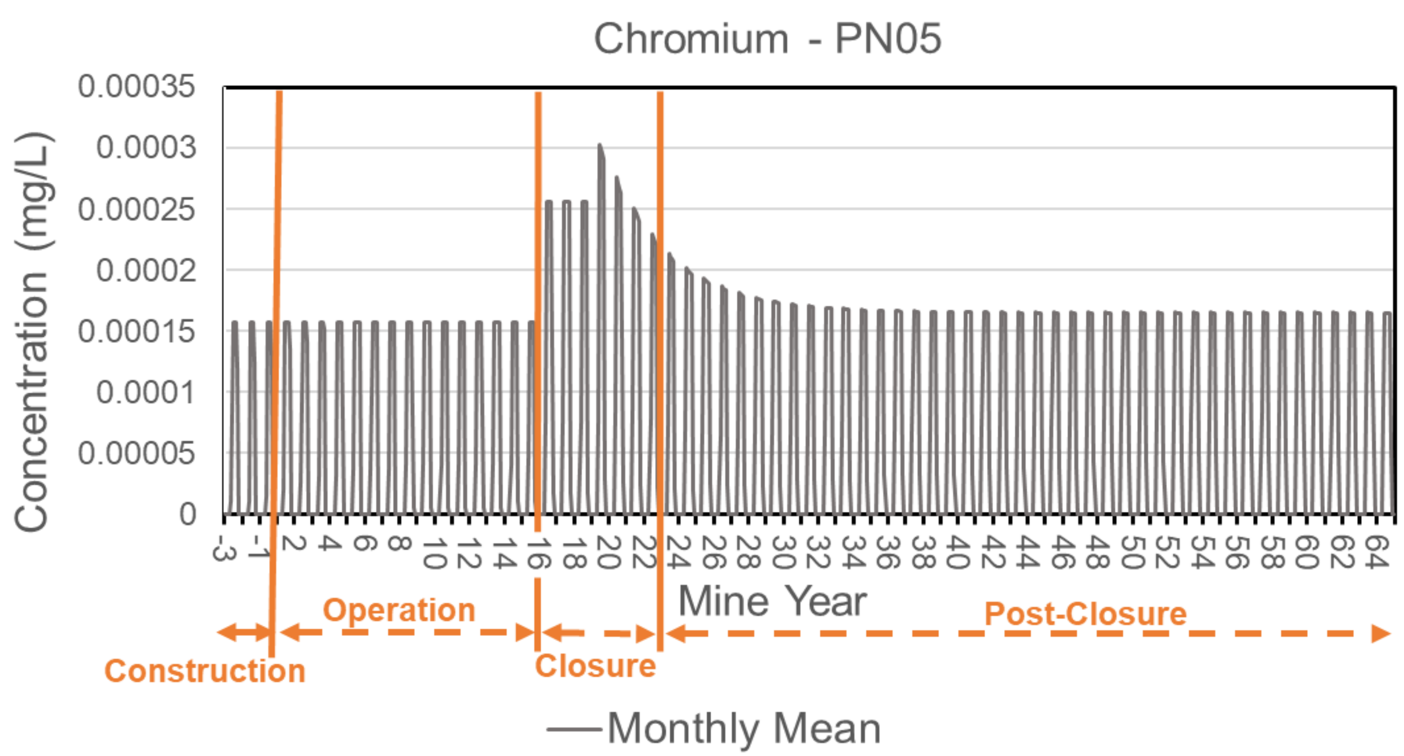


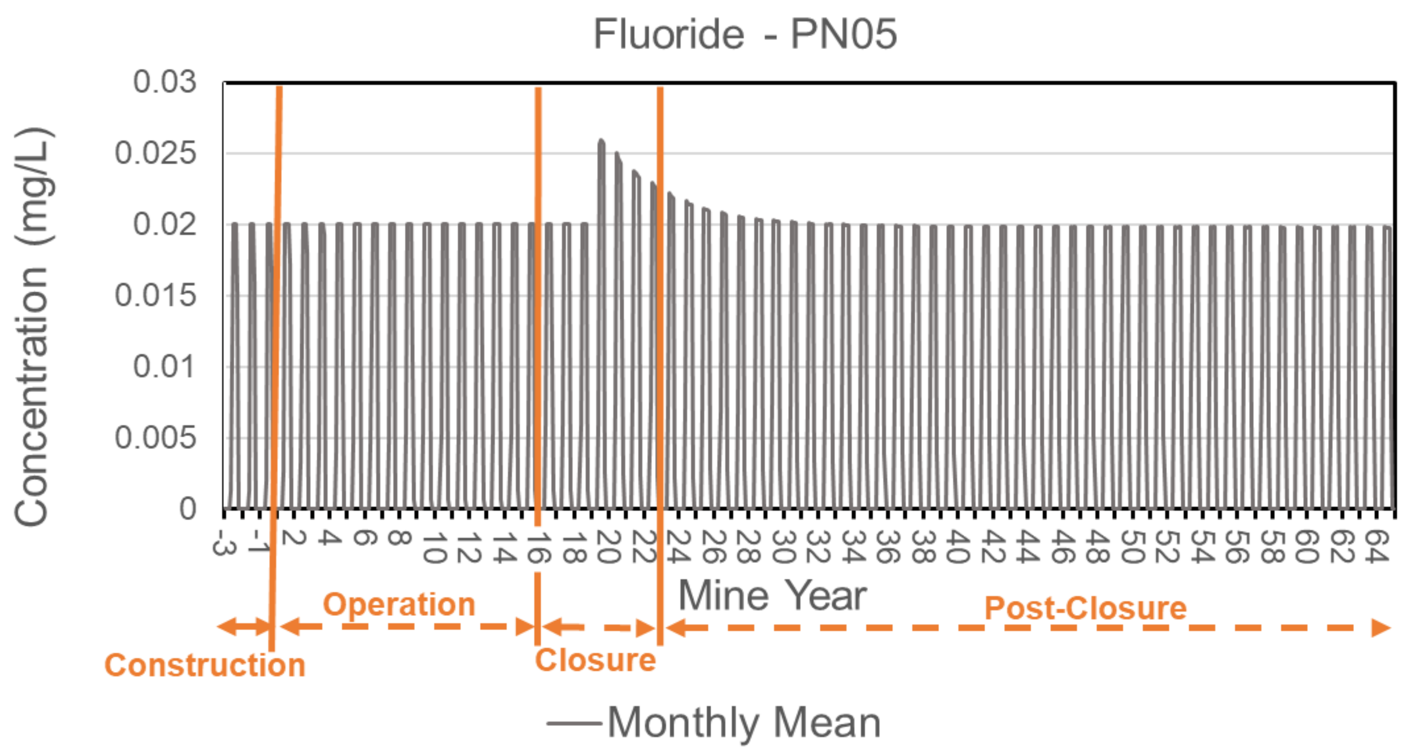
Uranium - PN05
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

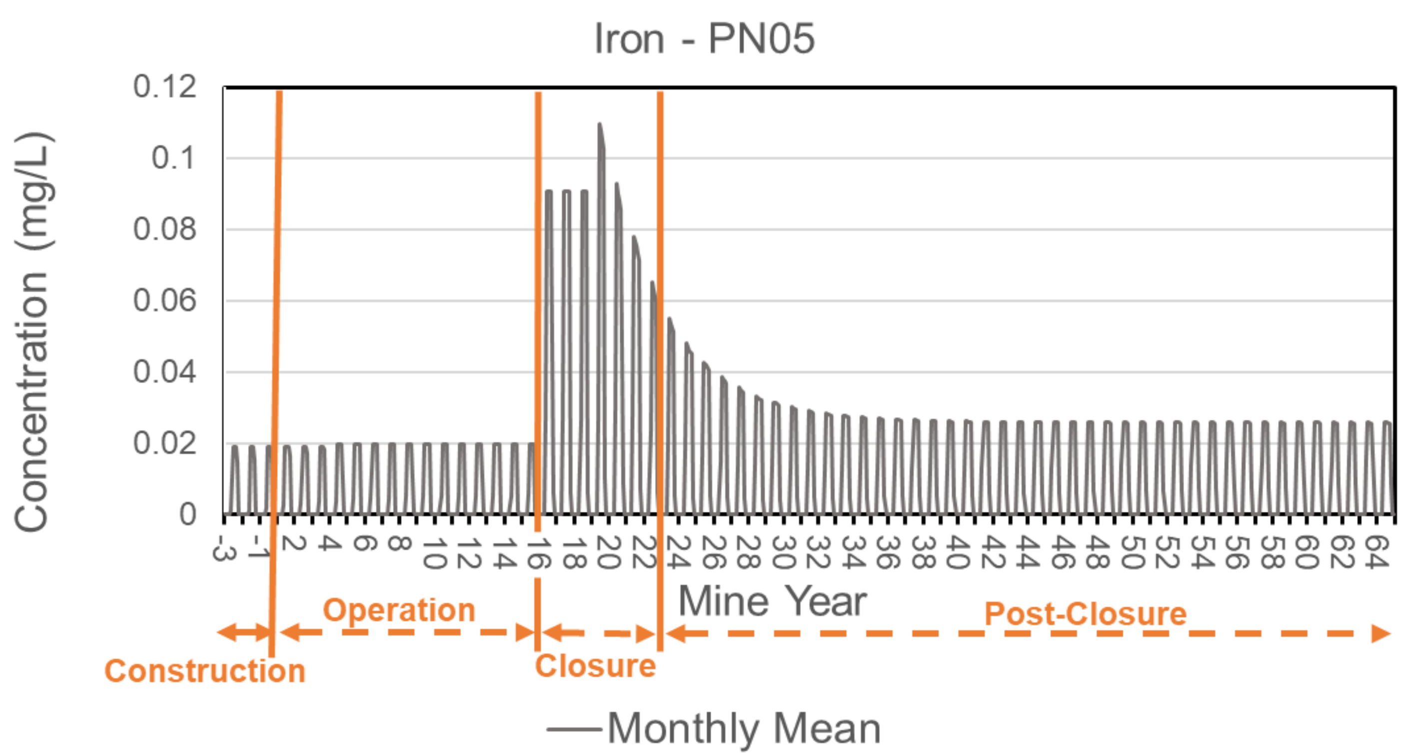

Ammonia - PN05
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

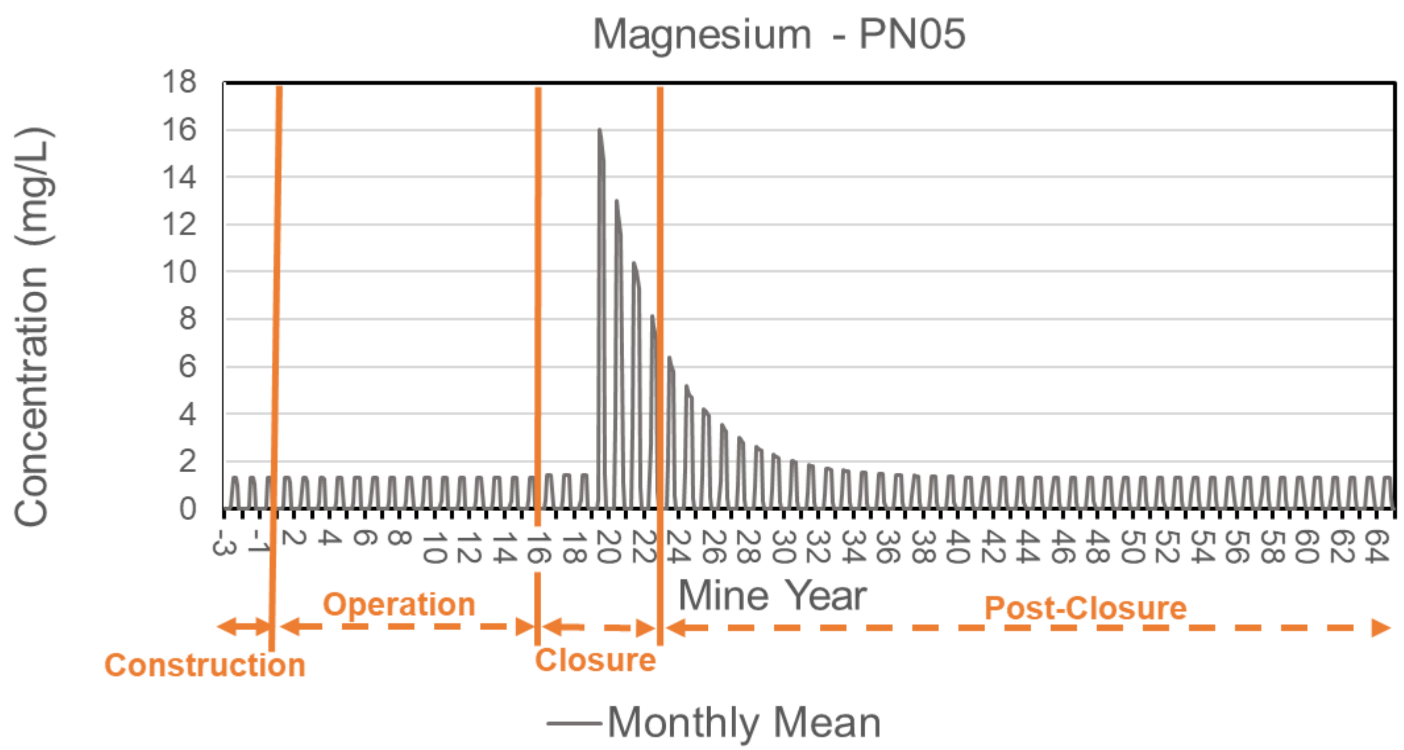

Aluminum - PN05
Concentration (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

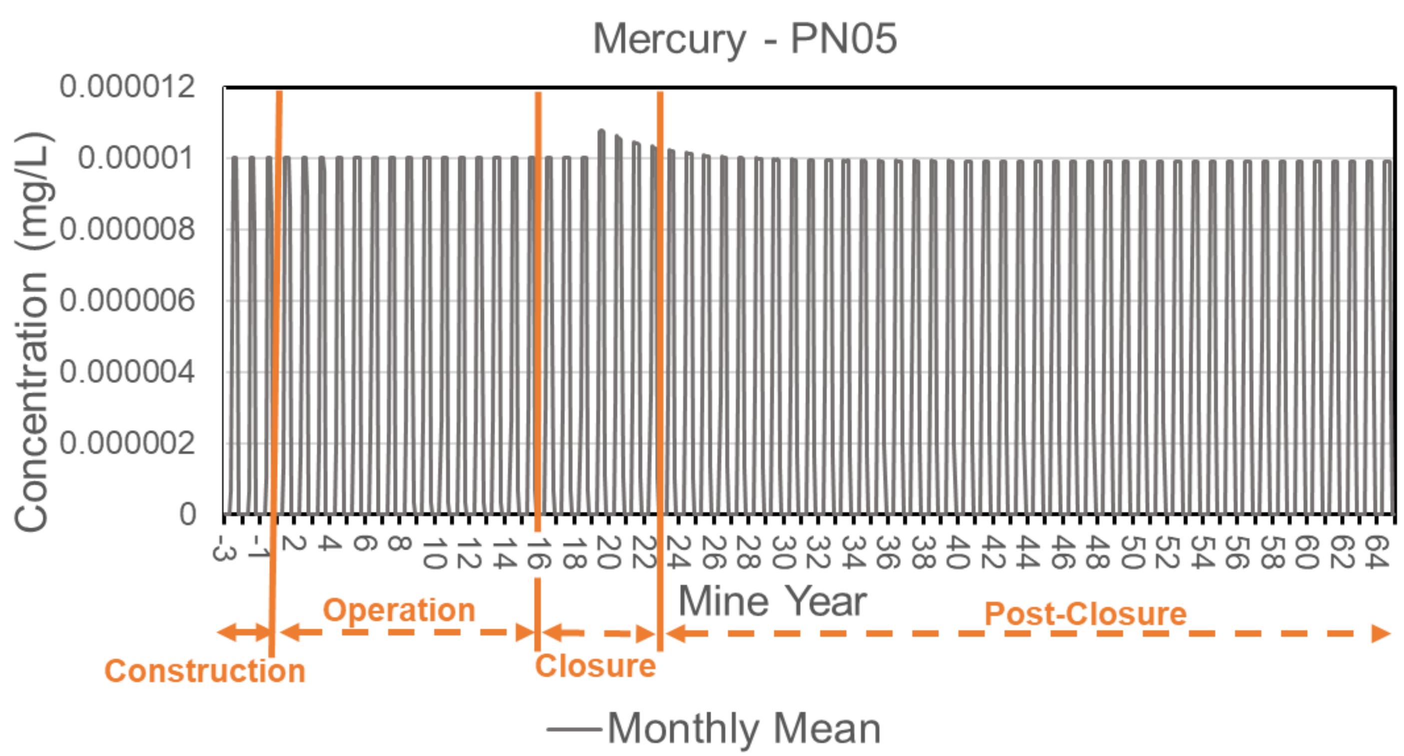

Calcium - PN05
Concentration (mg/L)
250
200
150
100
50
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

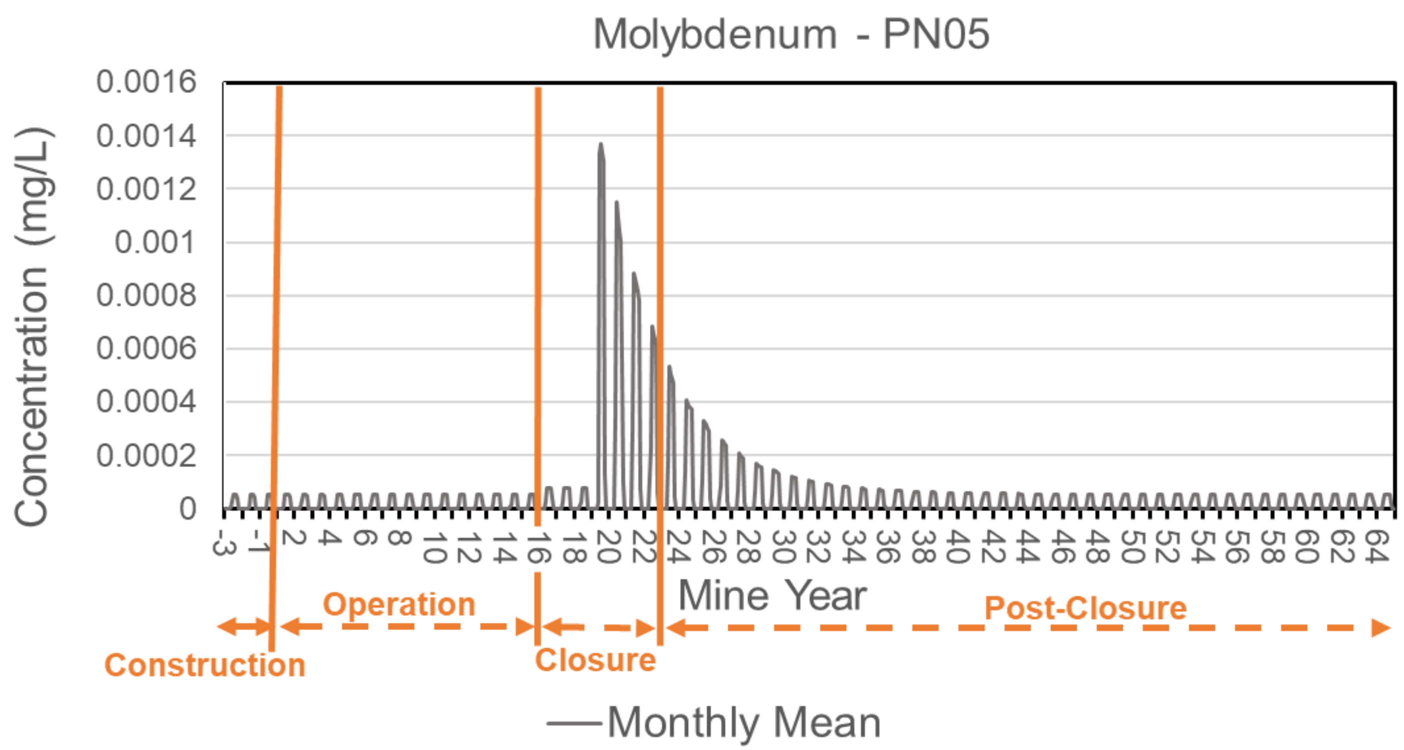

Chromium - PN05
Concentration (mg/L)
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean


Fluoride - PN05
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

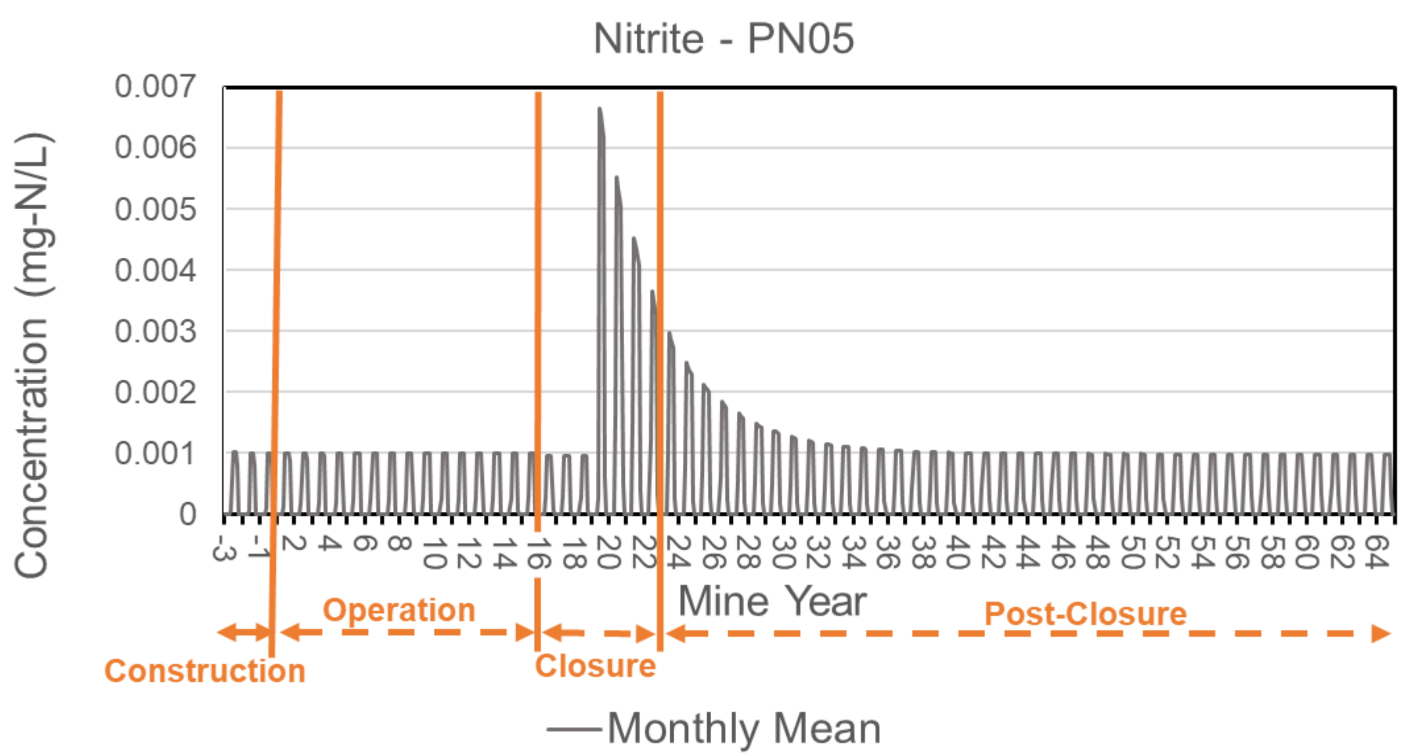

Iron - PN05
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Magnesium - PN05
Concentration (mg/L)
0
2
4
6
8
10
12
14
16
18
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

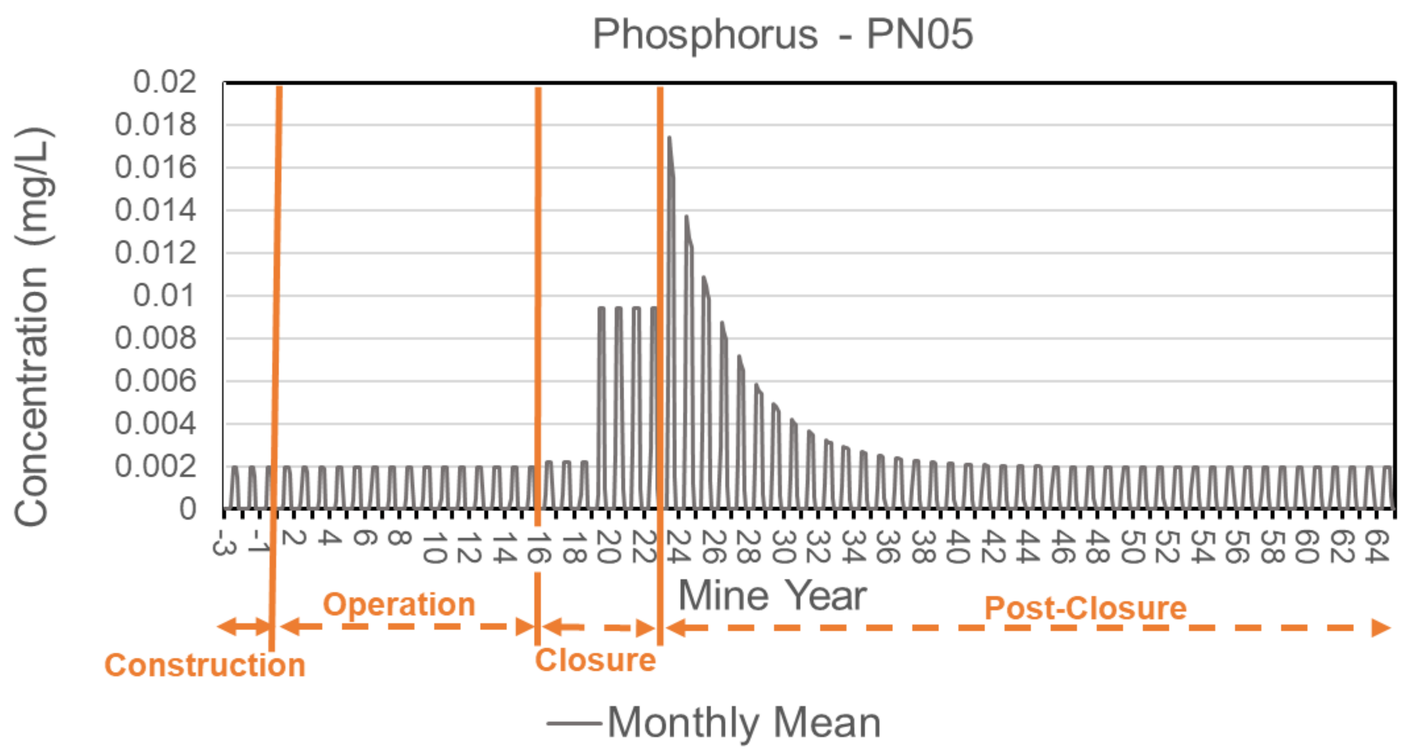

Mercury - PN05
Concentration (mg/L)
0
0.000002
0.000004
0.000006
0.000008
0.00001
0.000012
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



Molybdenum - PN05
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



Nitrite - PN05
Concentration (mg-N/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Phosphorus - PN05
Concentration (mg/L)
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
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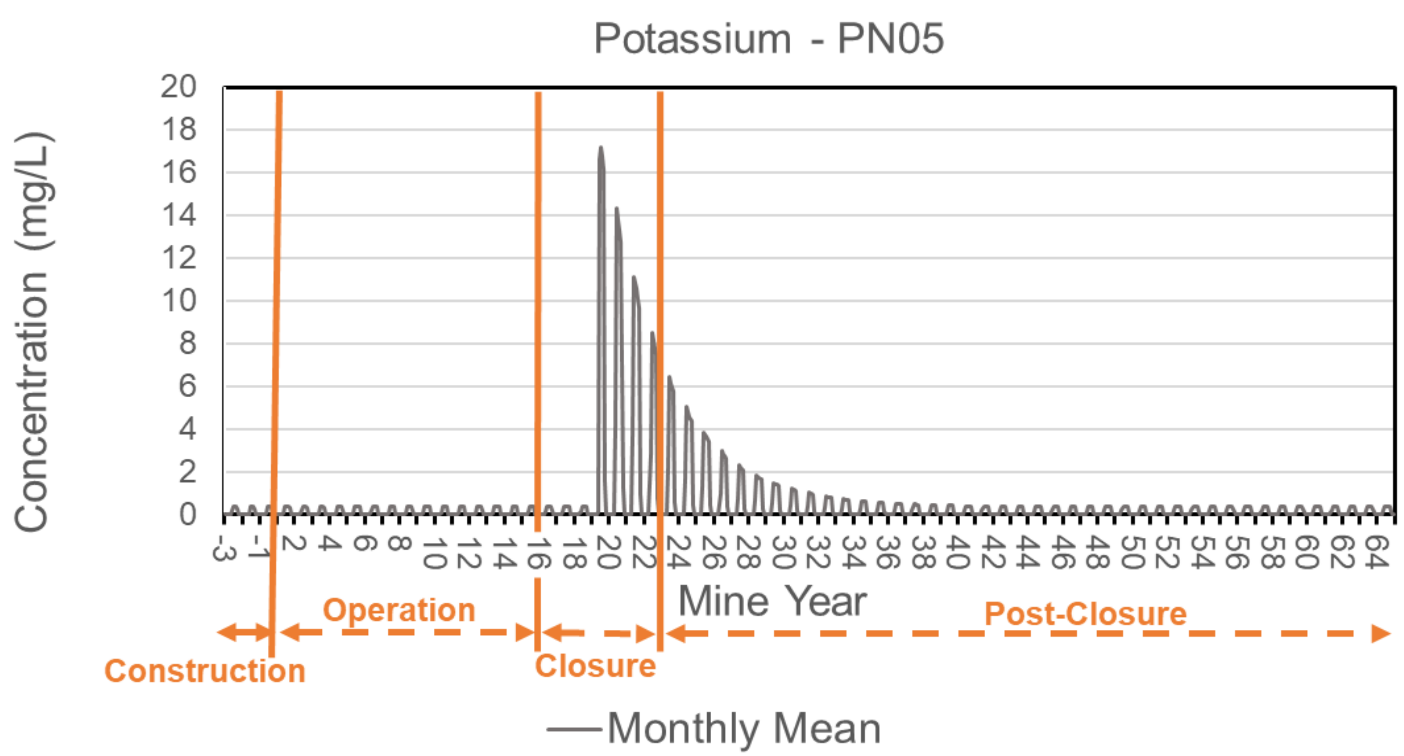
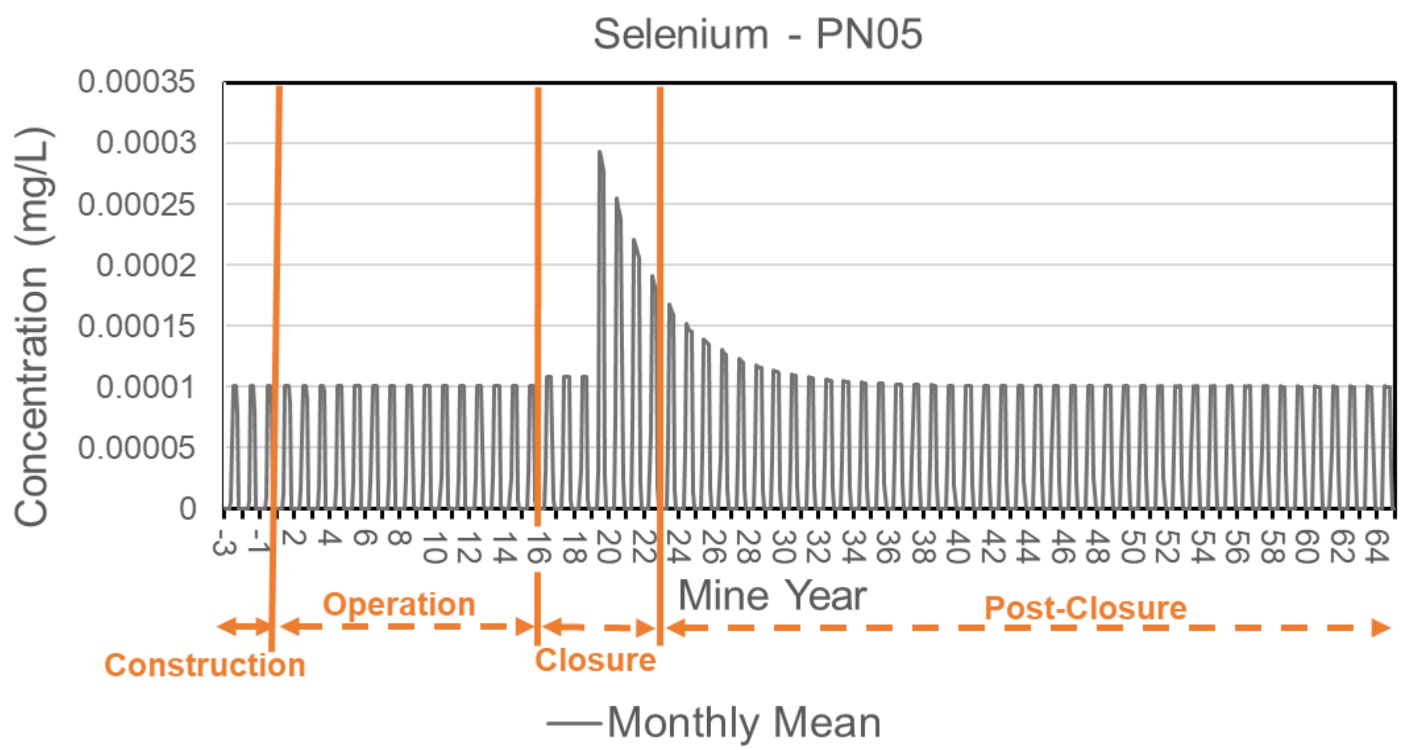
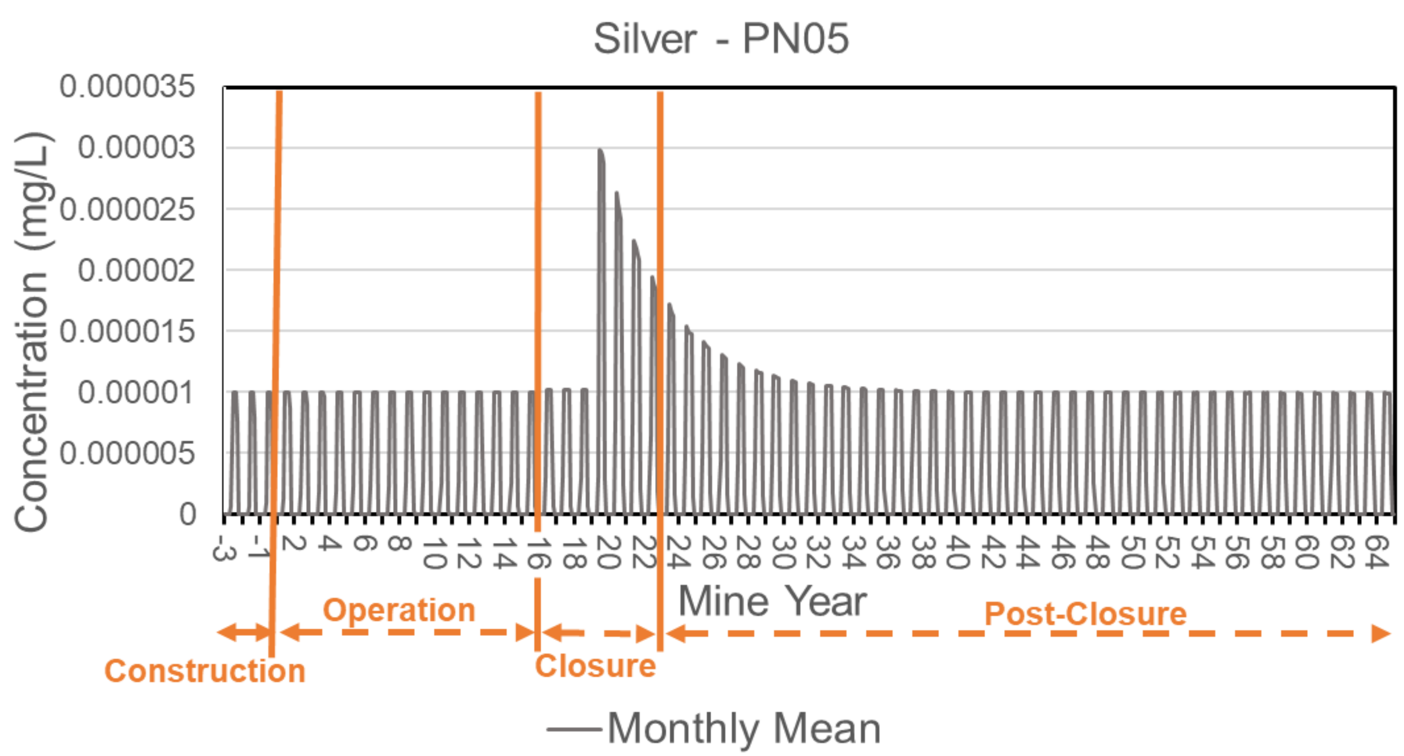
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

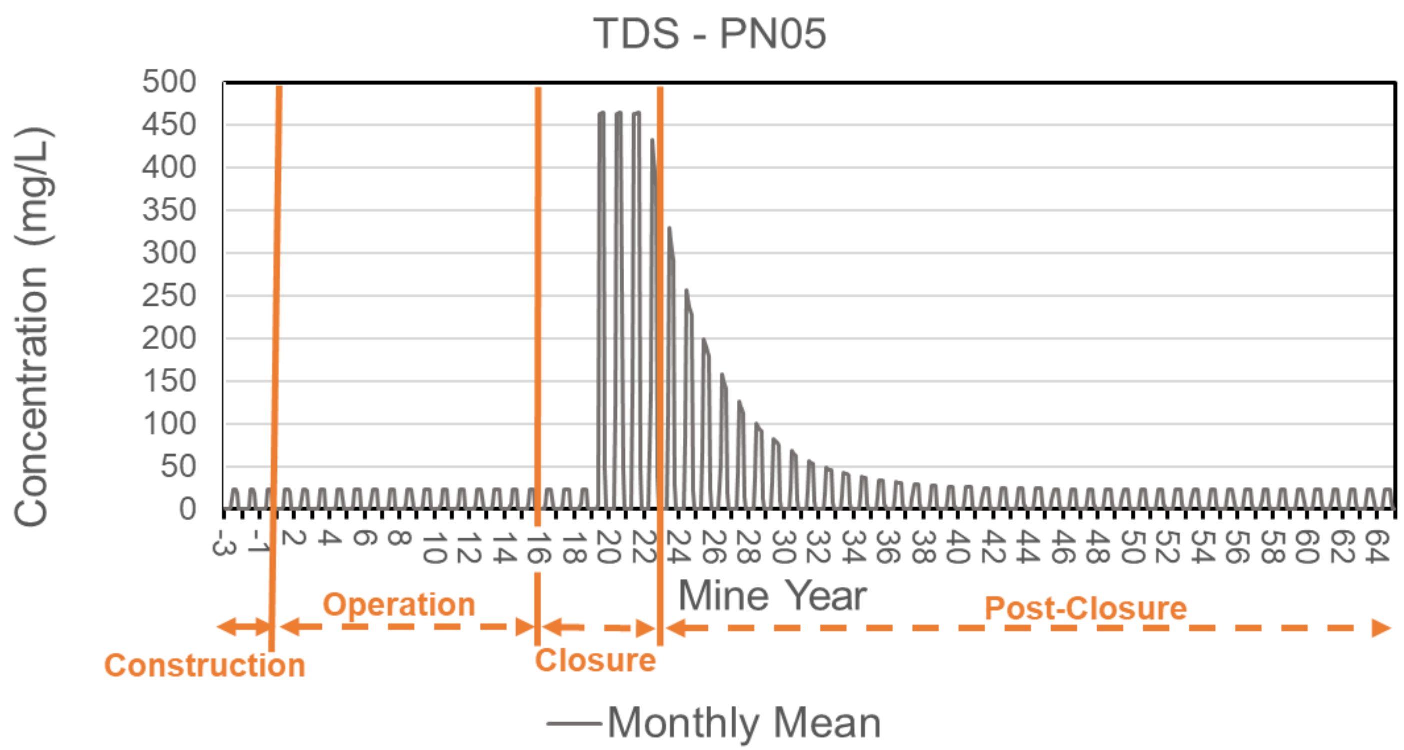

Potassium - PN05
Concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

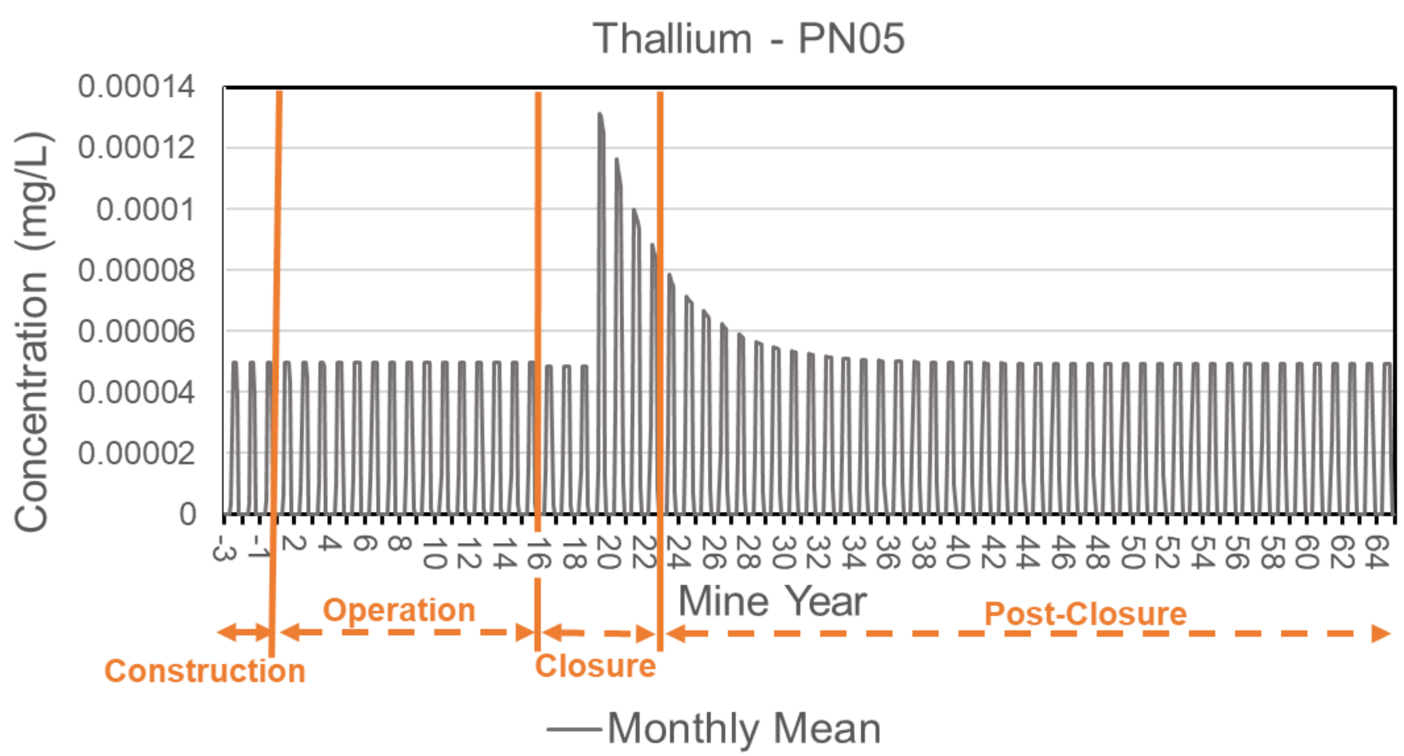


Selenium - PN05
Concentration (mg/L)
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



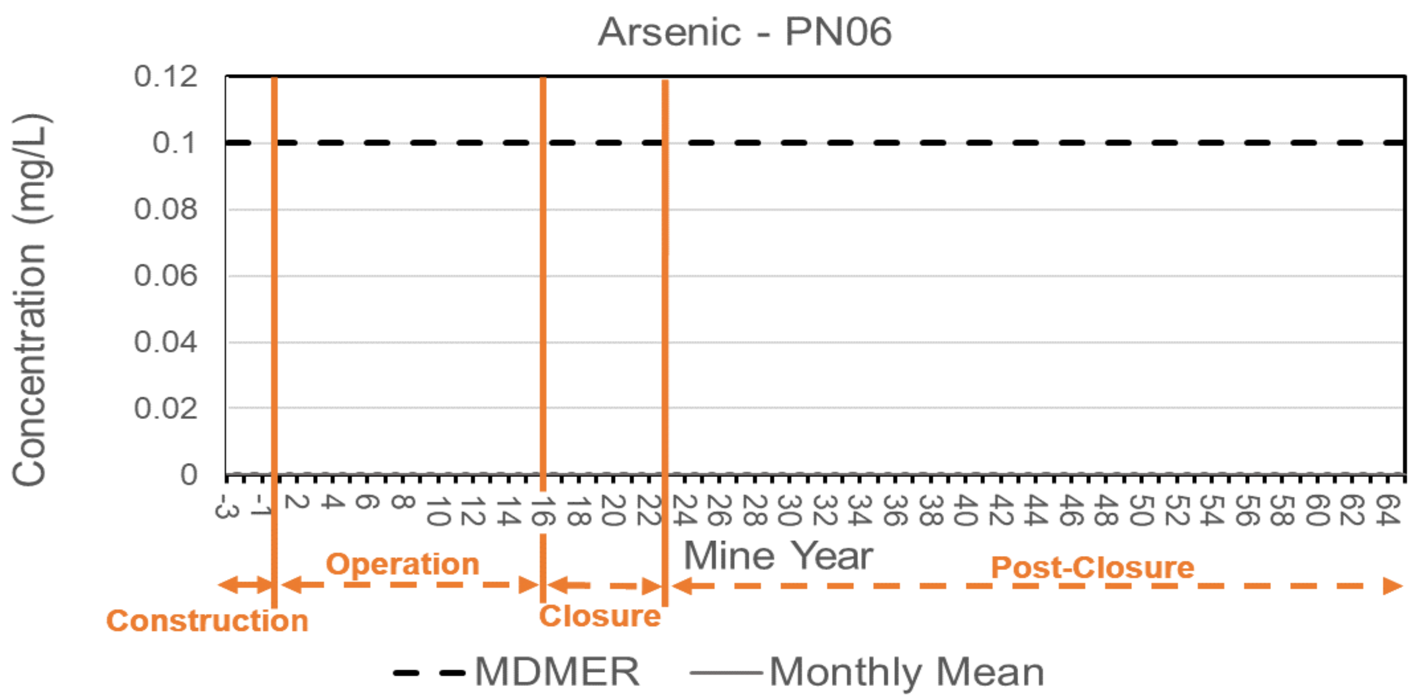
Silver - PN05
Concentration (mg/L)
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

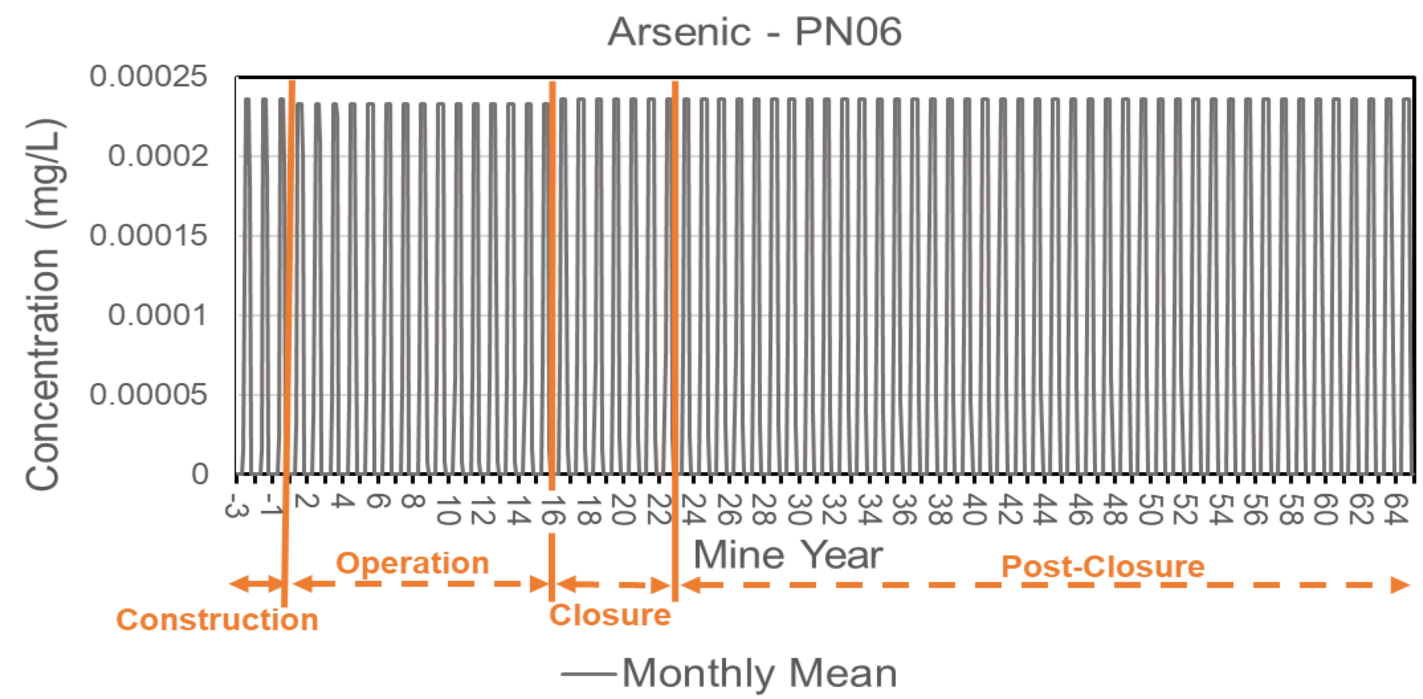


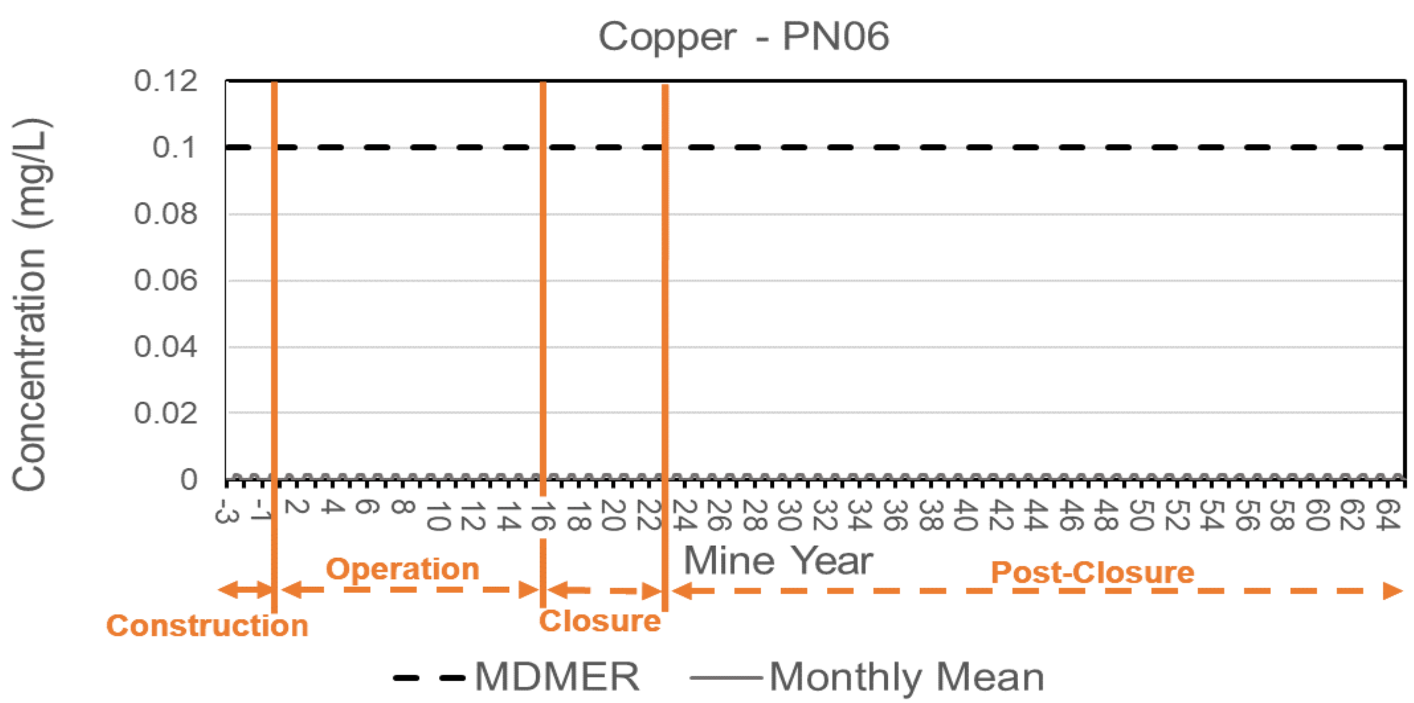


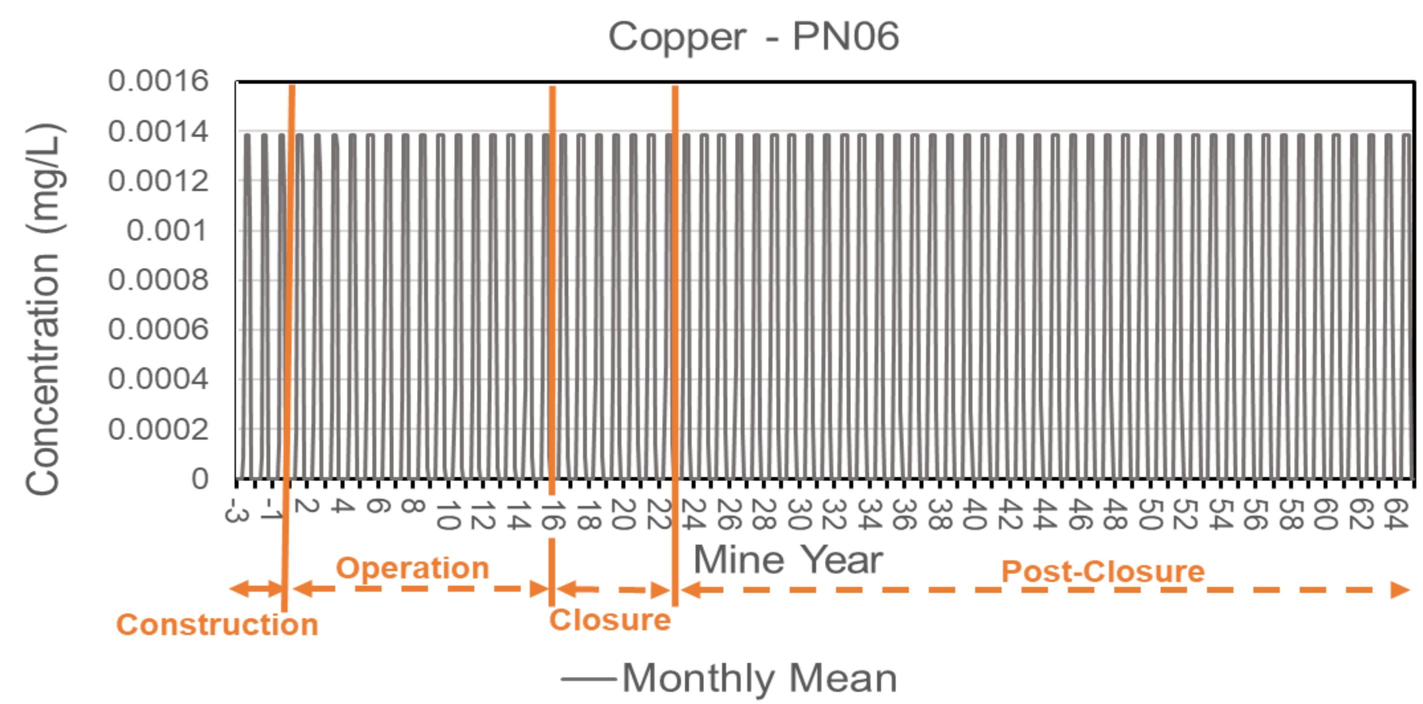
CWQG = Canadian Water Quality Guideline (from CCME 1999)

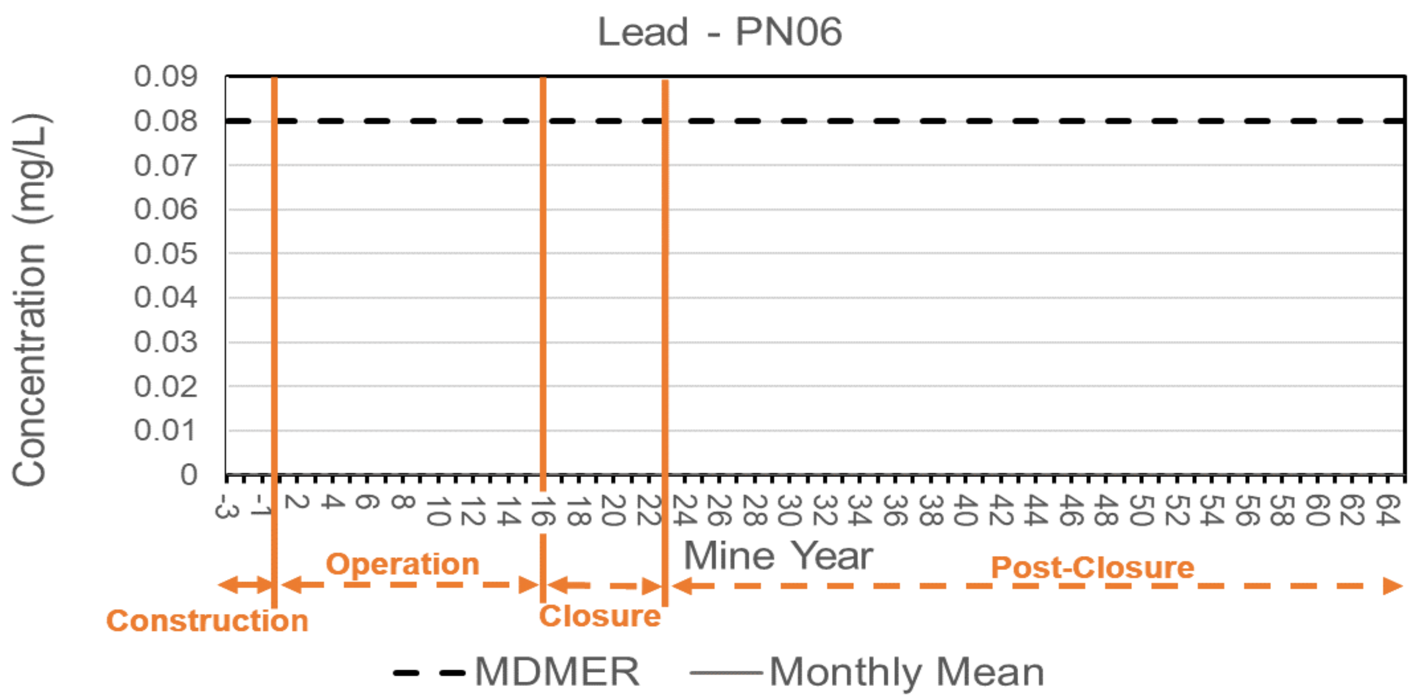
CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2019. Winnipeg, MB, Canada.

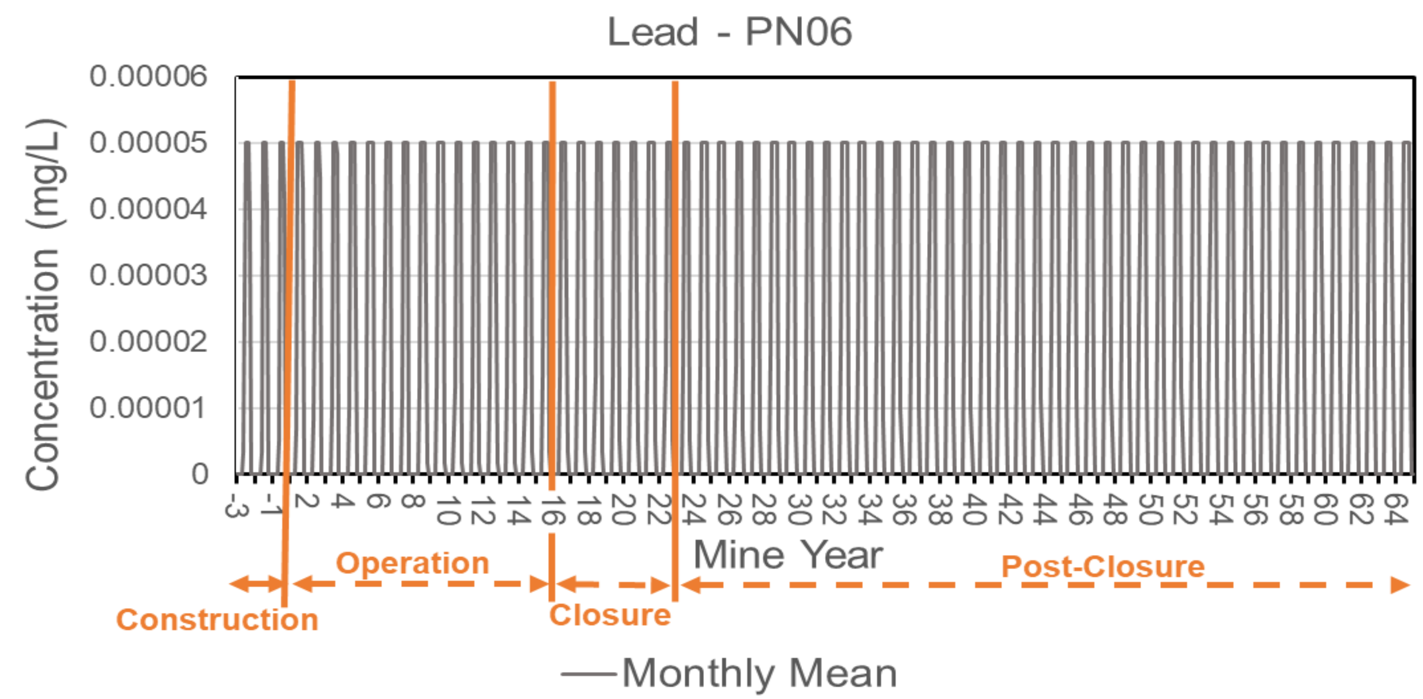

Arsenic - PN06
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

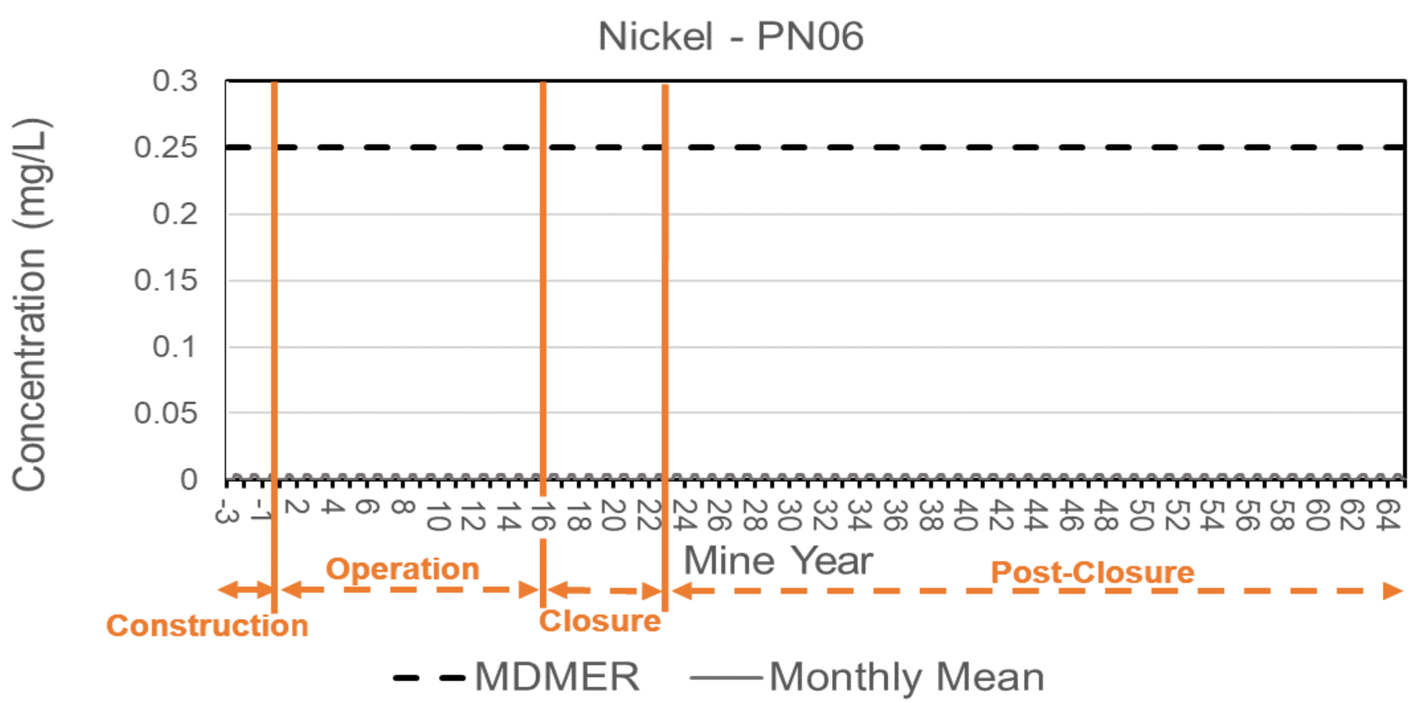

Arsenic - PN06
Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

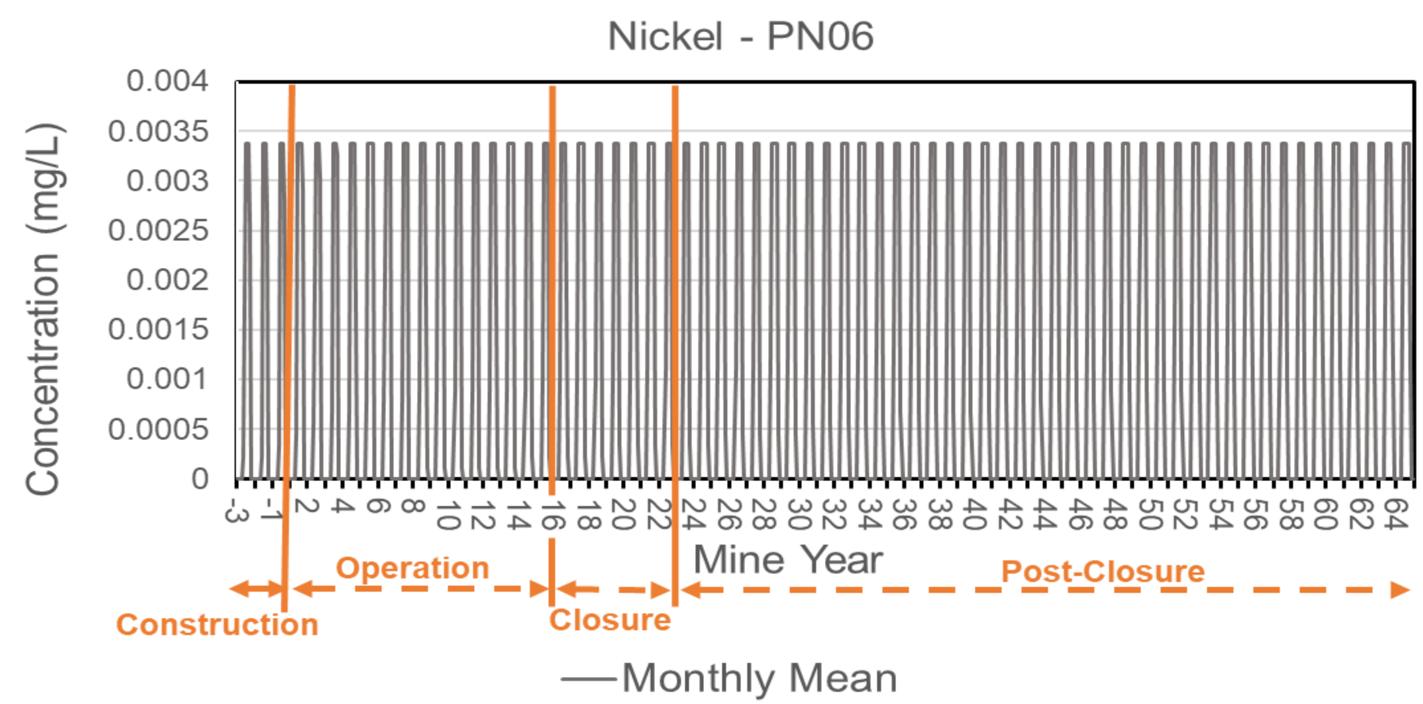

Copper - PN06
Concentration (mg/L)
0.12
0.1
0.08
0.06
0.04
0.02
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

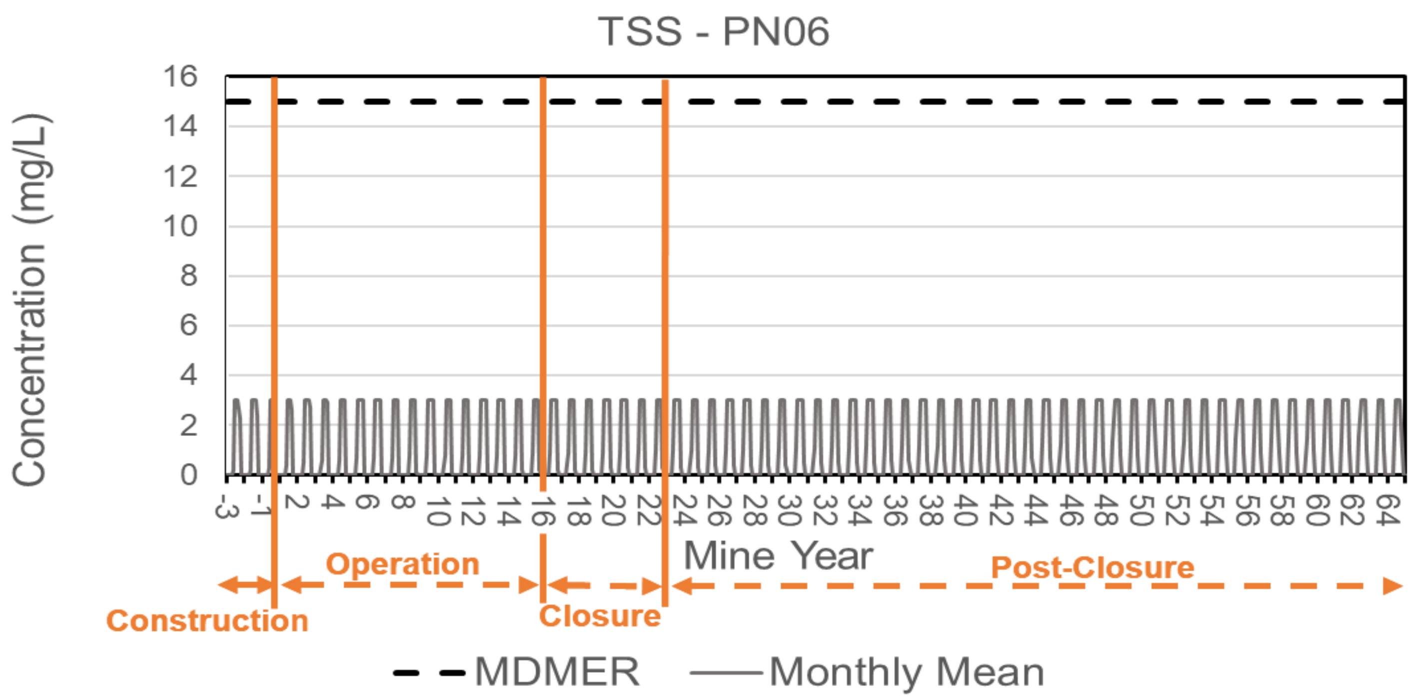

Copper - PN06
Concentration (mg/L)
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

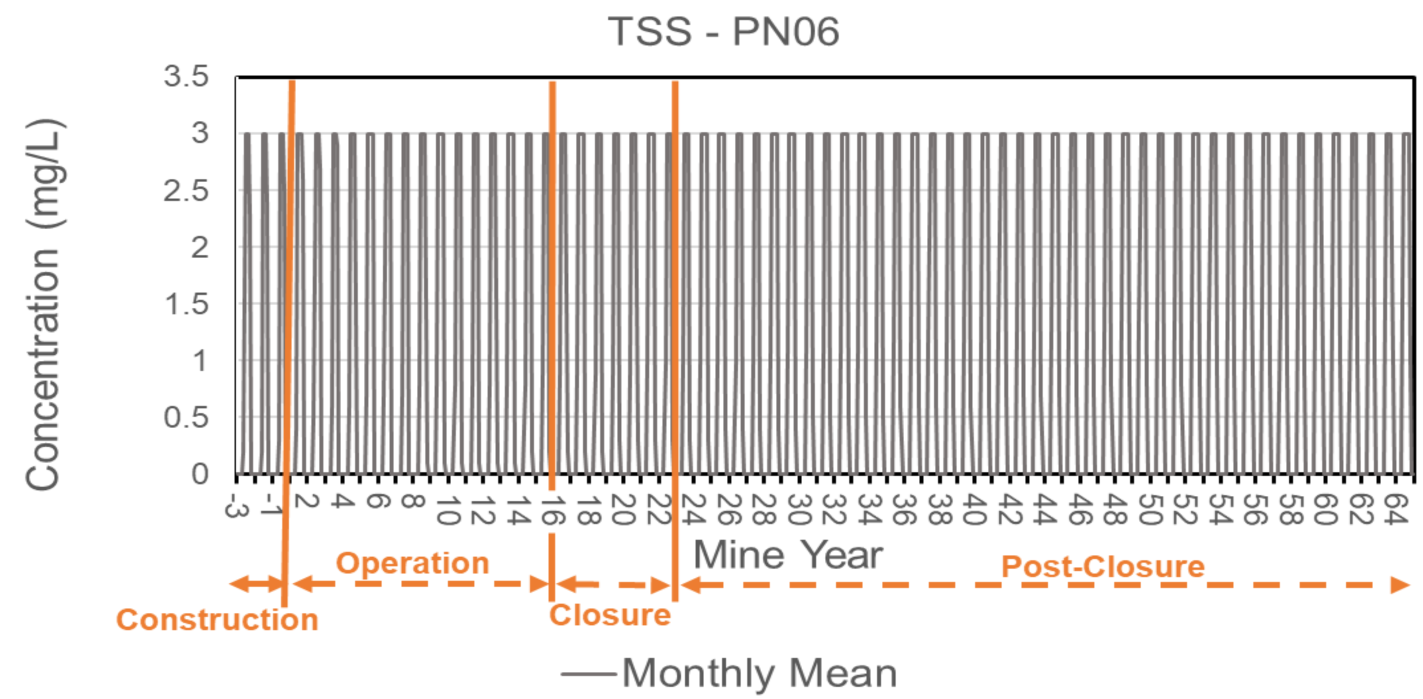

Lead - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

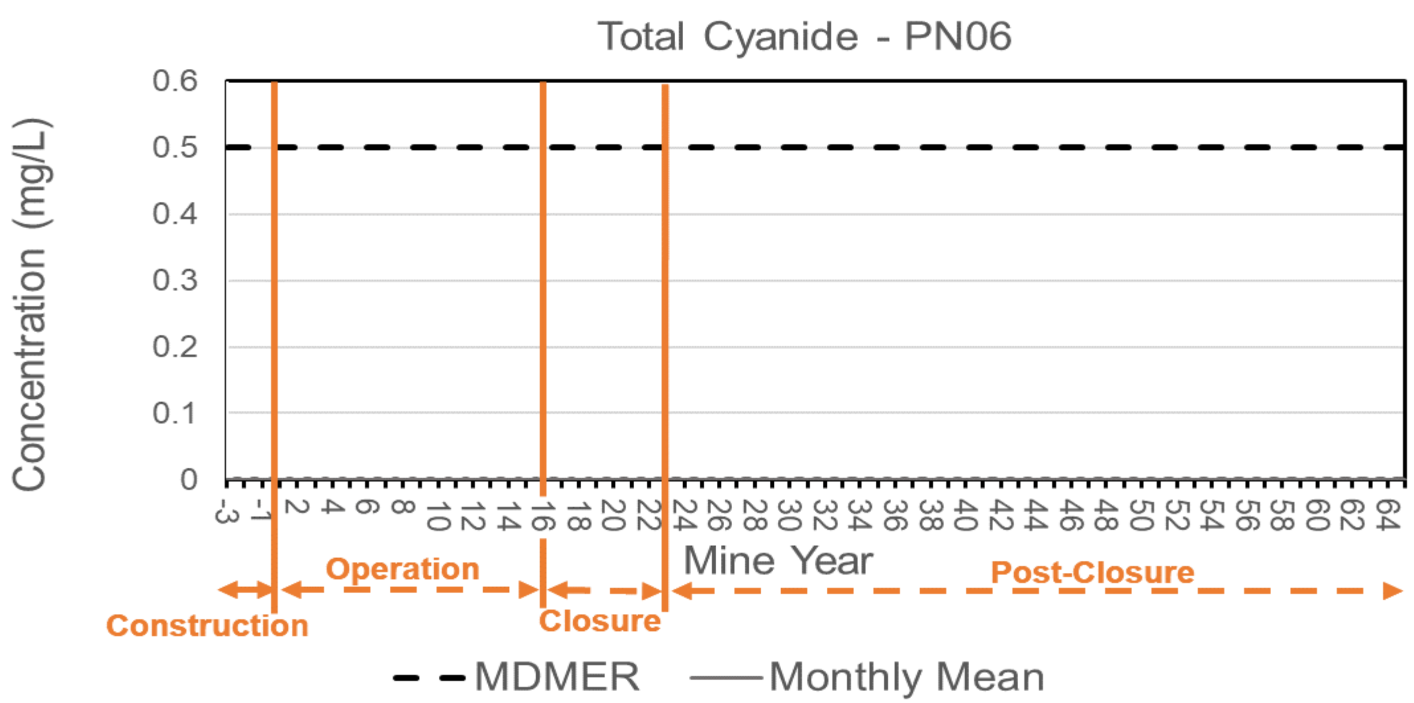

Lead - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

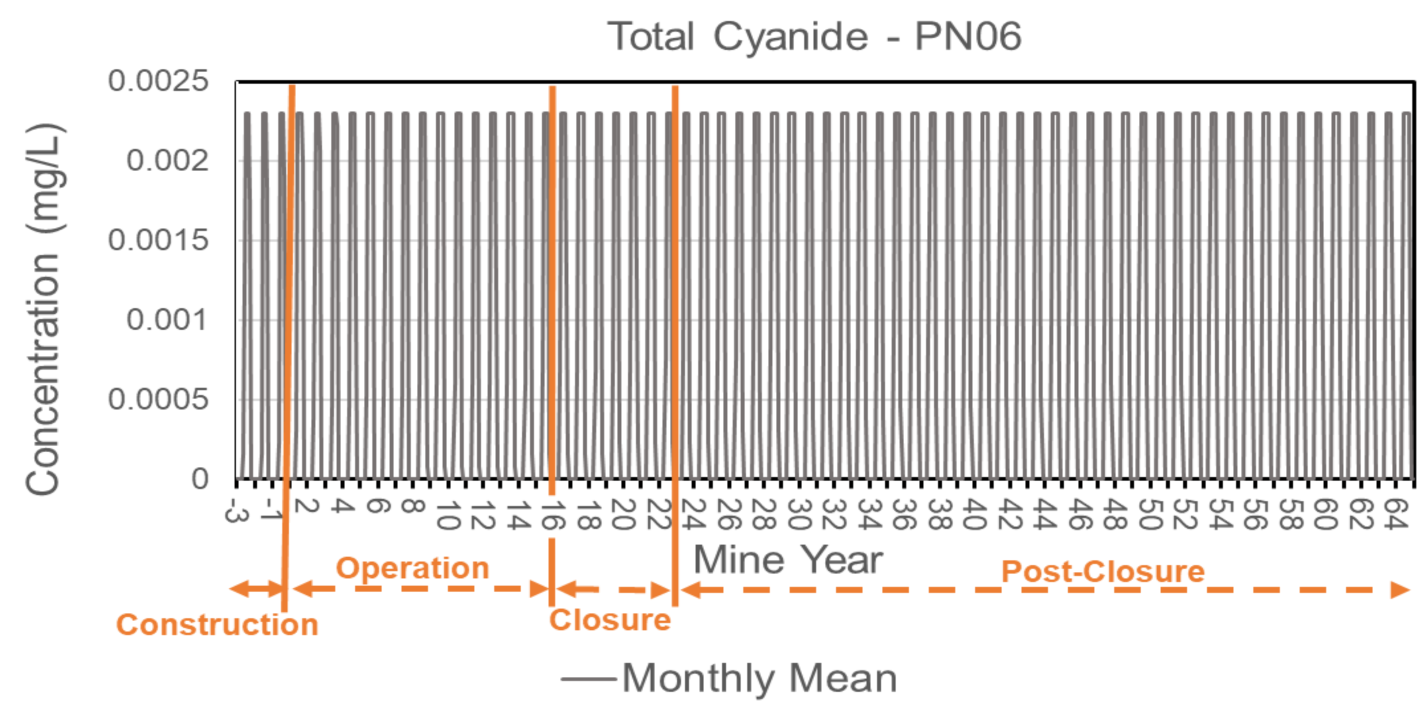

Nickel - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

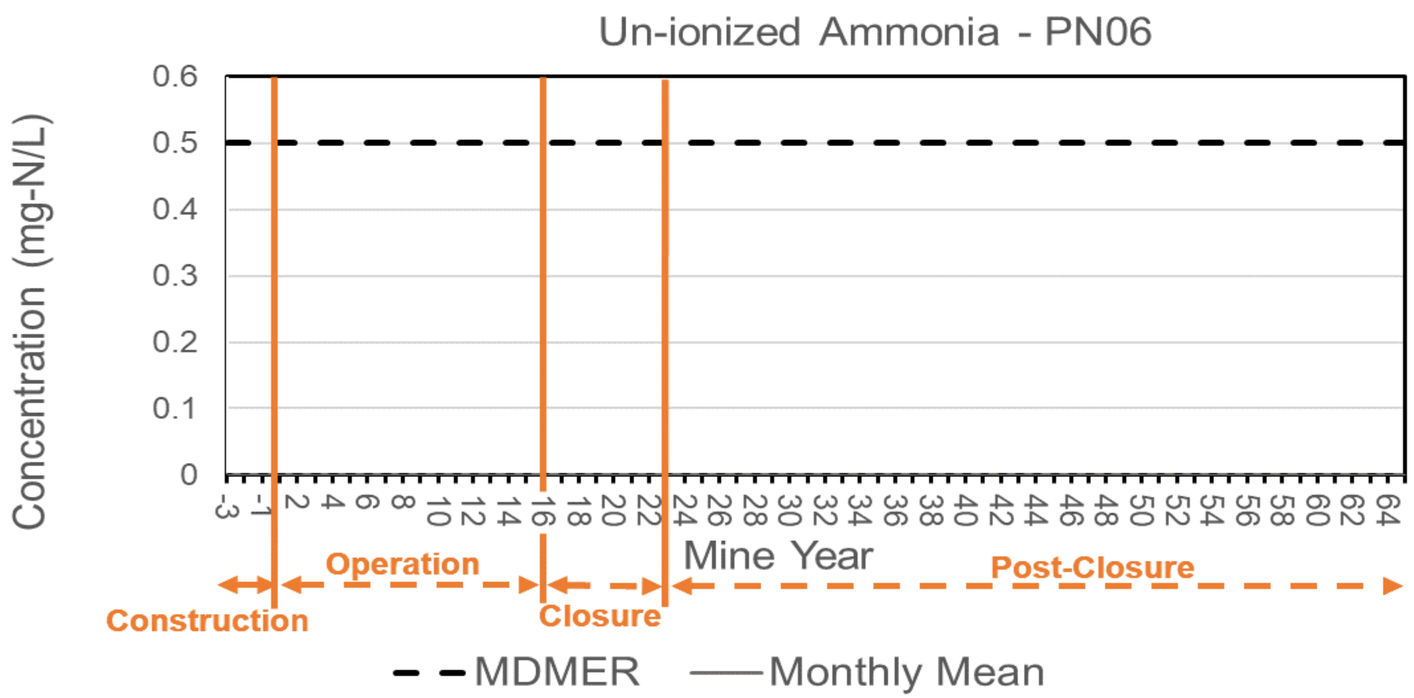

Nickel - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

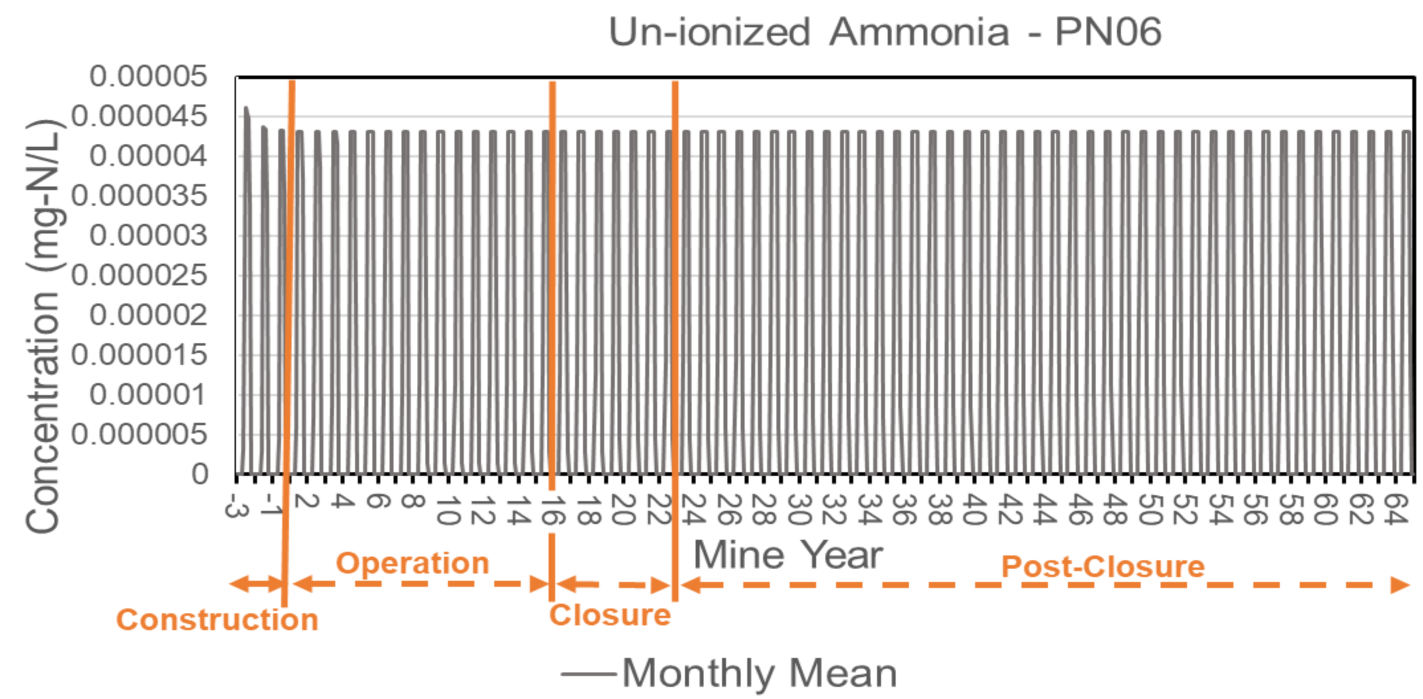

TSS - PN06
Concentration (mg/L)
16
14
12
10
8
6
4
2
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

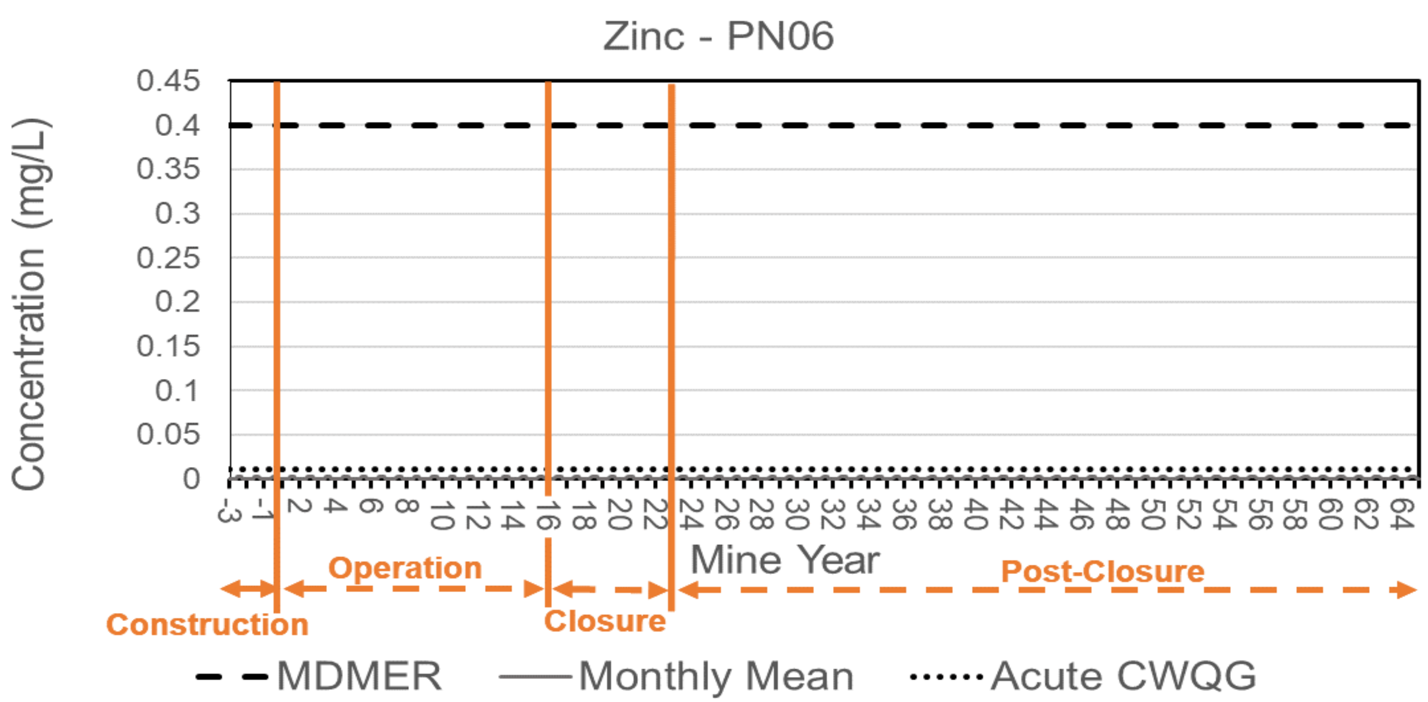

TSS - PN06
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

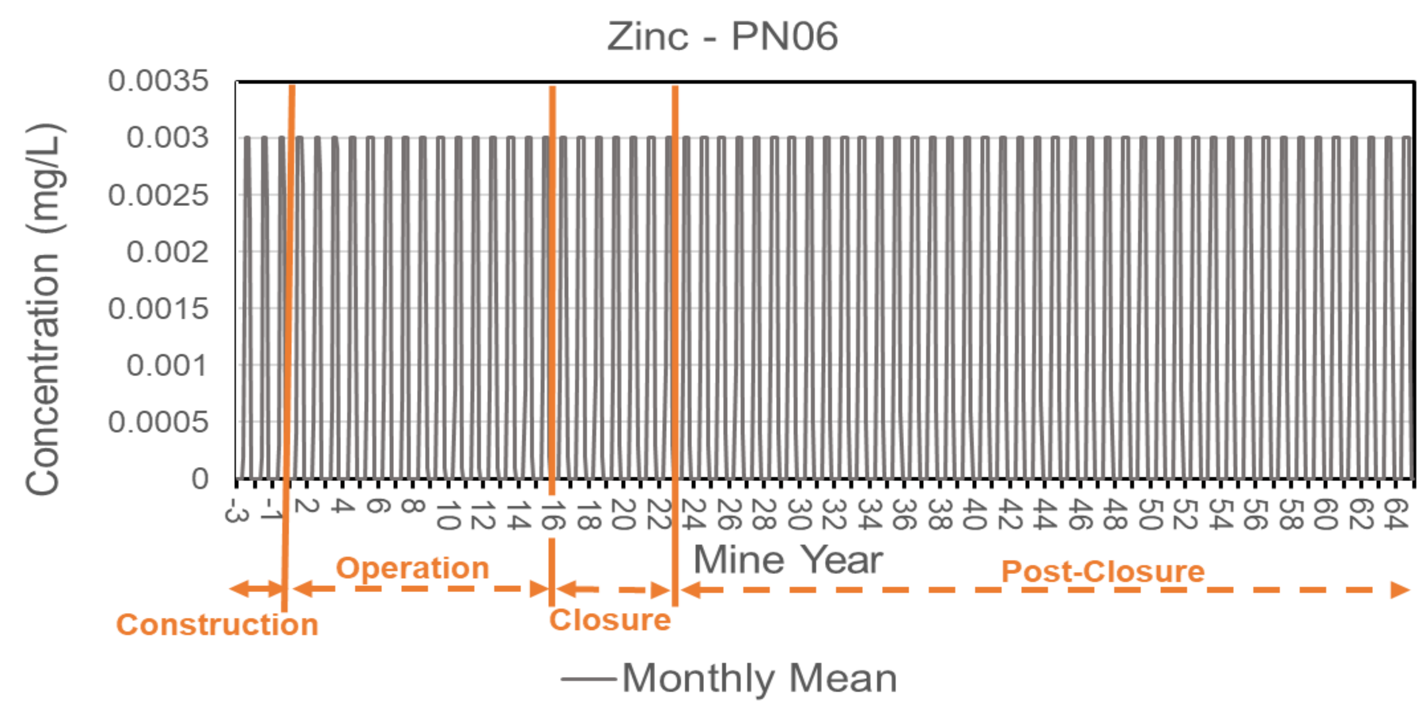

Total Cyanide - PN06
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

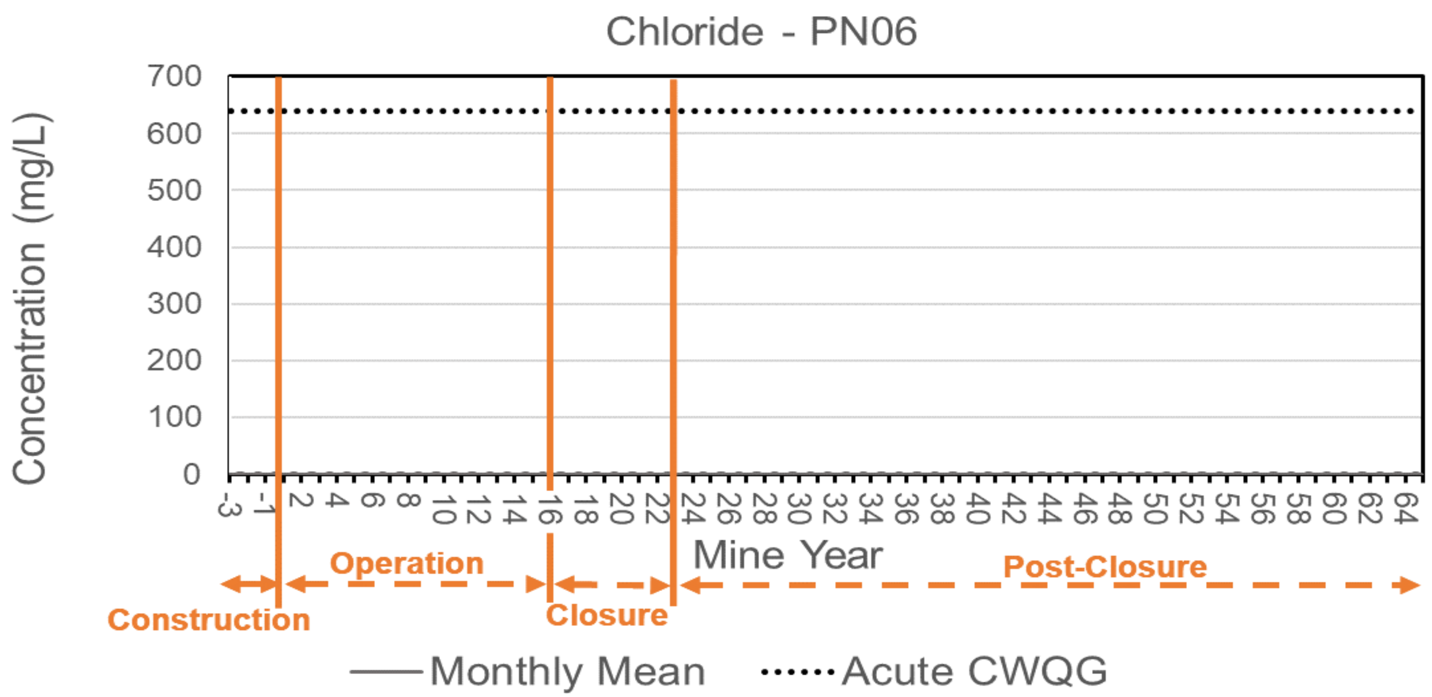

Total Cyanide - PN06
Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

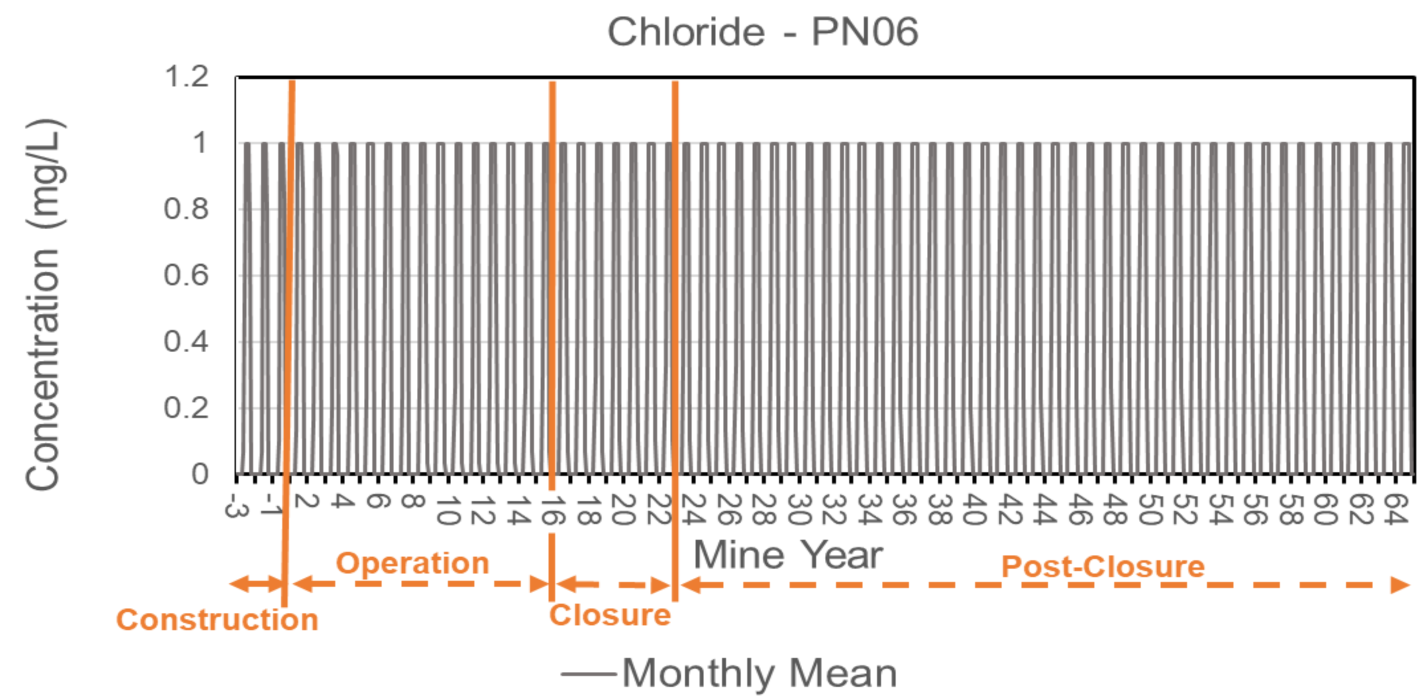

Un-ionized Ammonia - PN06
Concentration (mg-N/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

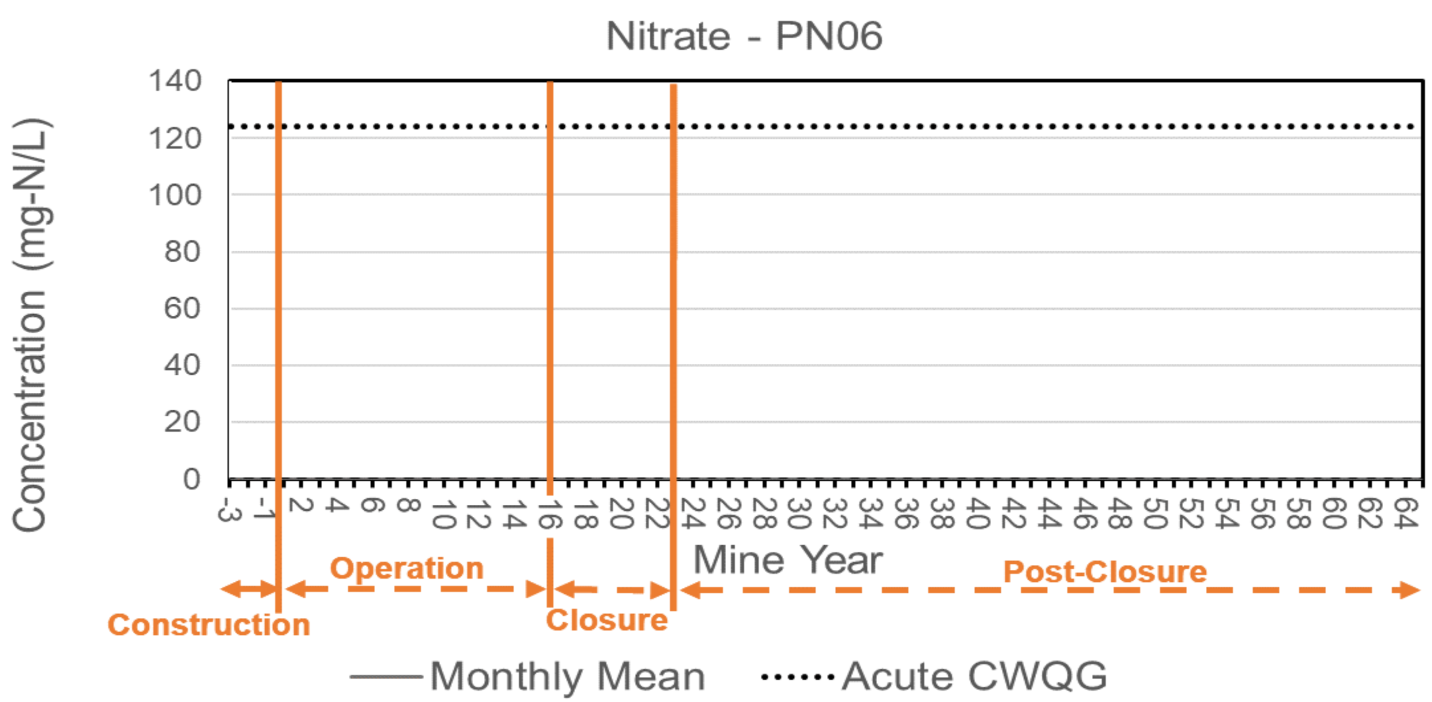

Un-ionized Ammonia - PN06
Concentration (mg-N/L)
0.00005
0.000045
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

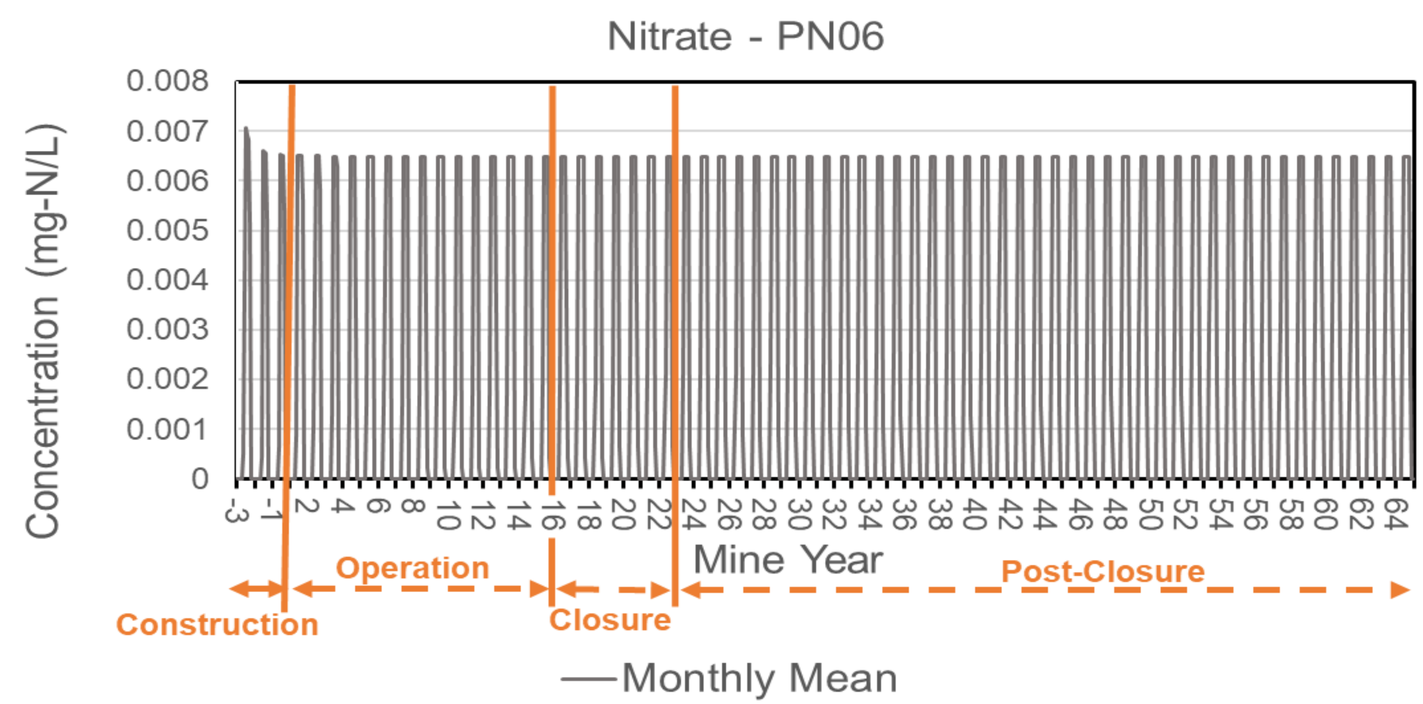

Zinc - PN06
Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Acute CWQG

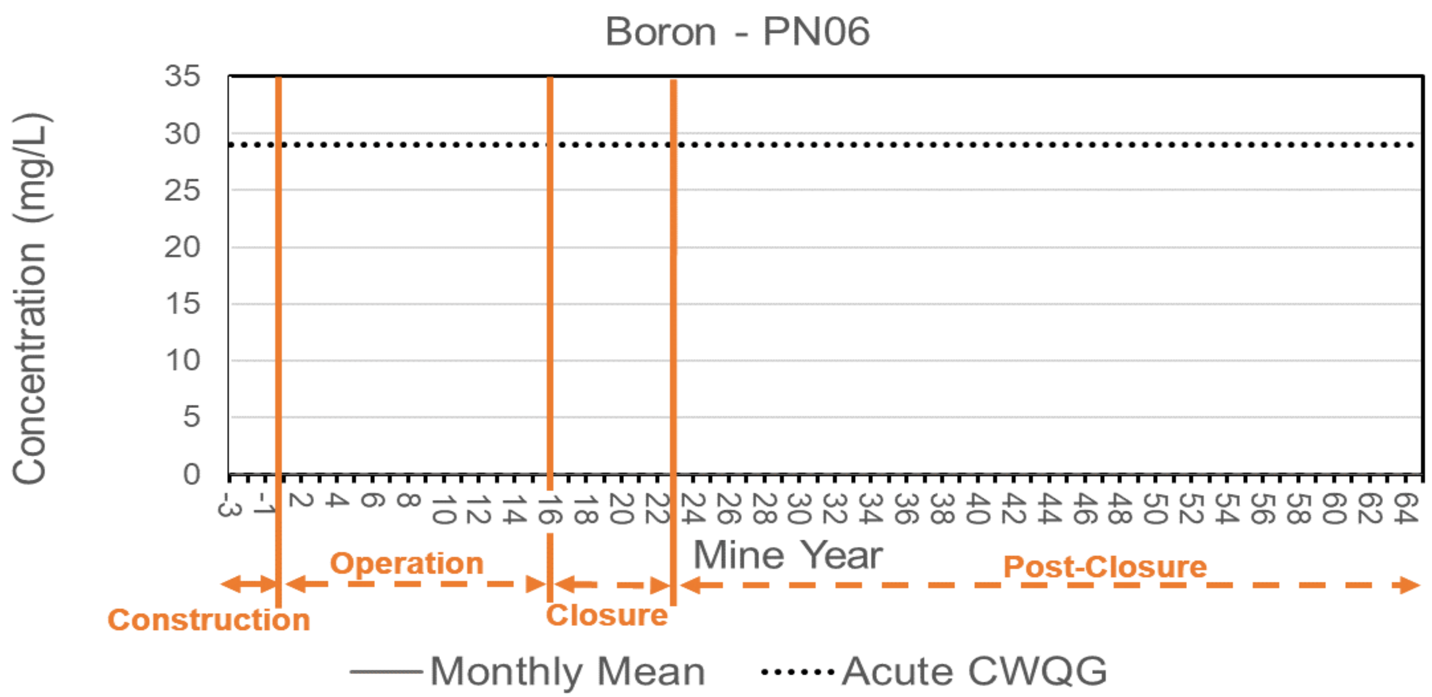

Zinc - PN06
Concentration (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

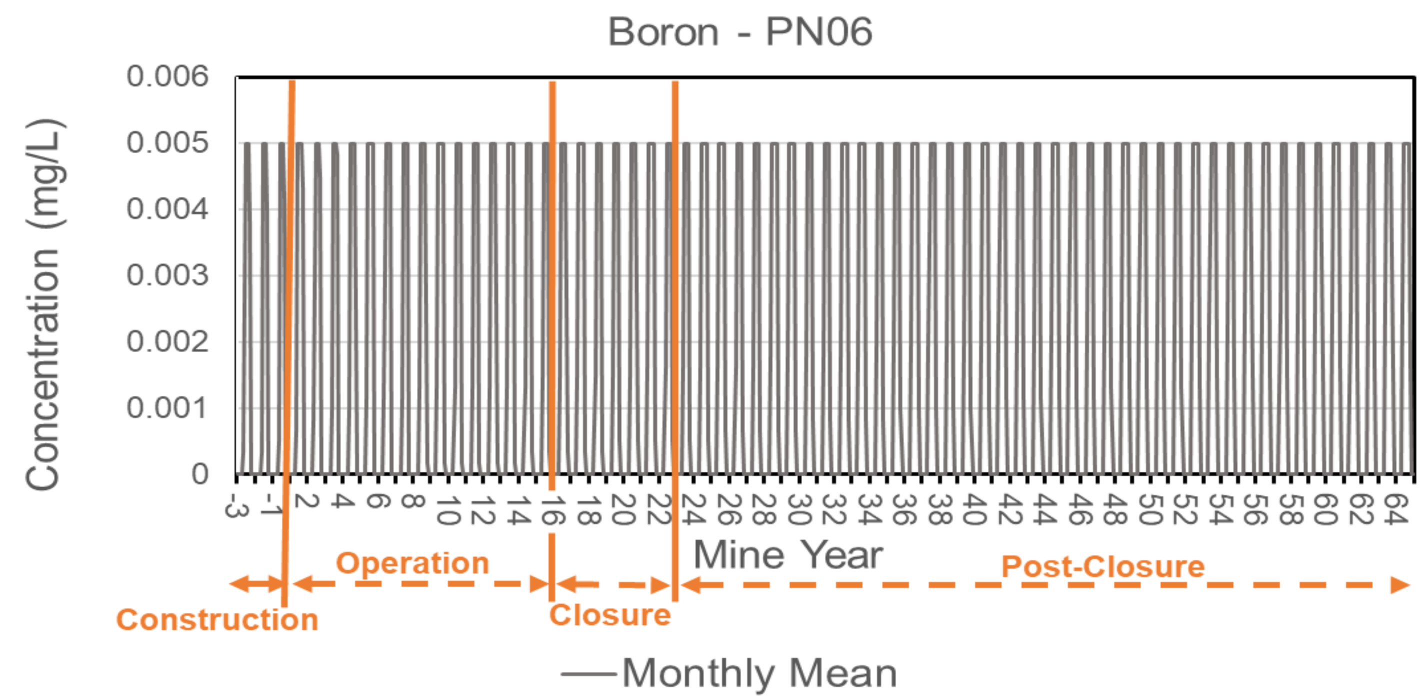

Chloride - PN06
Concentration (mg/L)
700
600
500
400
300
200
100
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

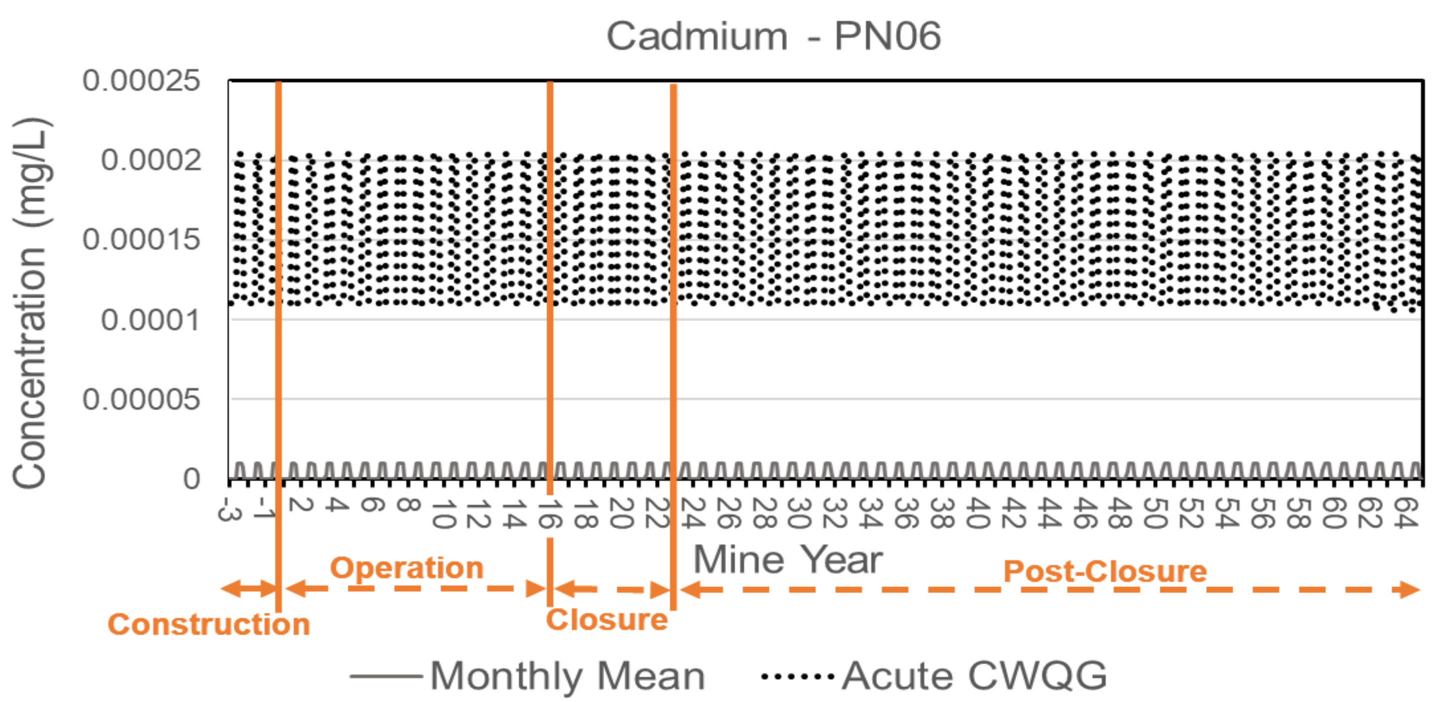

Chloride - PN06
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

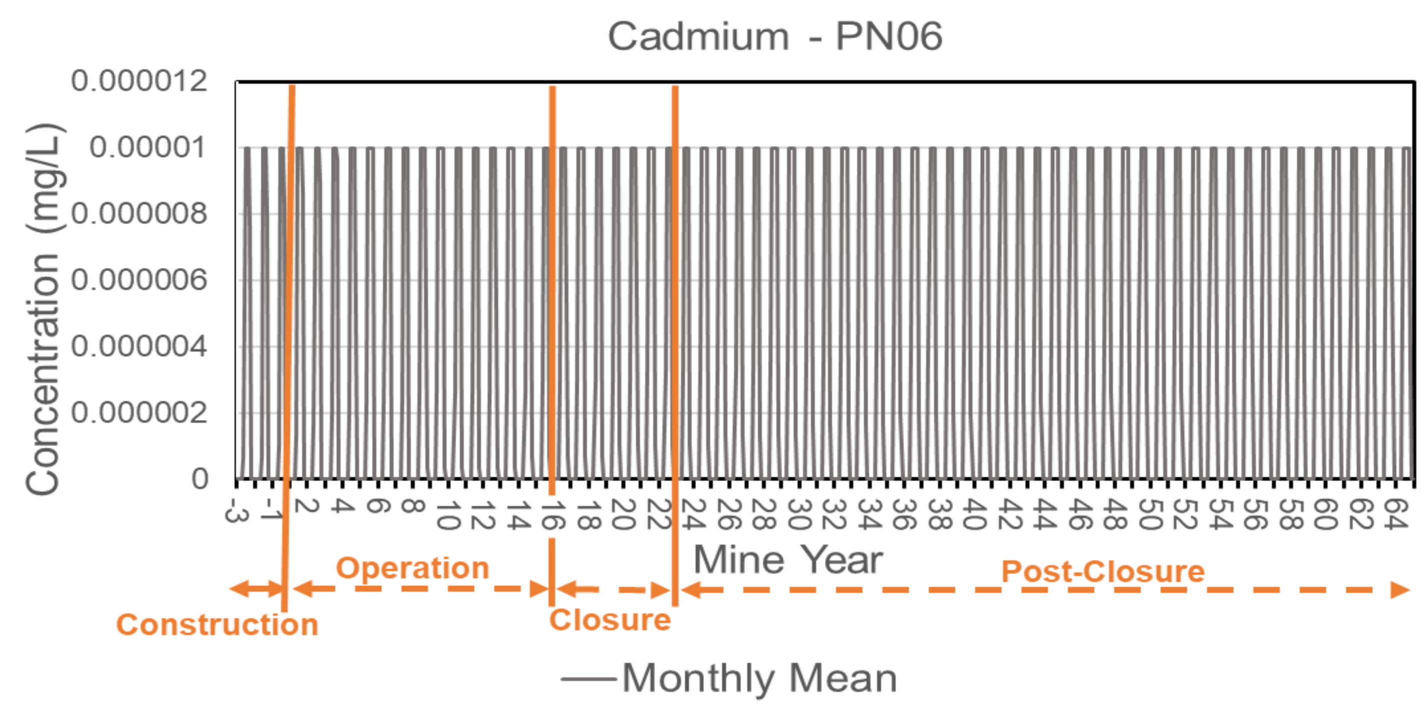

Nitrate - PN06
Concentration (mg-N/L)
140
120
100
80
60
40
20
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

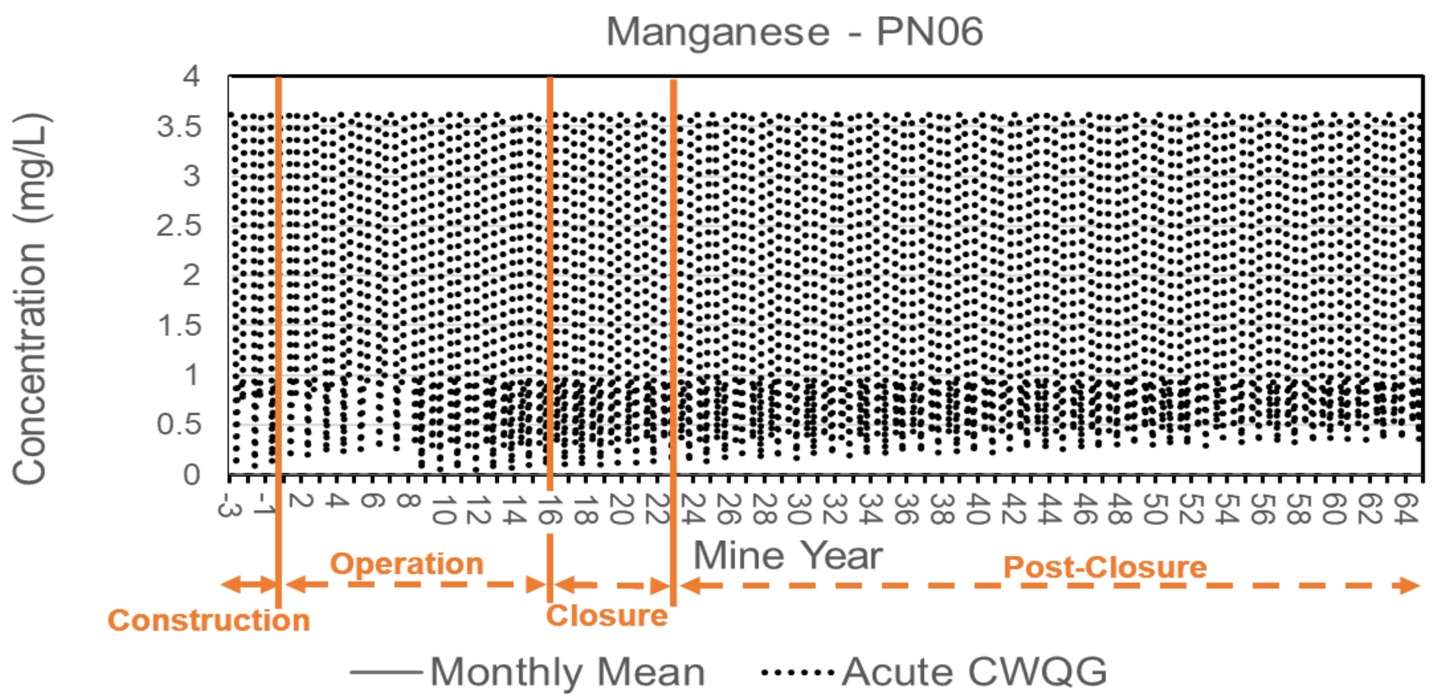

Nitrate - PN06
Concentration (mg-N/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

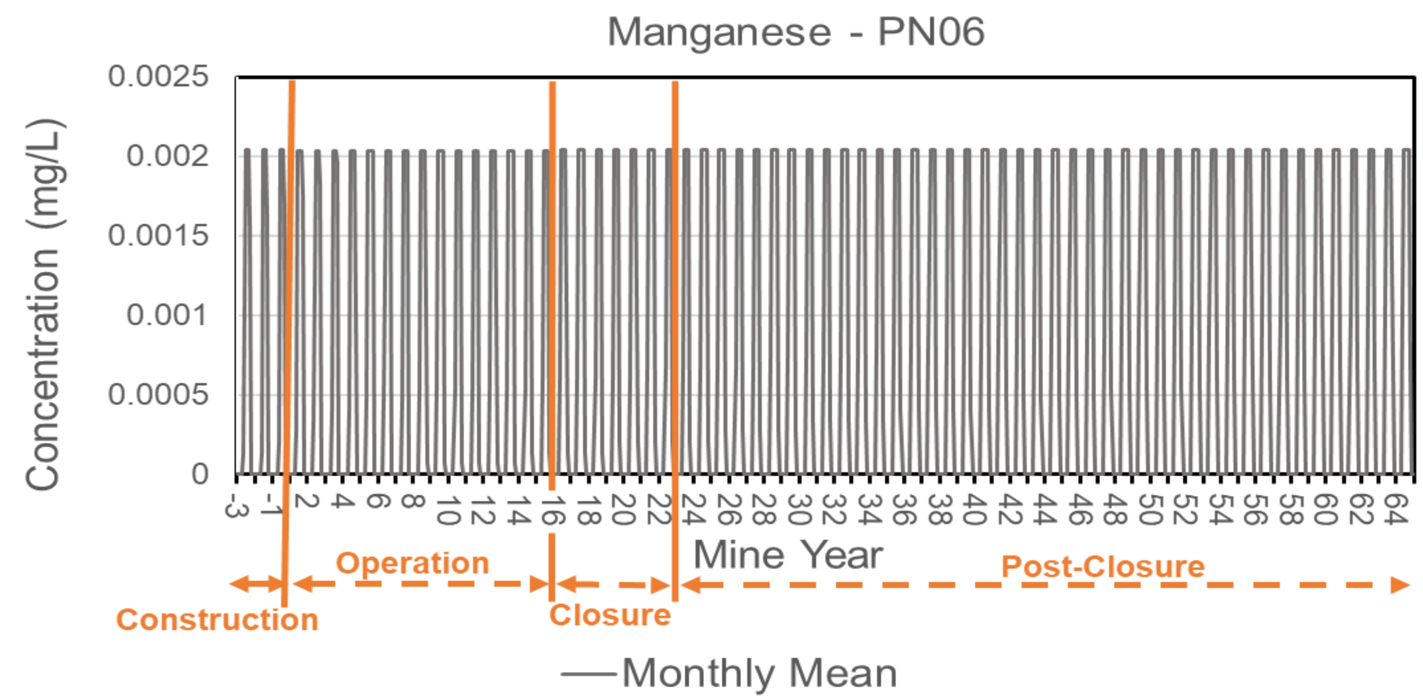

Boron - PN06
Concentration (mg/L)
35
30
25
20
15
10
5
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

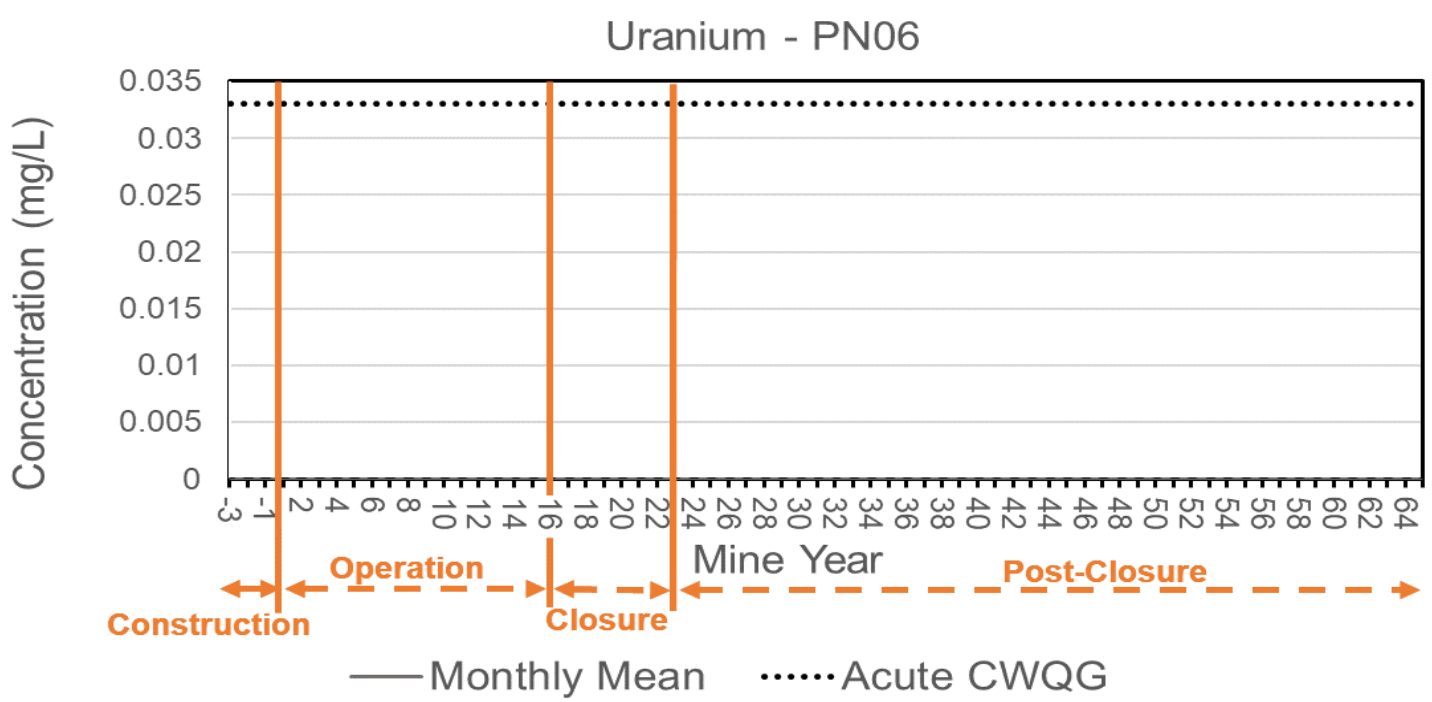

Boron - PN06
Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

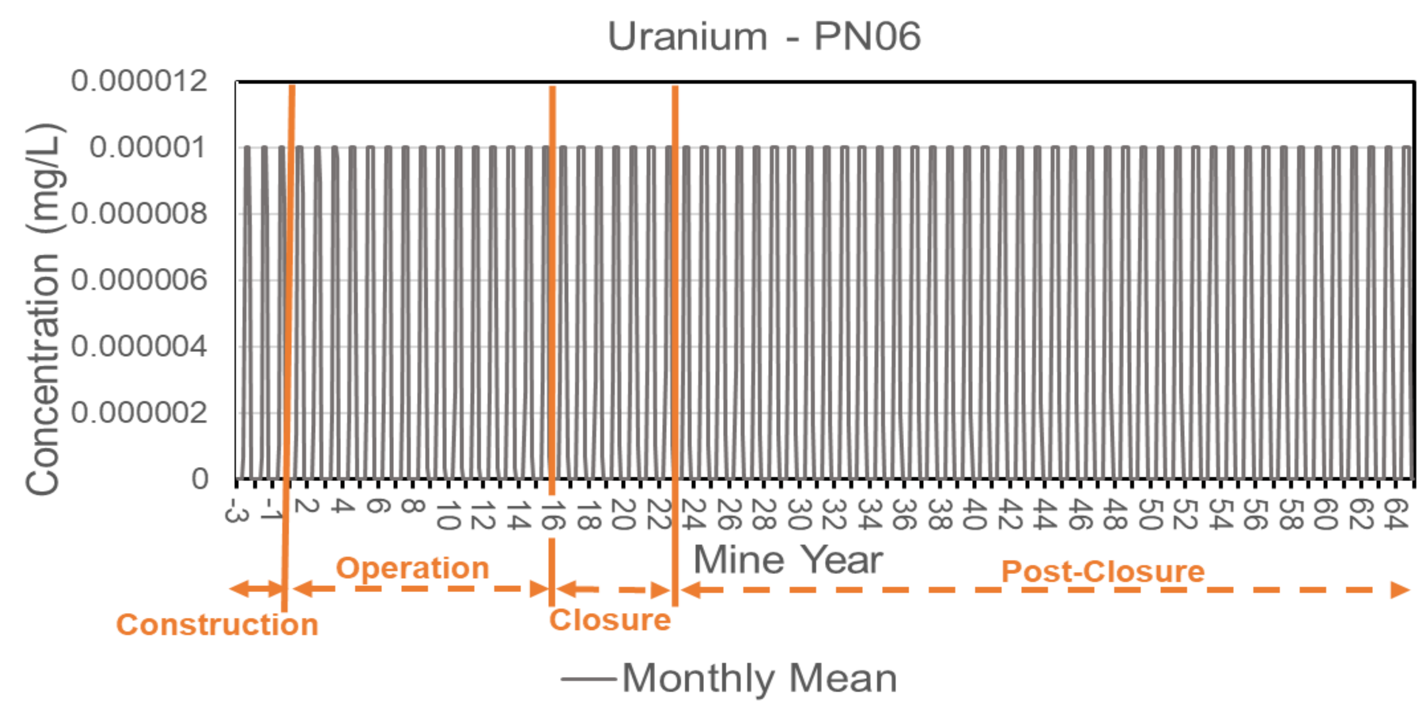

Cadmium - PN06
Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

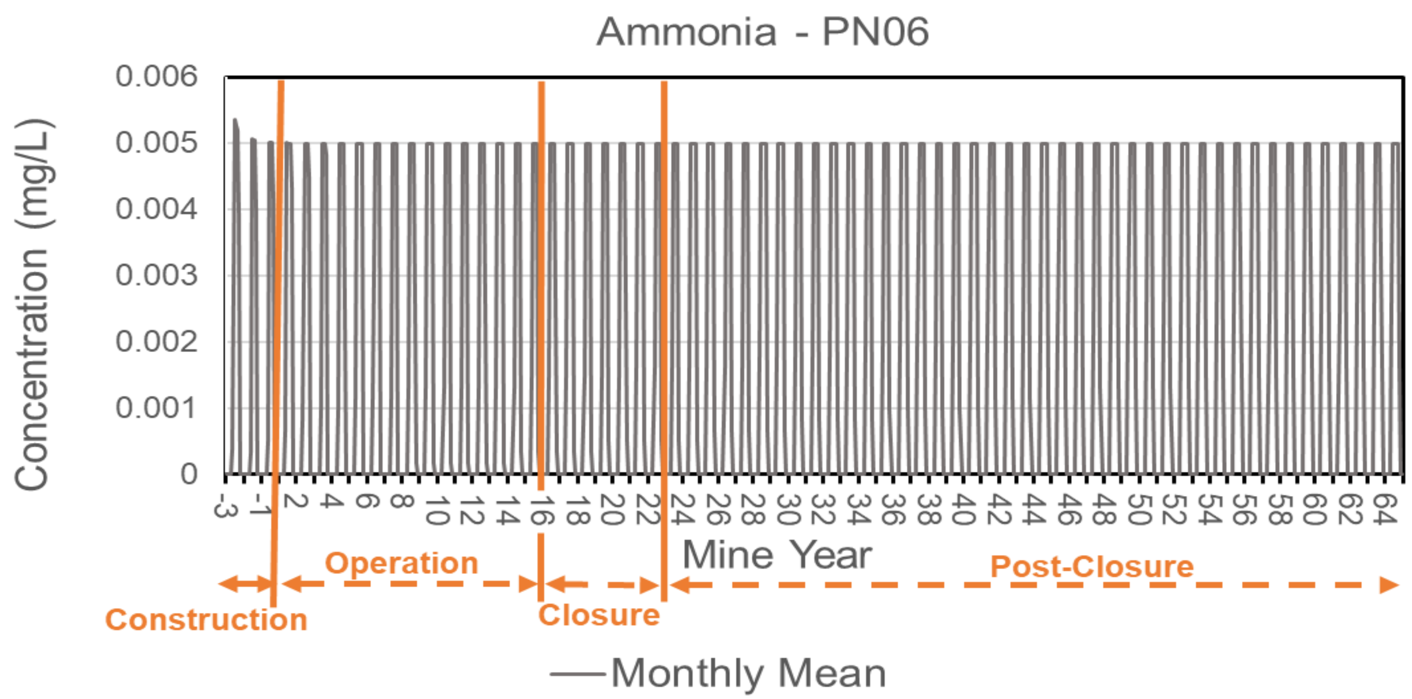

Cadmium - PN06
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Manganese - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

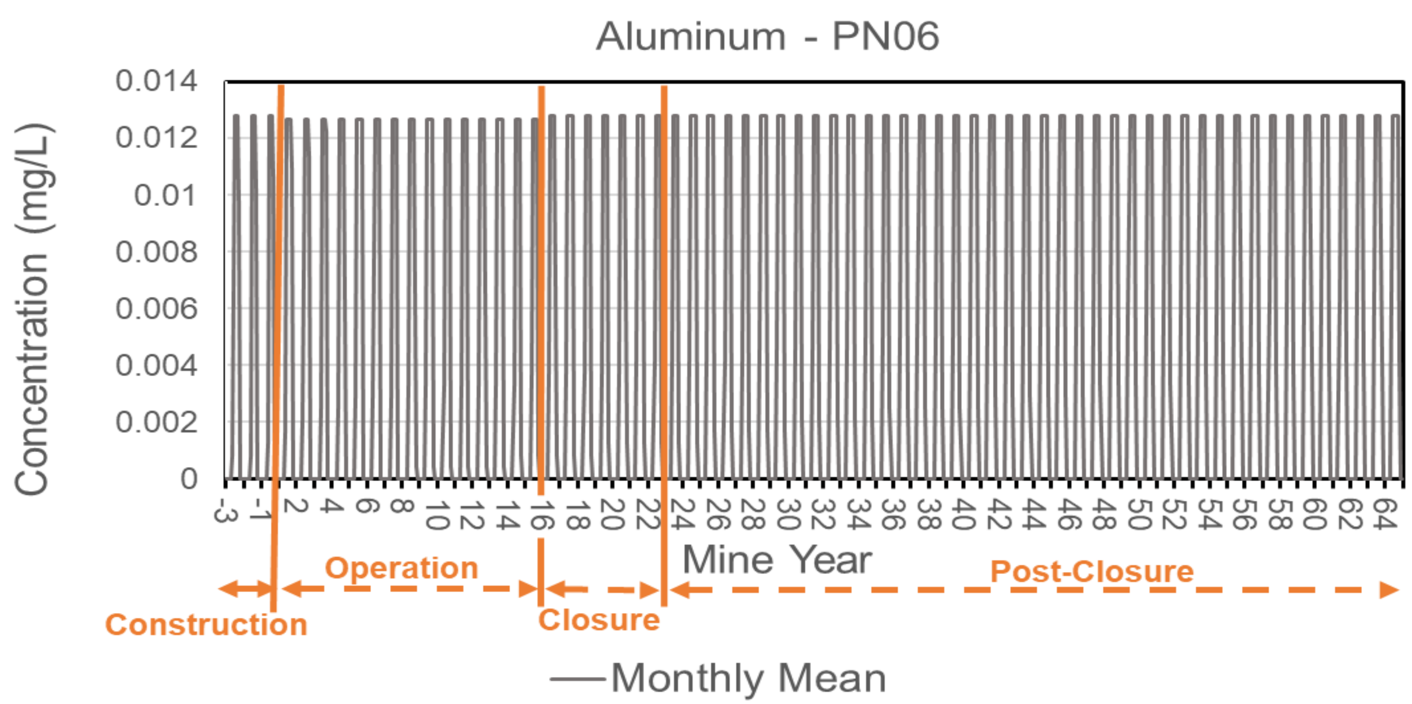

Manganese - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Uranium - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

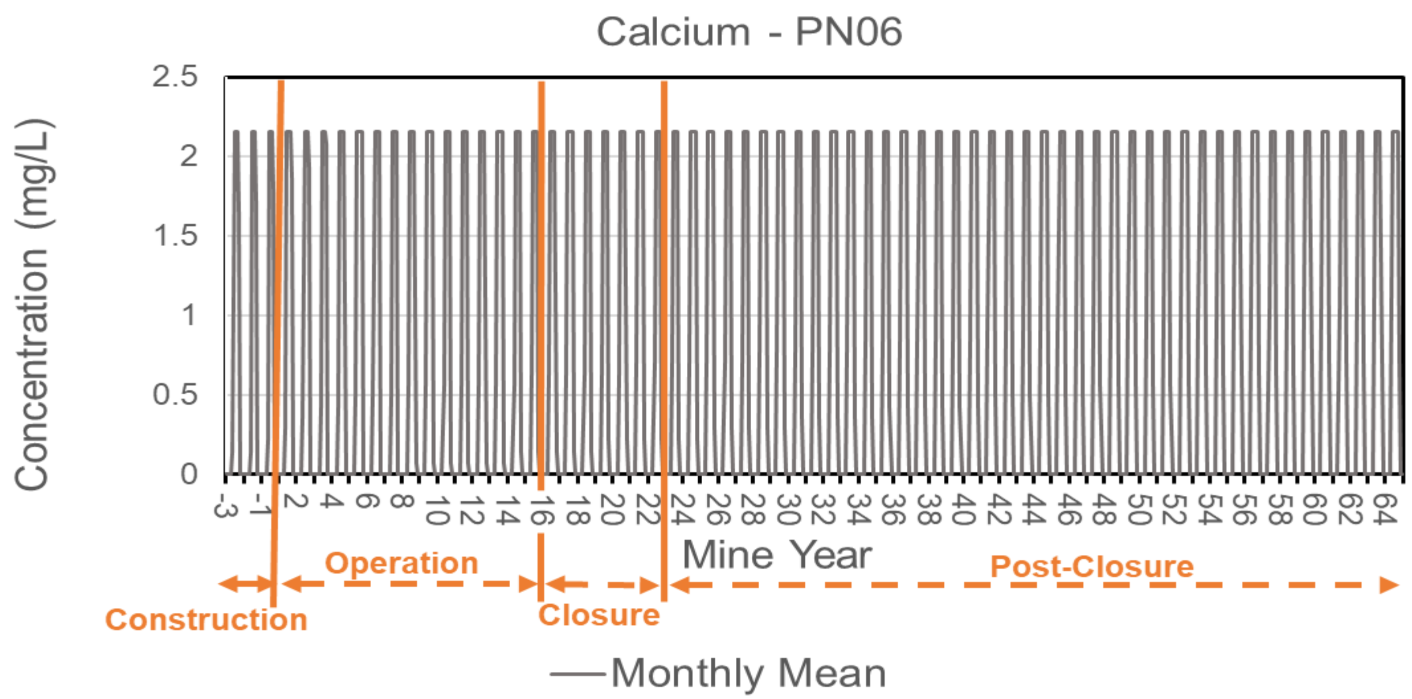

Uranium - PN06
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

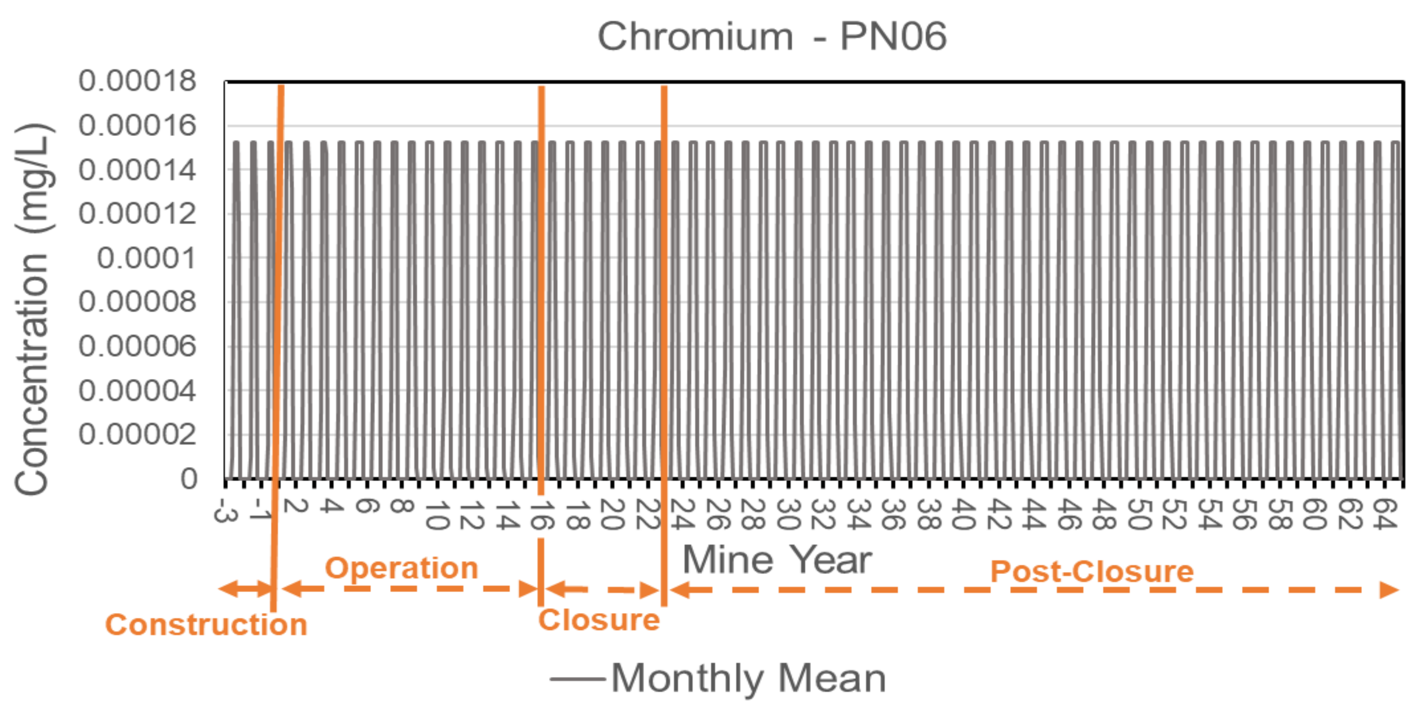


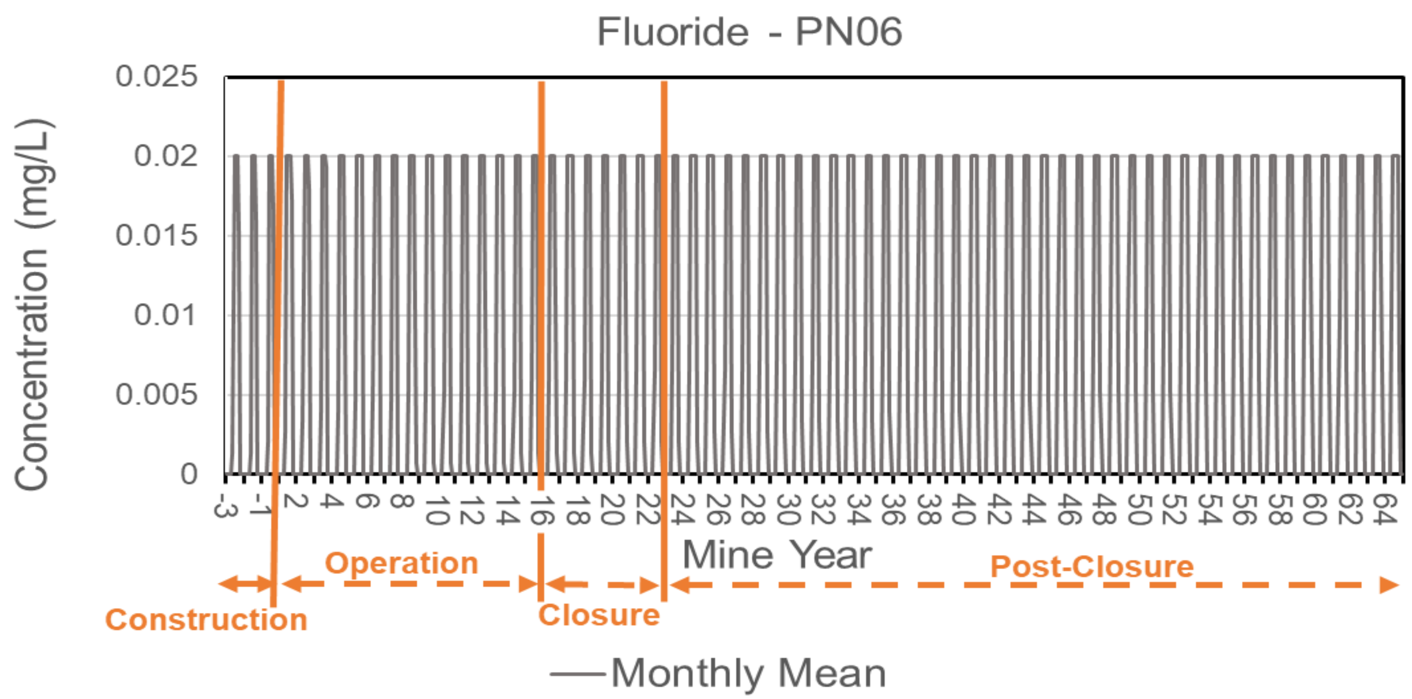
Ammonia - PN06
Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

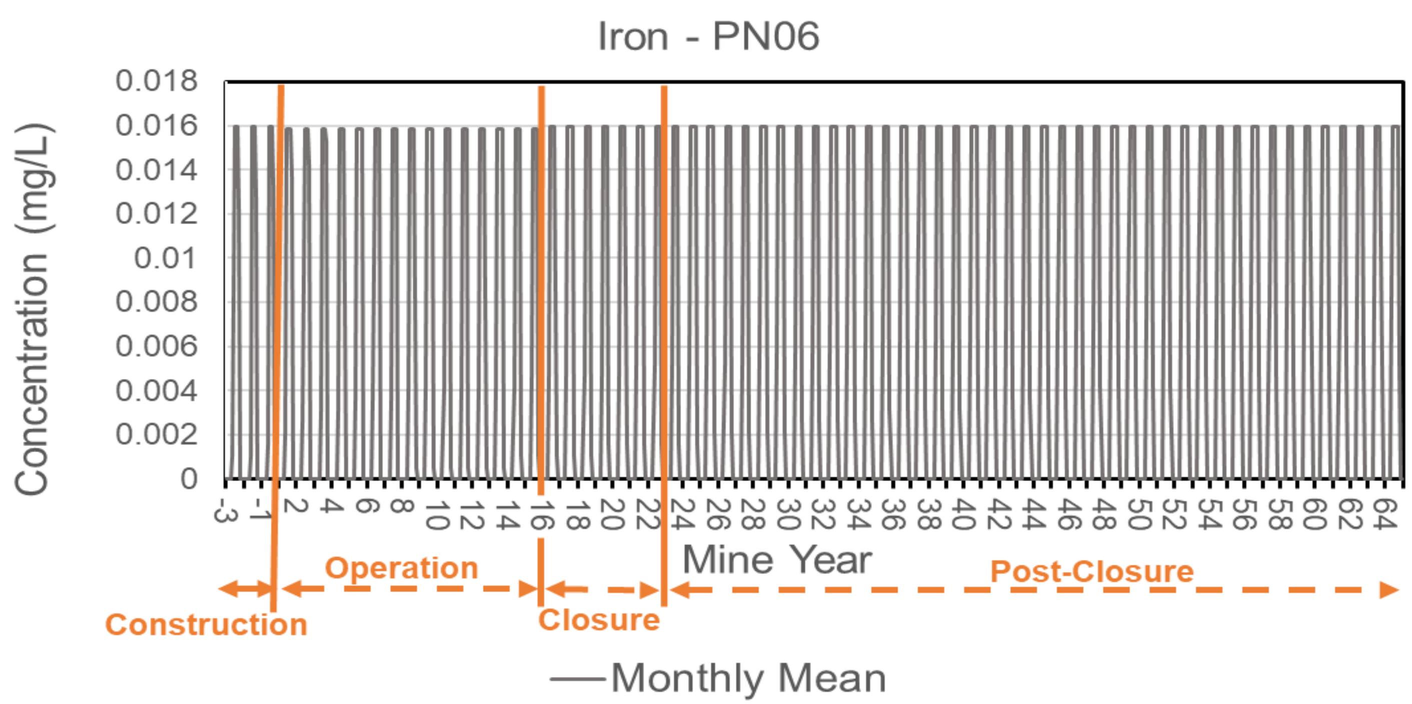


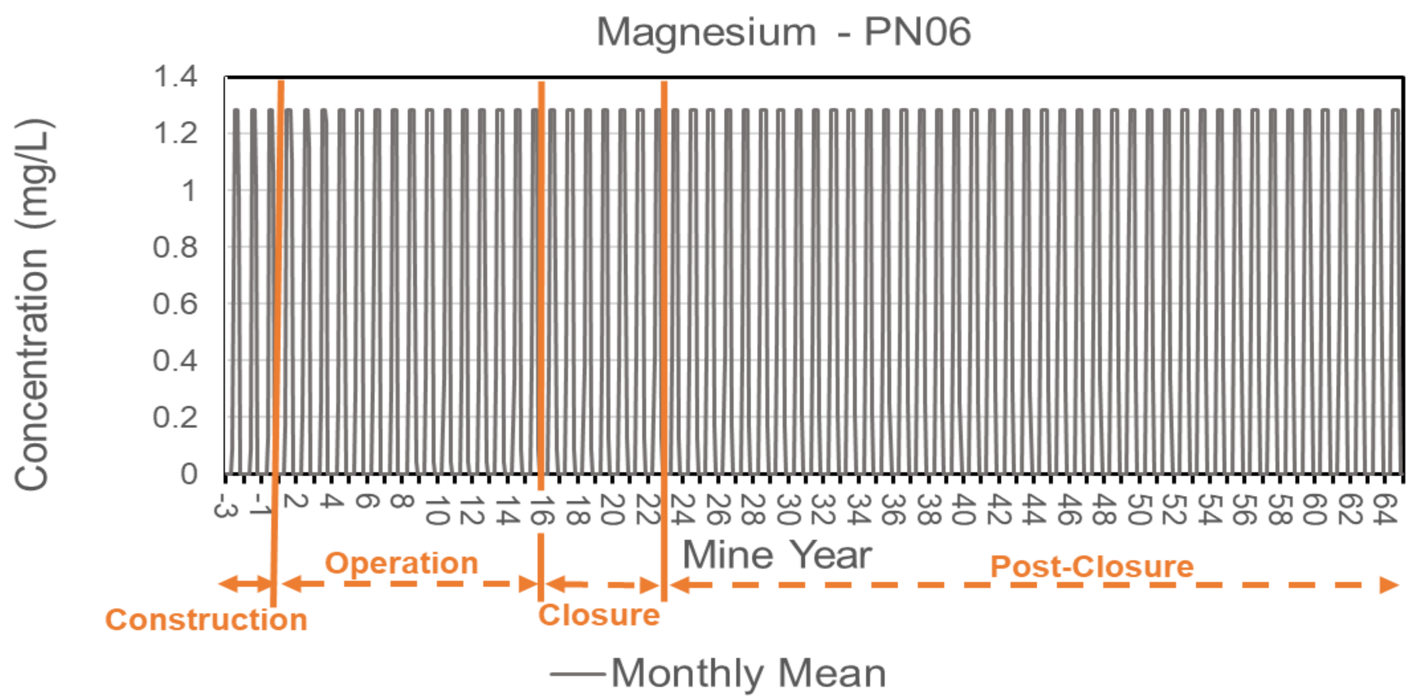
Aluminum - PN06
Concentration (mg/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

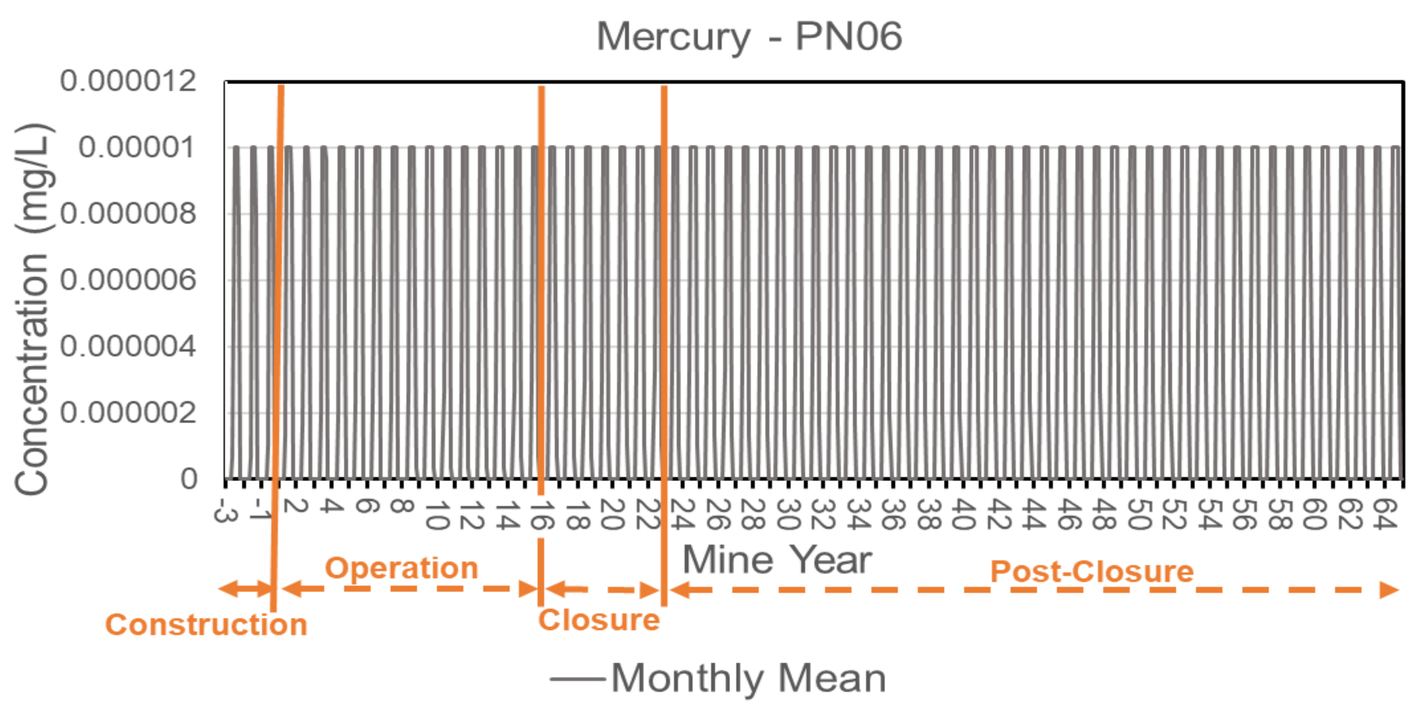

Calcium - PN06
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

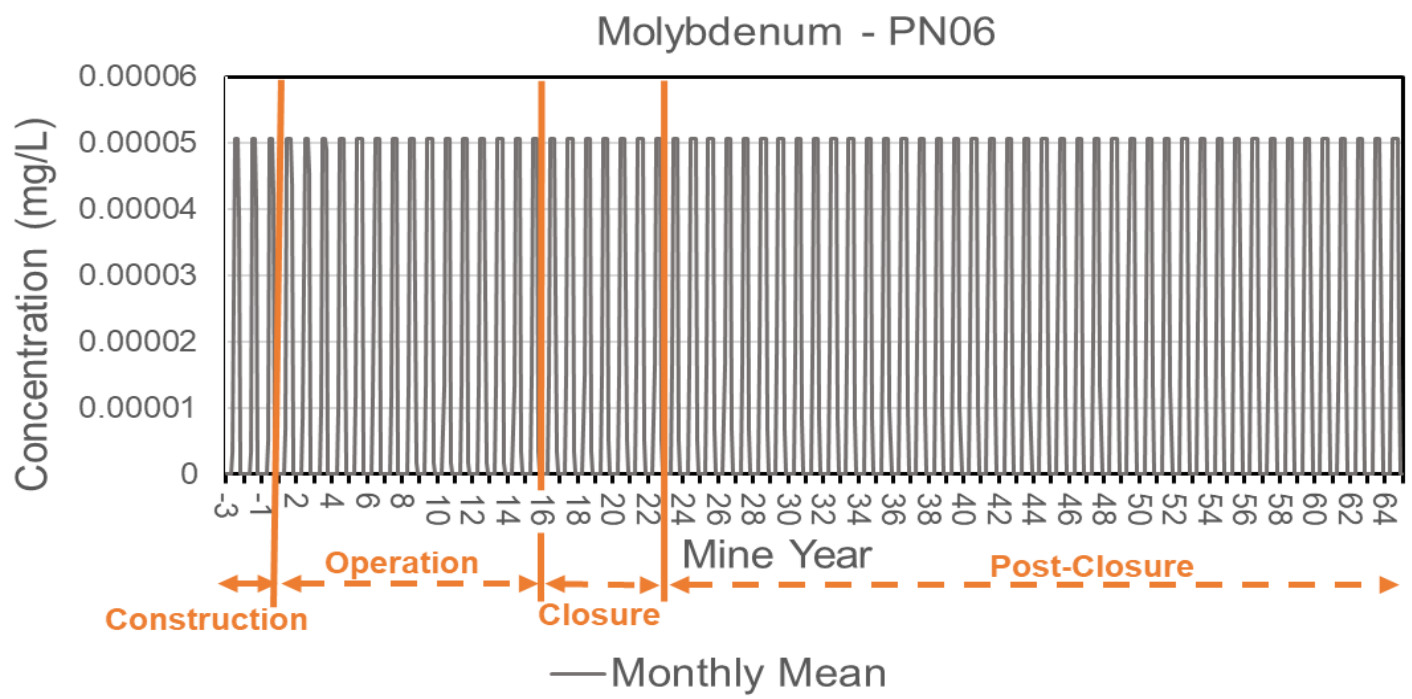

Chromium - PN06
Concentration (mg/L)
0.00018
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

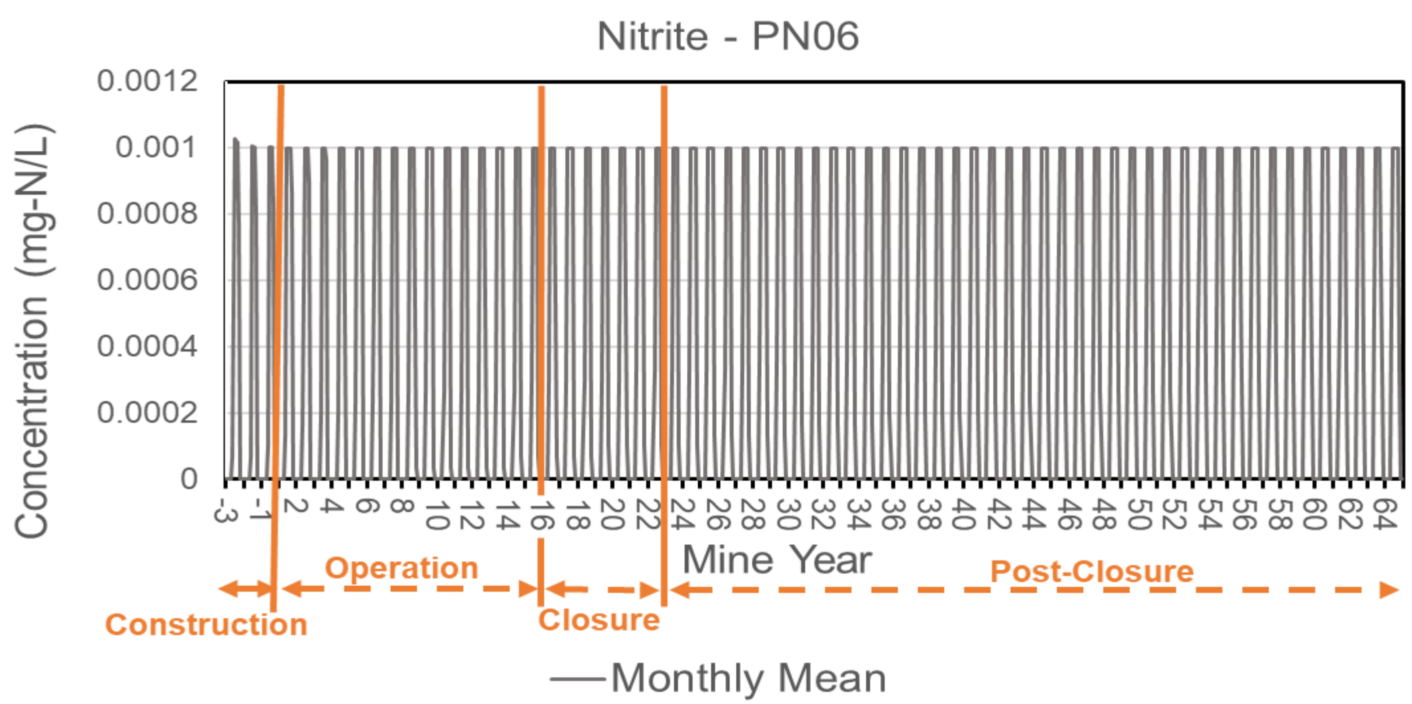

Fluoride - PN06
Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

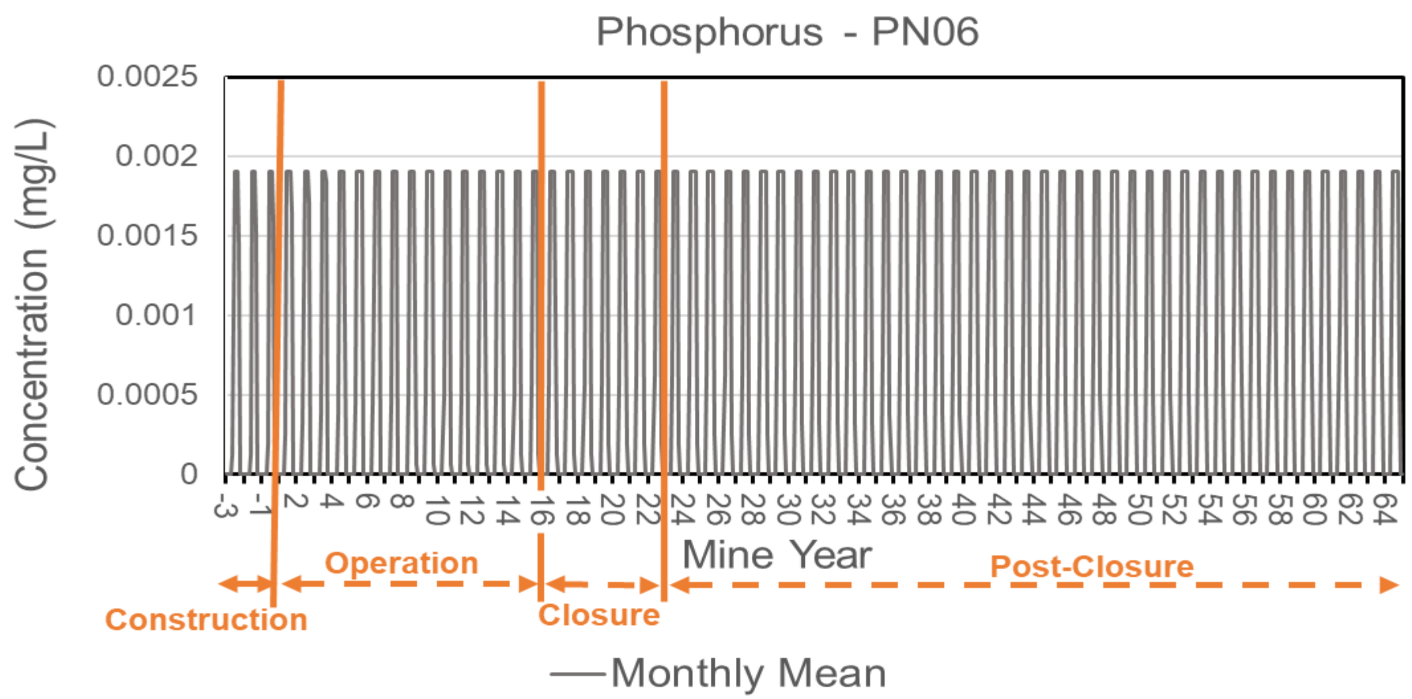

Iron - PN06
Concentration (mg/L)
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

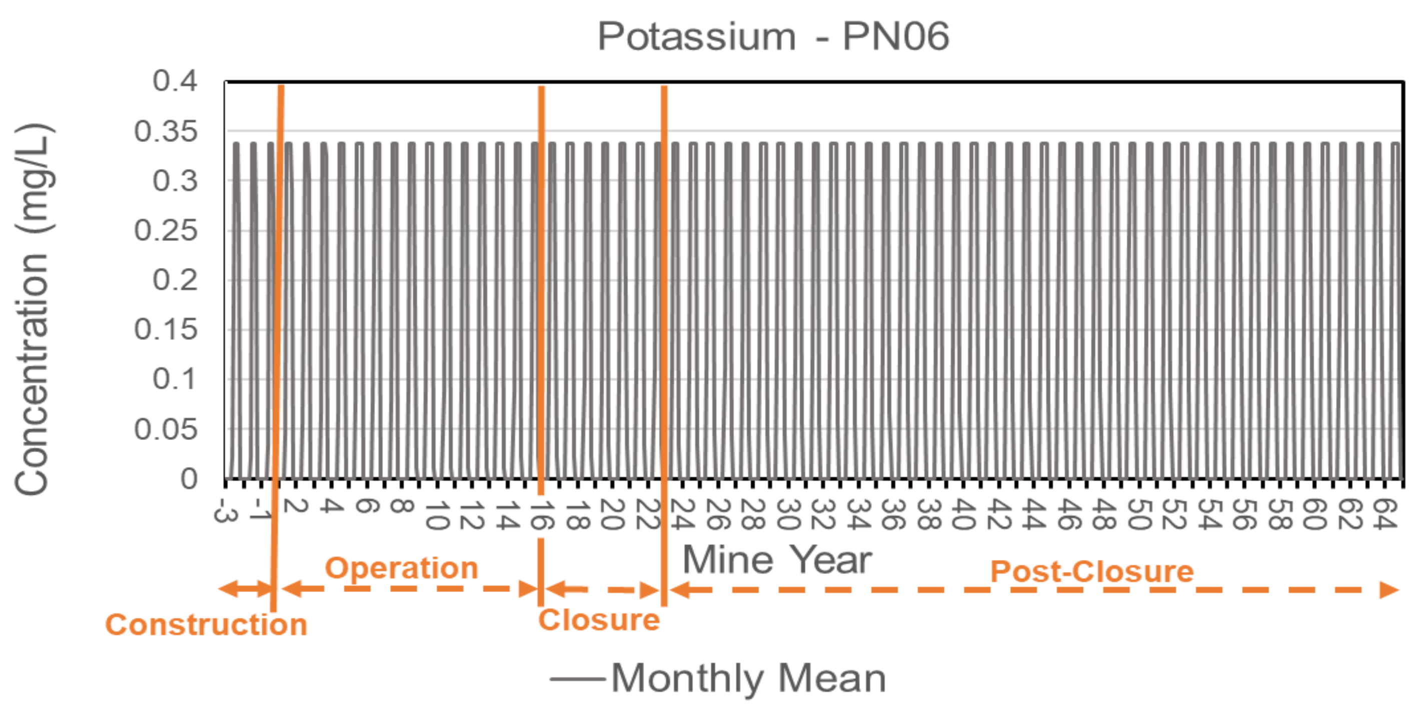

Magnesium - PN06
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

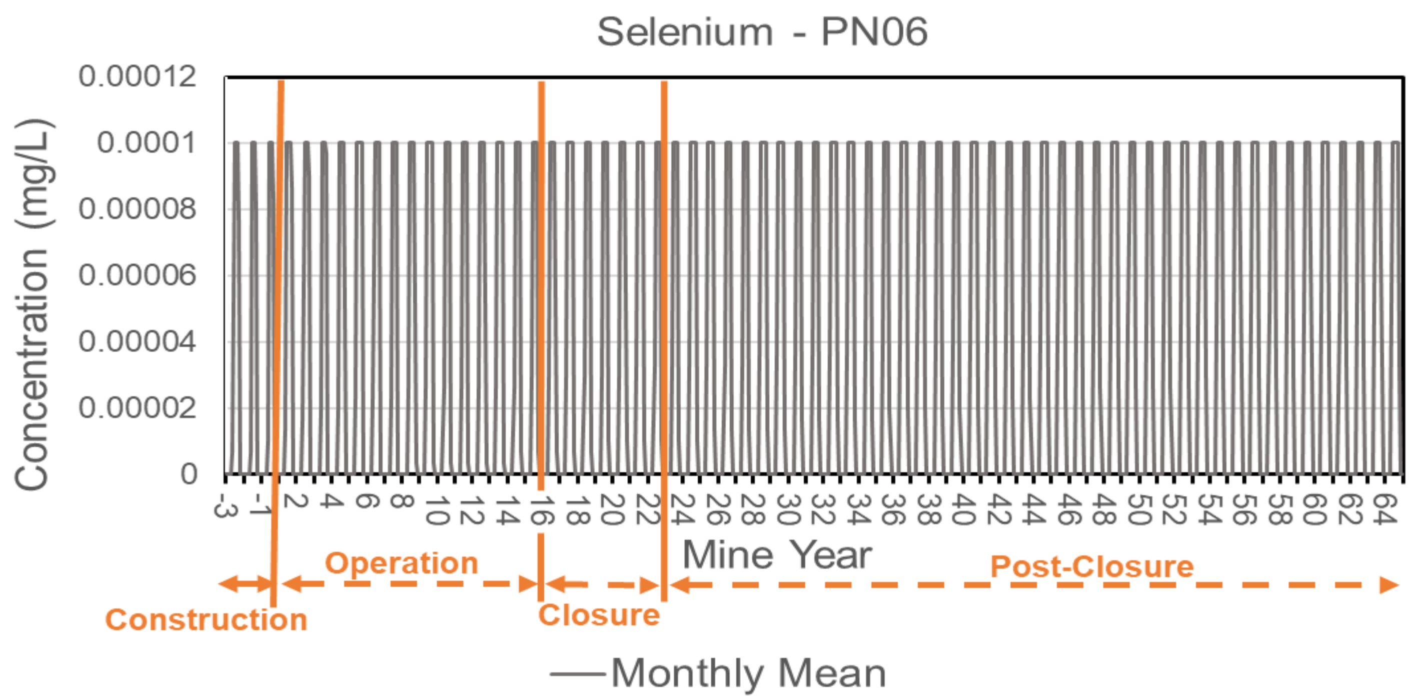

Mercury - PN06
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

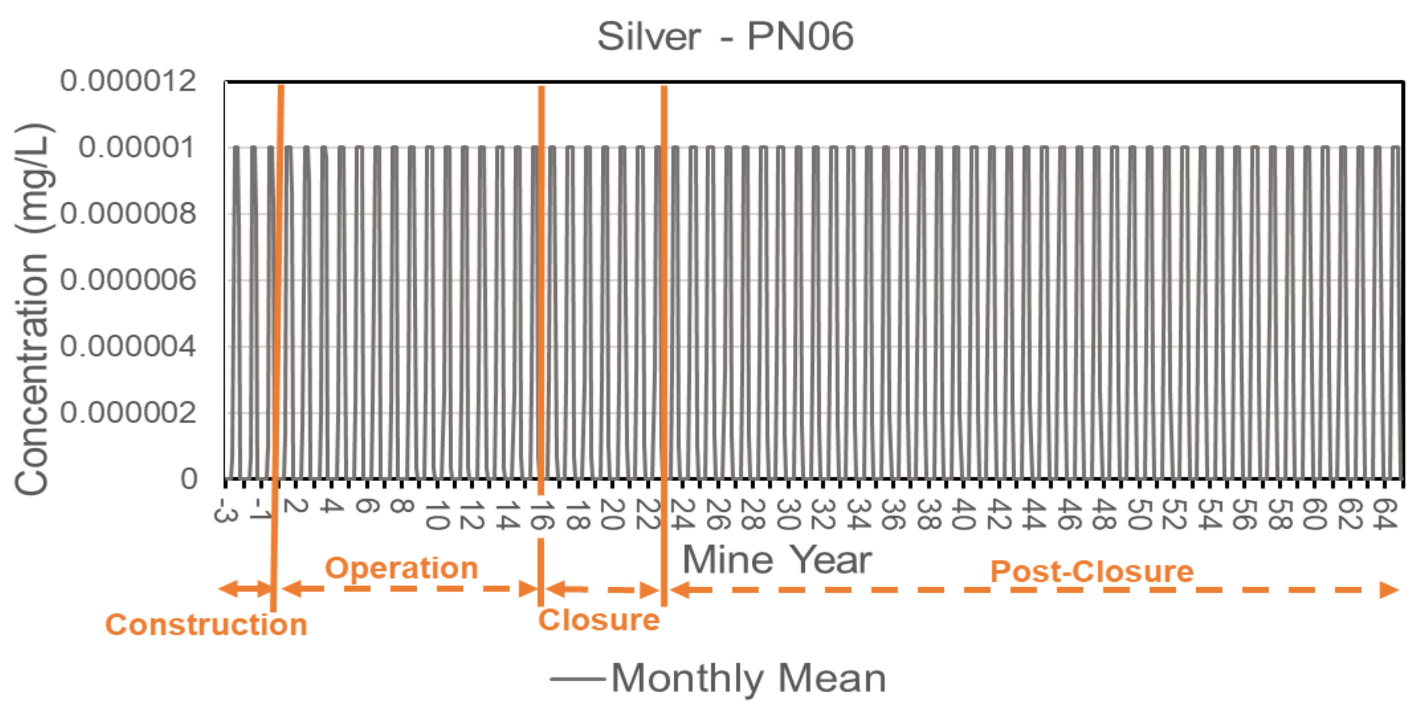

Molybdenum - PN06
Concentration (mg/L)
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

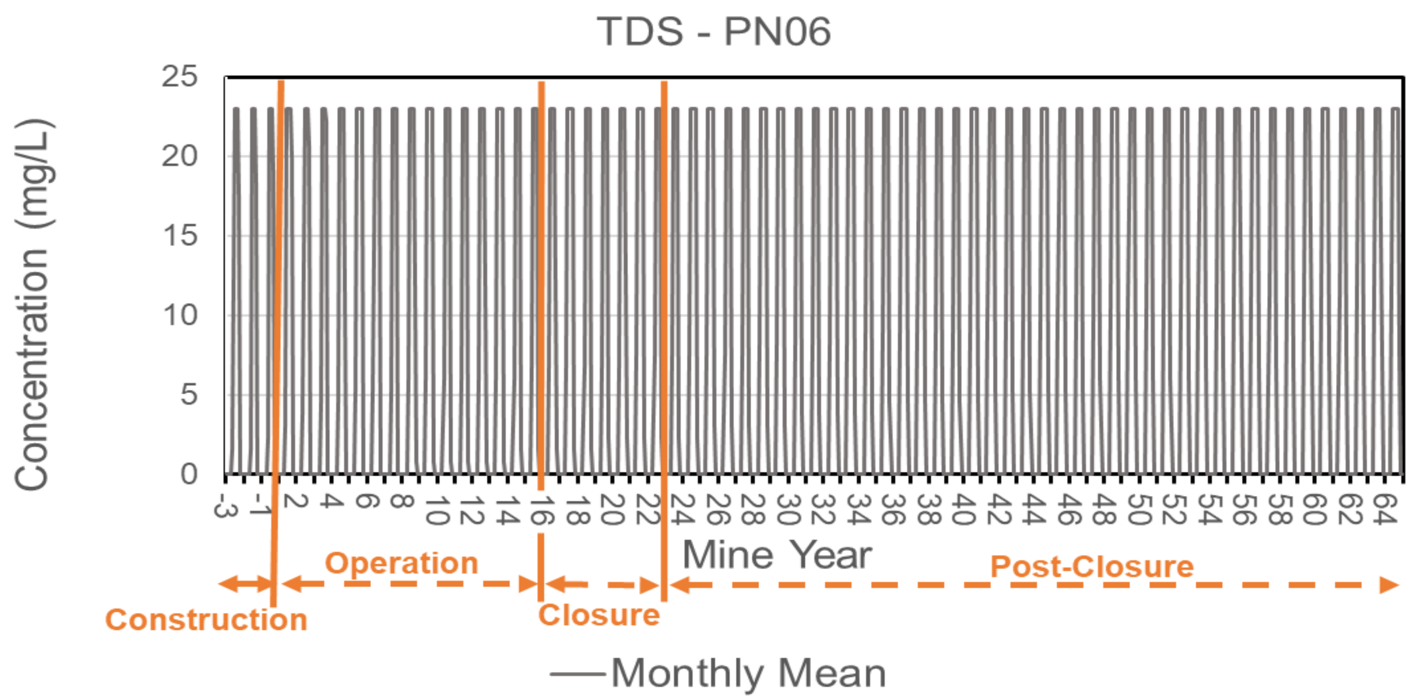

Nitrite - PN06
Concentration (mg-N/L)
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

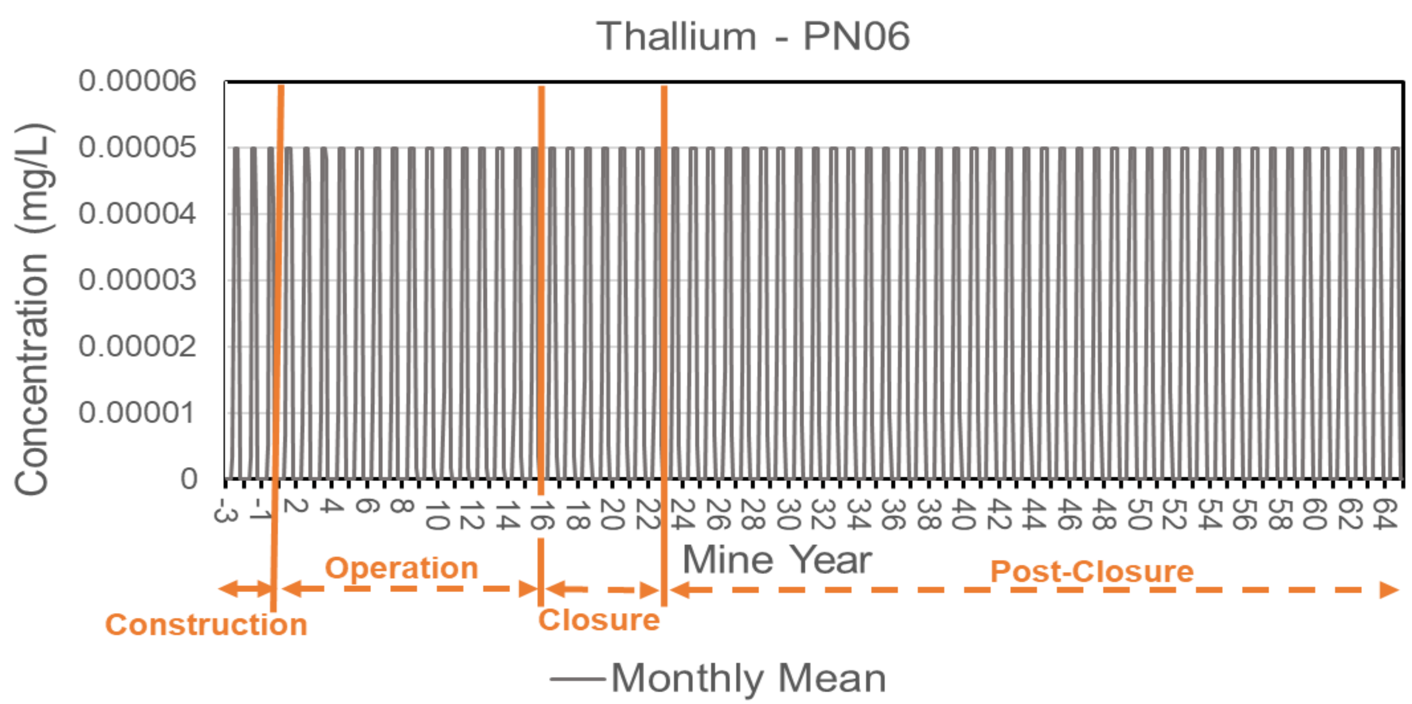

Phosphorus - PN06
Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean


Potassium - PN06
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean


Selenium - PN06
Concentration (mg/L)
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

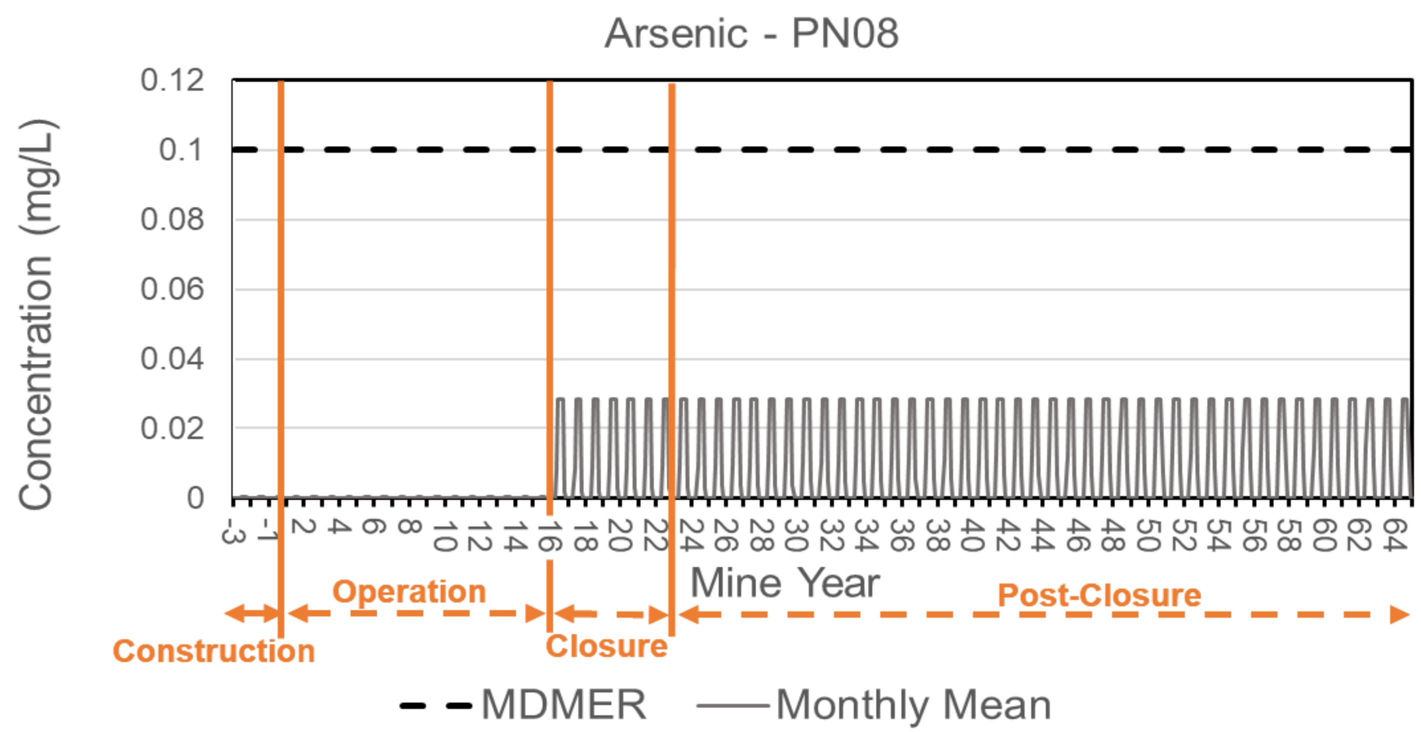

Silver - PN06
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

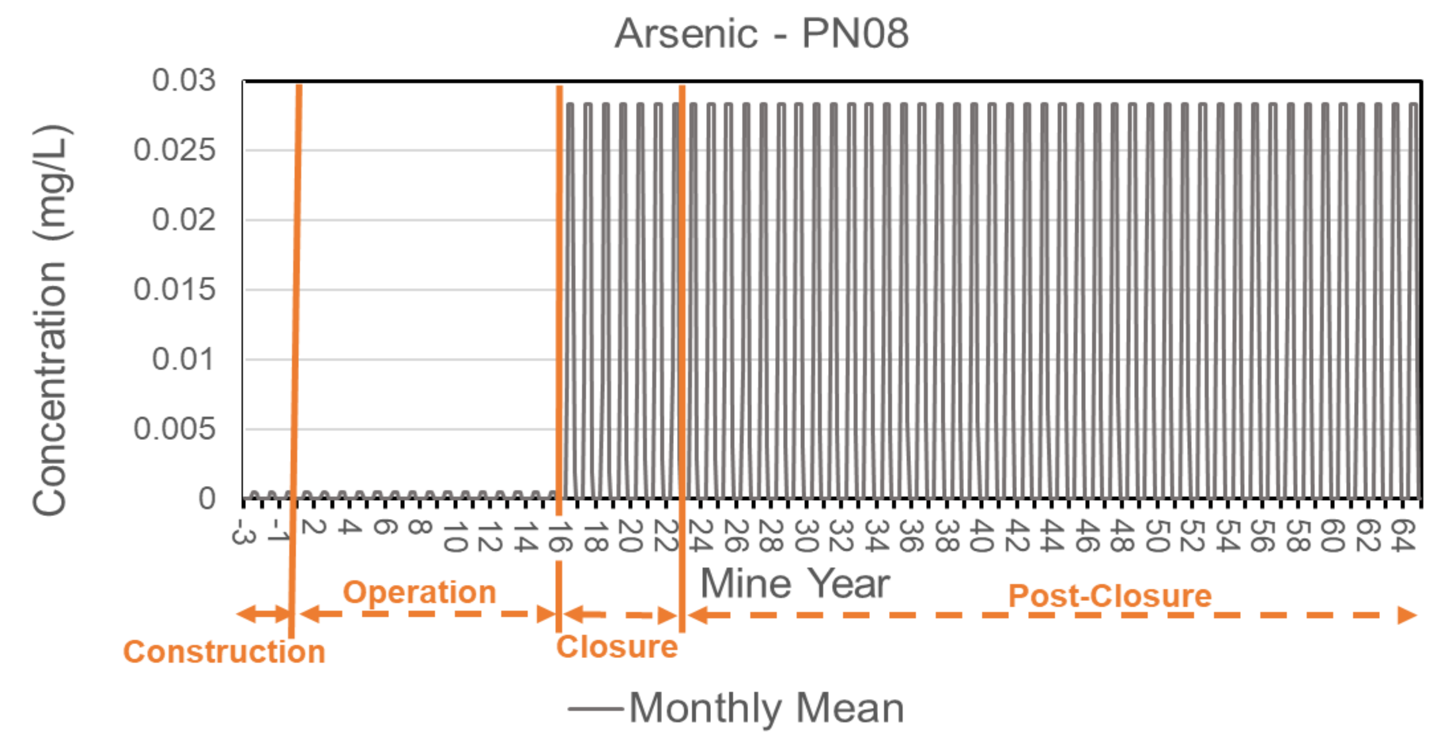


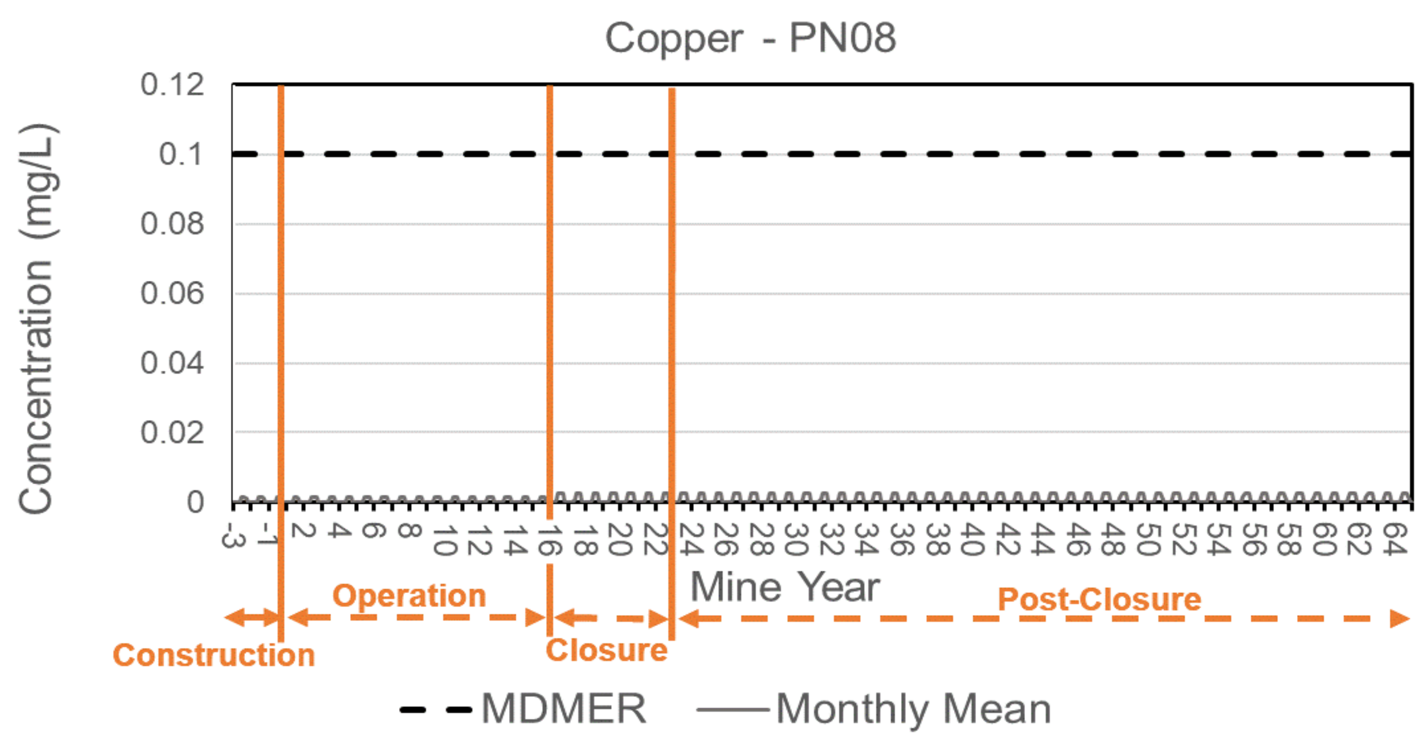


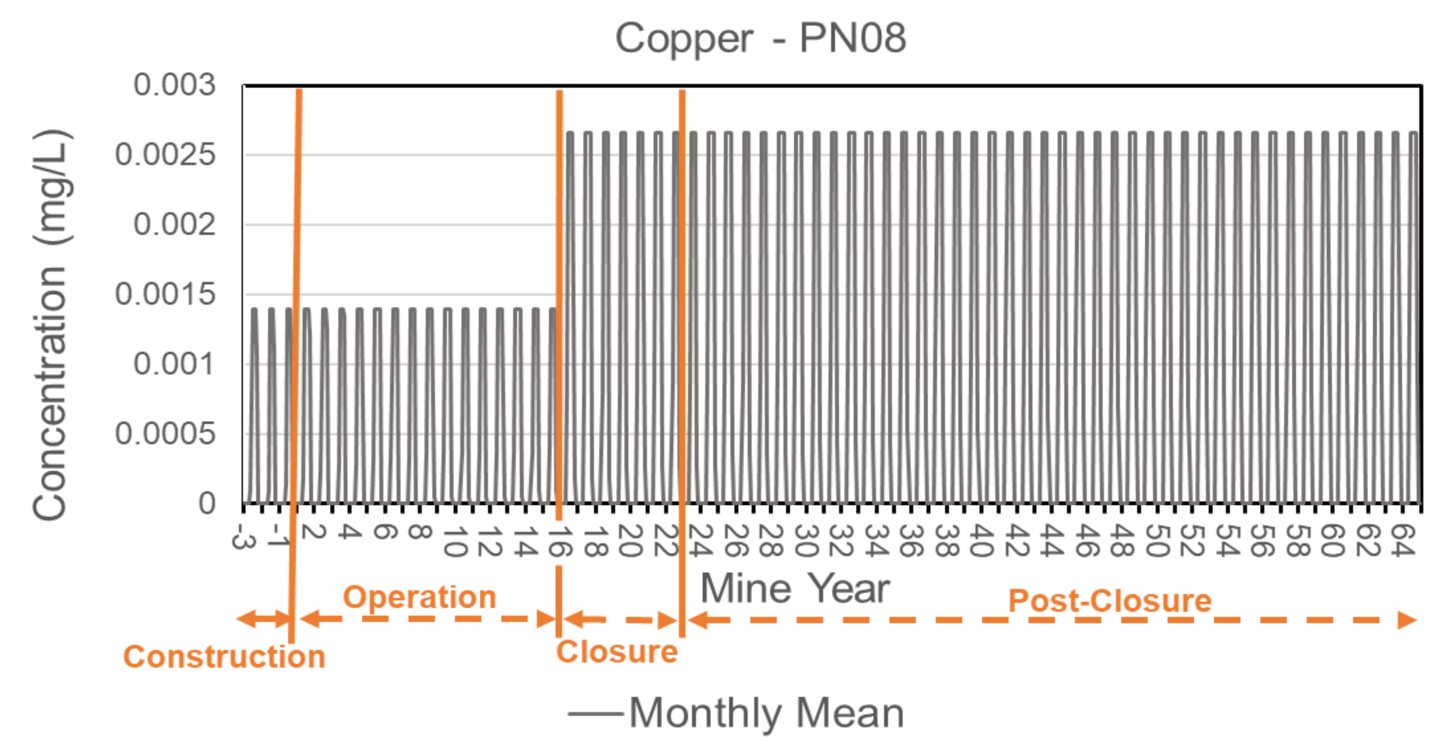
CWQG = Canadian Water Quality Guideline (from CCME 1999)

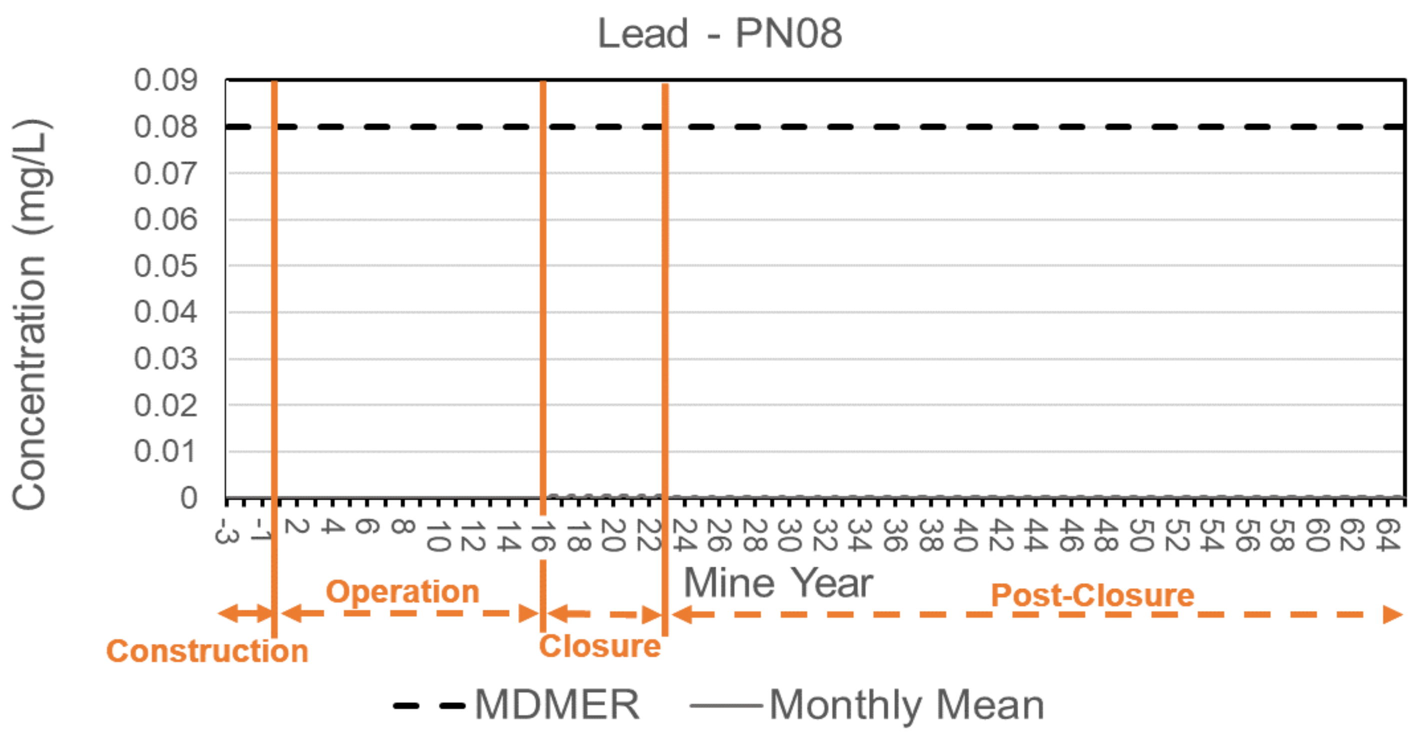
CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2019. Winnipeg, MB, Canada.

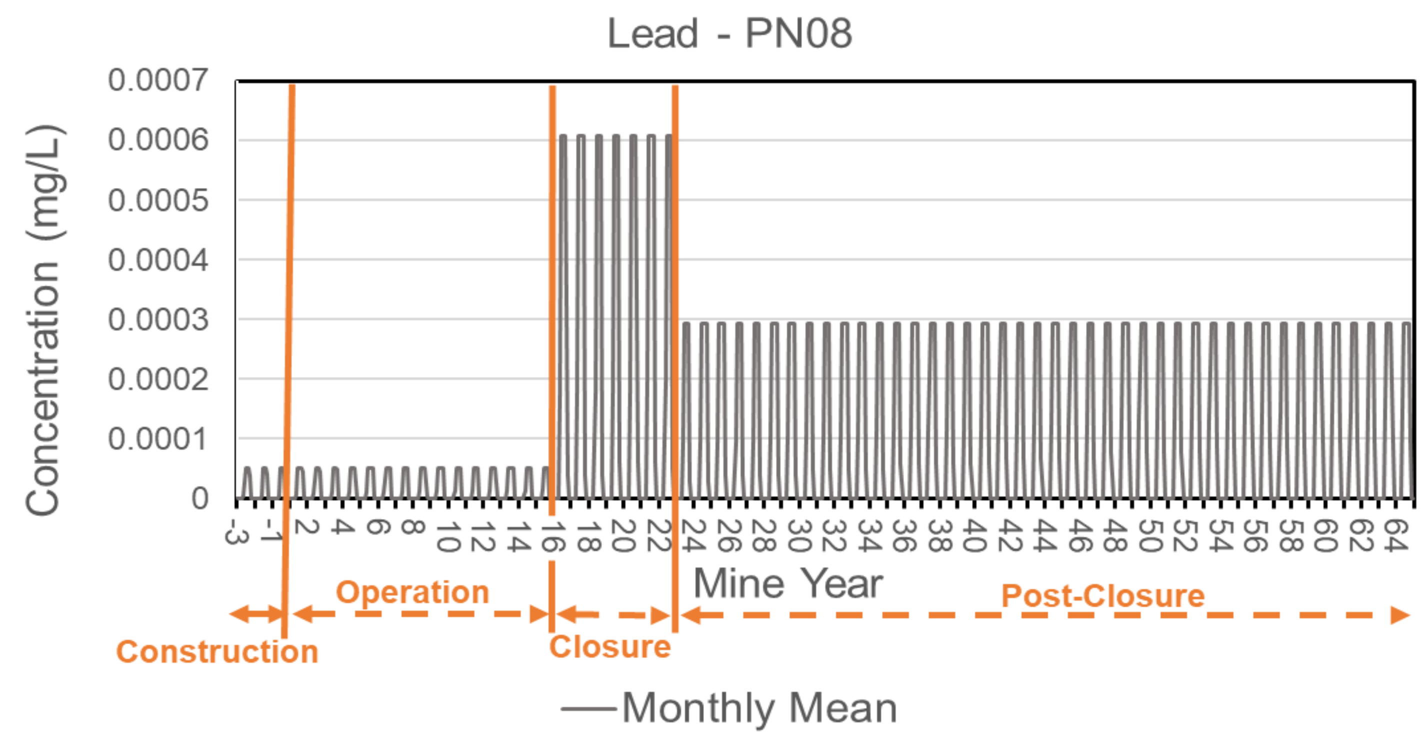

Arsenic - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

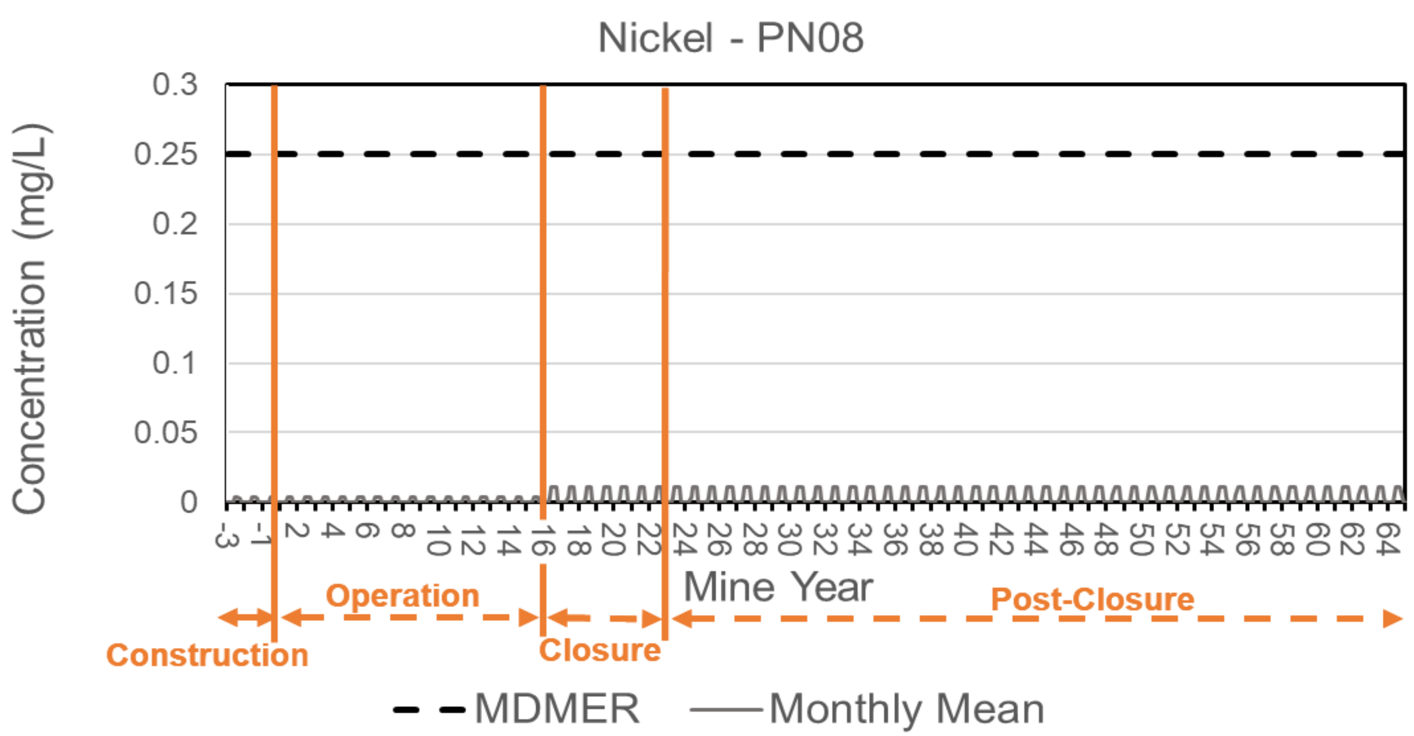

Arsenic - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

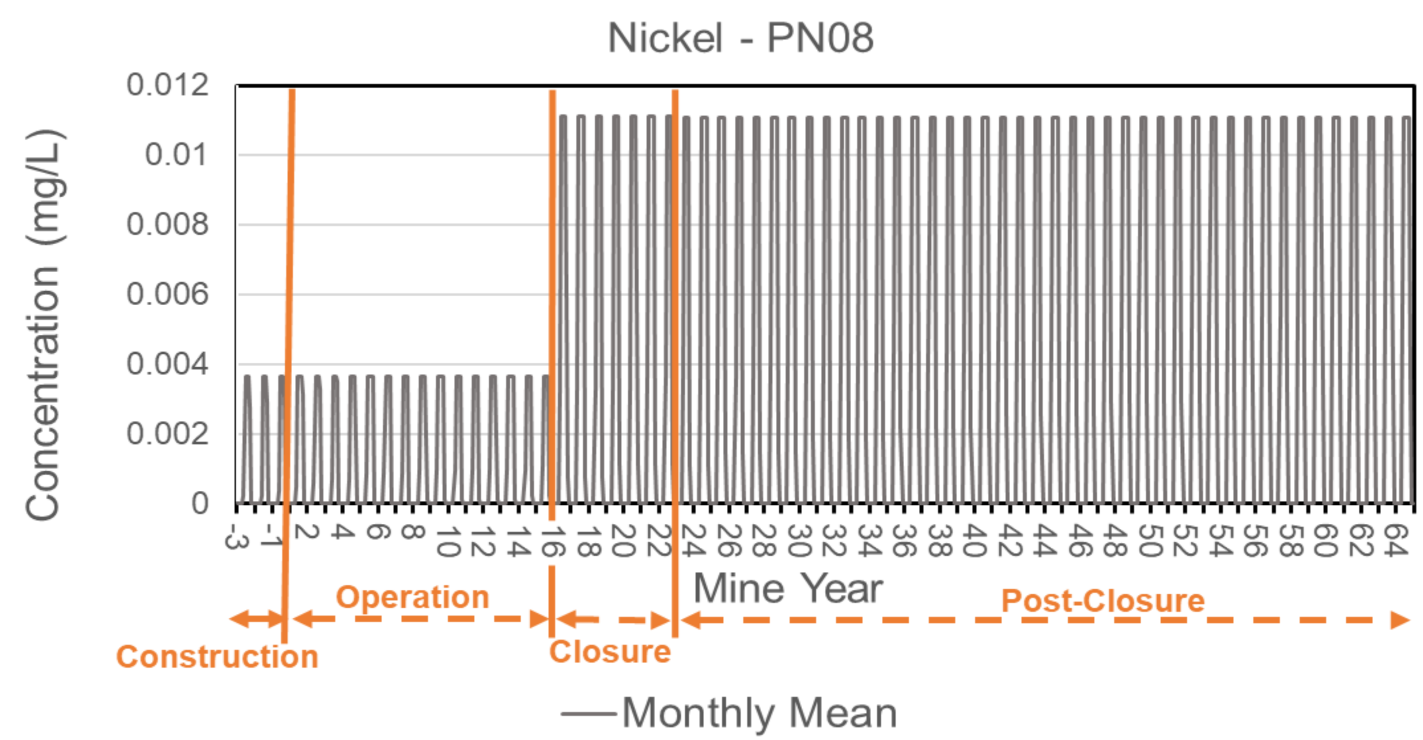

Copper - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

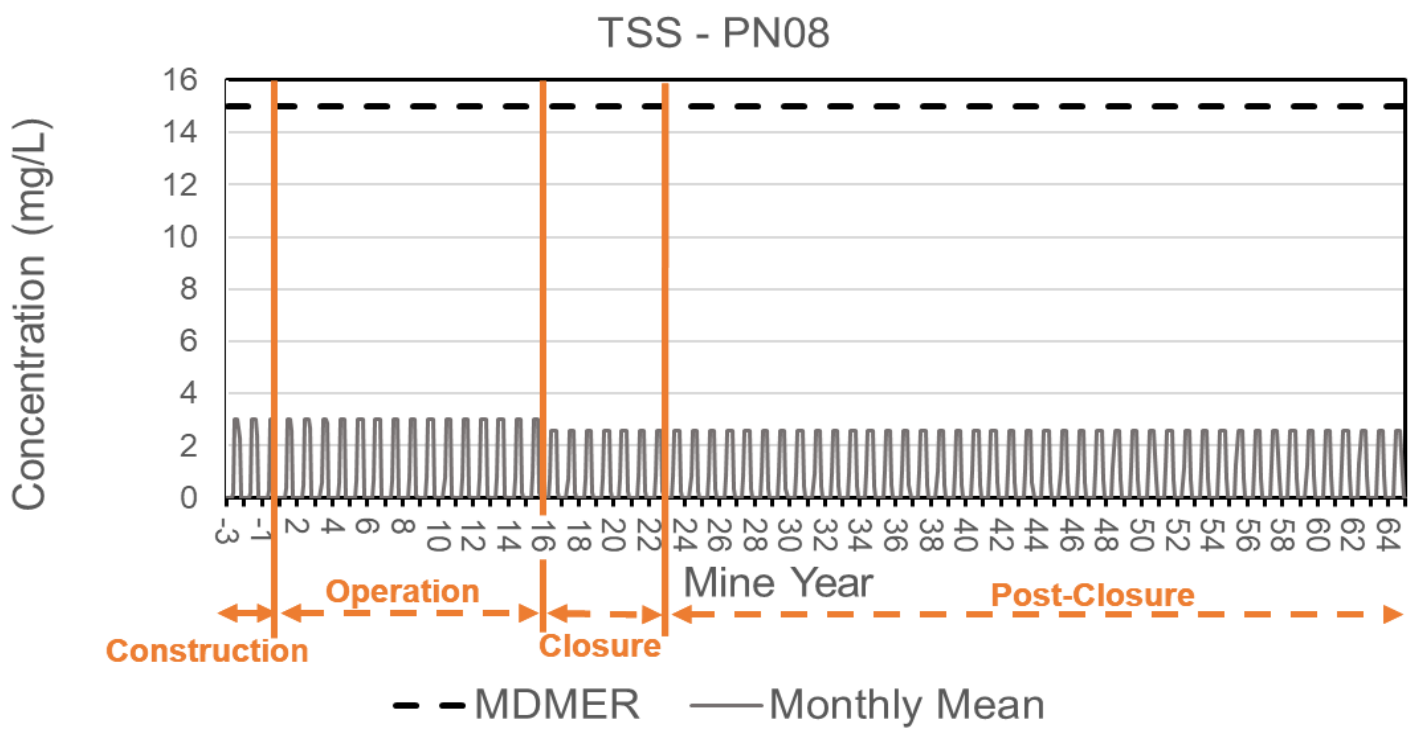

Copper - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

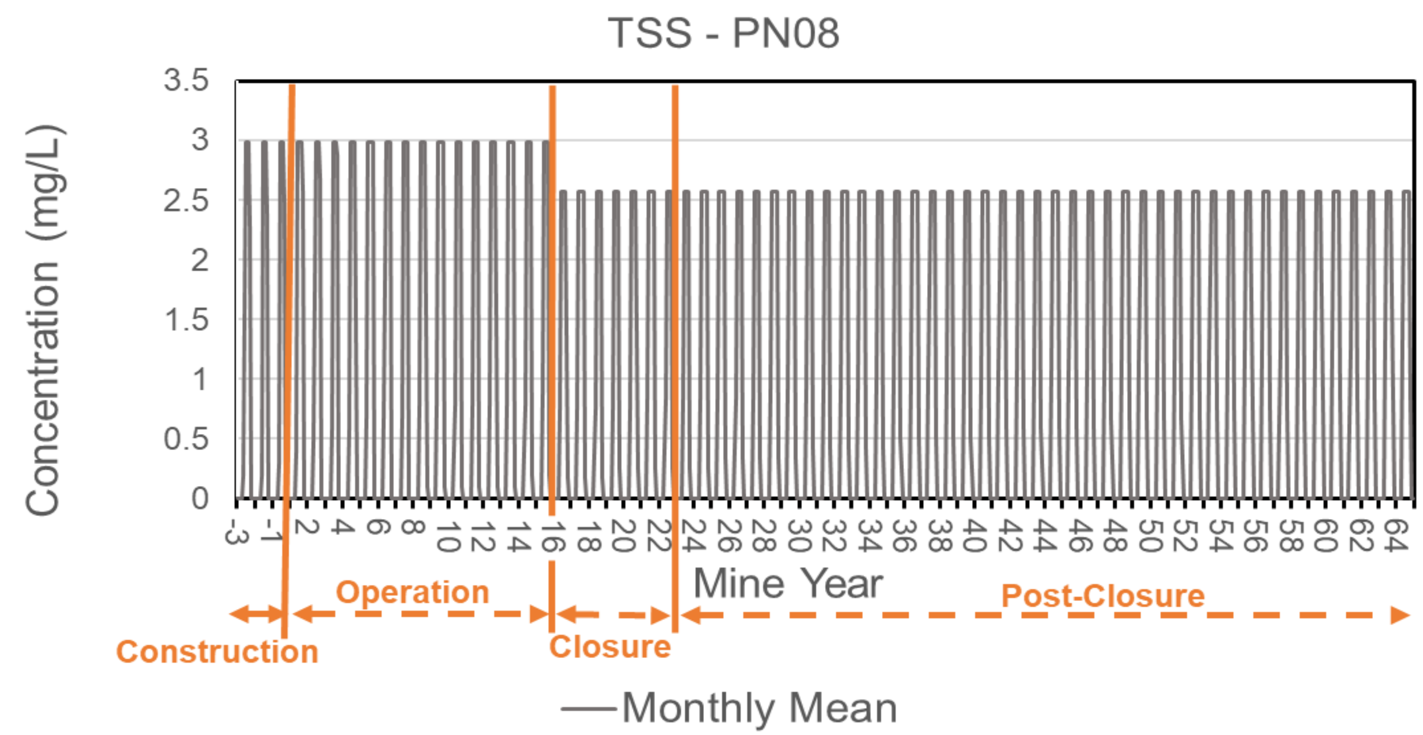

Lead - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

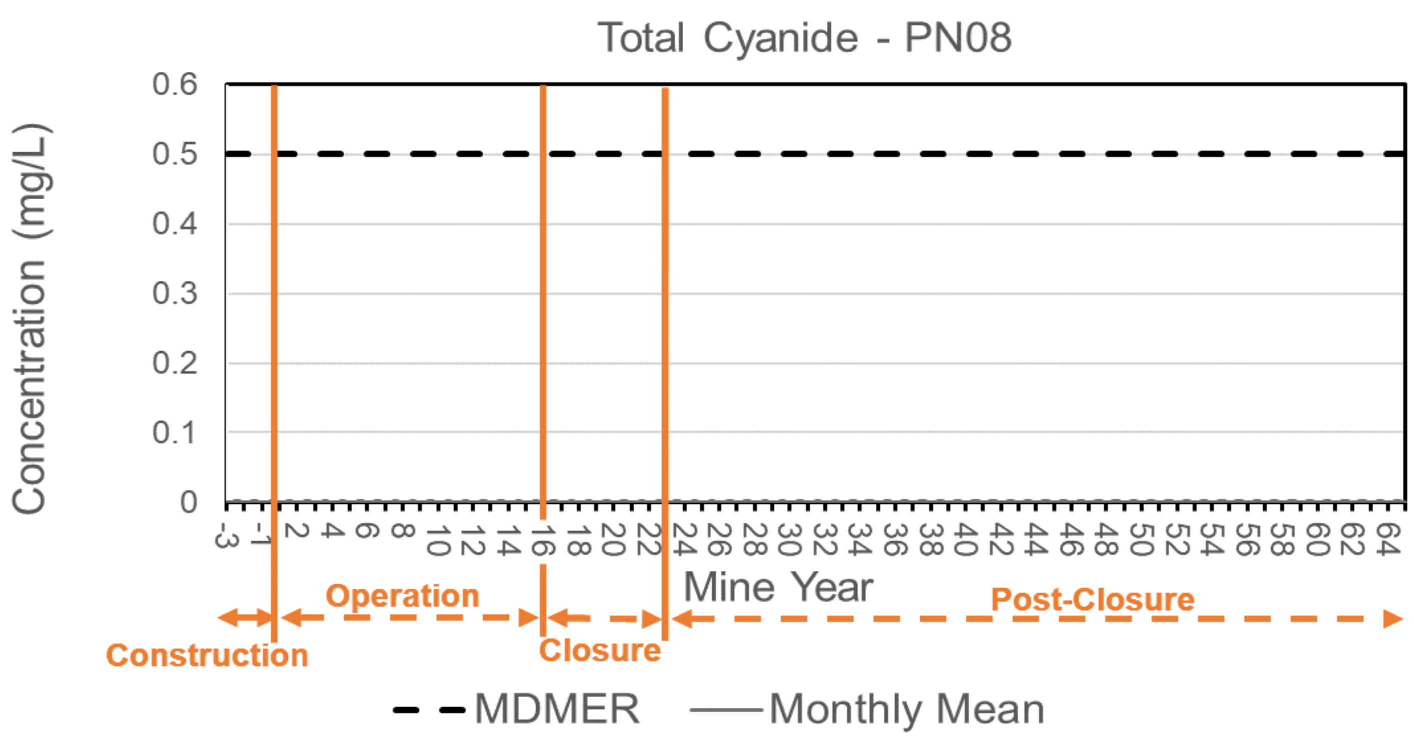

Lead - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

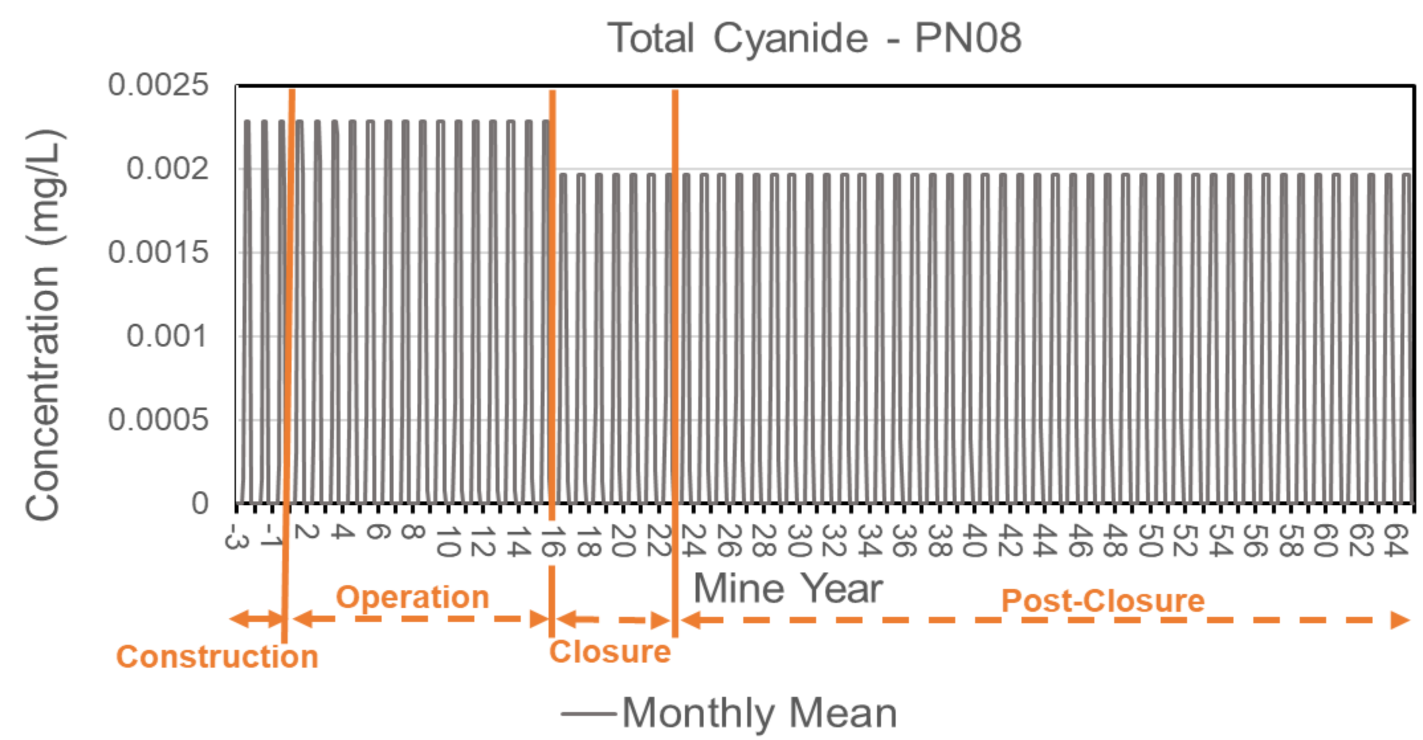

Nickel - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

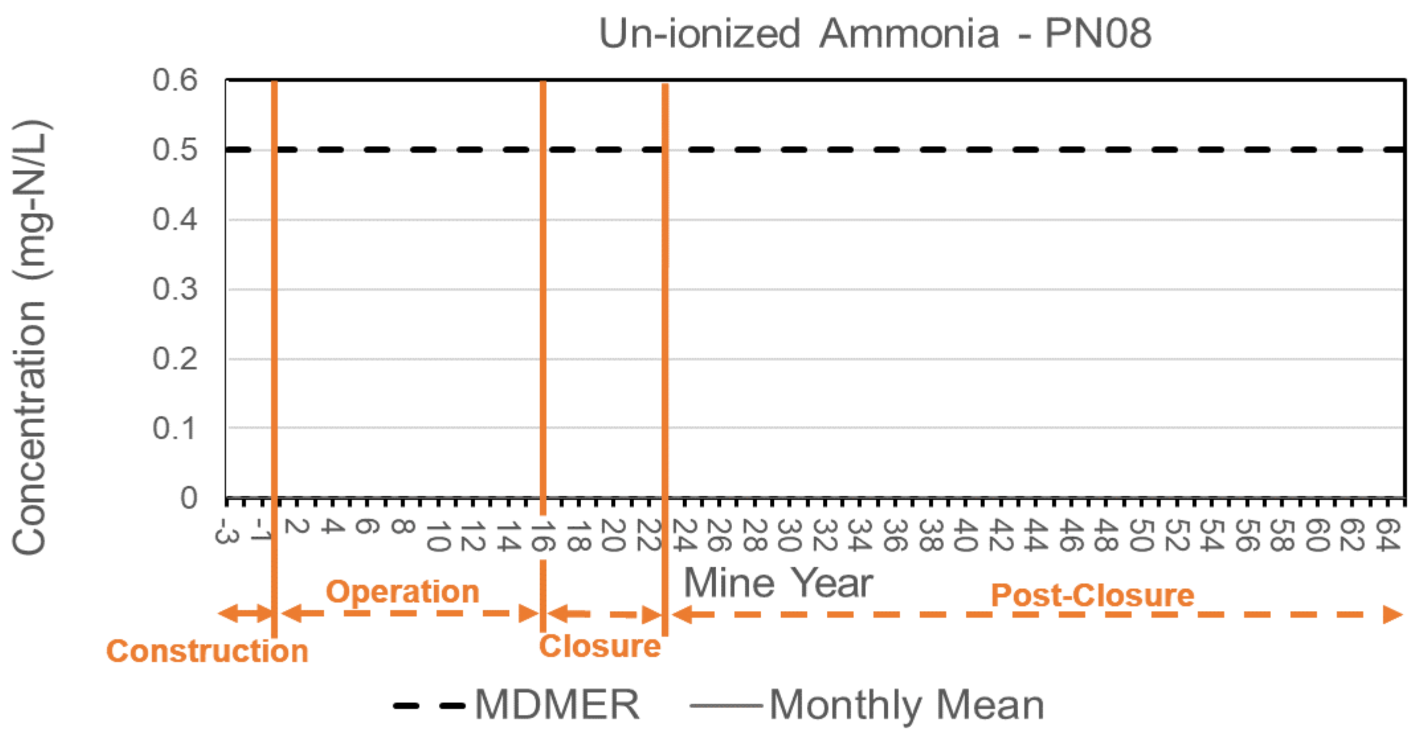

Nickel - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

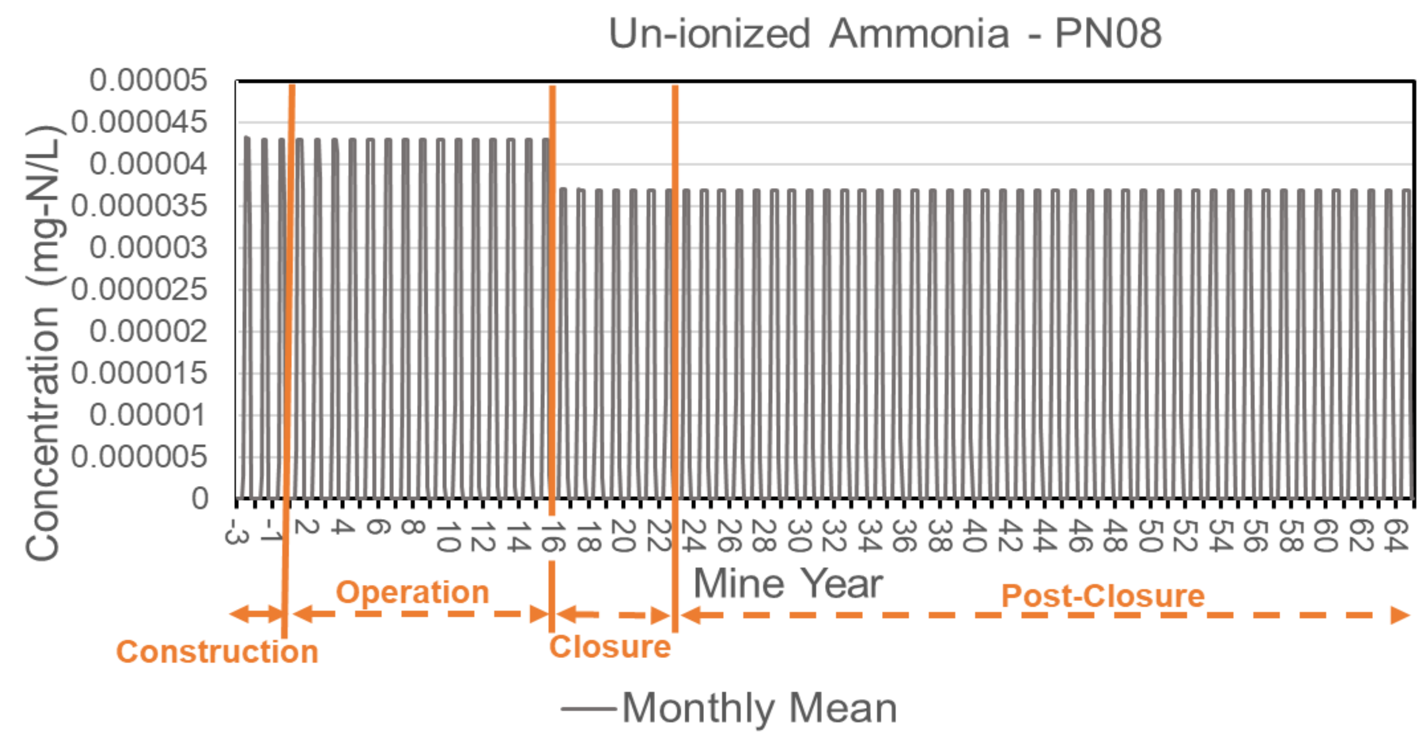

TSS - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

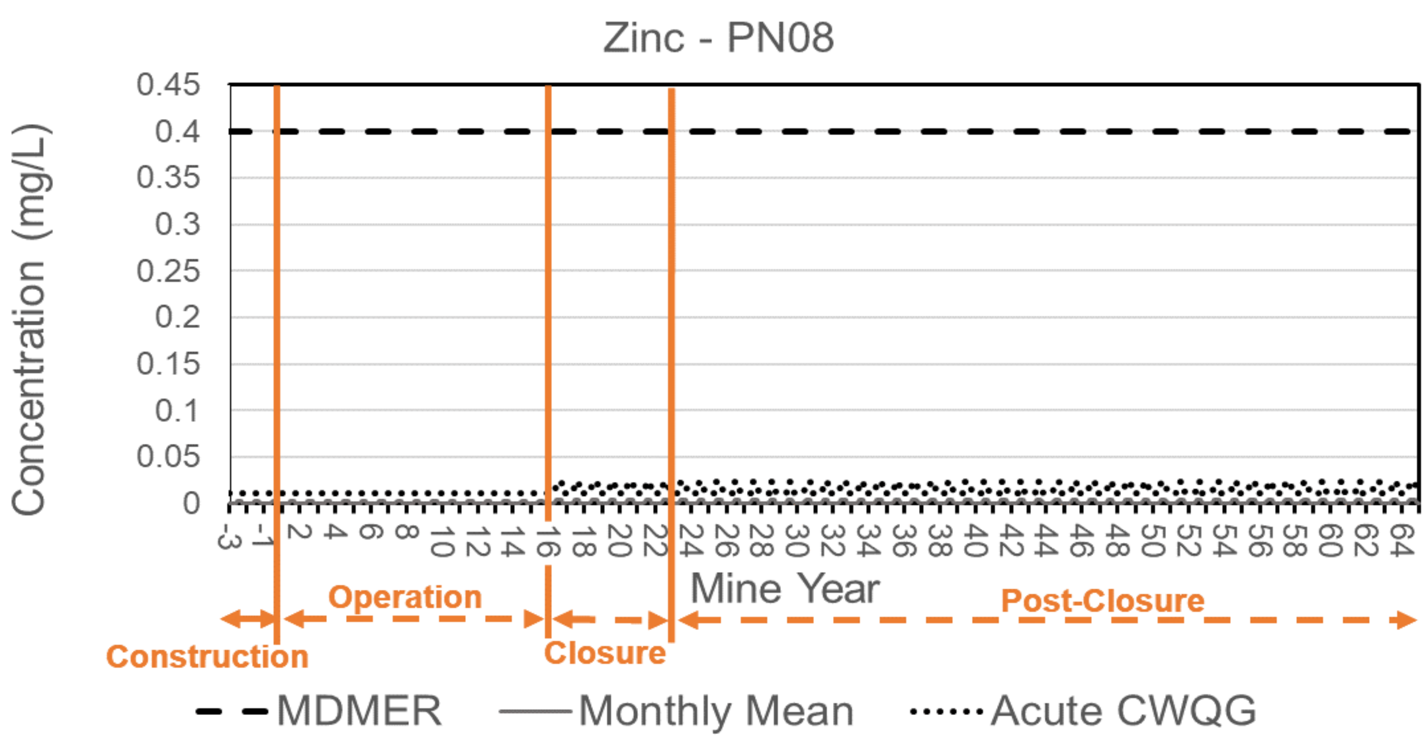

TSS - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

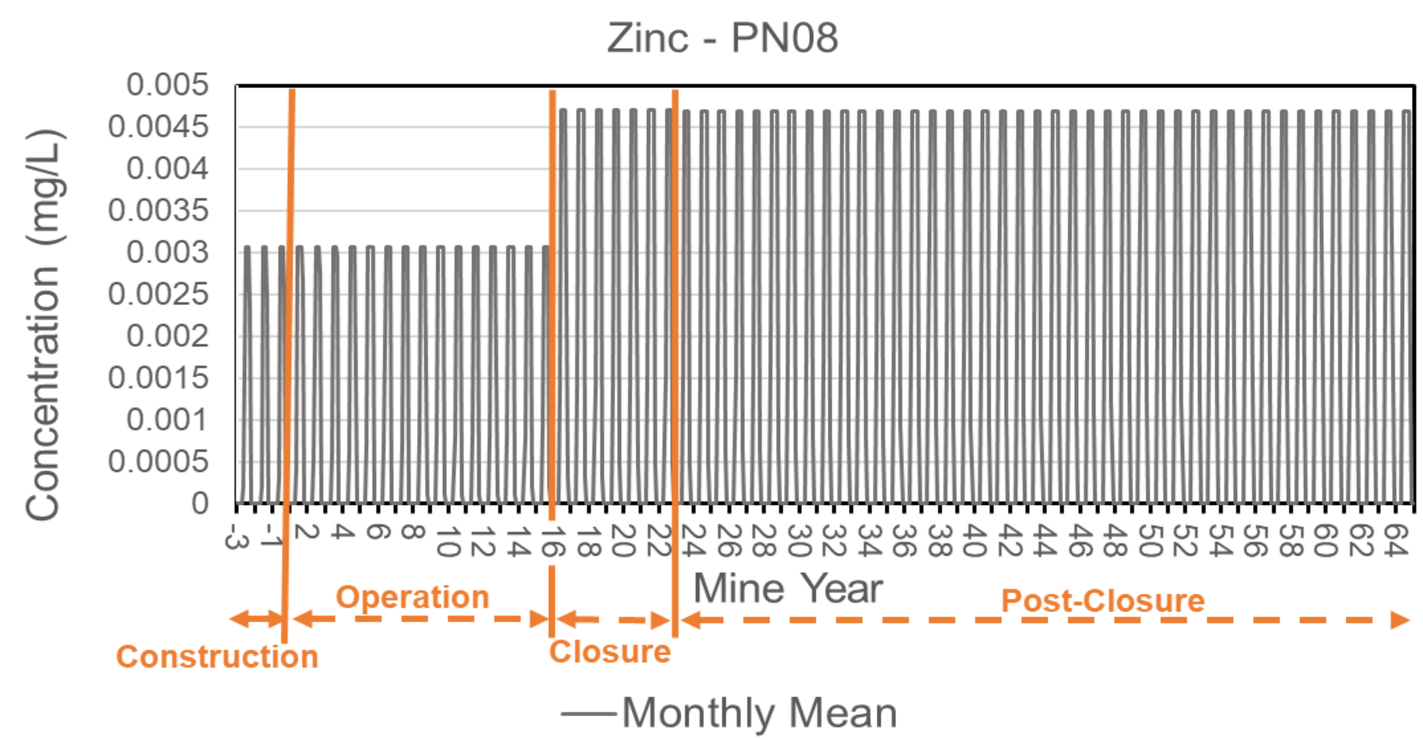

Total Cyanide - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

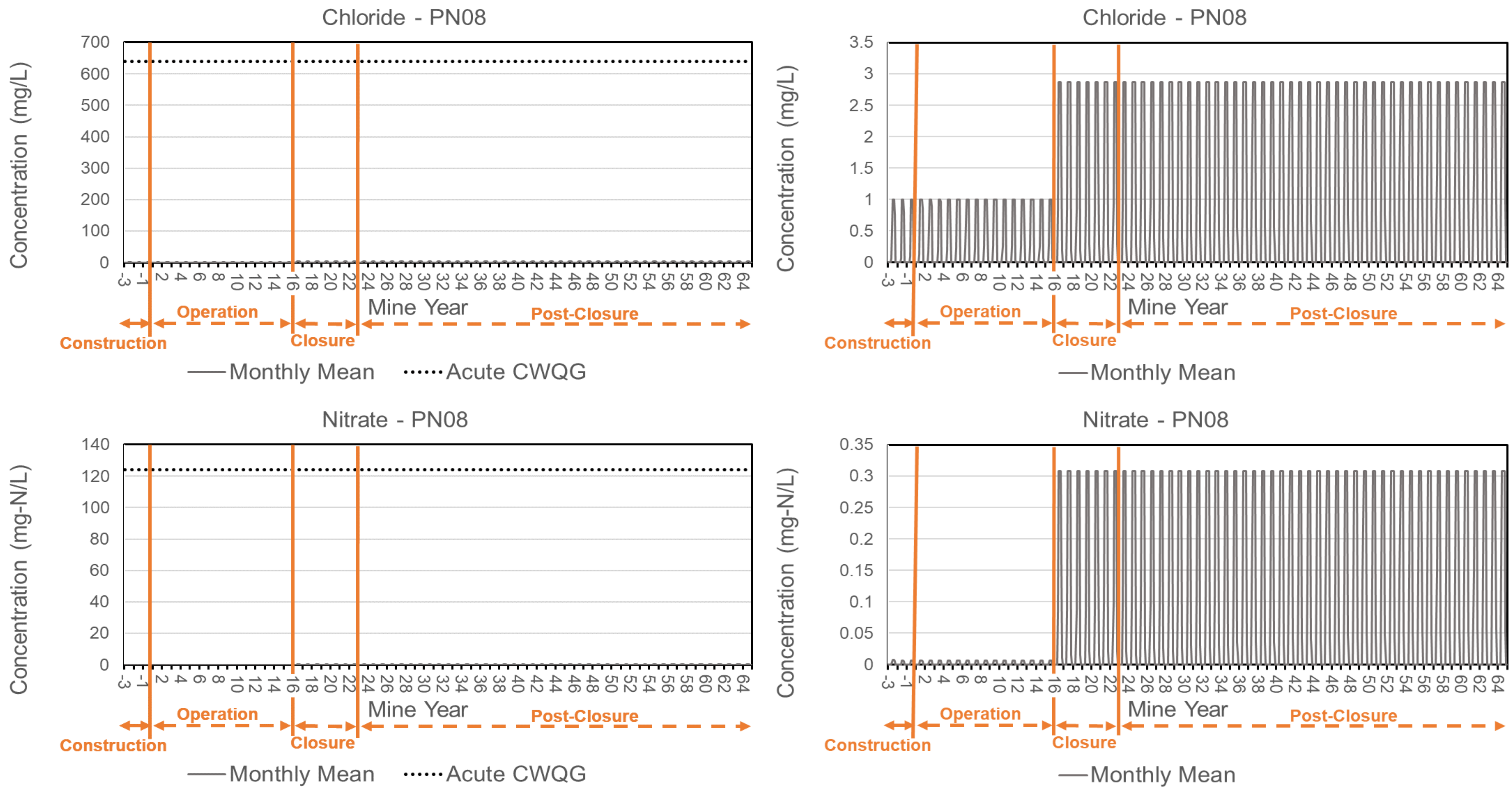

Total Cyanide - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

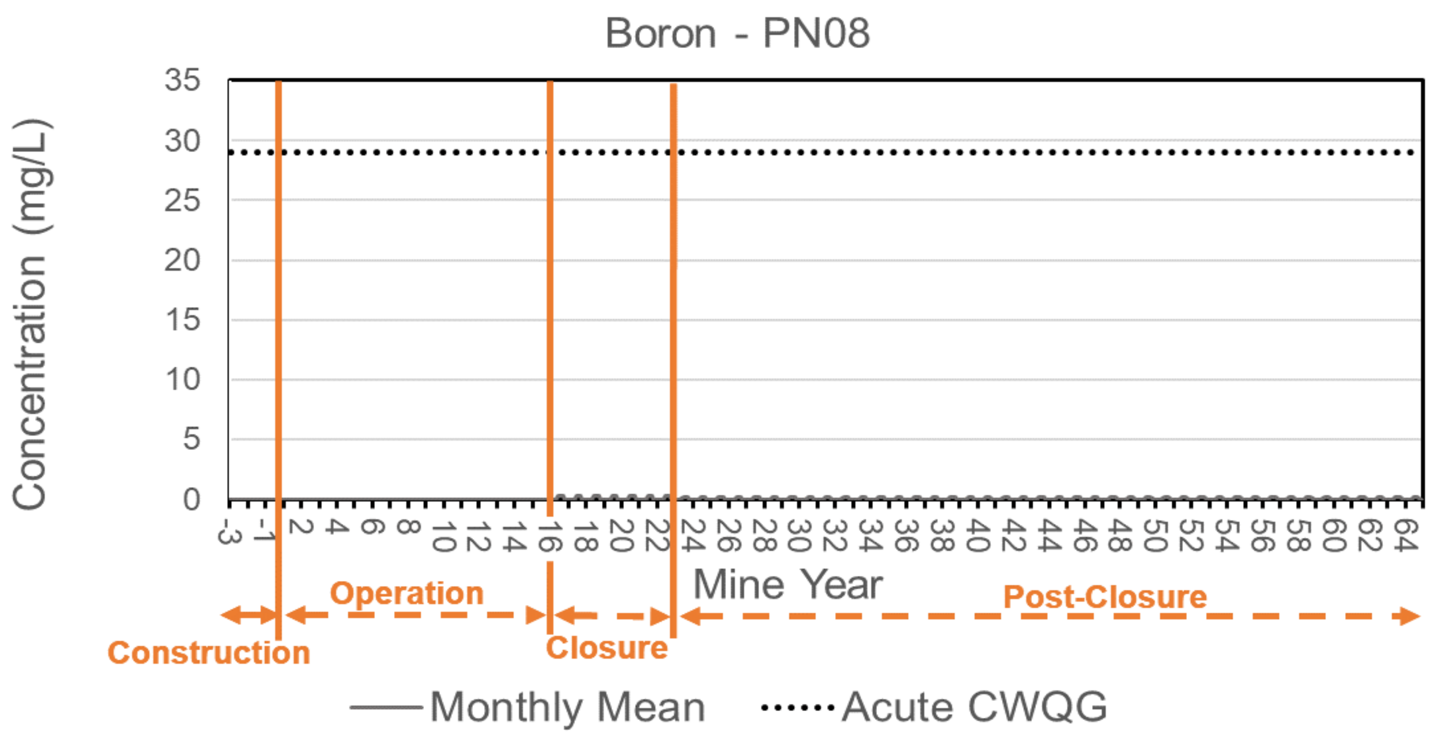

Un-ionized Ammonia - PN08
Concentration (mg-N/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

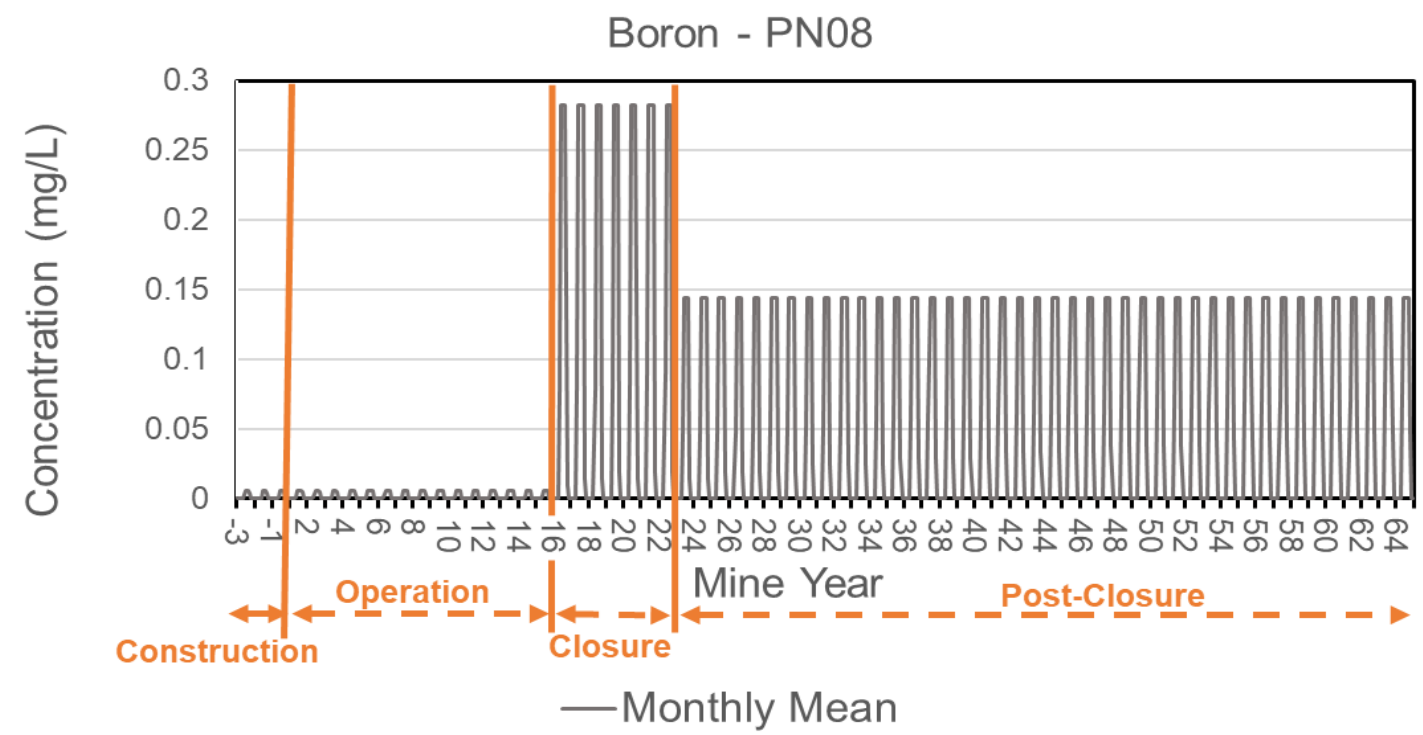

Un-ionized Ammonia - PN08
Concentration (mg-N/L)
0.00005
0.000045
0.00004
0.000035
0.00003
0.000025
0.00002
0.000015
0.00001
0.000005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

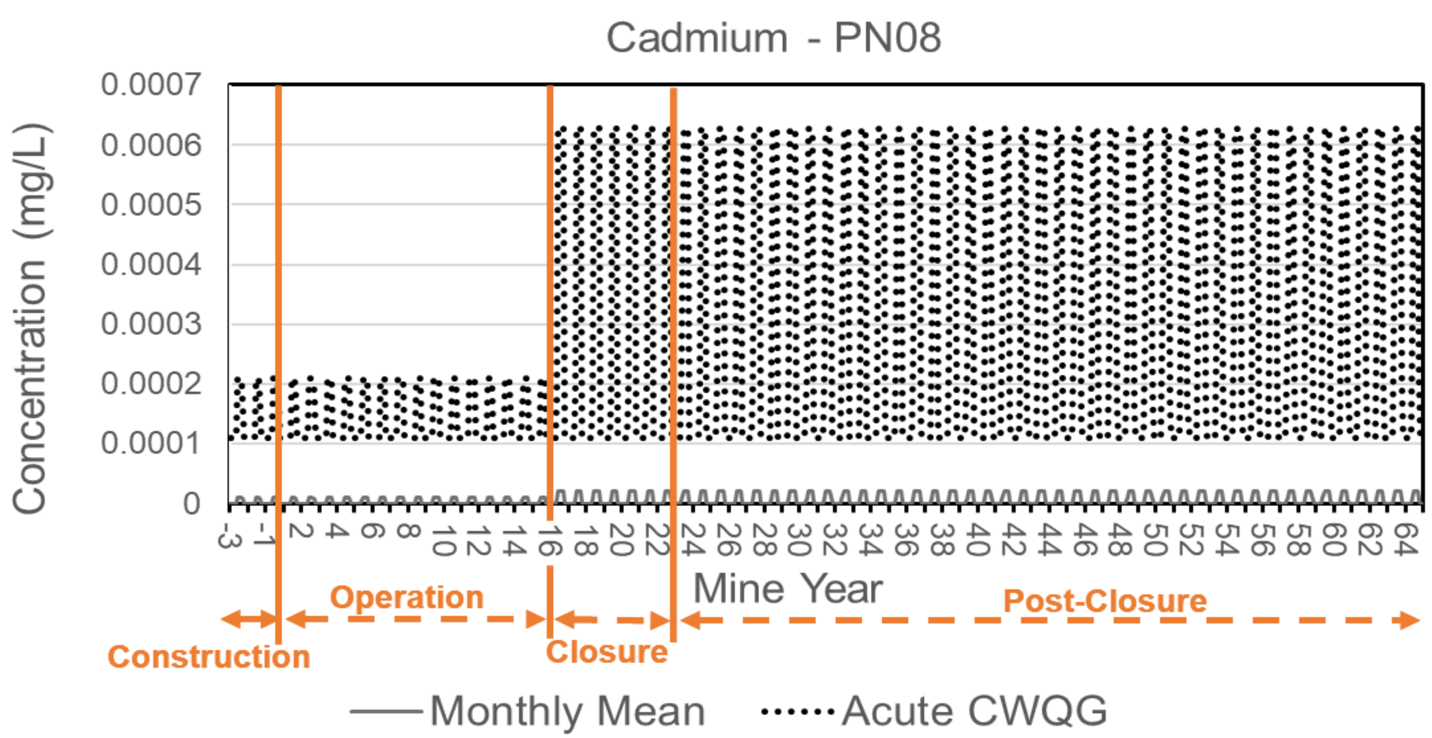

Zinc - PN08
Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Acute CWQG

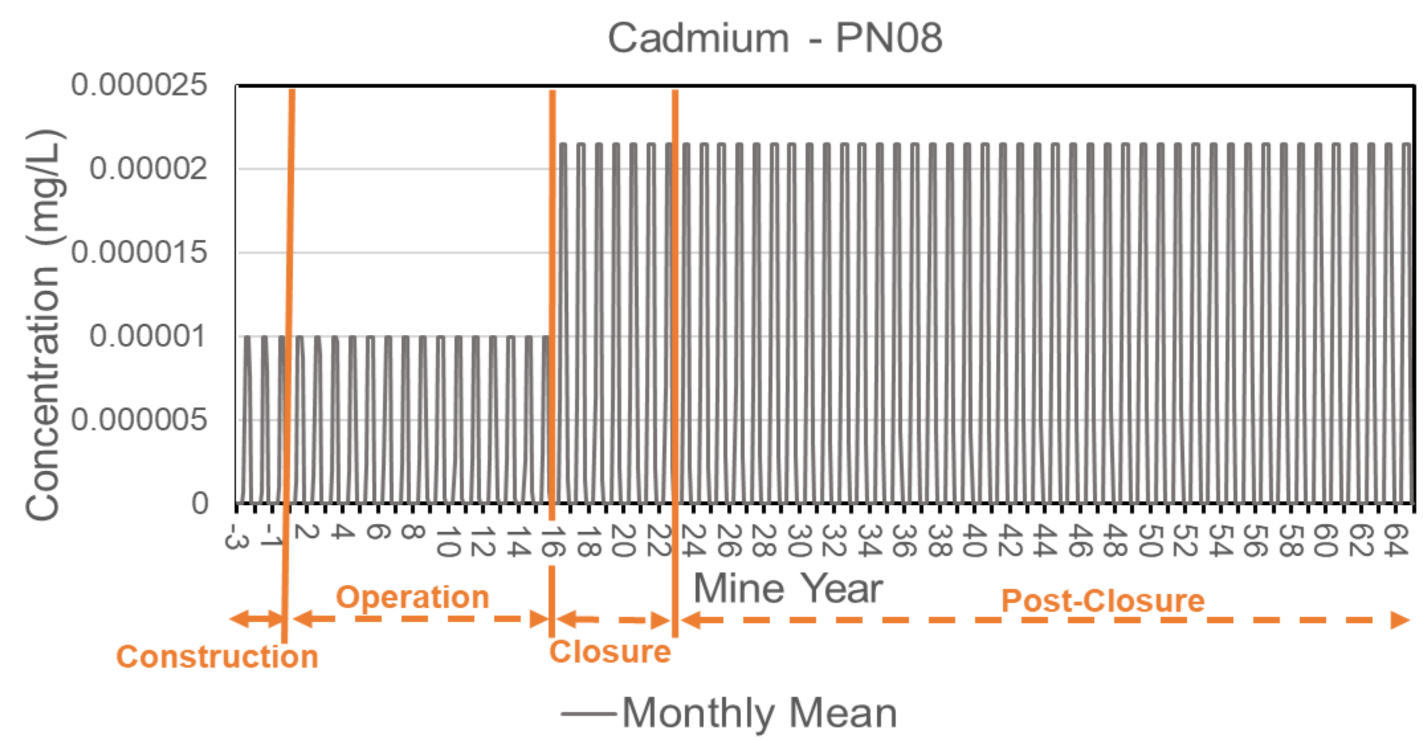

Zinc - PN08
Concentration (mg/L)
0.005
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

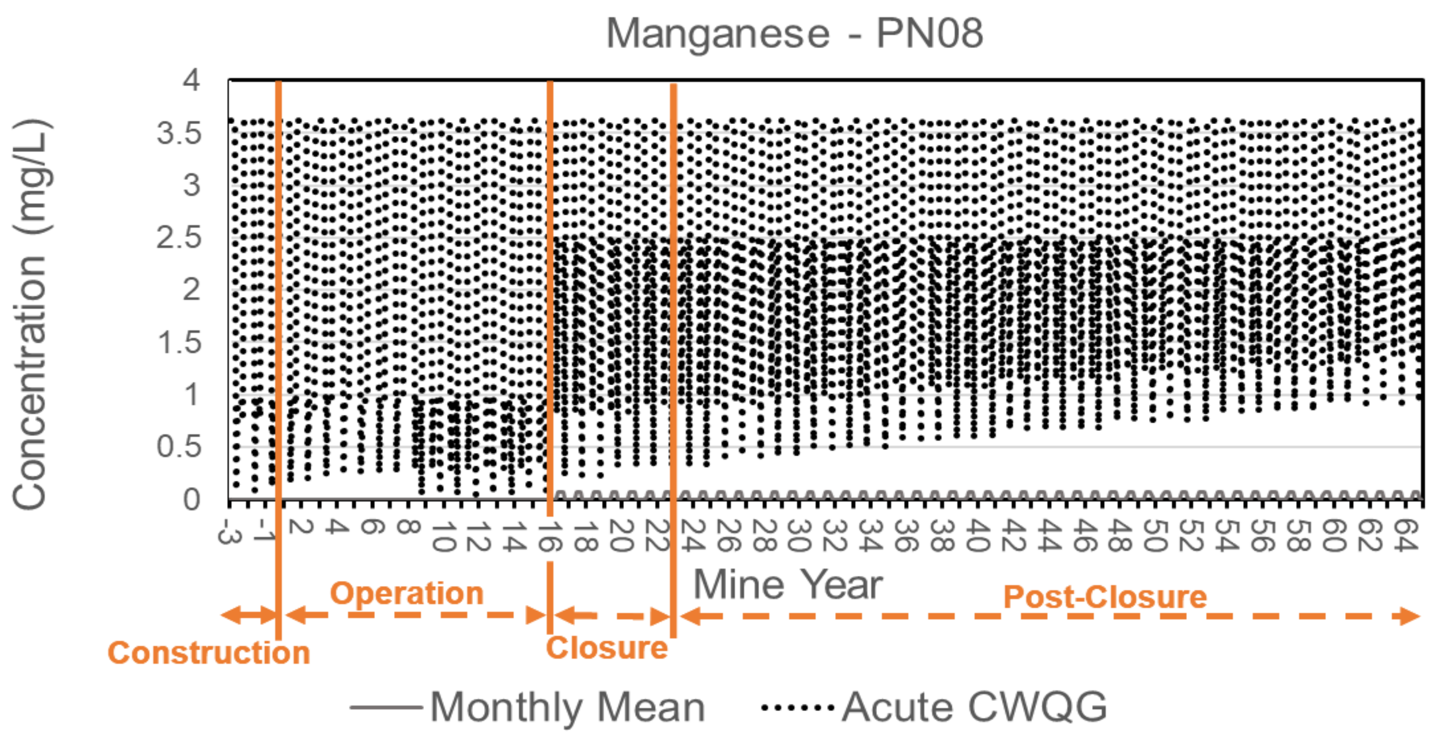

Chloride - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG
Chloride - PN08
Concentration (mg/L)
Mine Year
Monthly Mean
Nitrate - PN08
Concentration (mg-N/L)
Mine Year
Monthly Mean
Acute CWQG
Nitrate - PN08
Concentration (mg-N/L)
Mine Year
Monthly Mean

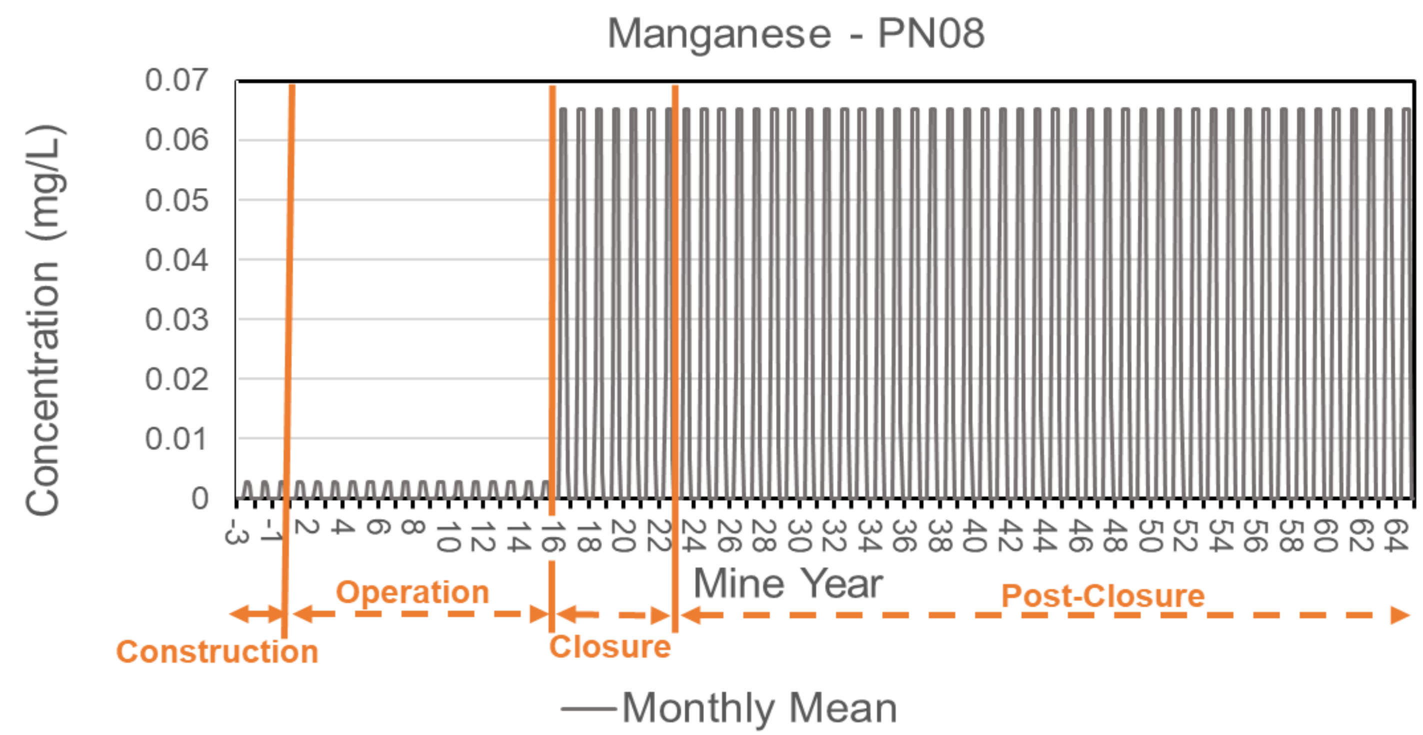

Boron - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

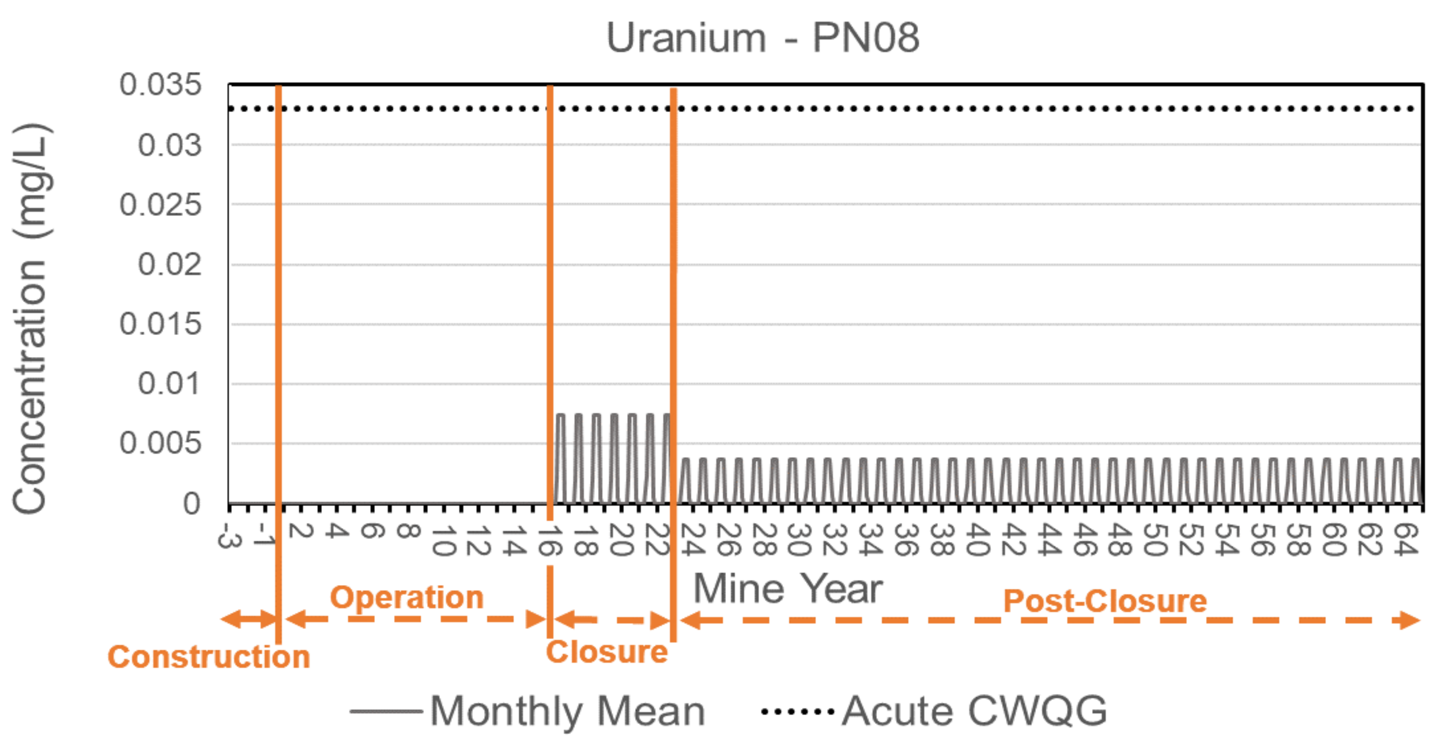

Boron - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

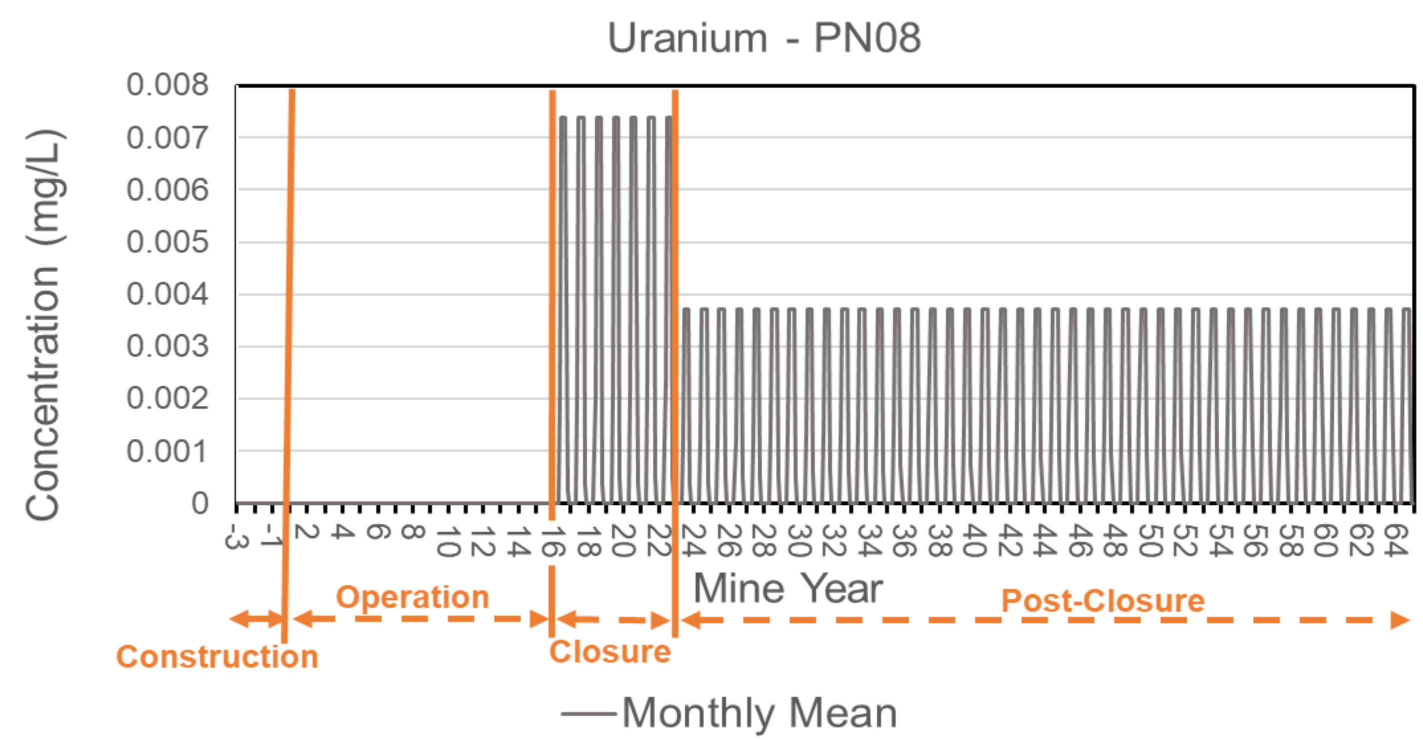

Cadmium - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

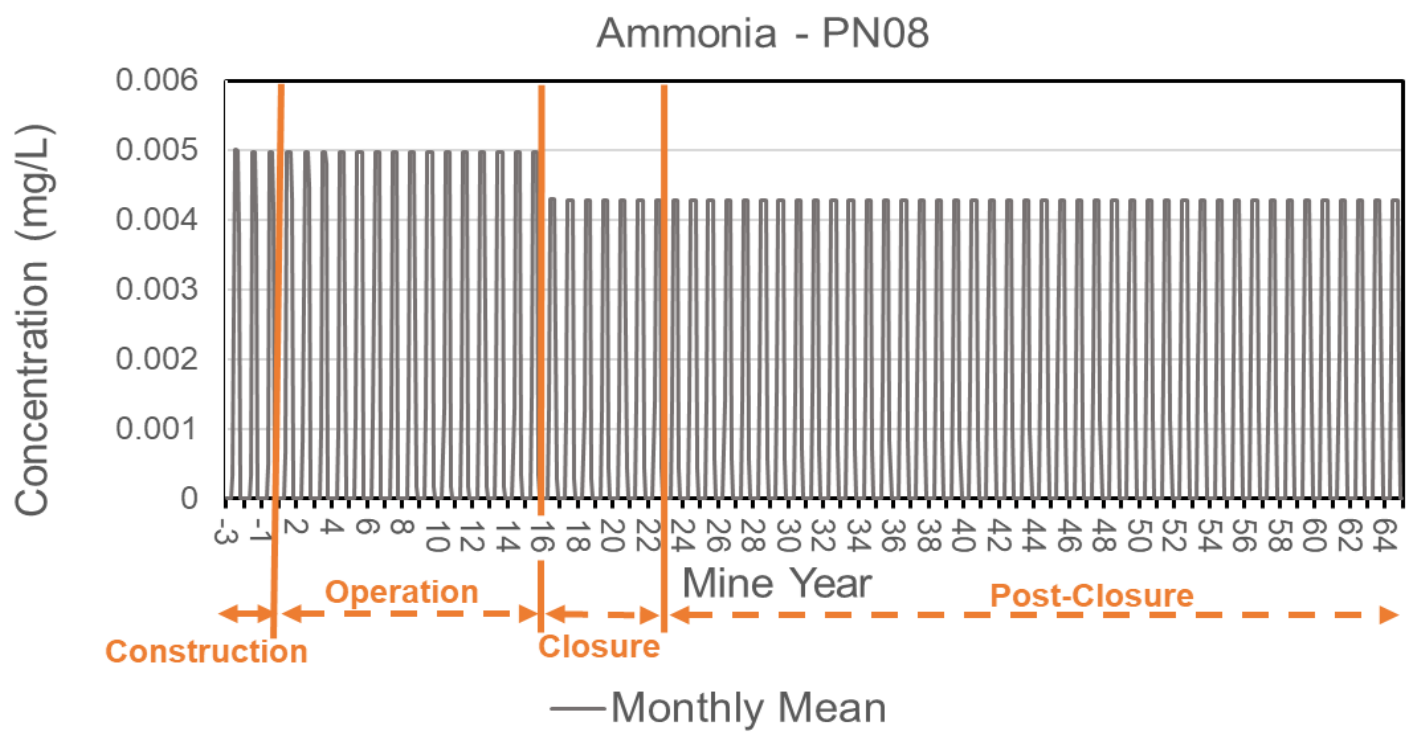

Cadmium - PN08
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

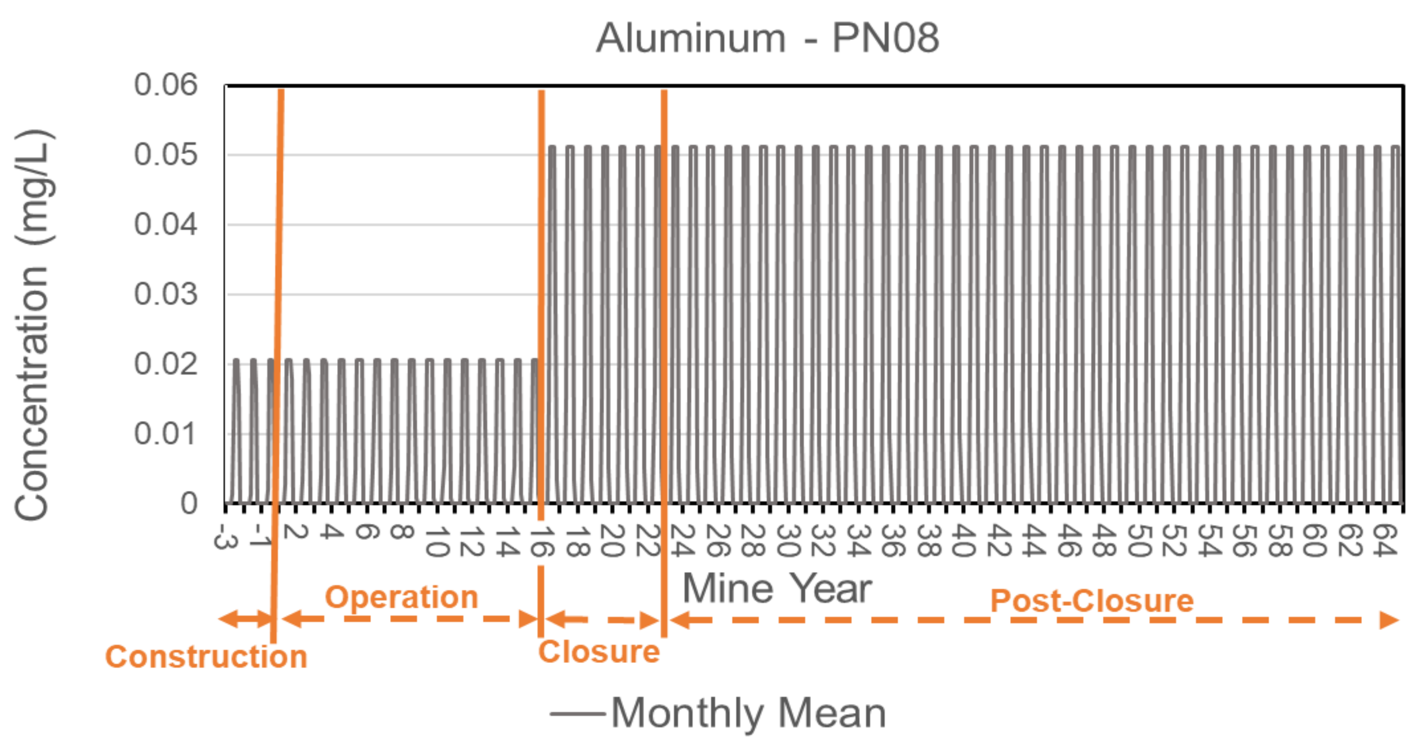

Manganese - PN08
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean
Acute CWQG

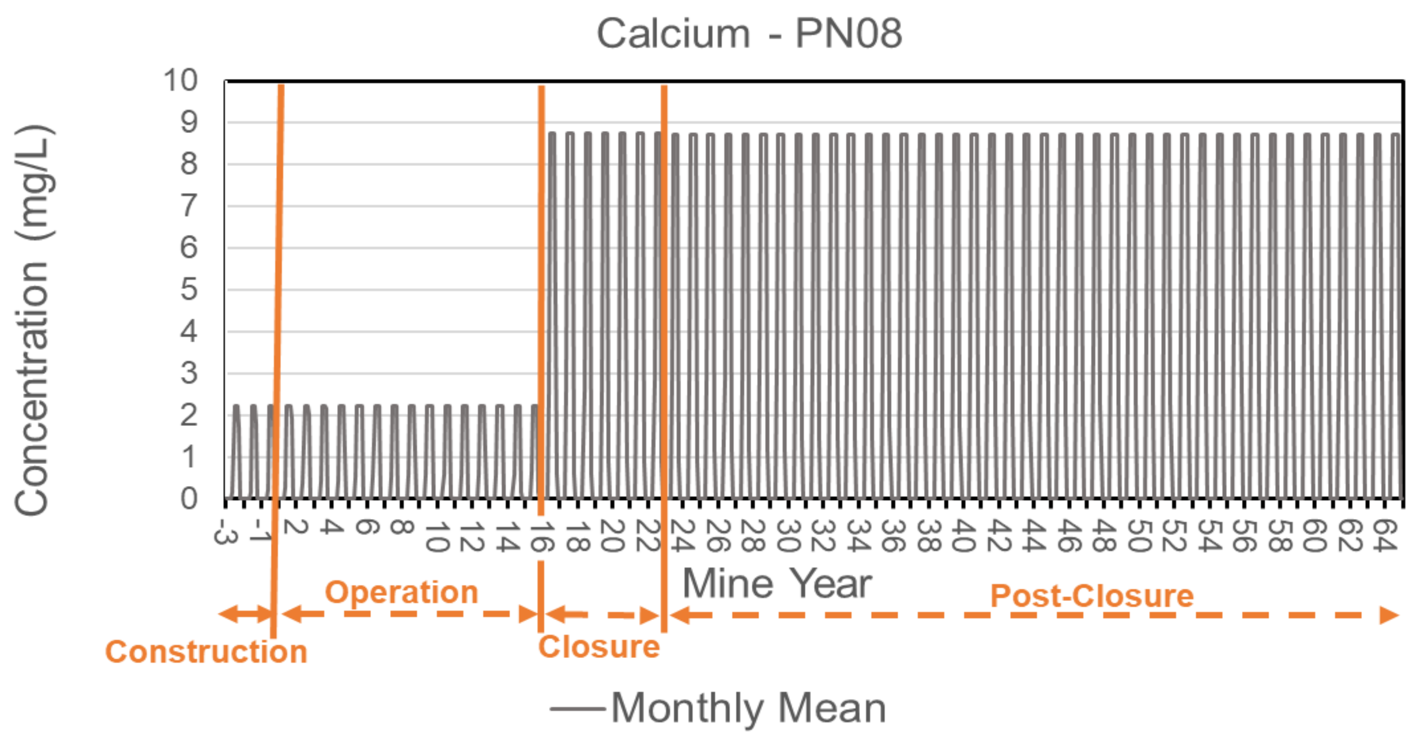

Manganese - PN08
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

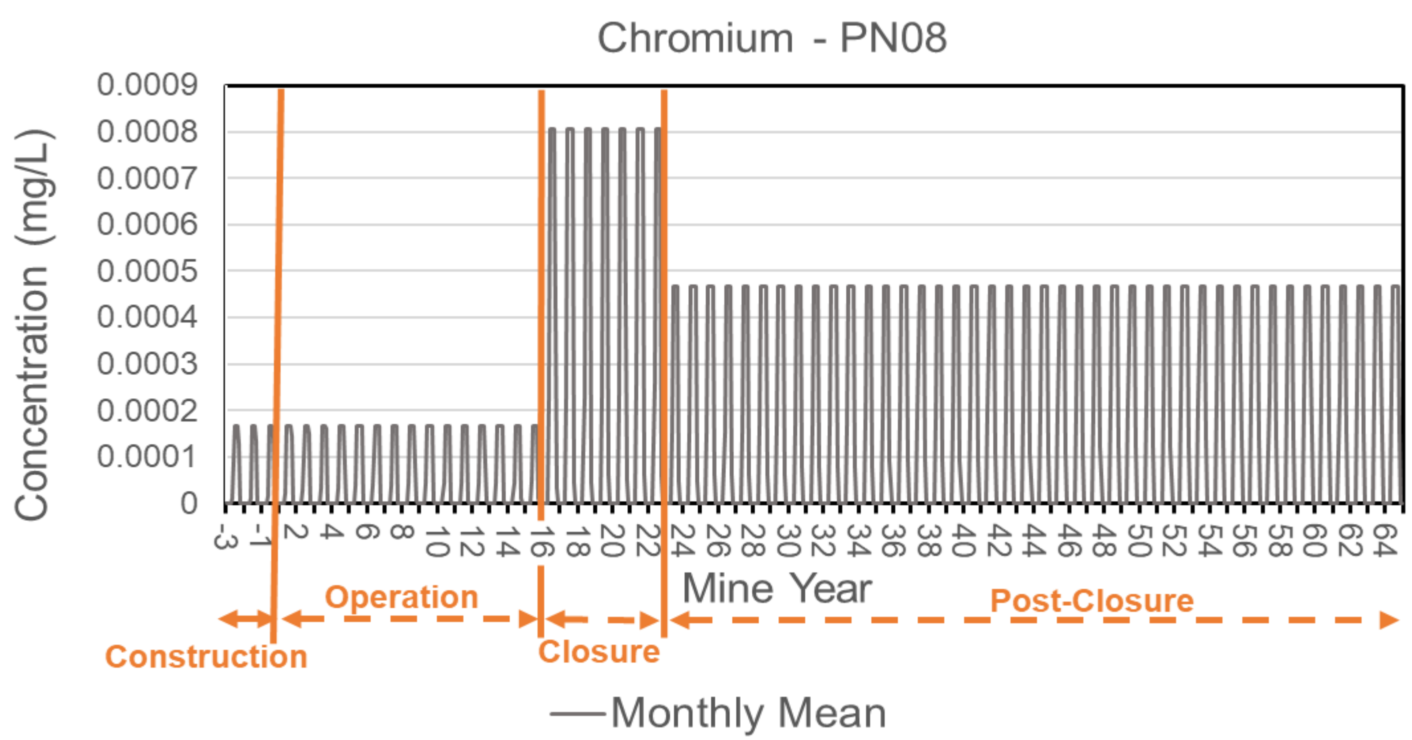

Uranium - PN08
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean
Acute CWQG

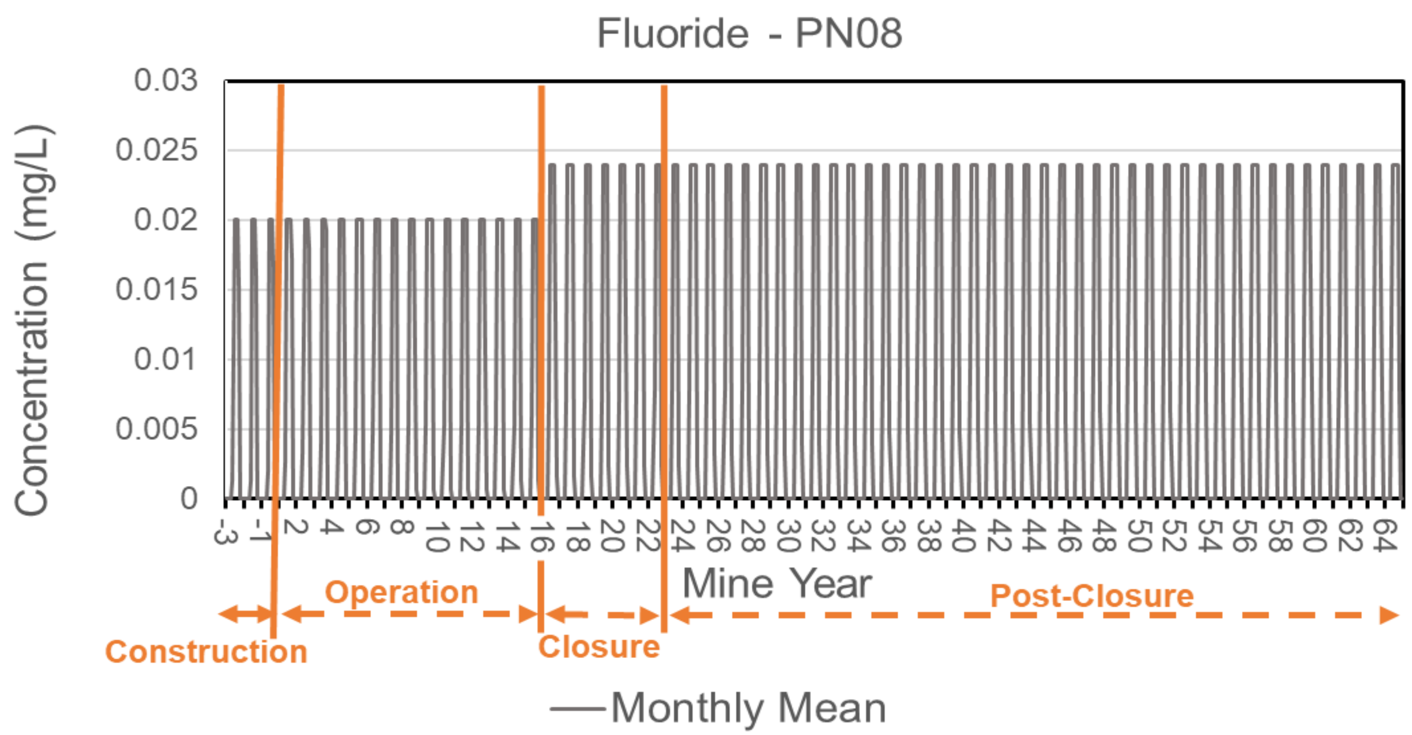

Uranium - PN08
Concentration (mg/L)
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

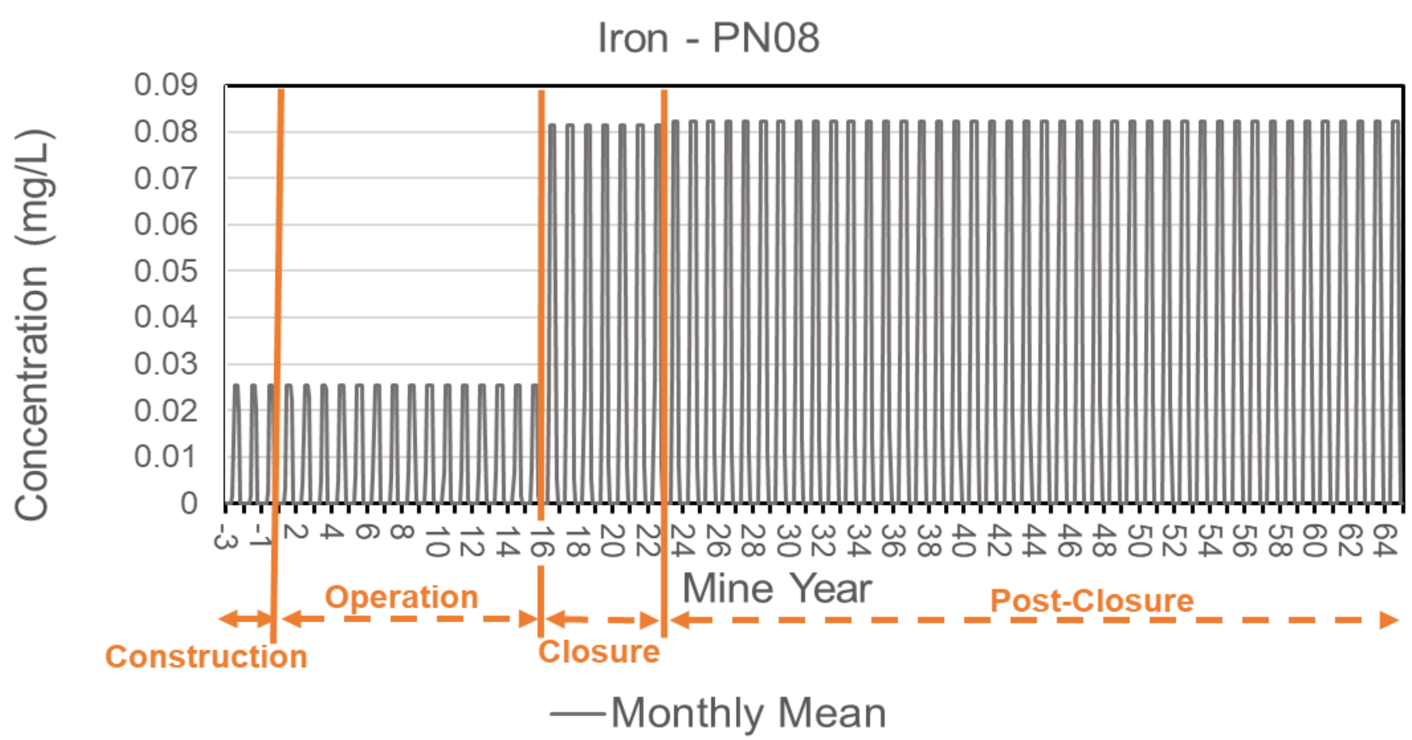

Ammonia - PN08
Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

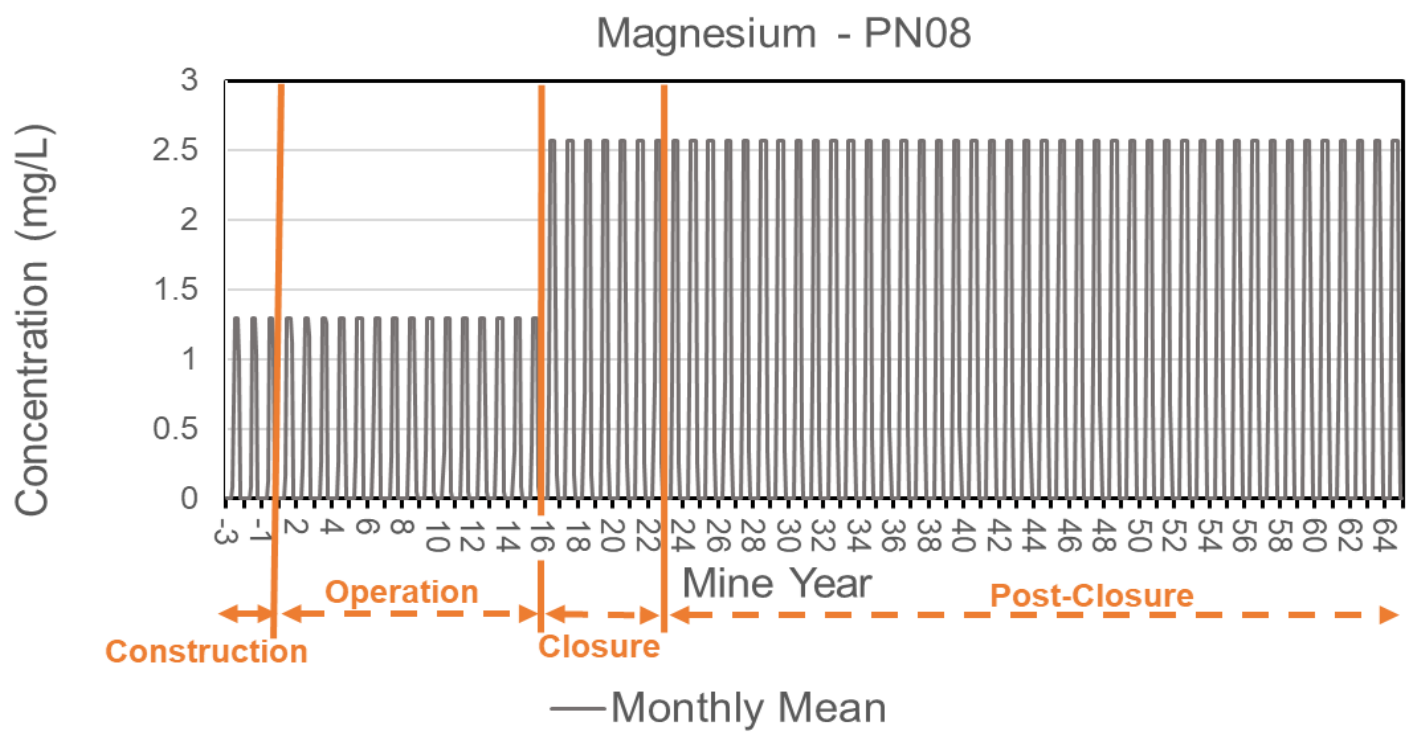

Aluminum - PN08
Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

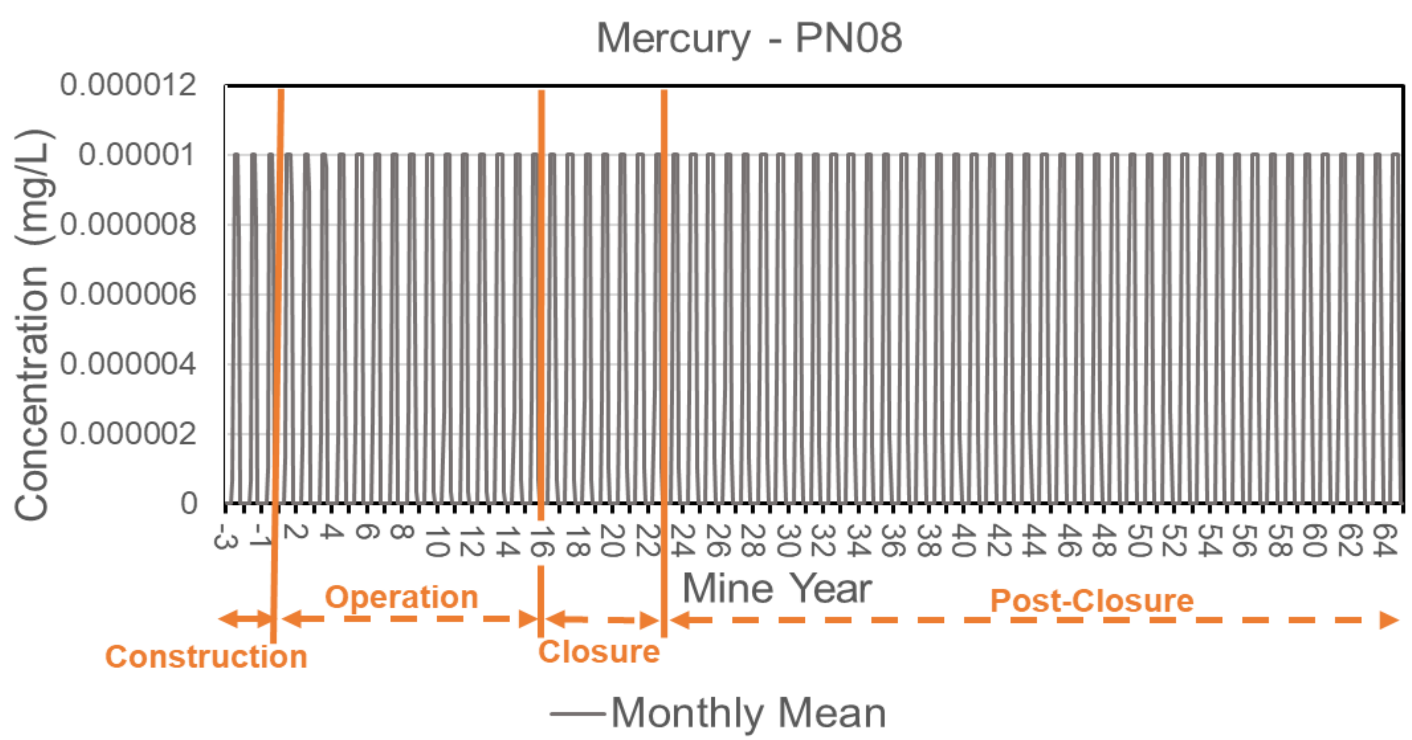

Calcium - PN08
Concentration (mg/L)
10
9
8
7
6
5
4
3
2
1
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

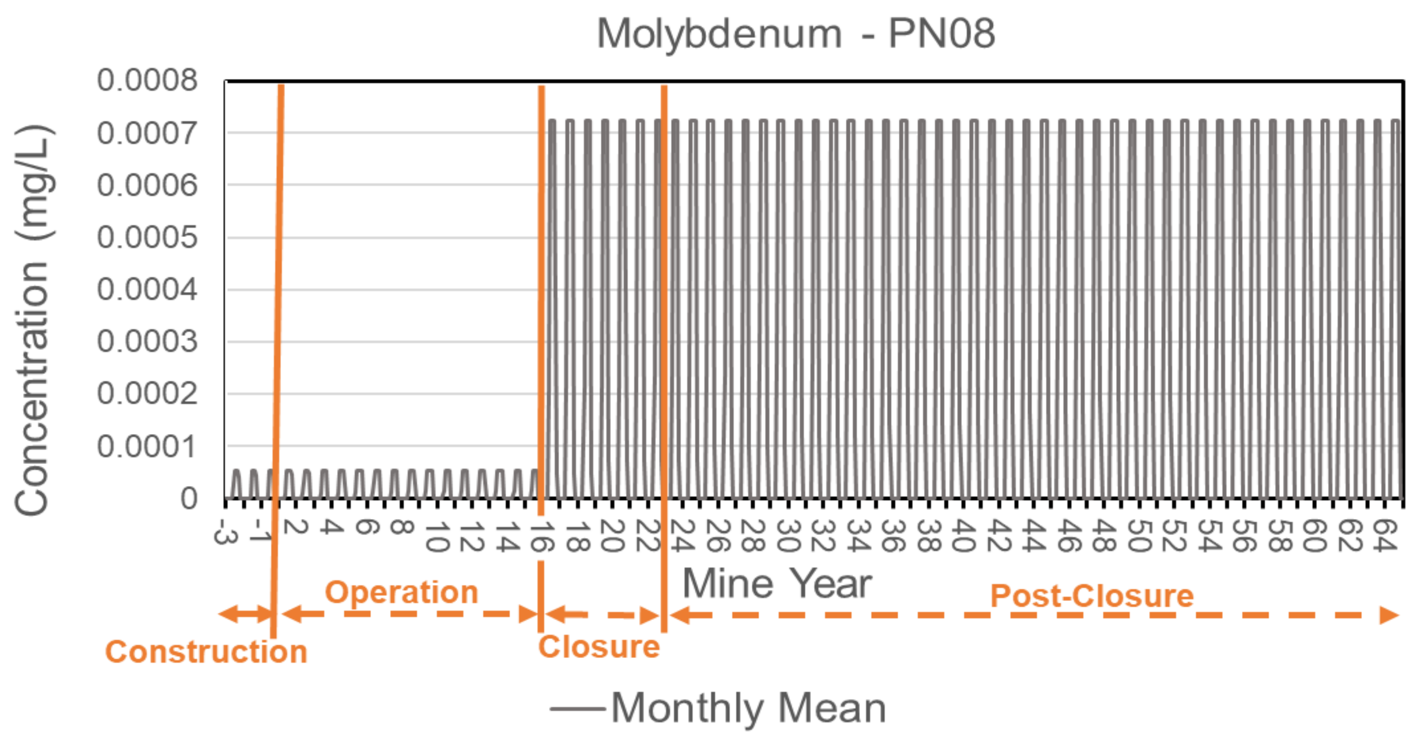

Chromium - PN08
Concentration (mg/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

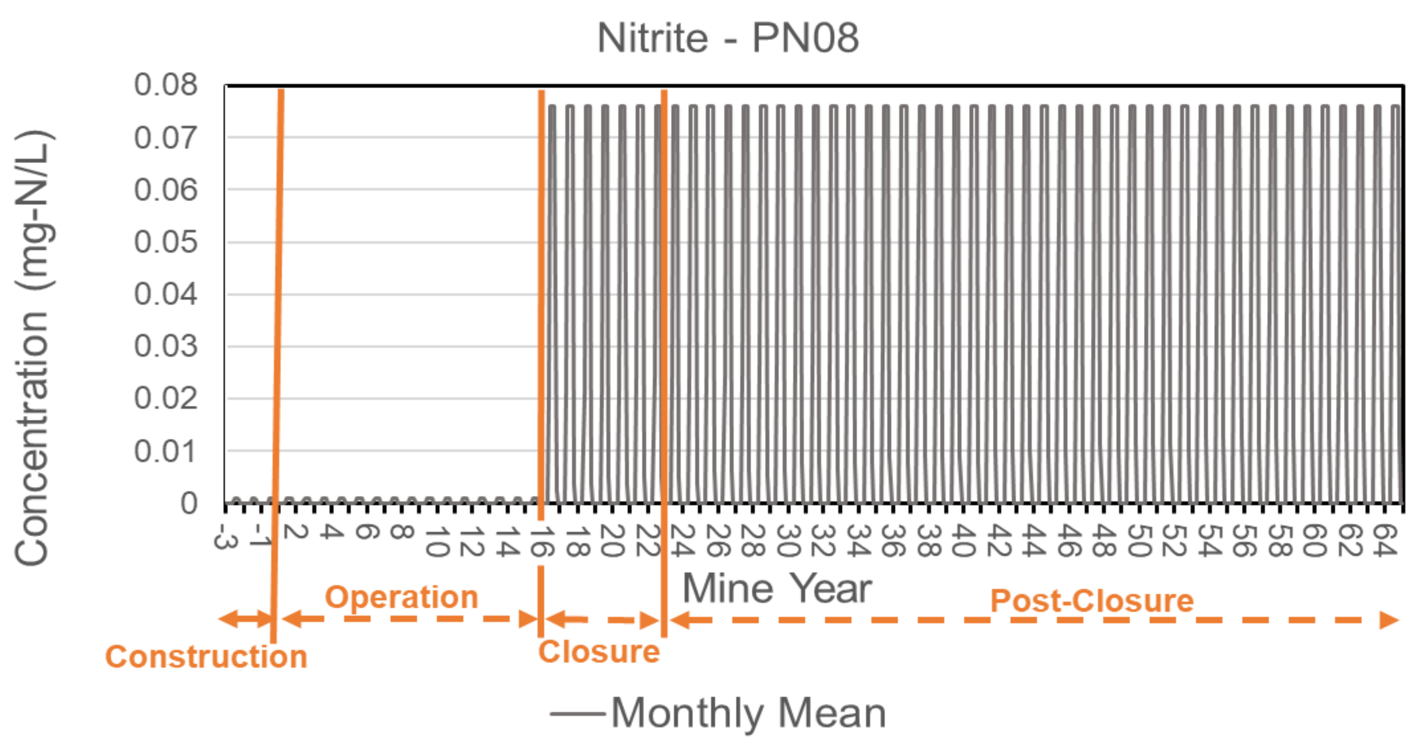

Fluoride - PN08
Concentration (mg/L)
0.03
0.025
0.02
0.015
0.01
0.005
0
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

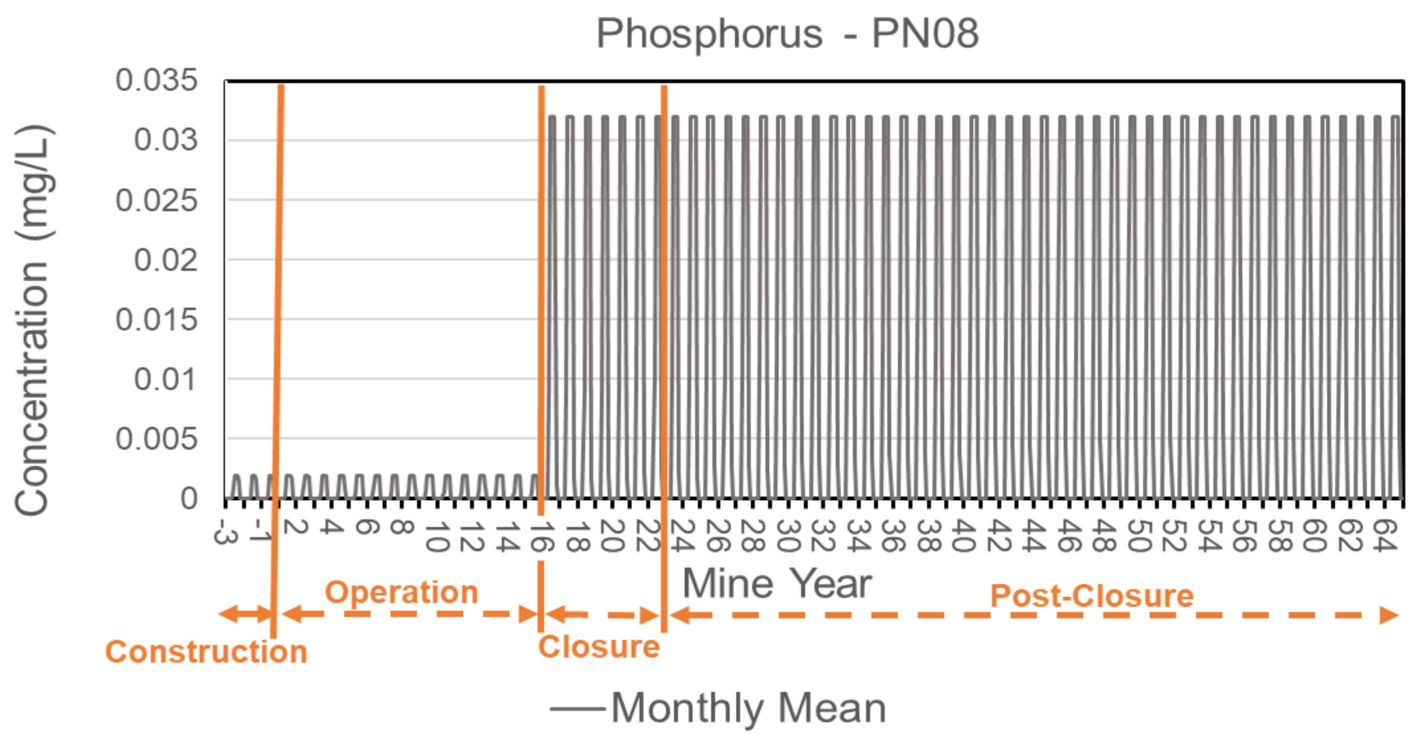

Iron - PN08
Concentration (mg/L)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

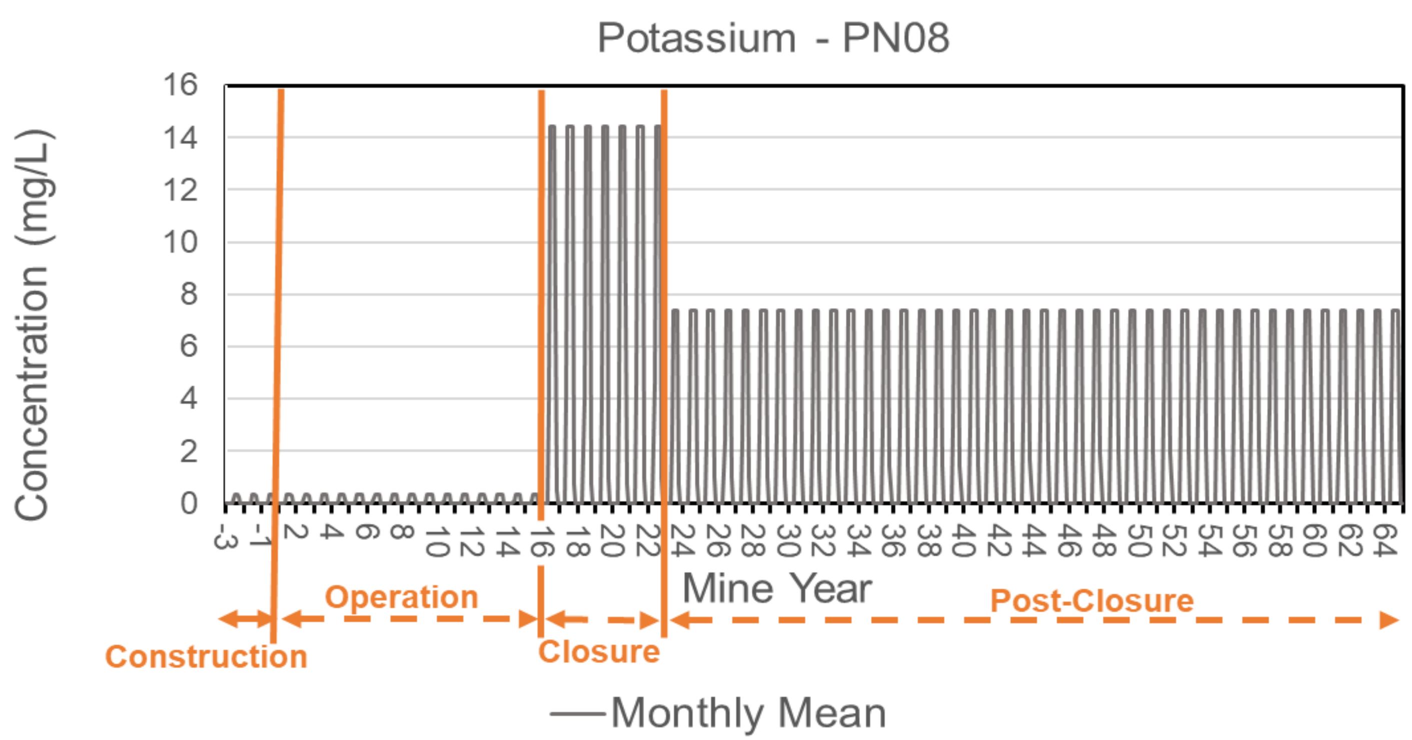

Magnesium - PN08
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

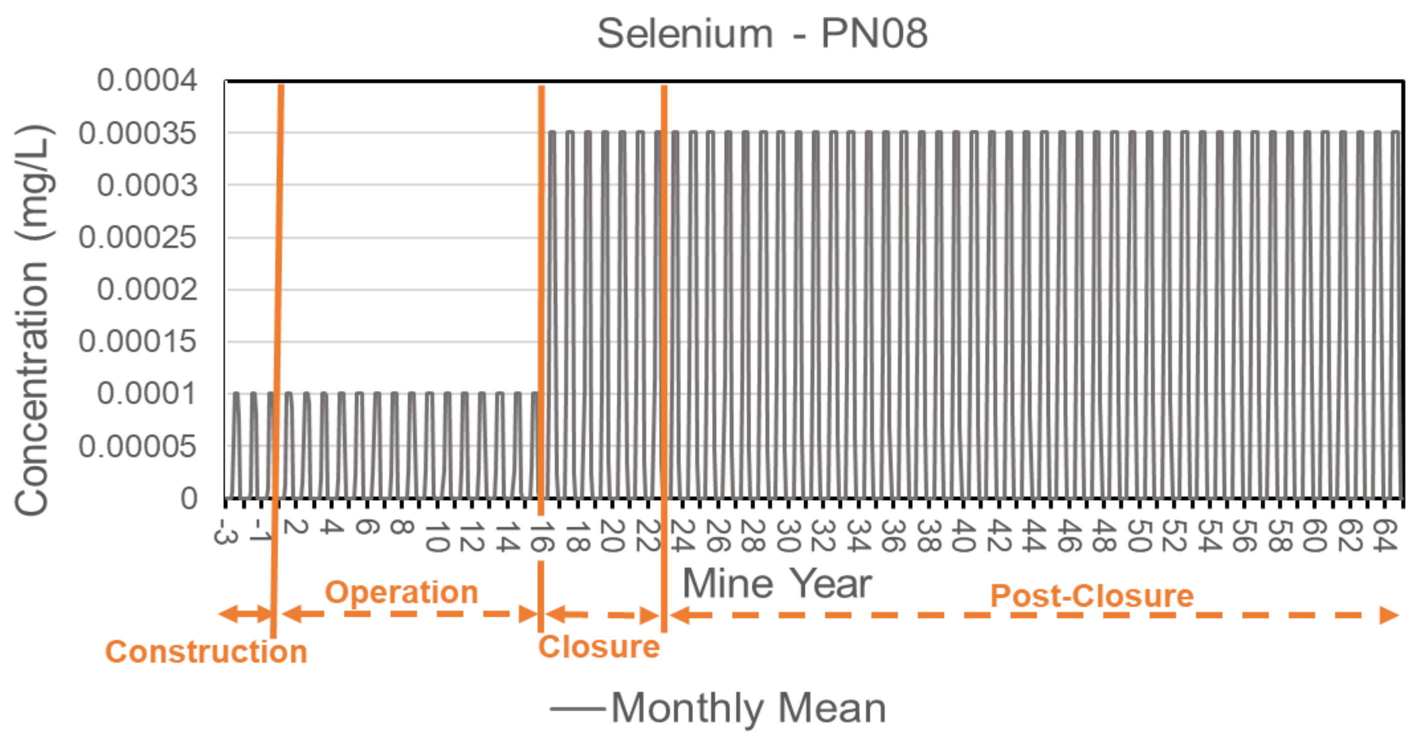

Mercury - PN08
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

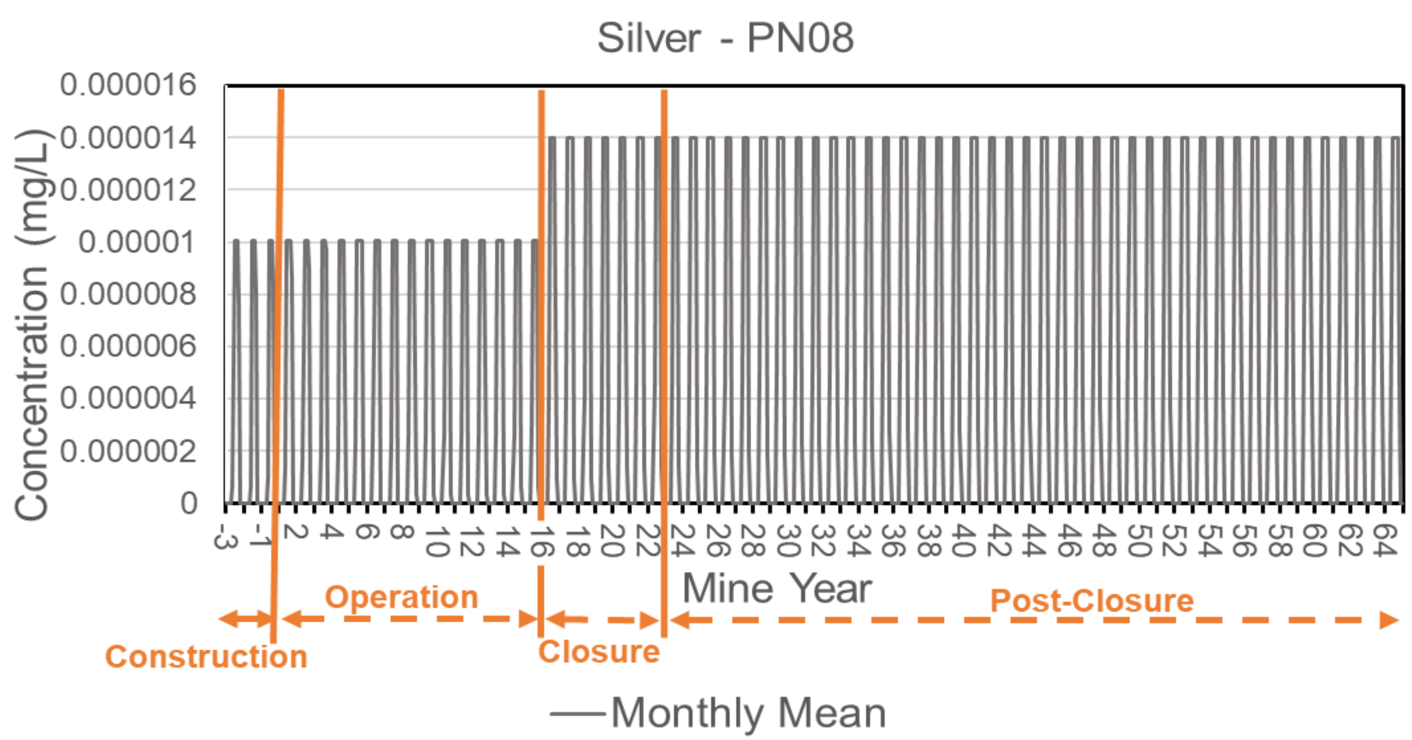

Molybdenum - PN08
Concentration (mg/L)
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

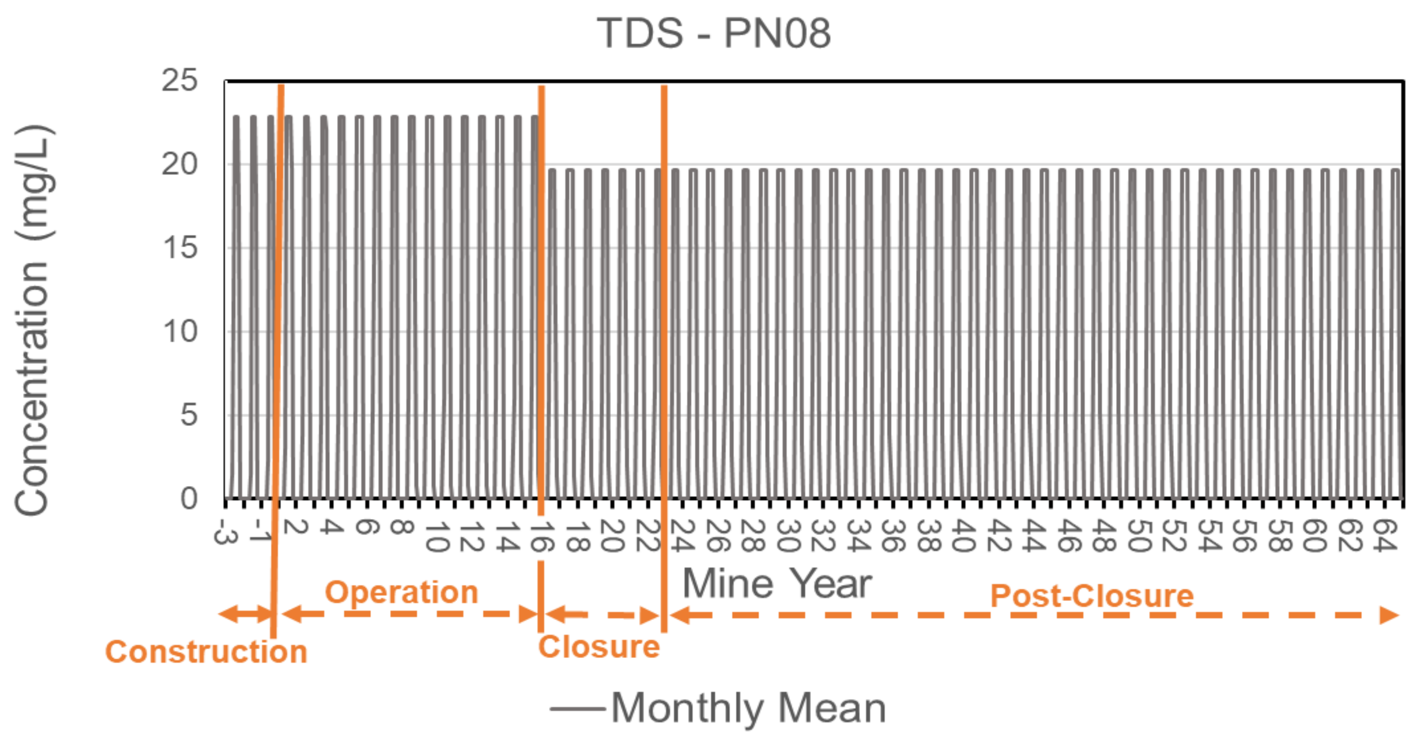

Nitrite - PN08
Concentration (mg-N/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

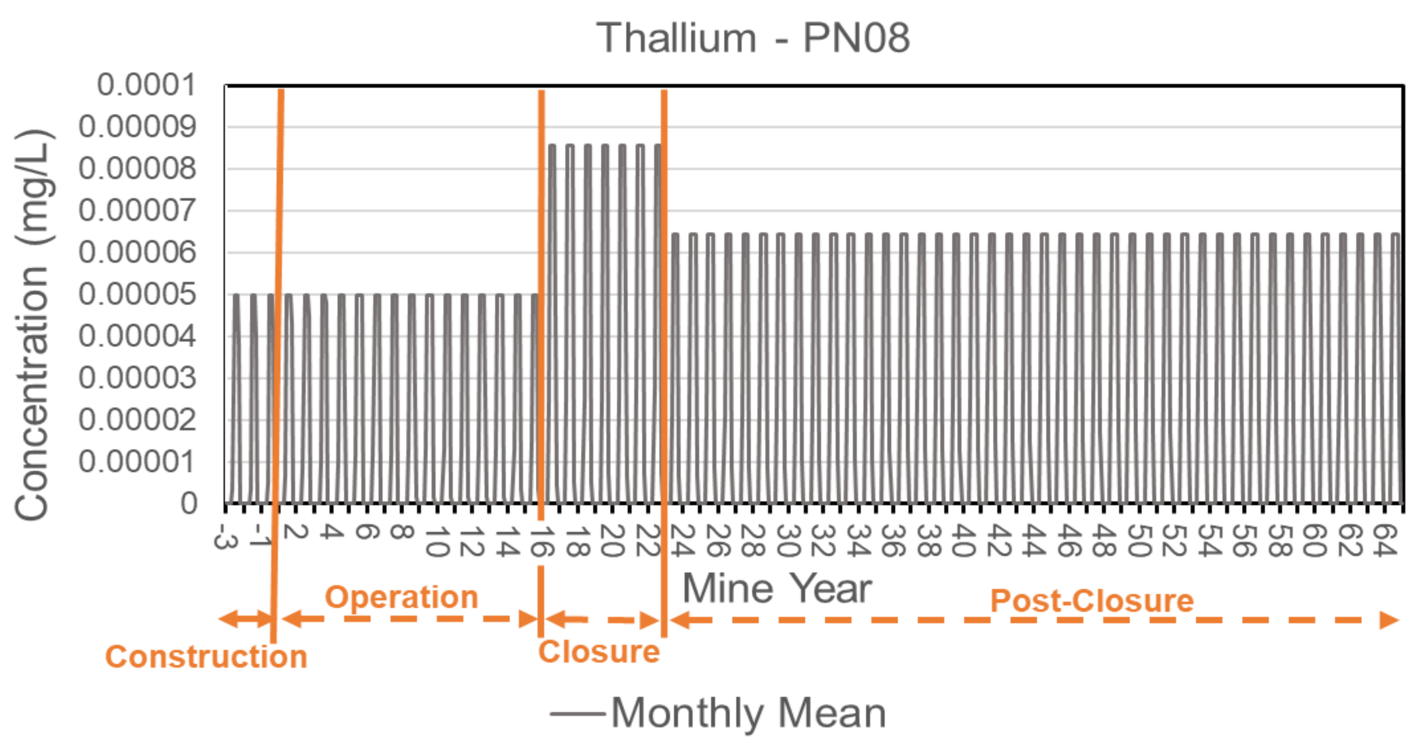

Phosphorus - PN08
Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Potassium - PN08
Concentration (mg/L)
16
14
12
10
8
6
4
2
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

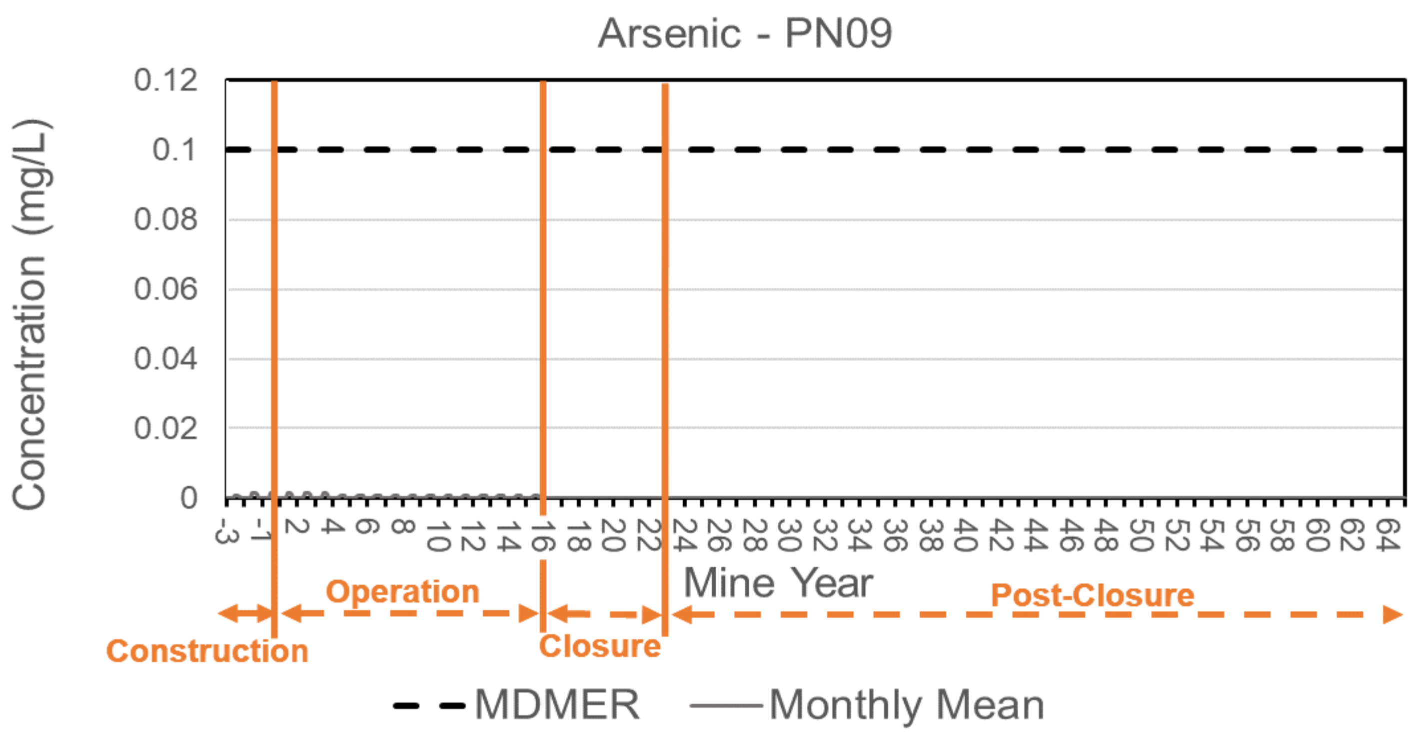

Selenium - PN08
Concentration (mg/L)
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

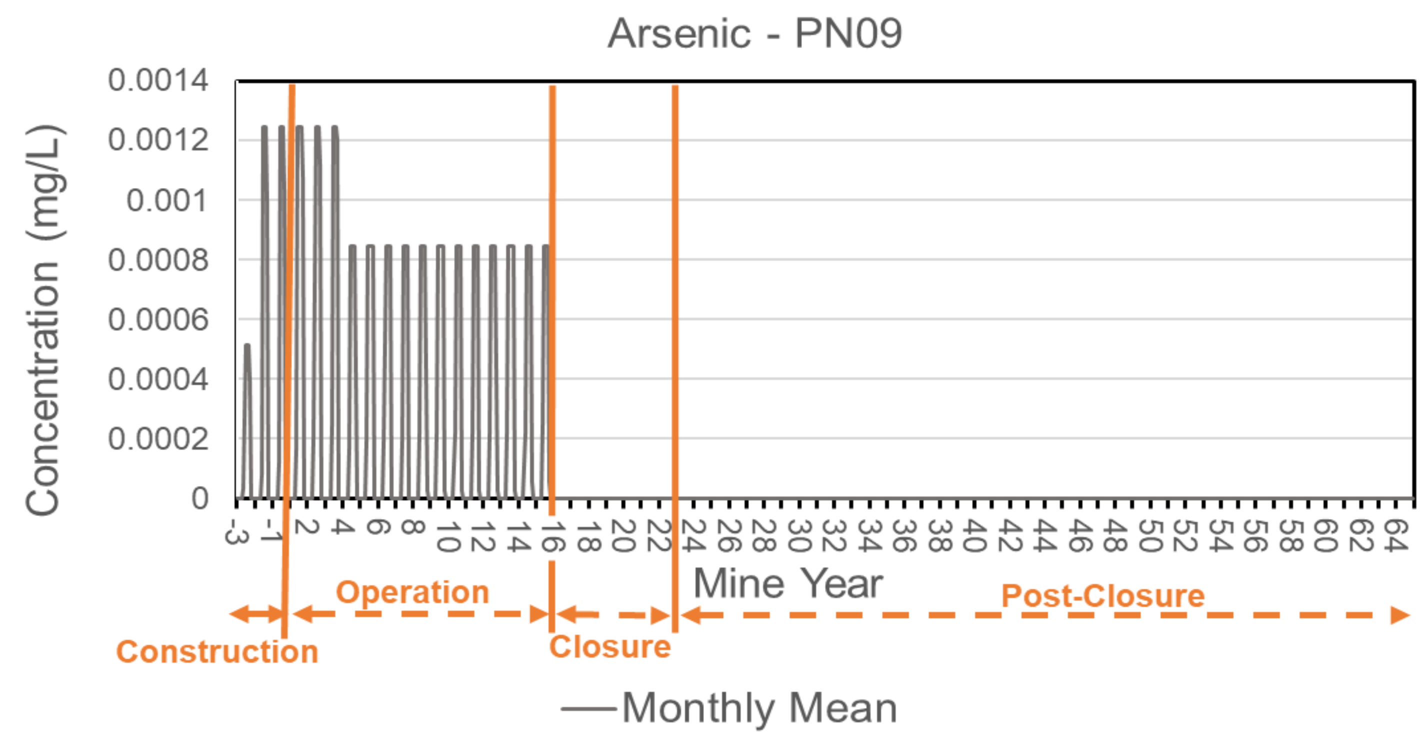

Silver - PN08
Concentration (mg/L)
0.000016
0.000014
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

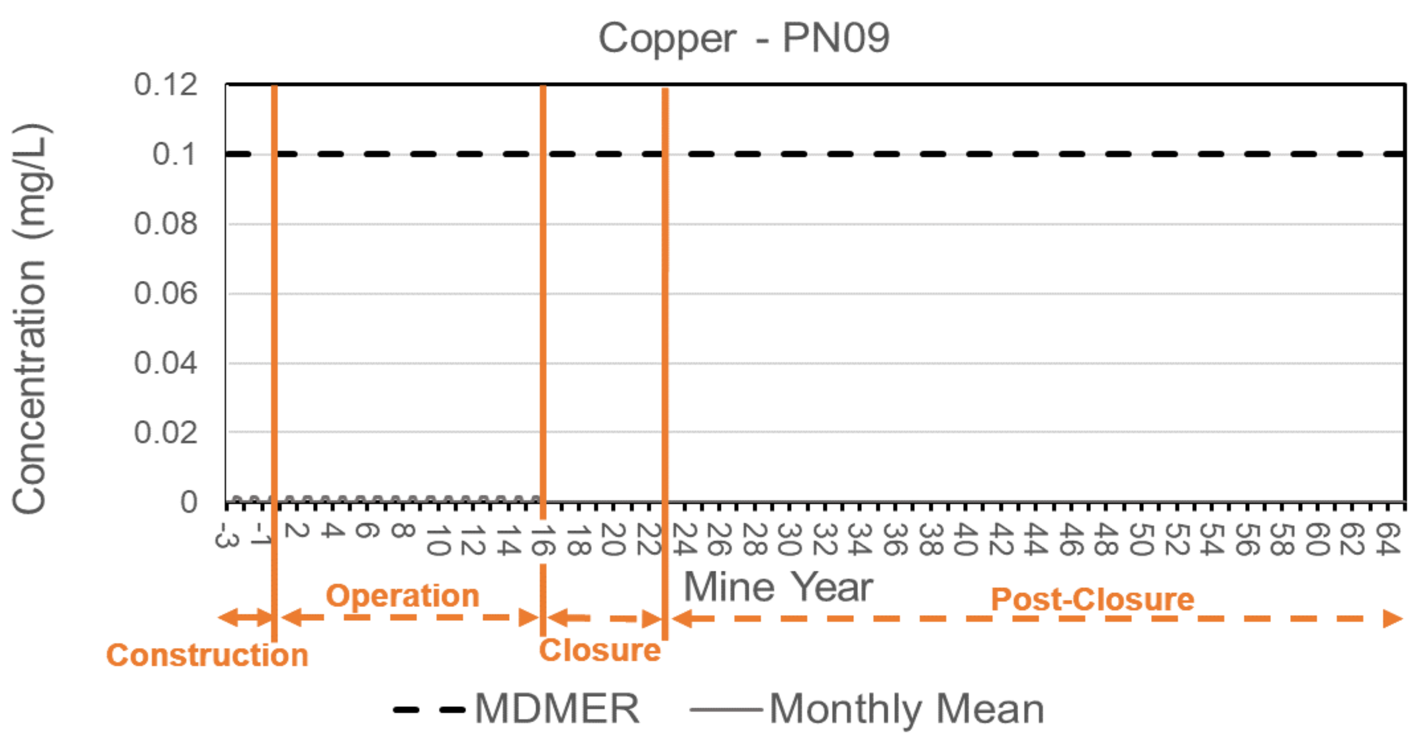


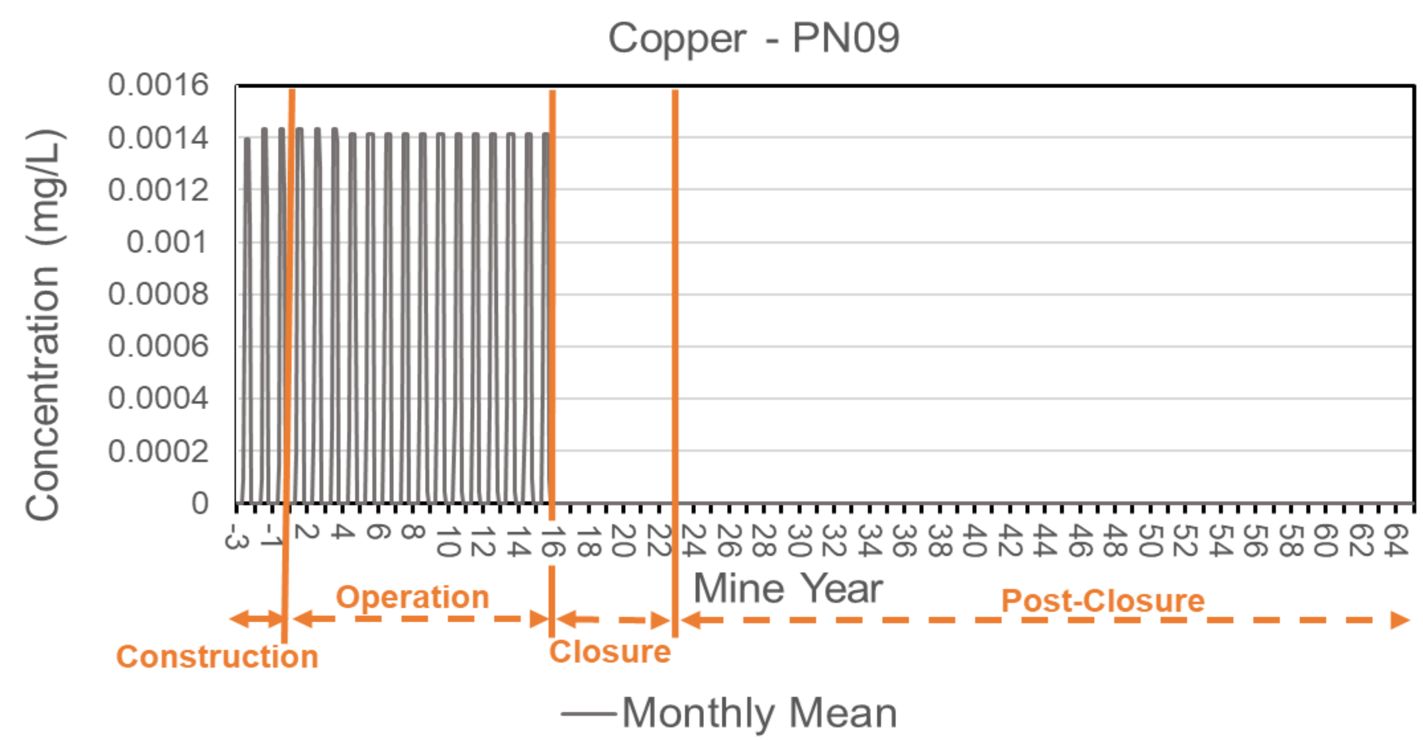


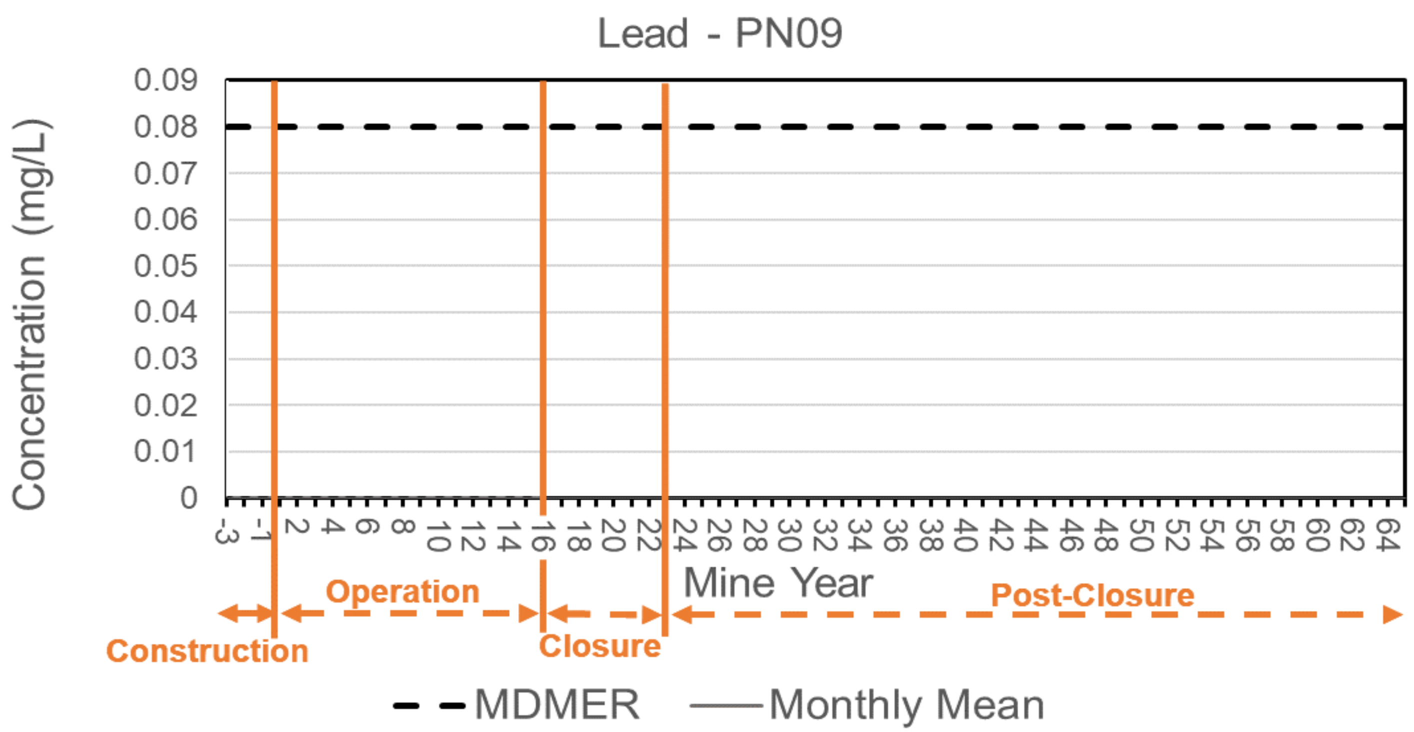
CWQG = Canadian Water Quality Guideline (from CCME 1999)
CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2019. Winnipeg, MB, Canada.

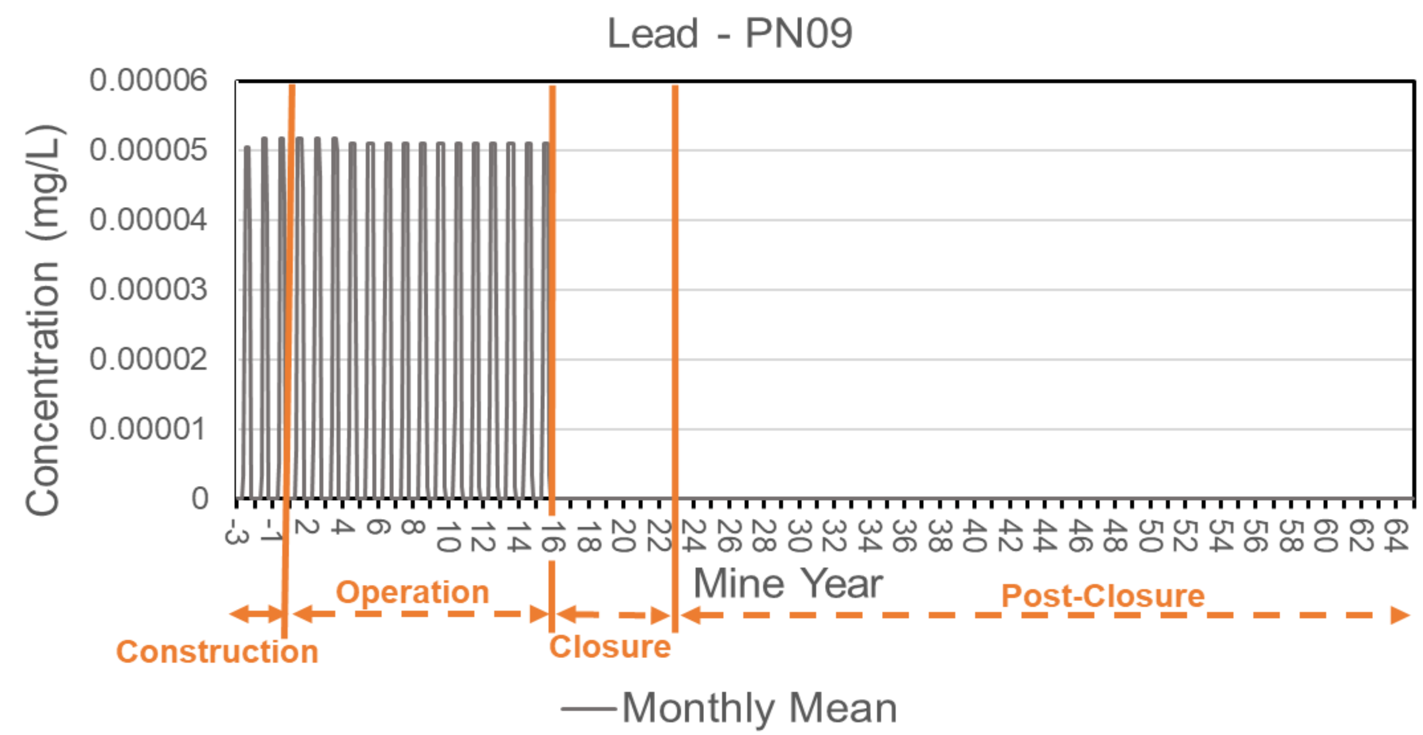

Arsenic - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

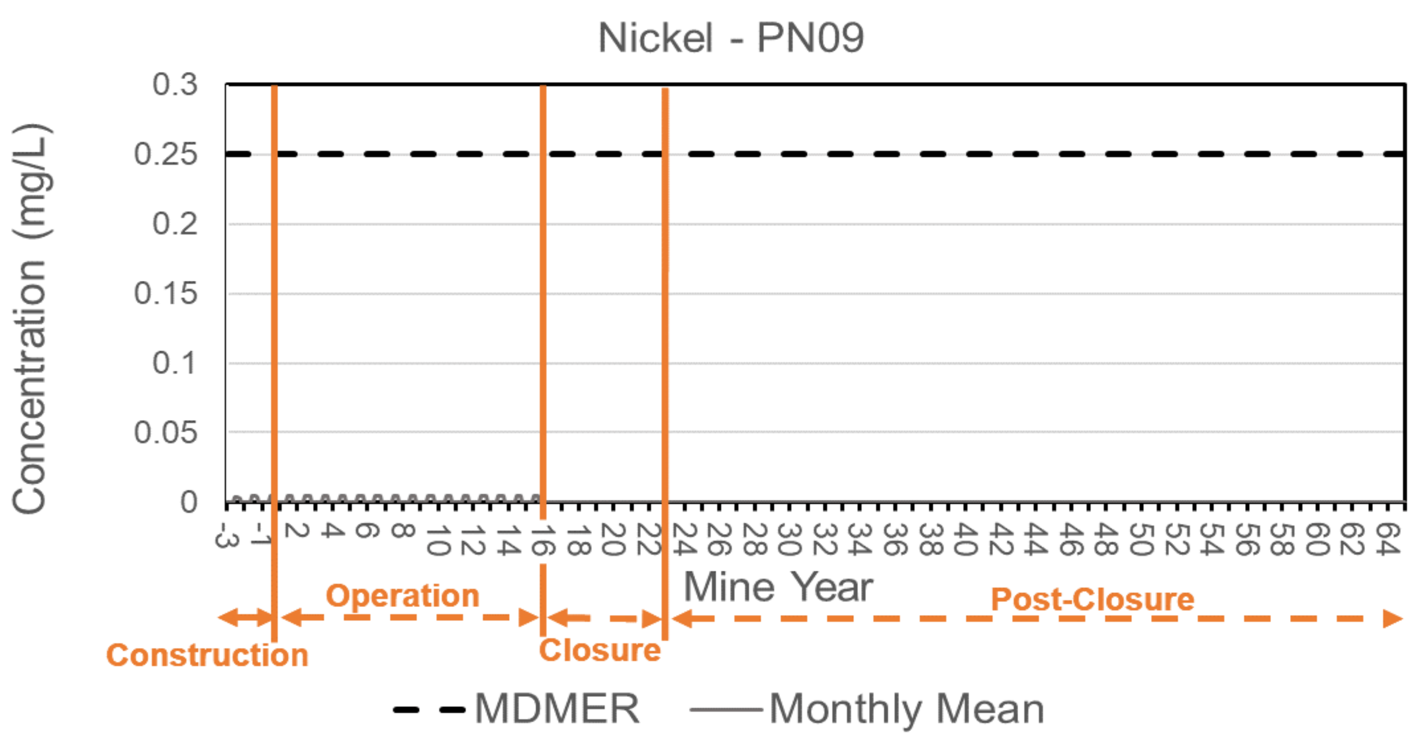

Arsenic - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

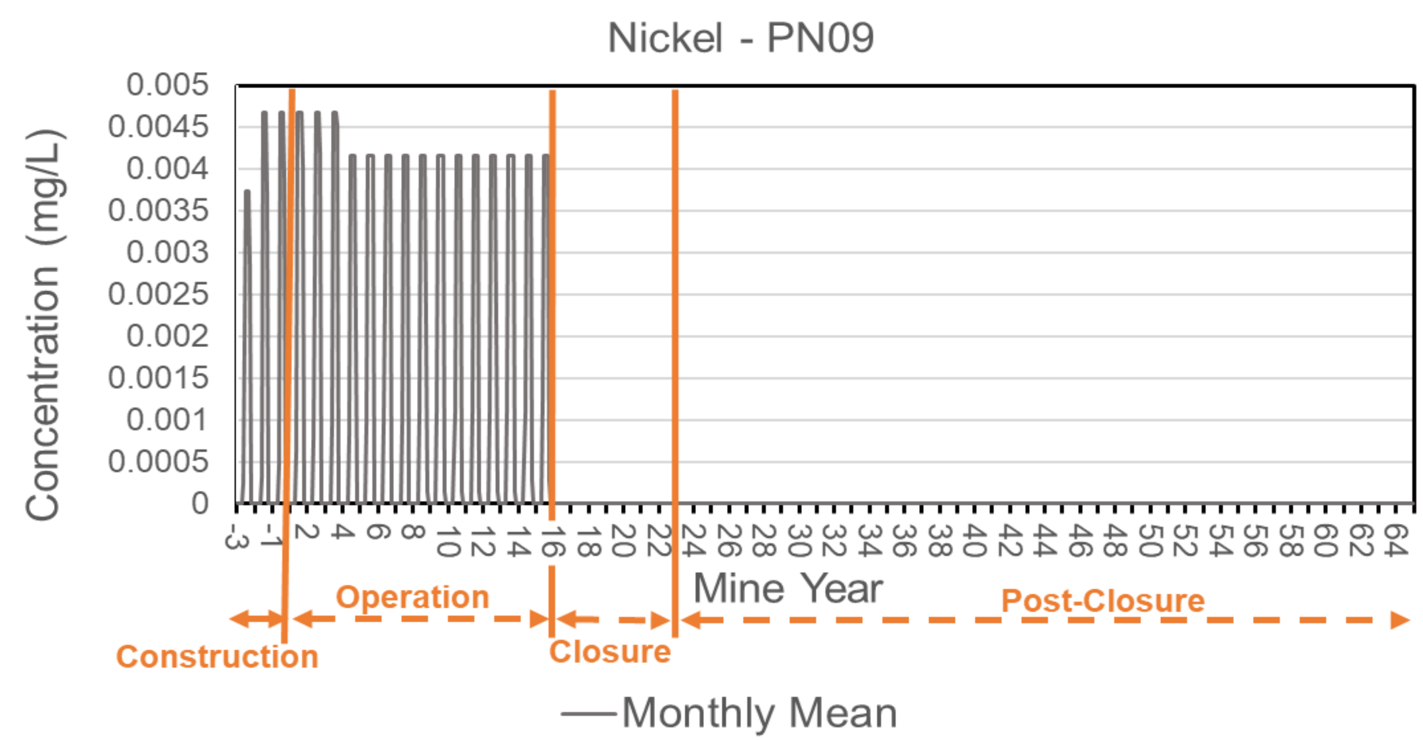

Copper - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

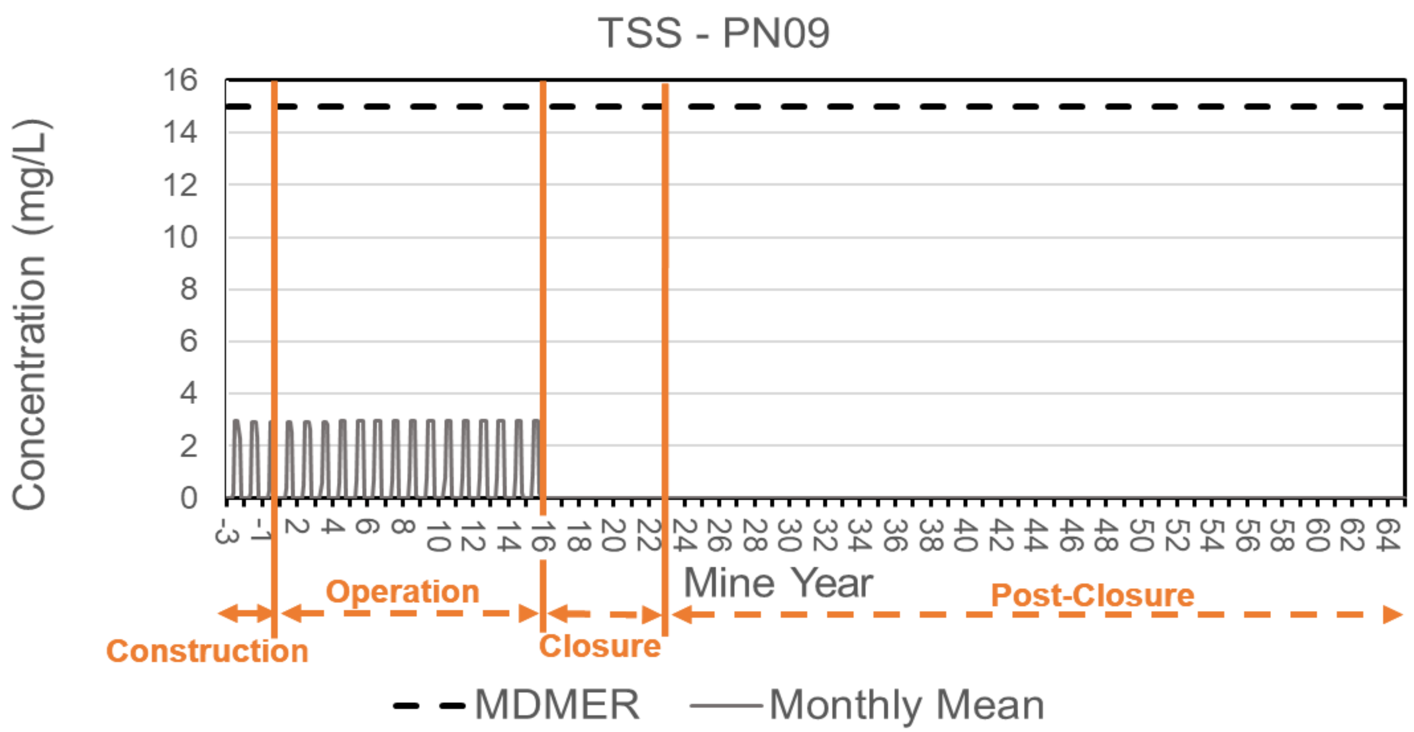

Copper - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

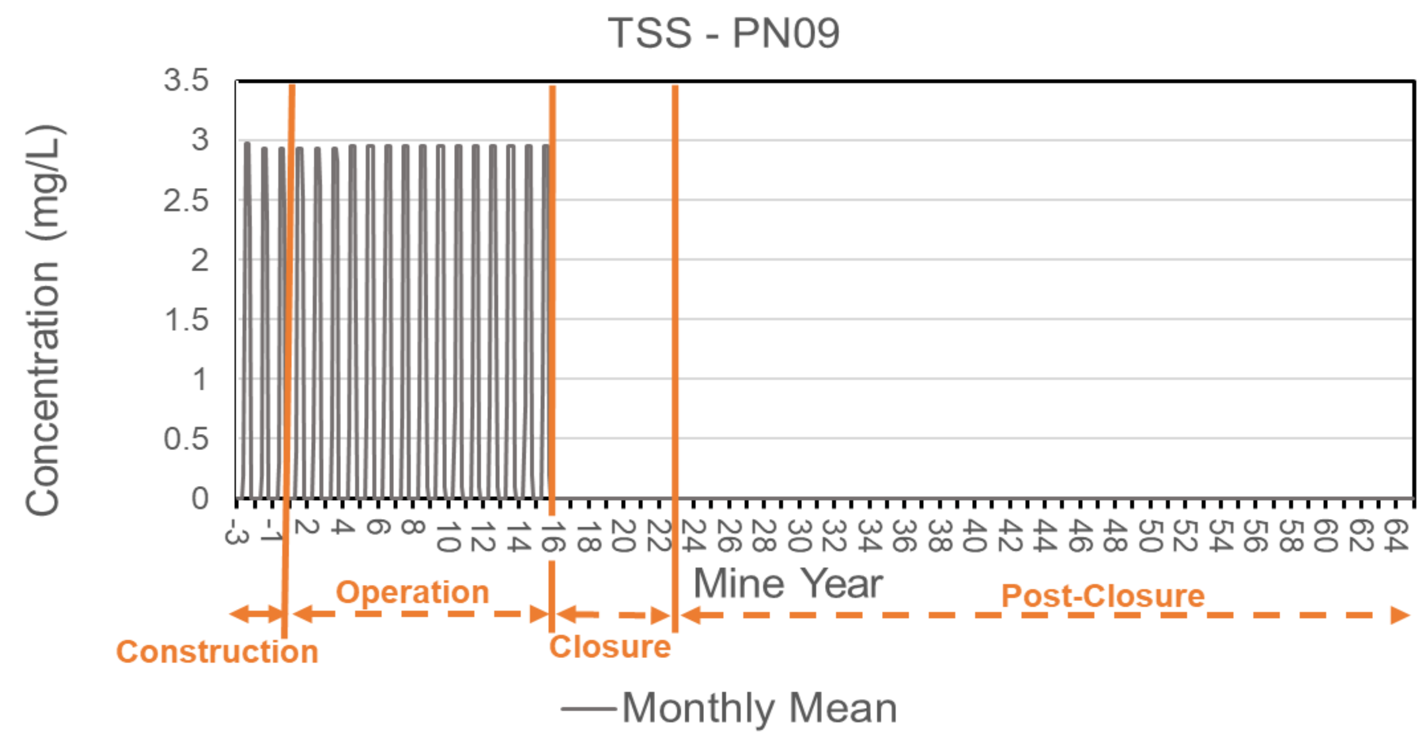

Lead - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

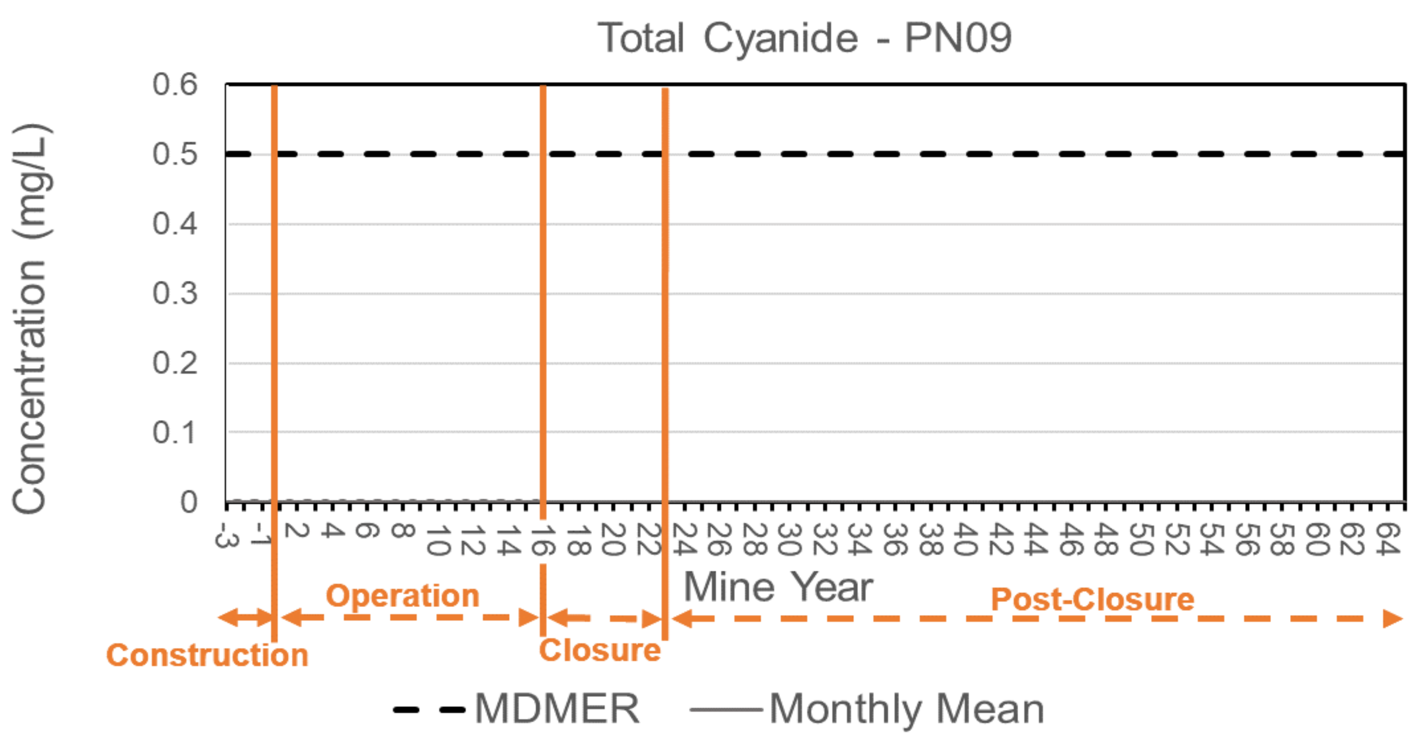

Lead - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

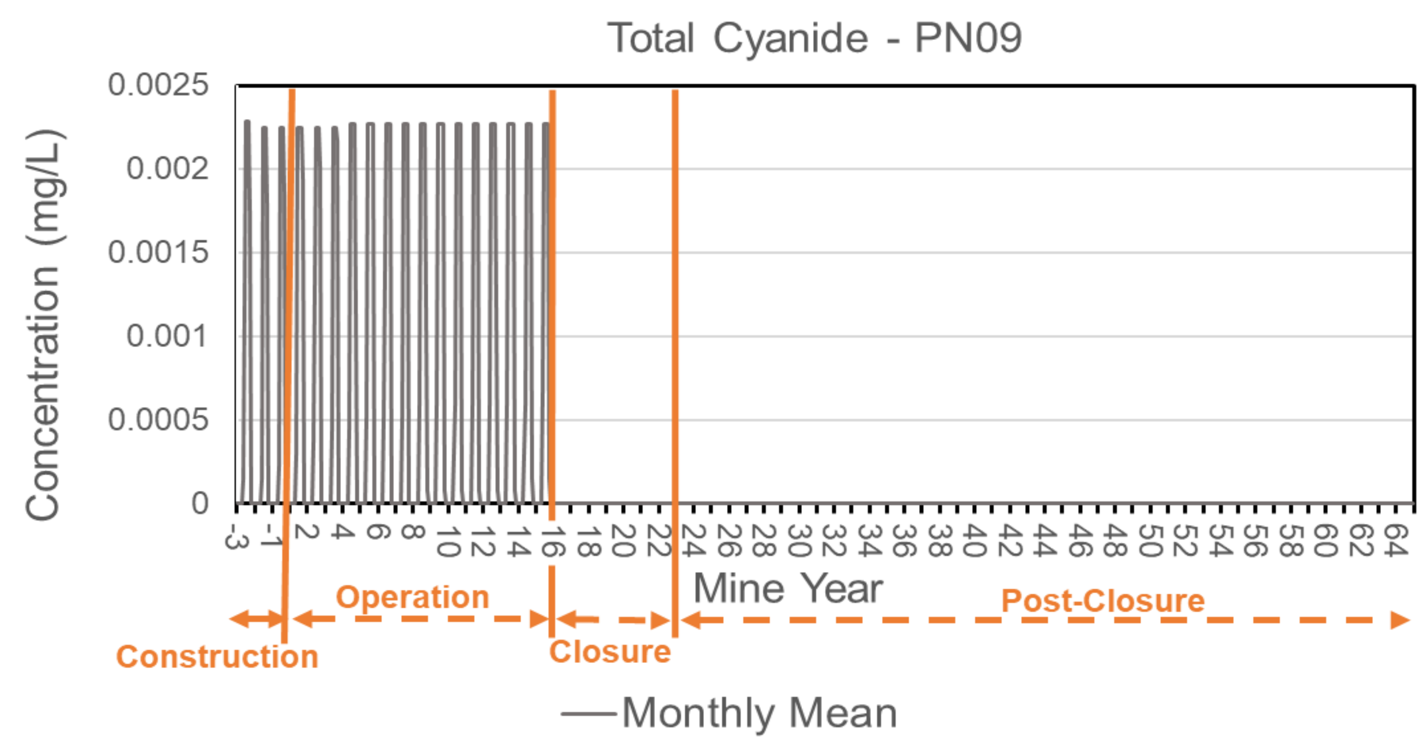

Nickel - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

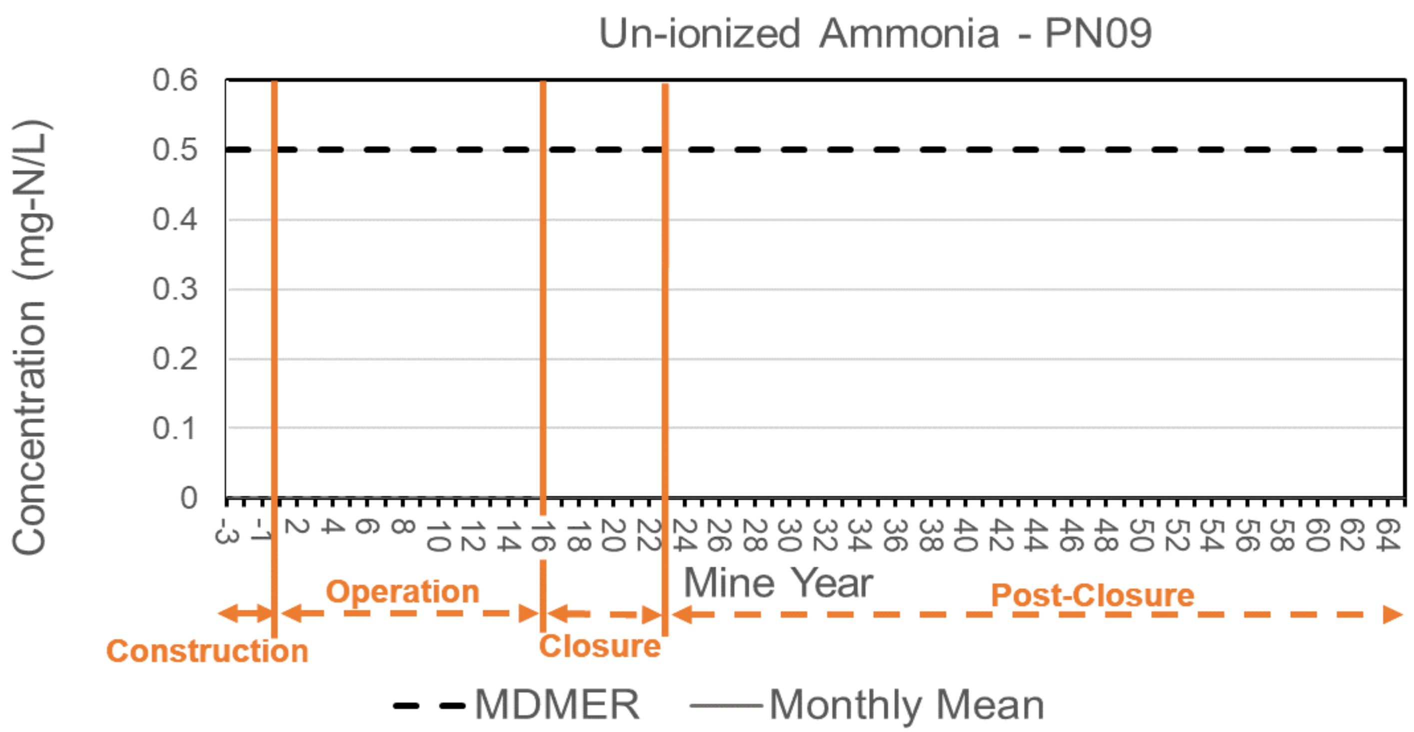

Nickel - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


TSS - PN09
Concentration (mg/L)
16
14
12
10
8
6
4
2
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

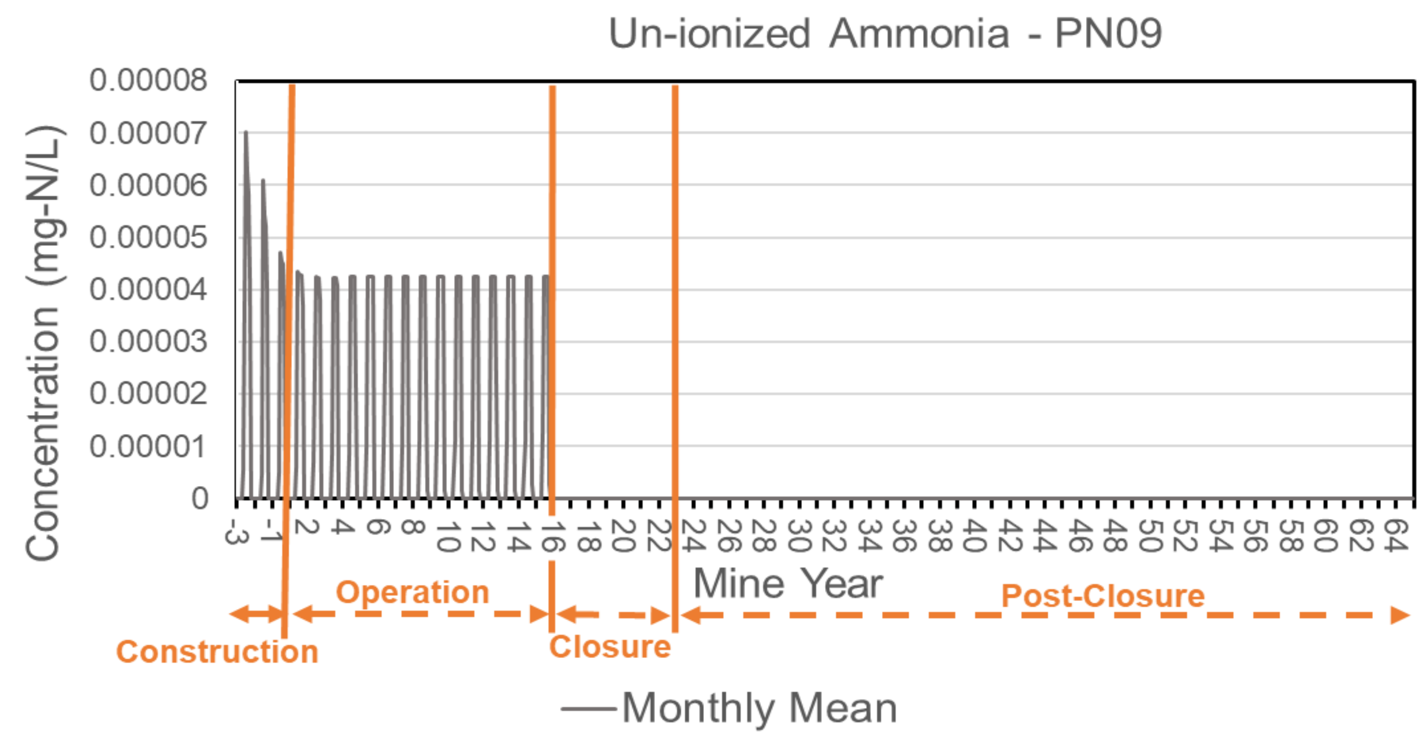

TSS - PN09
Concentration (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Total Cyanide - PN09
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean

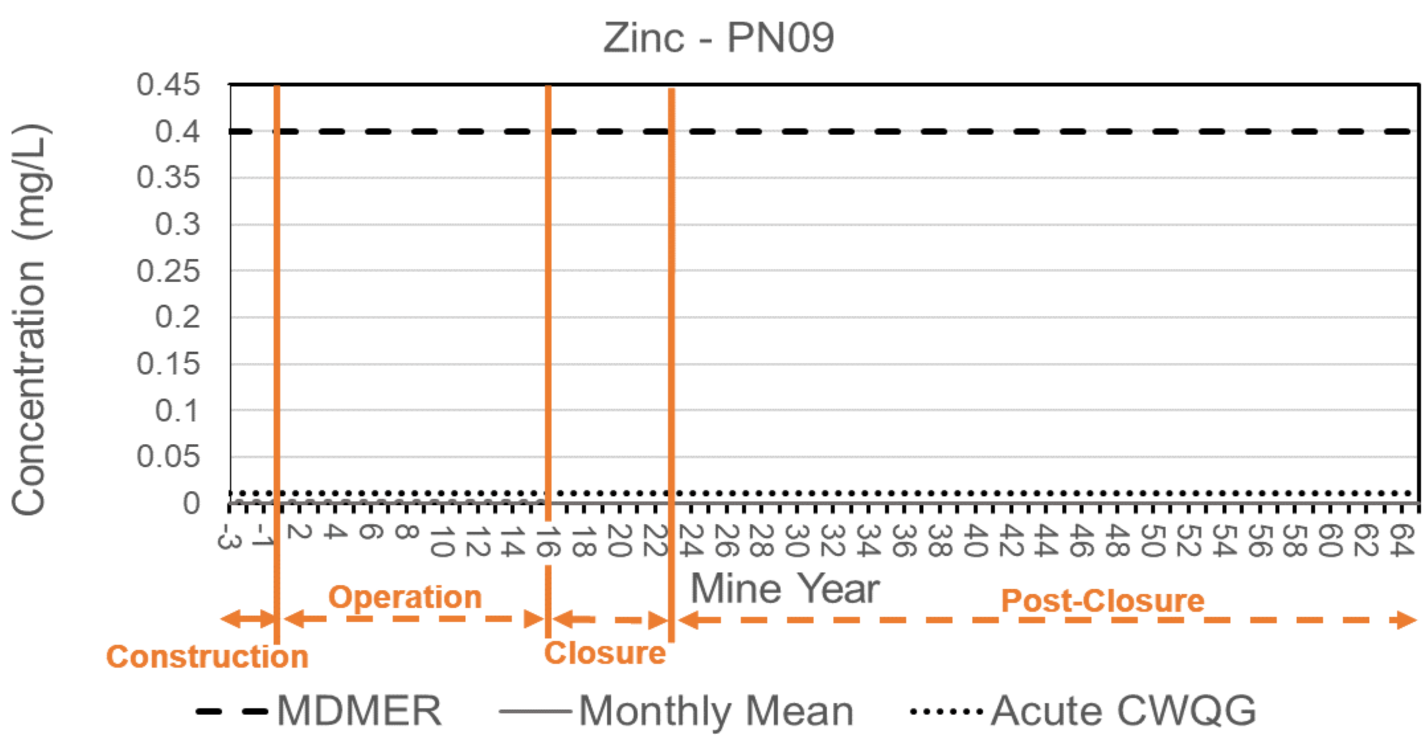

Total Cyanide - PN09
Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



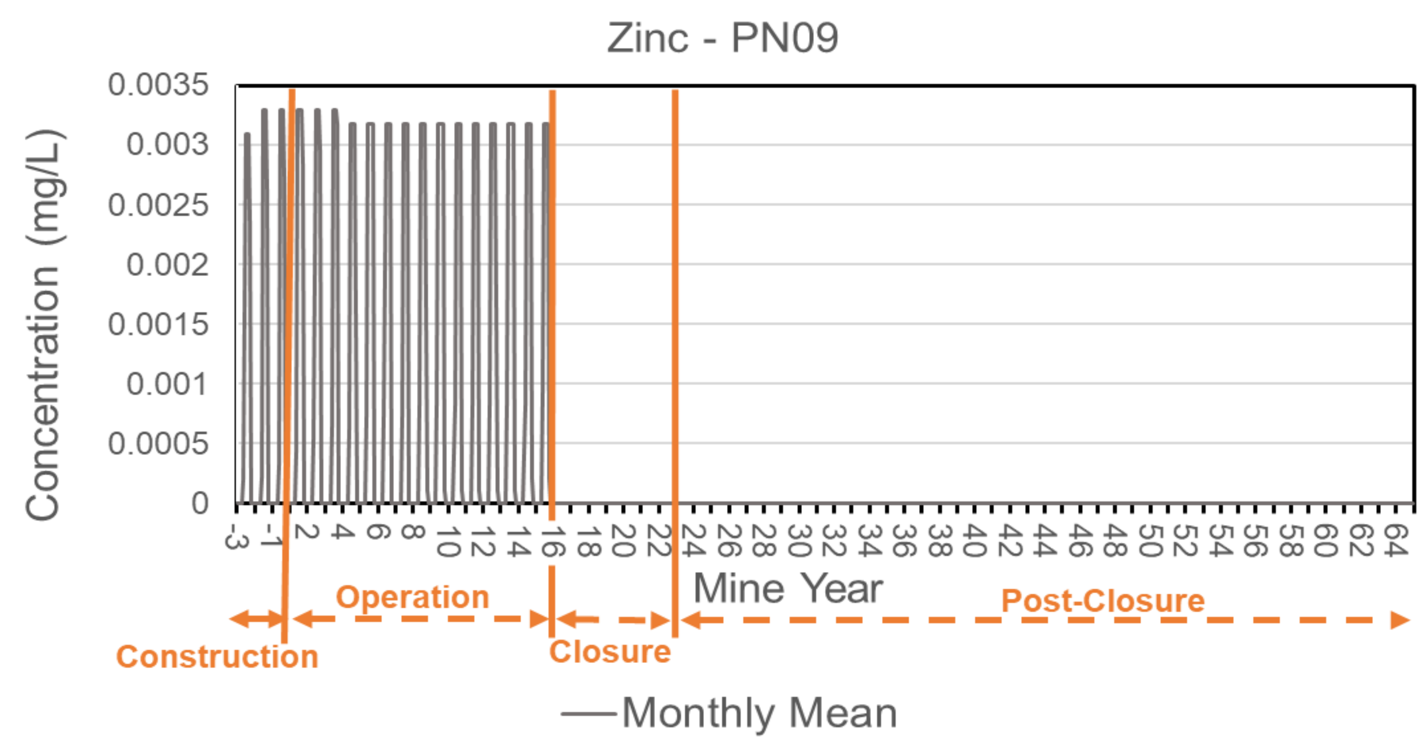
Un-ionized Ammonia - PN09
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean



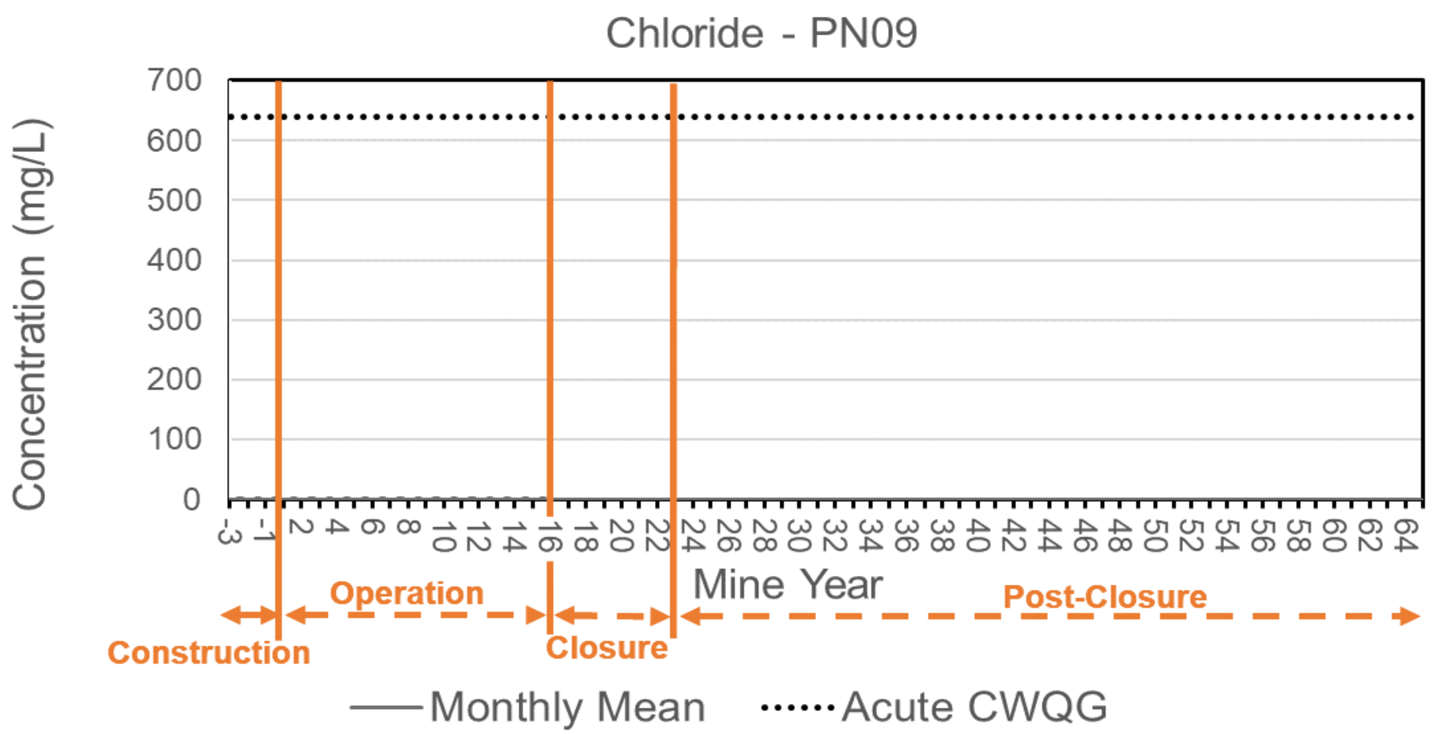
Un-ionized Ammonia - PN09
Concentration (mg-N/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

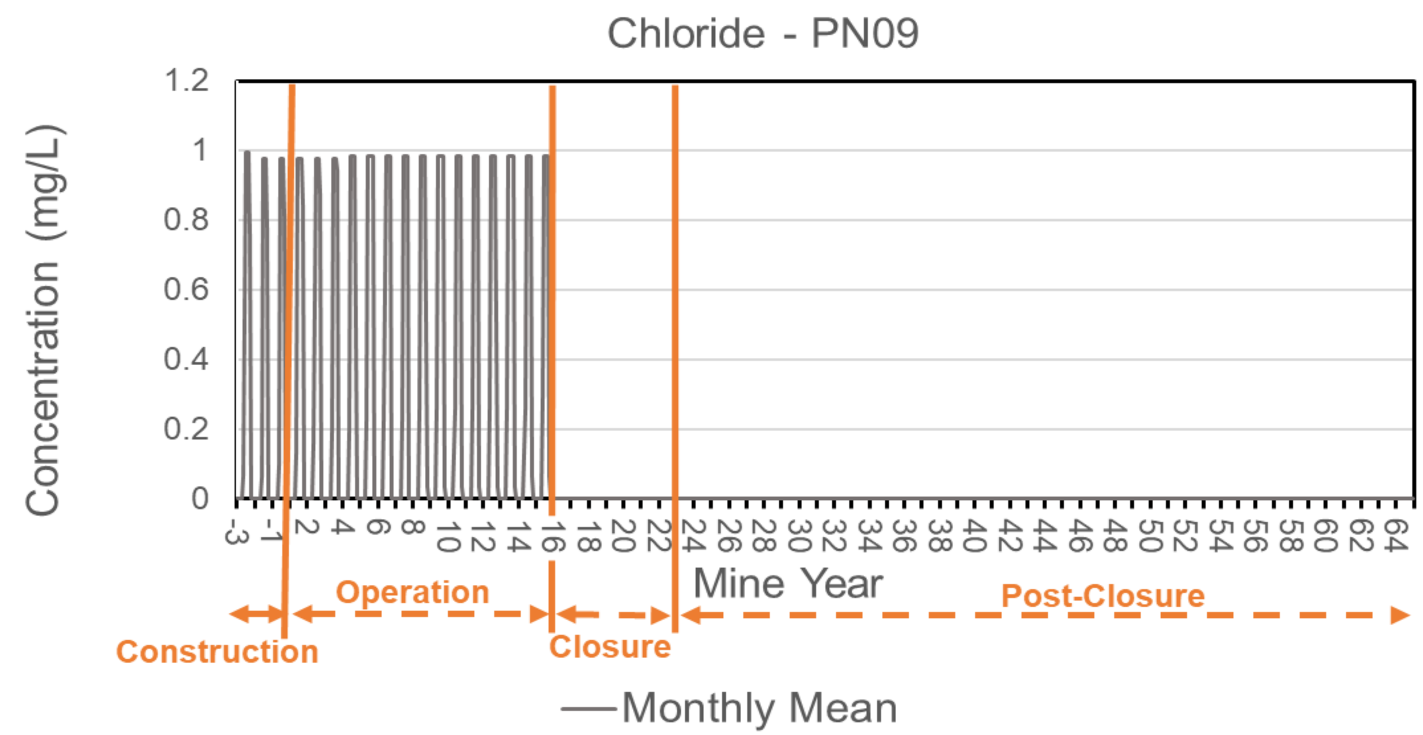


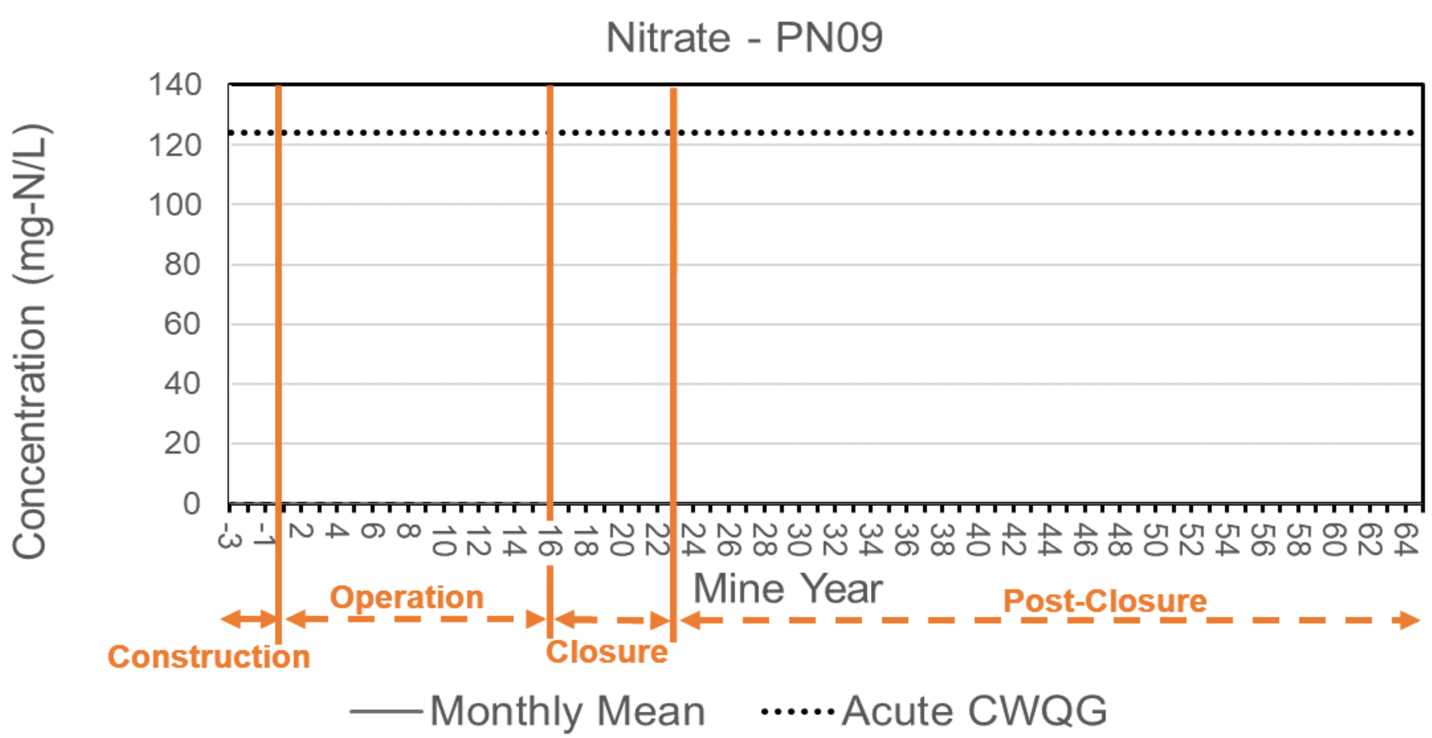
Zinc - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
MDMER
Monthly Mean
Acute CWQG

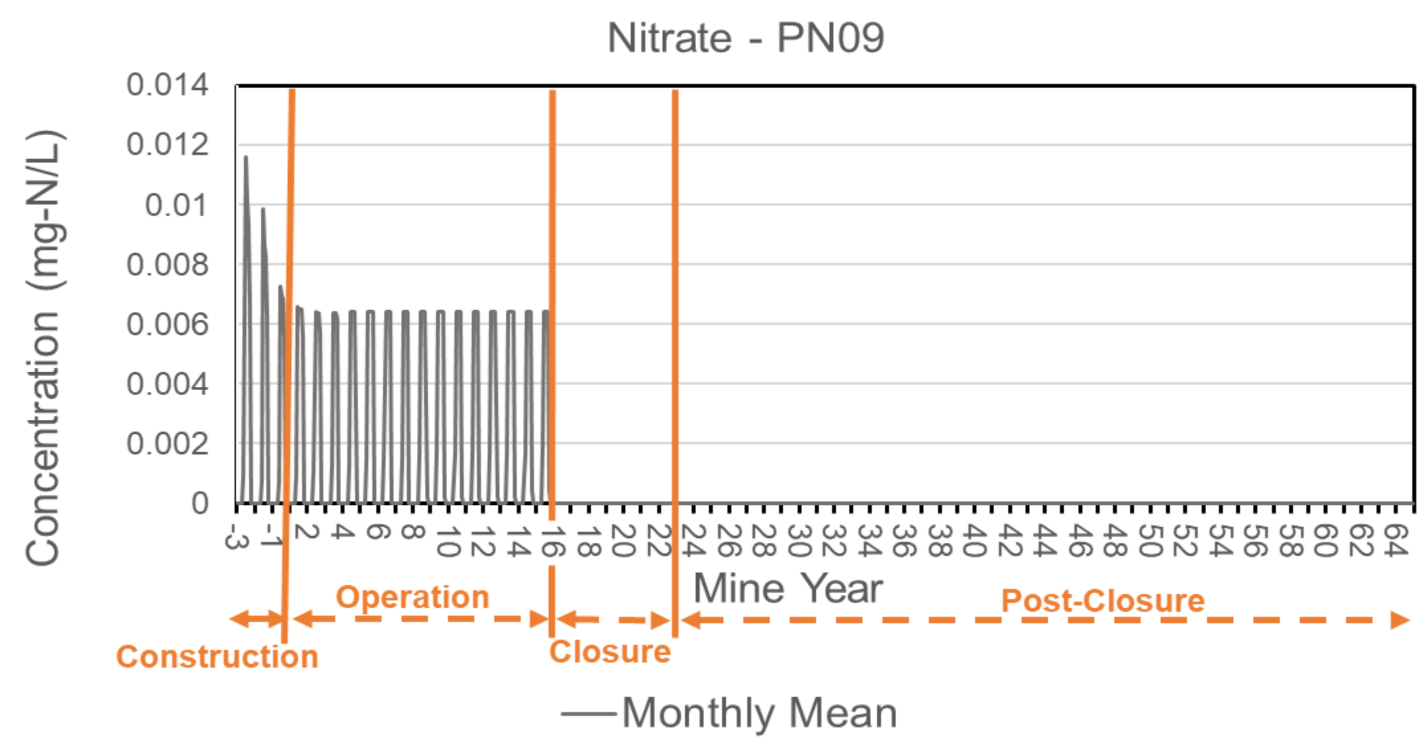


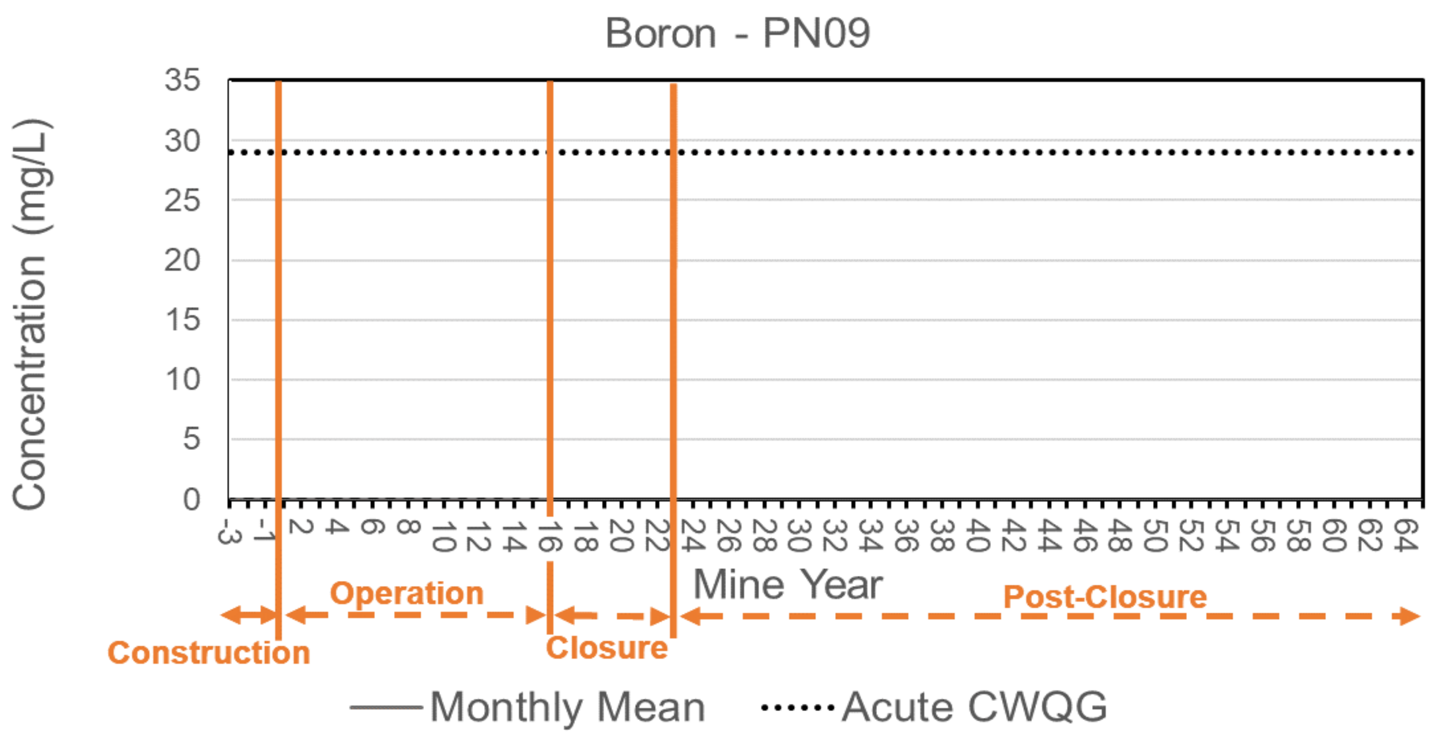
Zinc - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

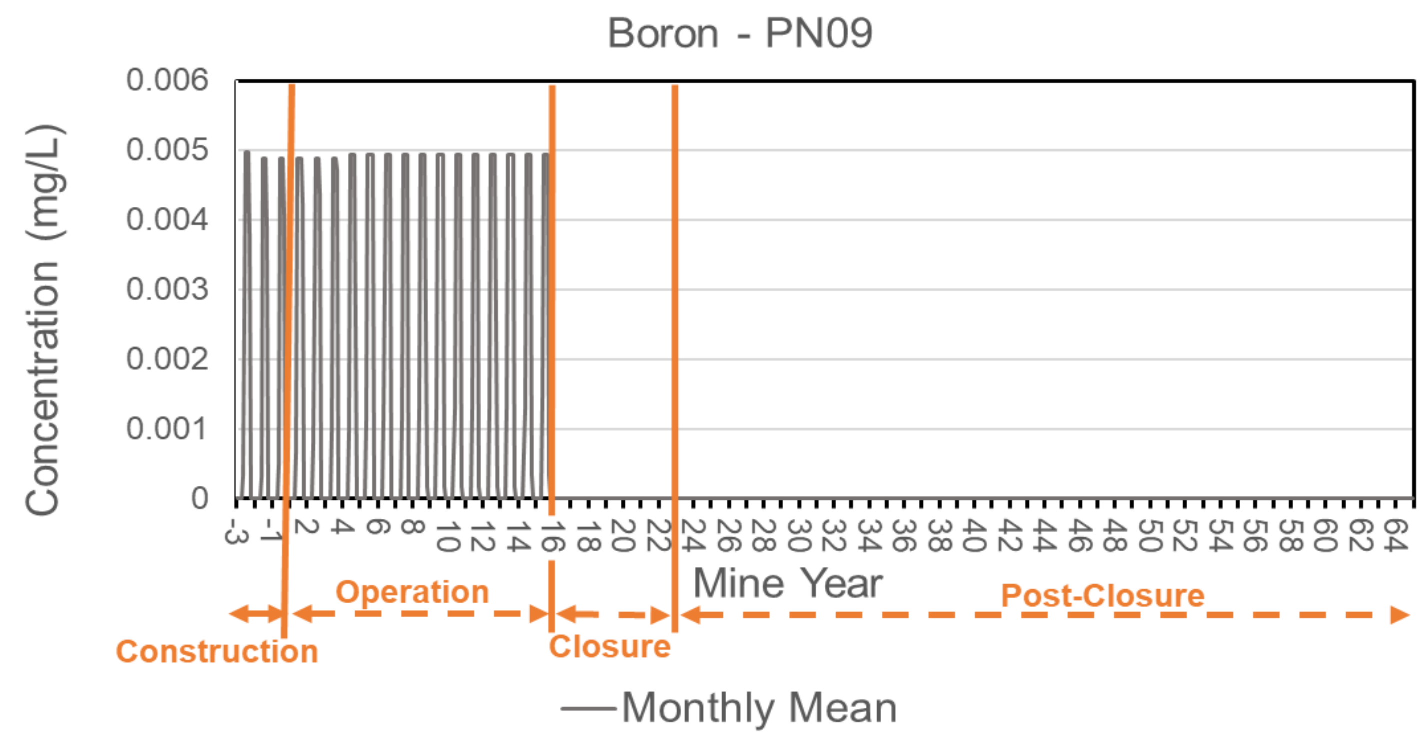

Chloride - PN09
Concentration (mg/L)
700
600
500
400
300
200
100
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

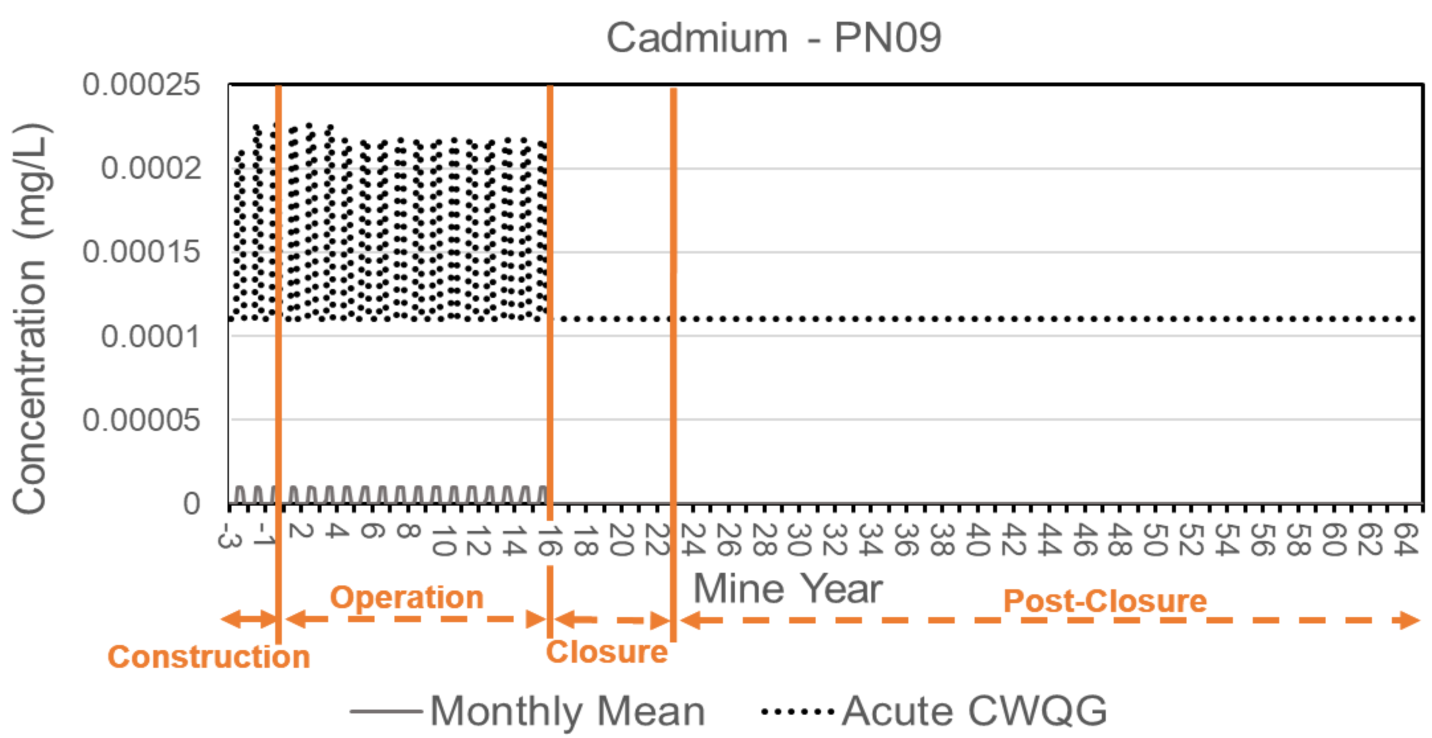

Chloride - PN09
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

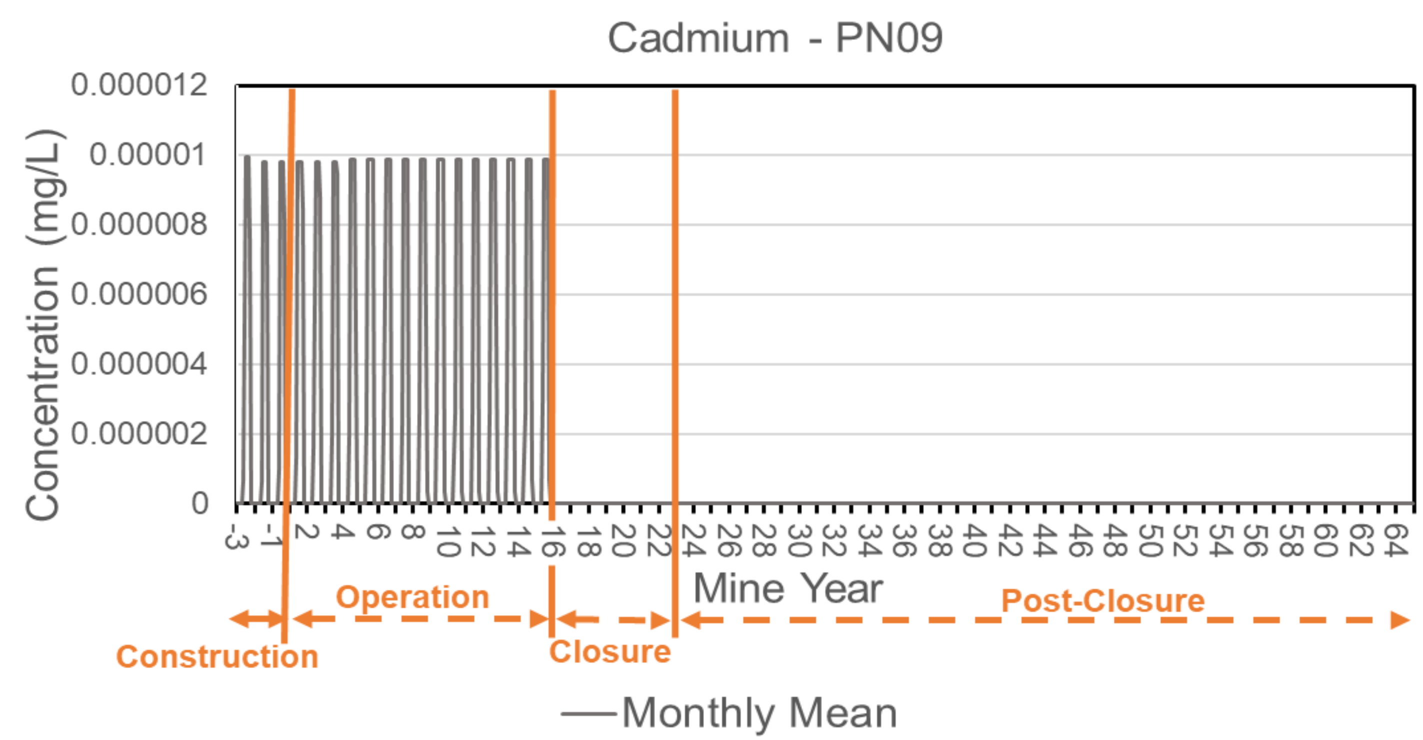

Nitrate - PN09
Concentration (mg-N/L)
140
120
100
80
60
40
20
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

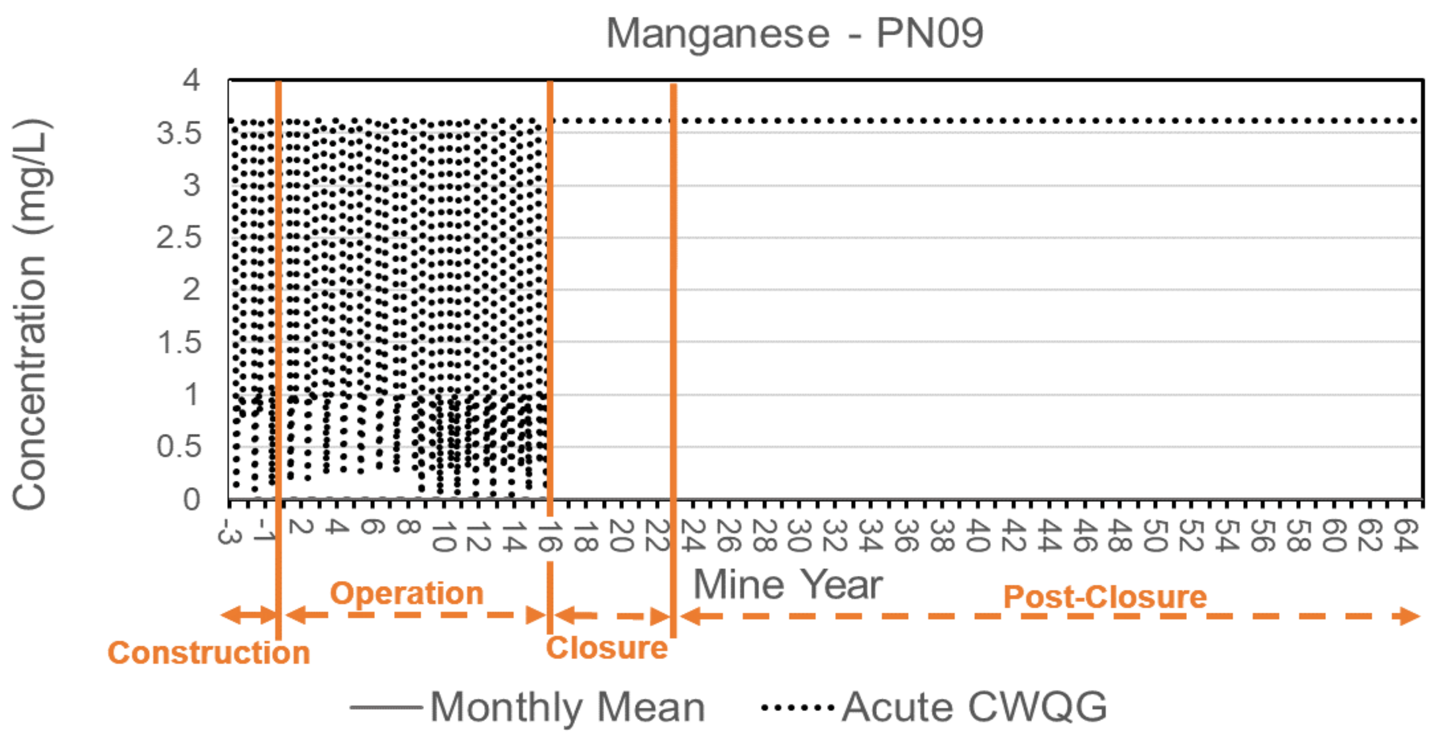

Nitrate - PN09
Concentration (mg-N/L)
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Boron - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

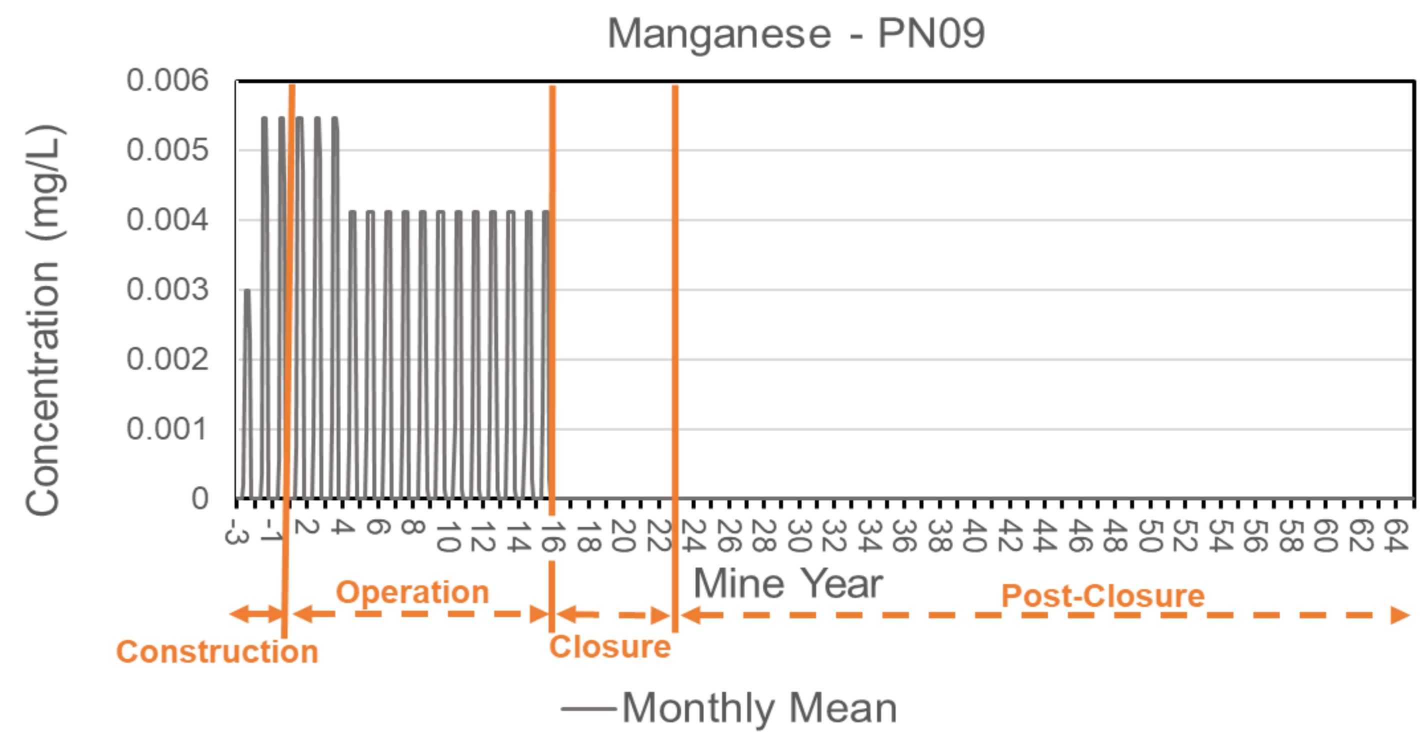

Boron - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Cadmium - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean
Acute CWQG

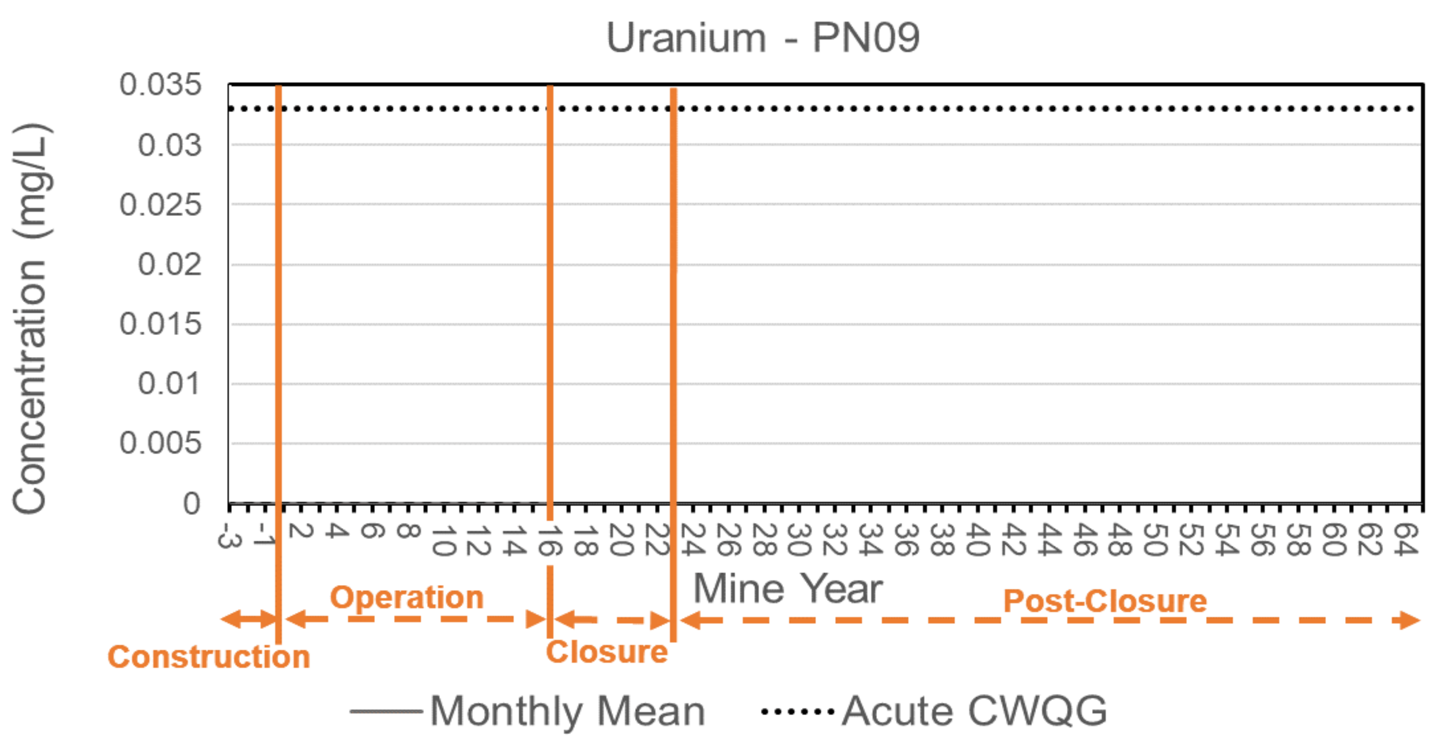

Cadmium - PN09
Concentration (mg/L)
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean



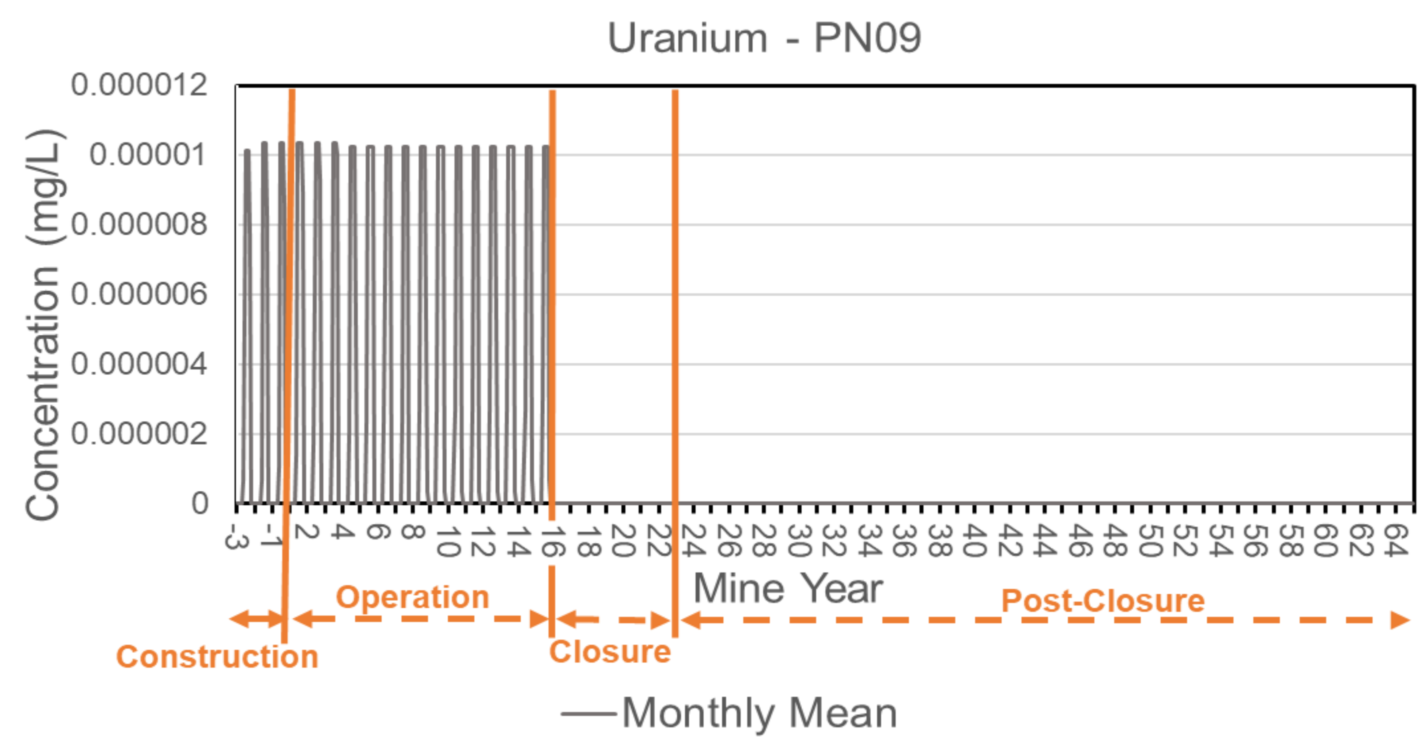
Manganese - PN09
Concentration (mg/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean
Acute CWQG



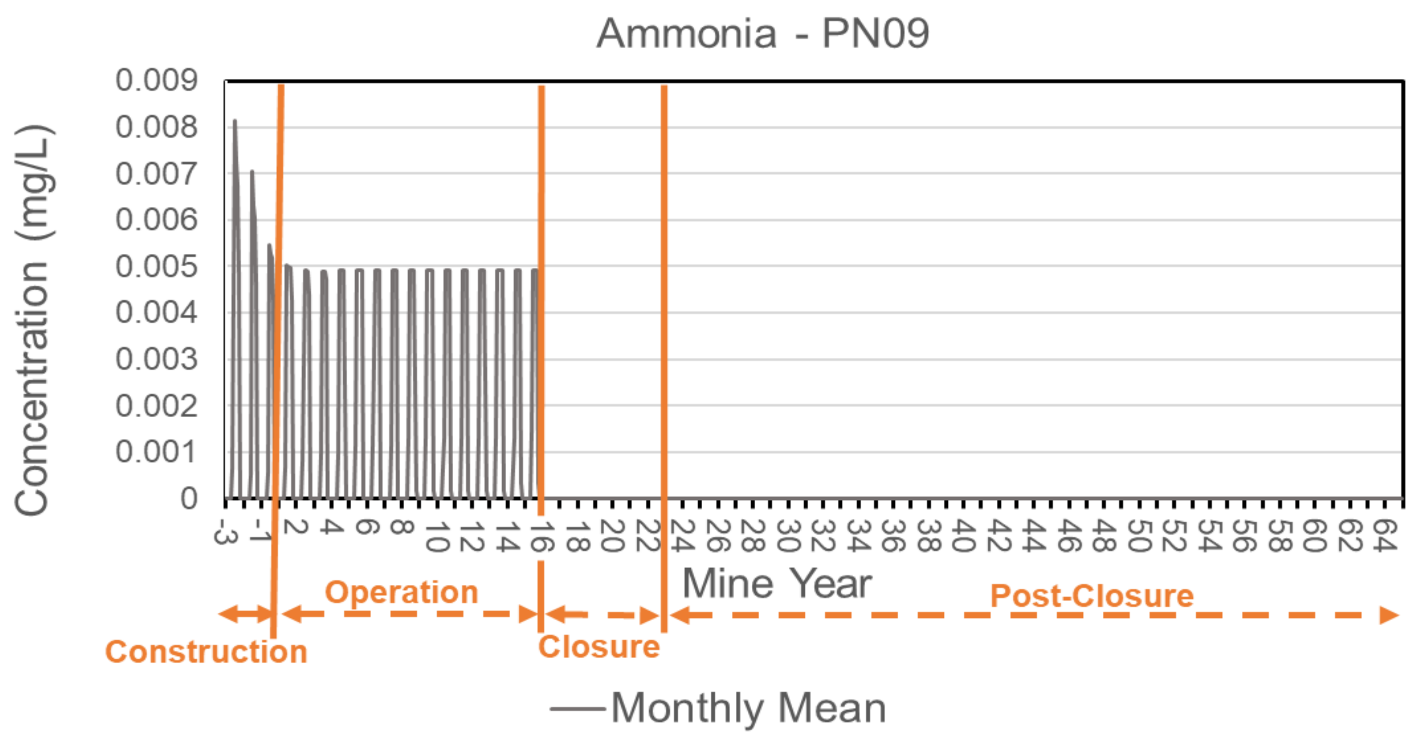
Manganese - PN09
Concentration (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

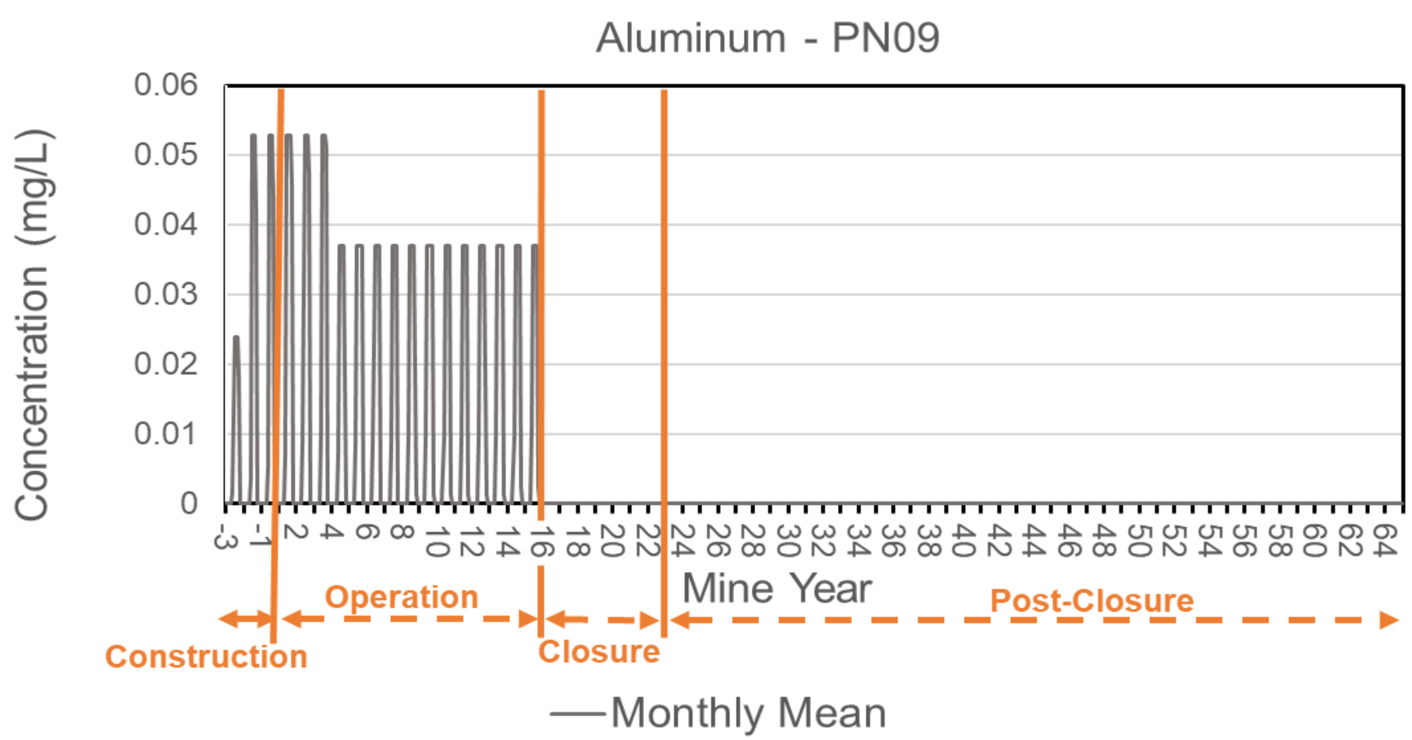


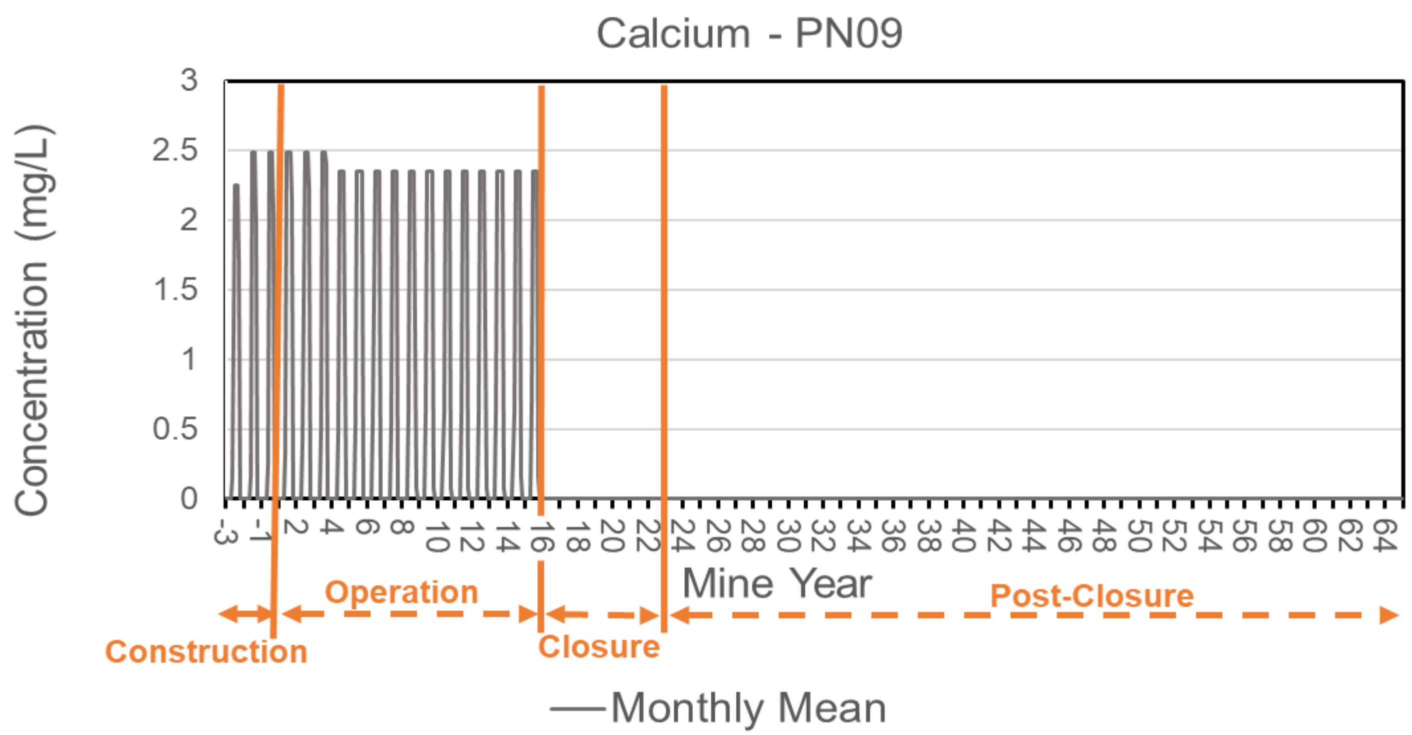
Uranium - PN09
Concentration (mg/L)
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean
Acute CWQG

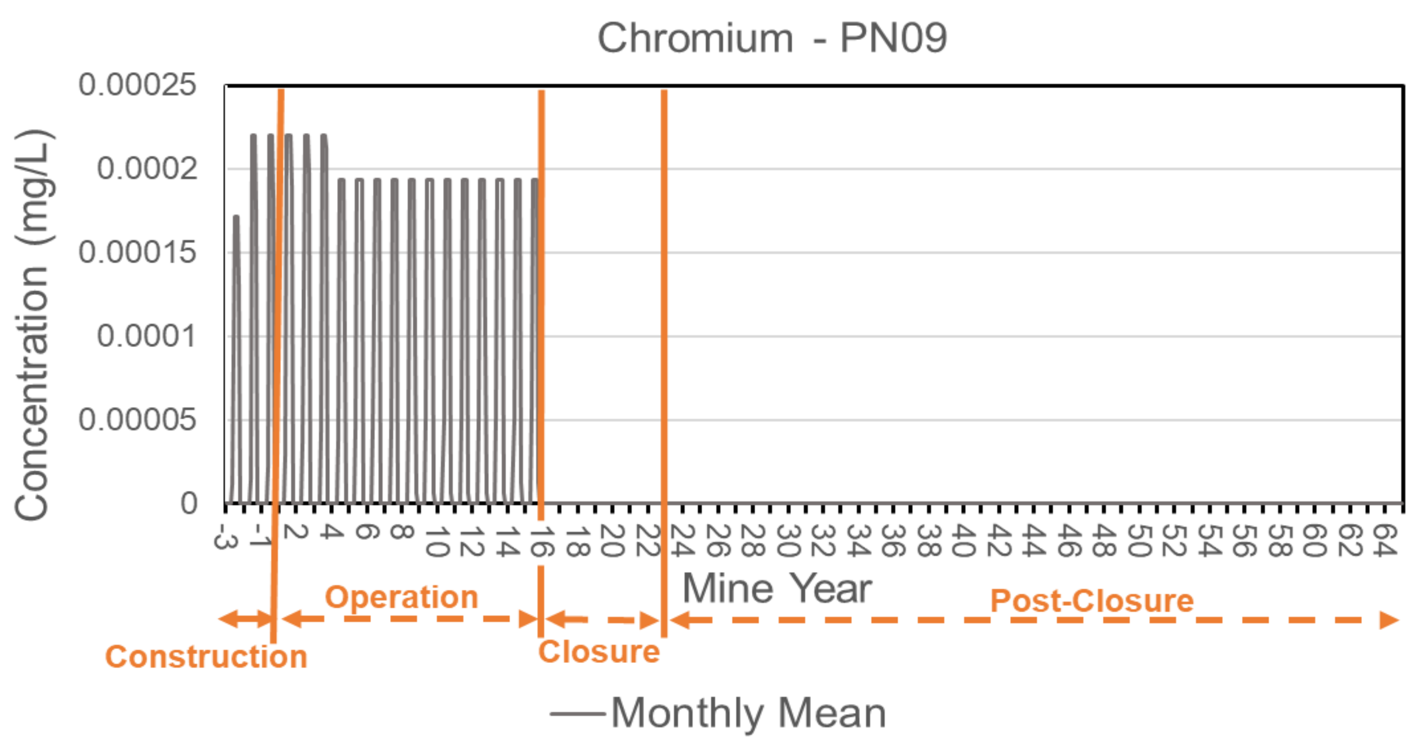


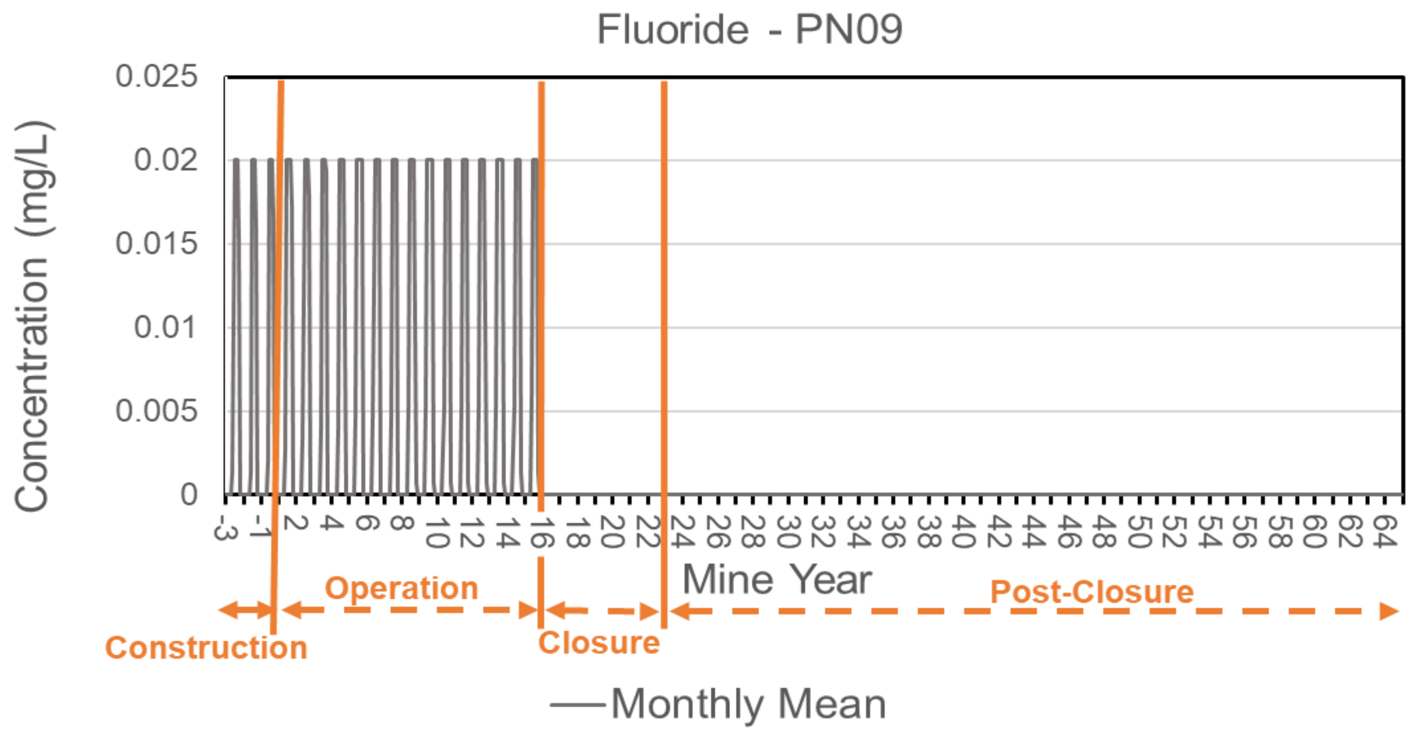
Uranium - PN09
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

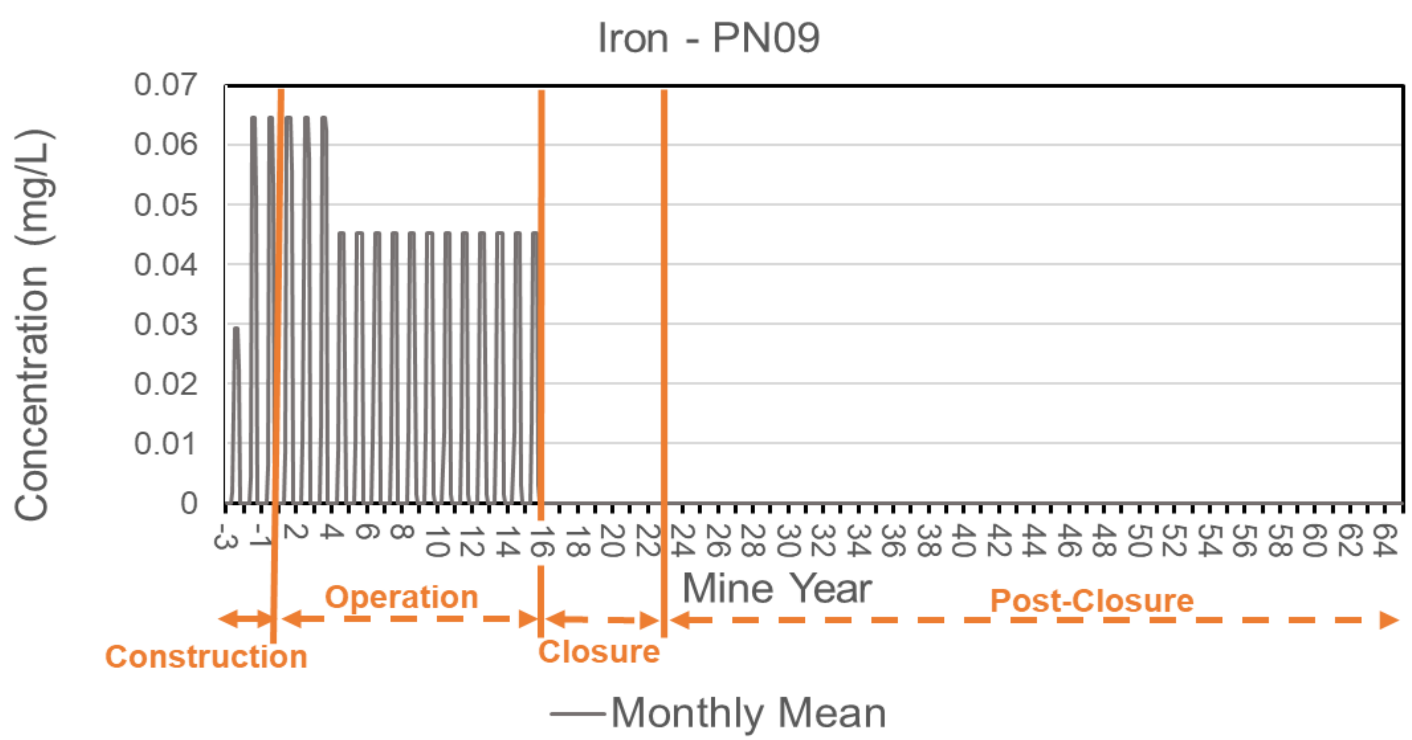

Ammonia - PN09
Concentration (mg/L)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

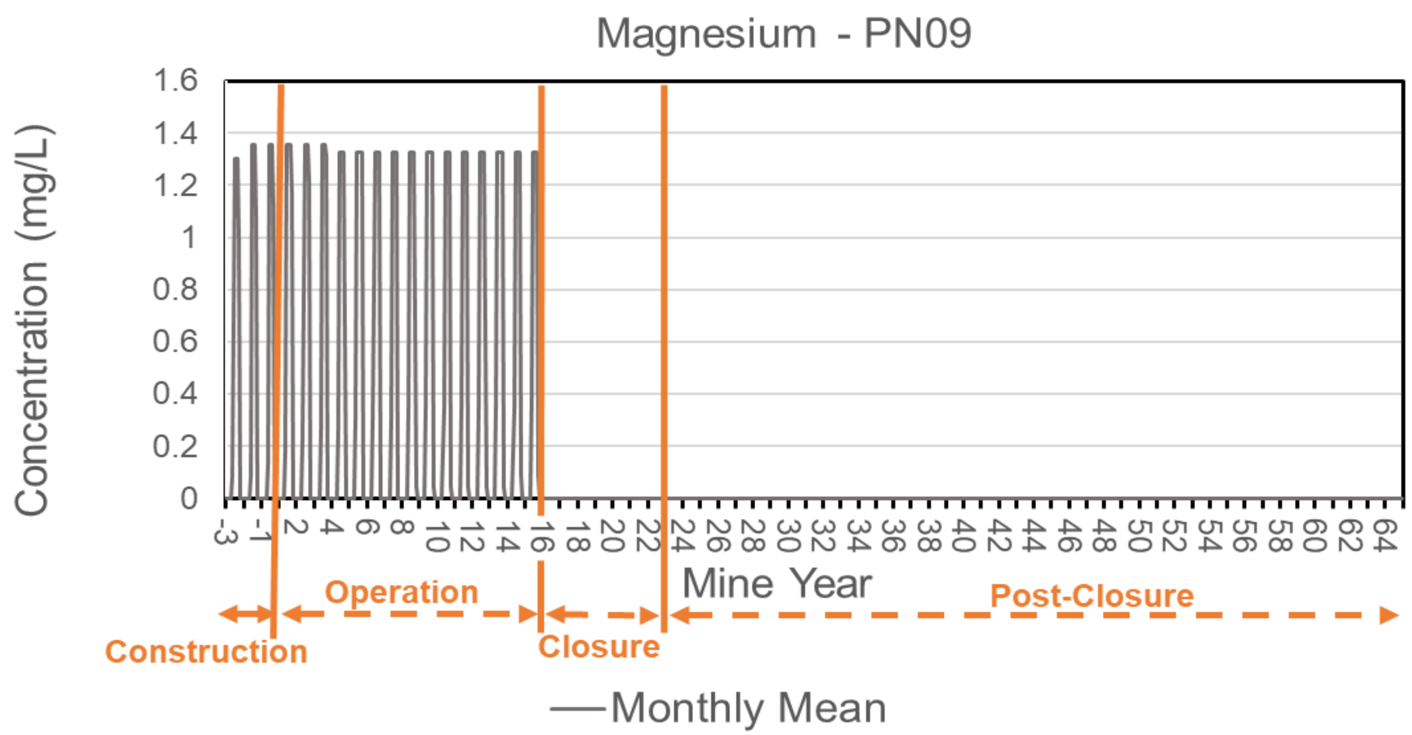

Aluminum - PN09
Concentration (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
-3 -1 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

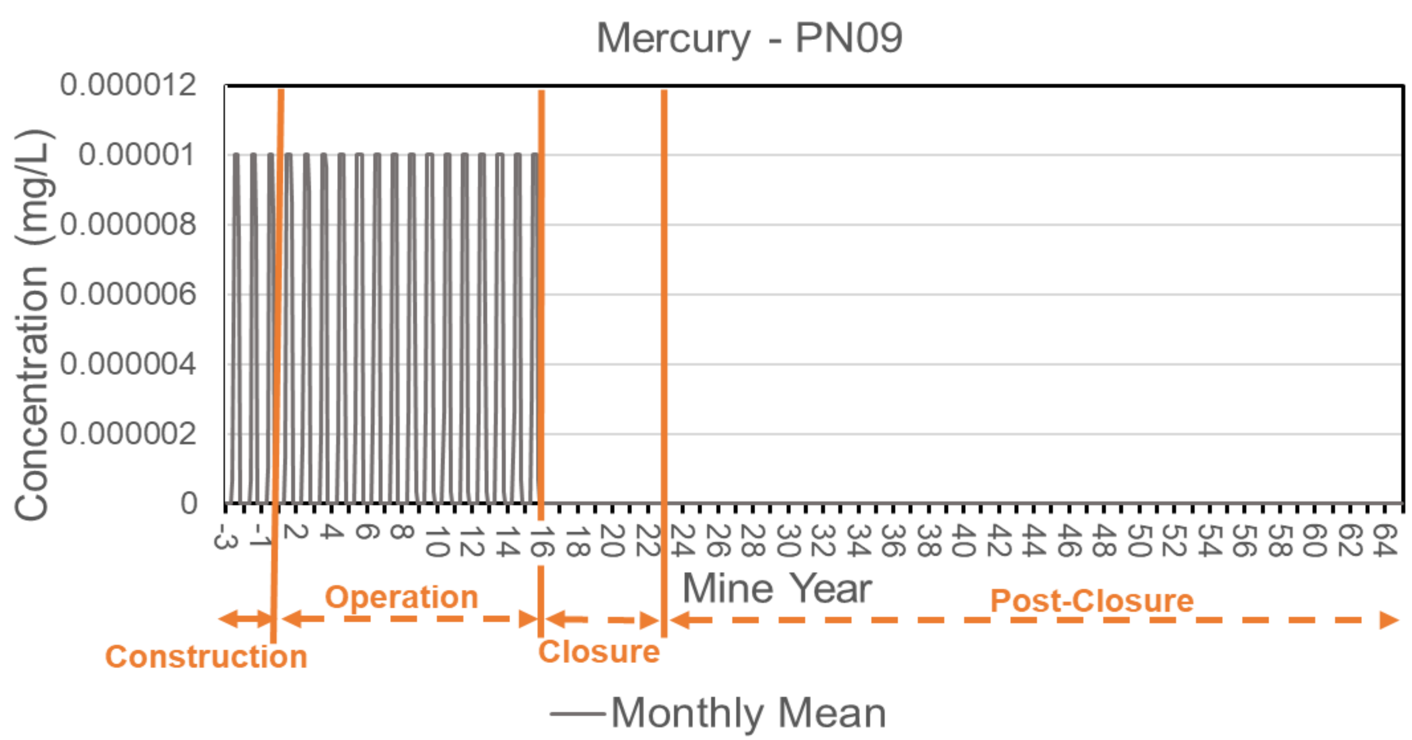

Calcium - PN09
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

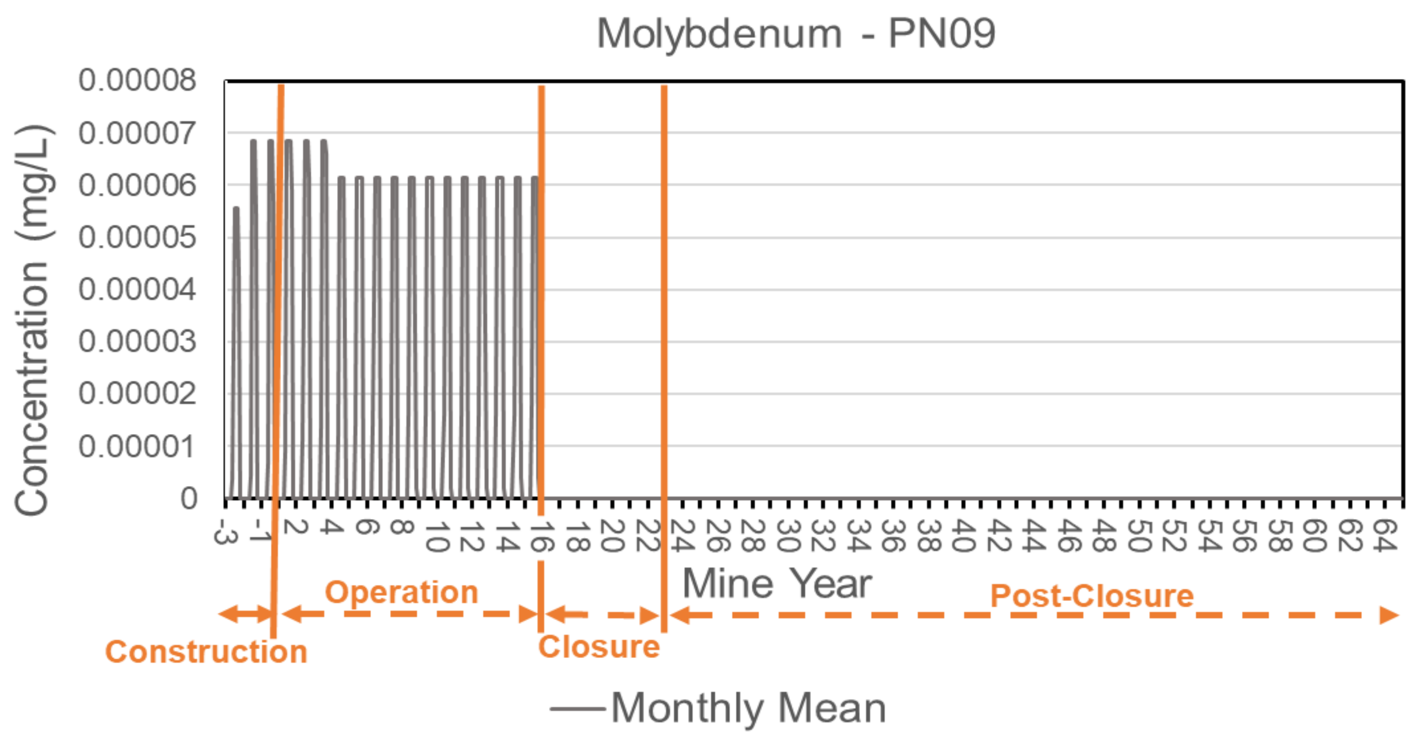

Chromium - PN09
Concentration (mg/L)
0.00025
0.0002
0.00015
0.0001
0.00005
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Operation
Post-Closure
Construction
Closure
Monthly Mean

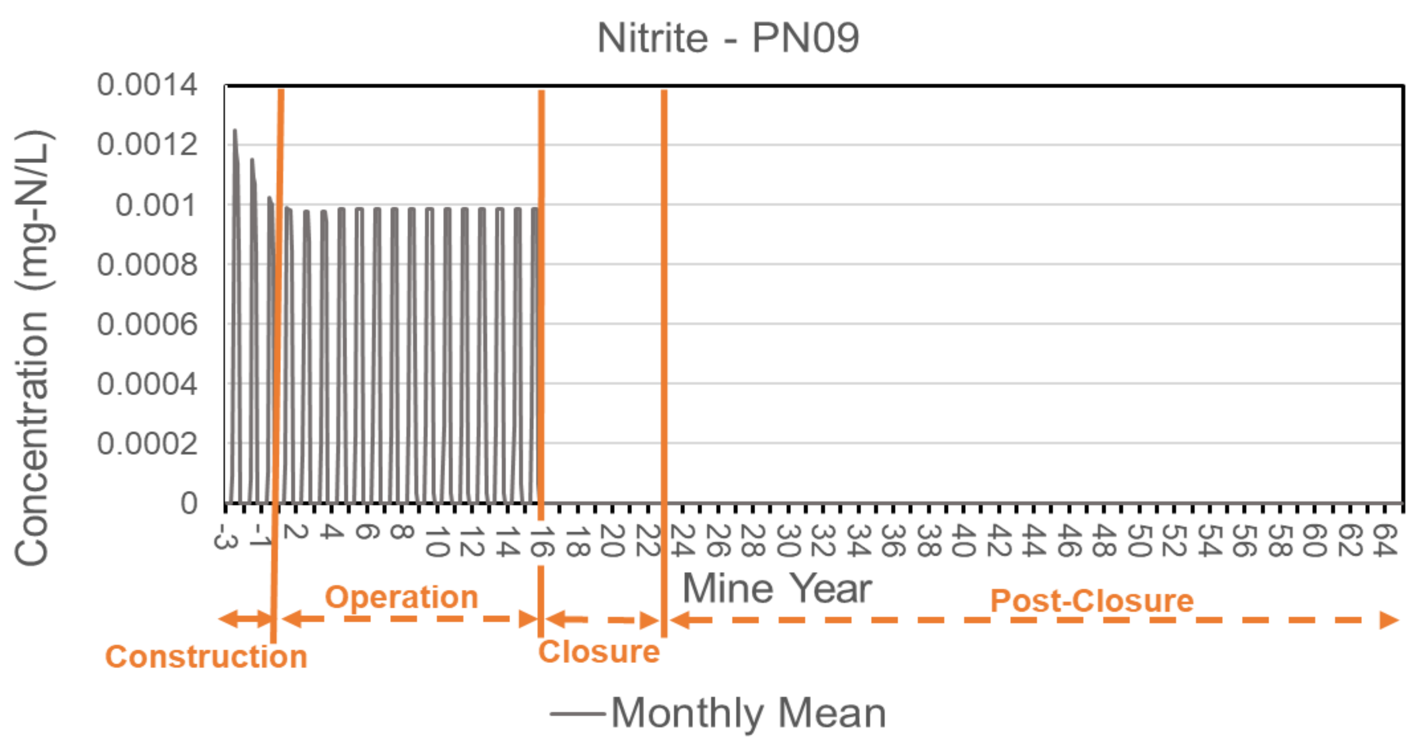

Fluoride - PN09
Concentration (mg/L)
0.025
0.02
0.015
0.01
0.005
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

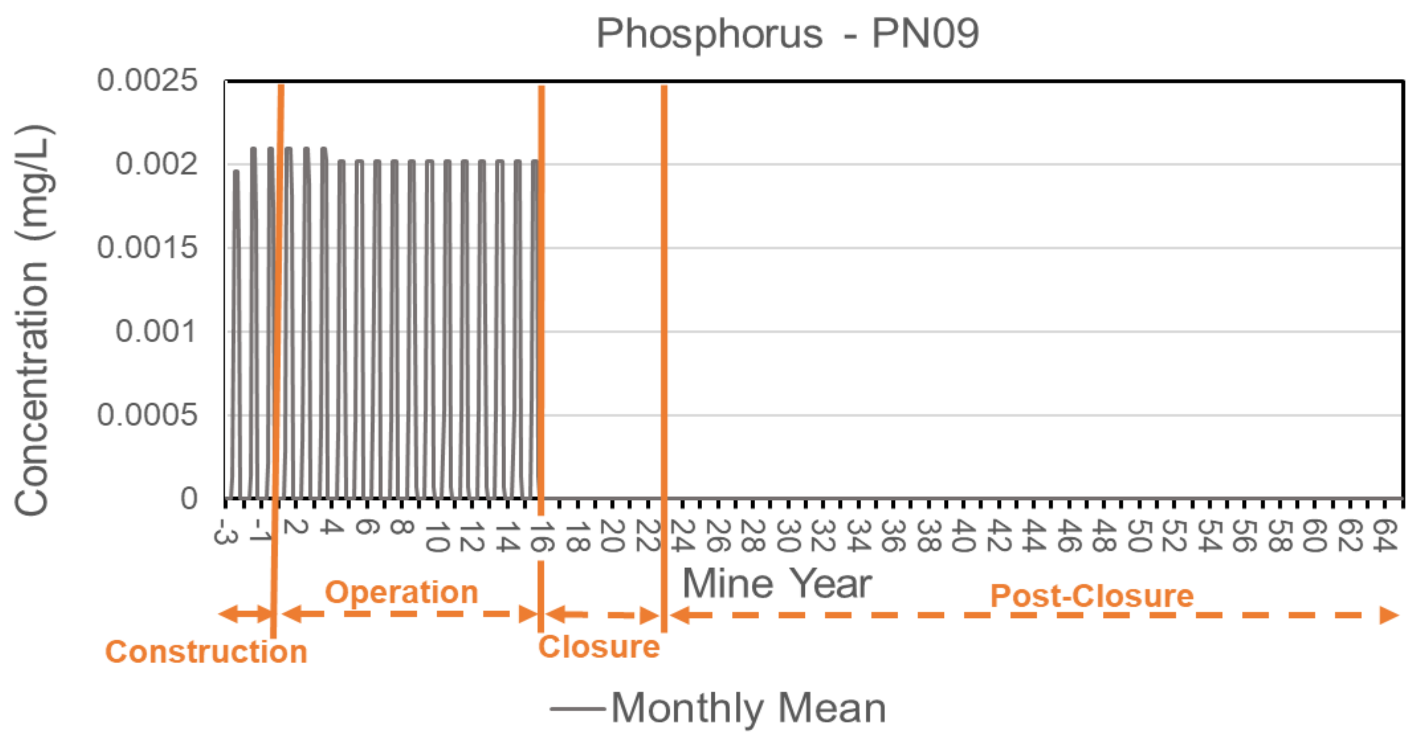

Iron - PN09
Concentration (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

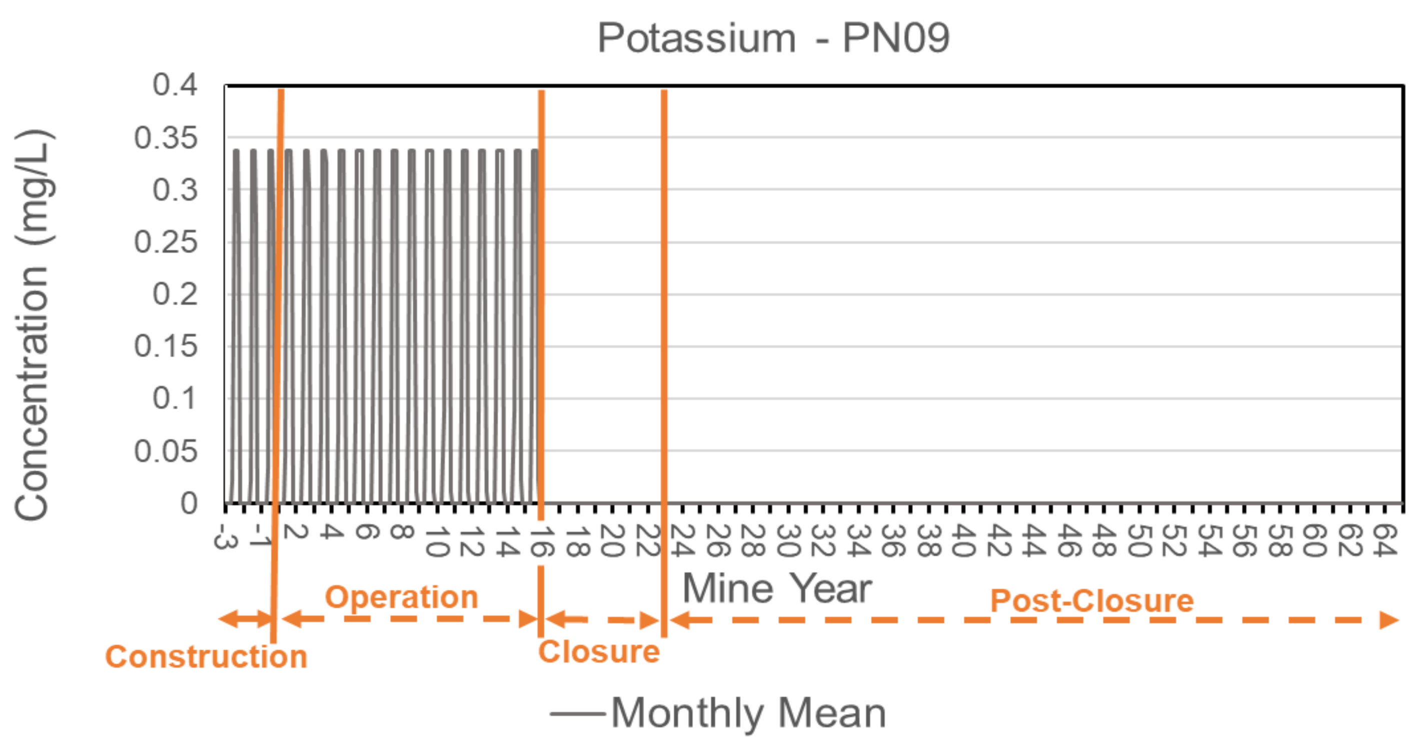

Magnesium - PN09
Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

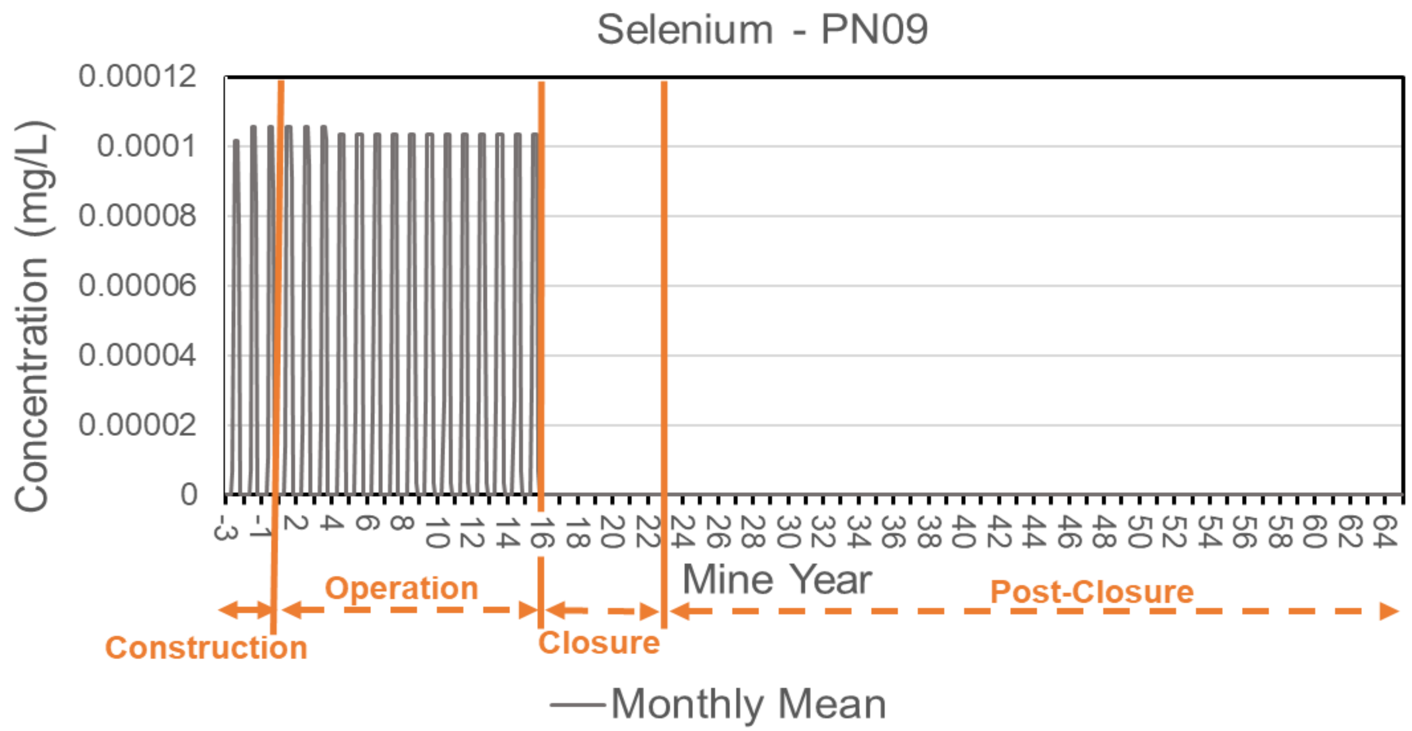

Mercury - PN09
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
Mine Year
Operation
Construction
Closure
Post-Closure
Monthly Mean

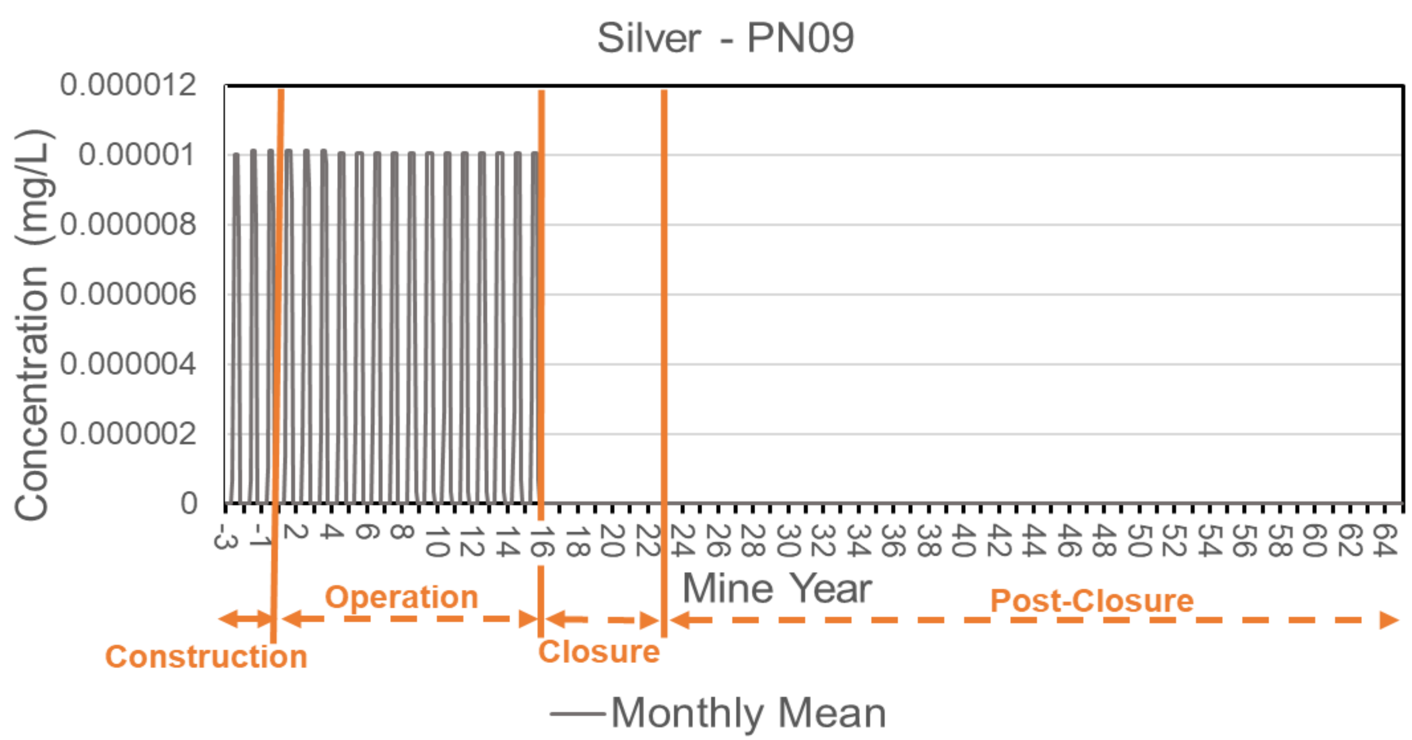

Molybdenum - PN09
Concentration (mg/L)
0.00008
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

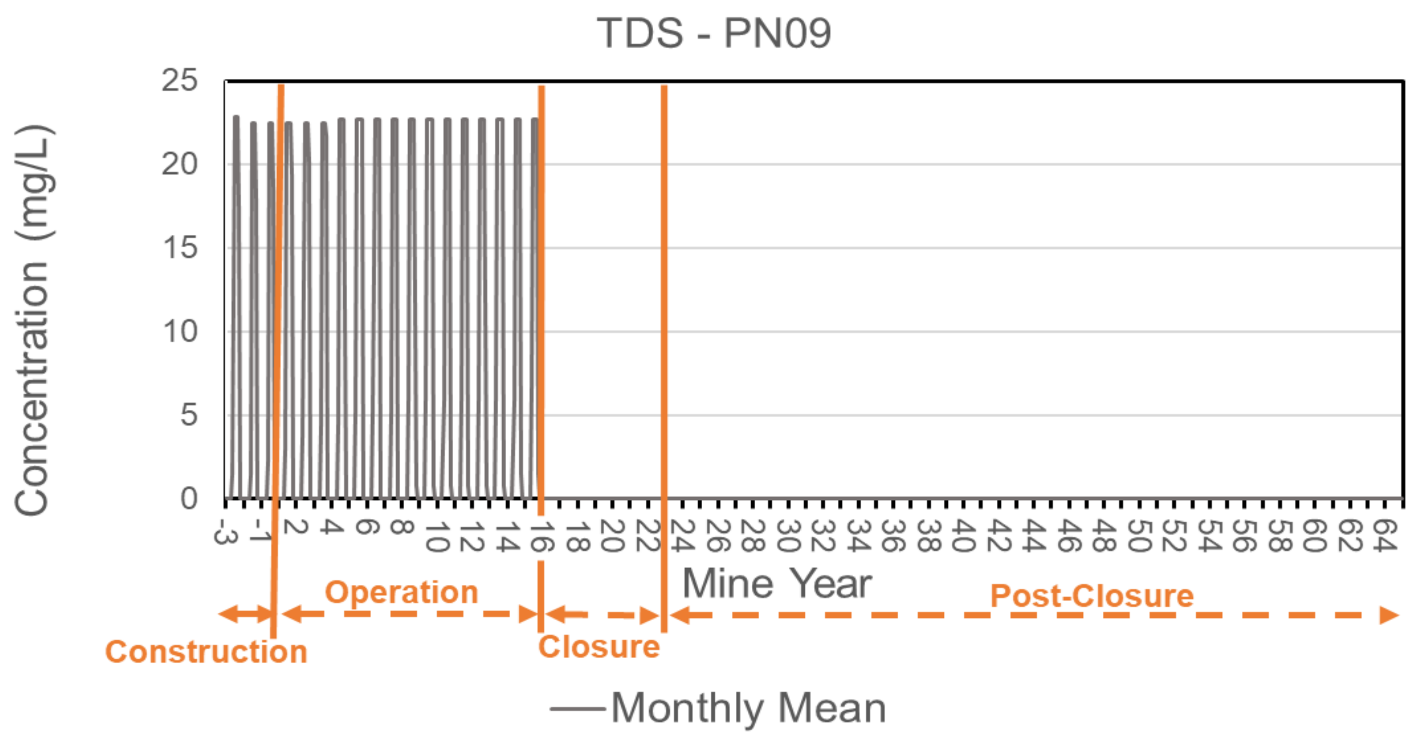

Nitrite - PN09
Concentration (mg-N/L)
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean

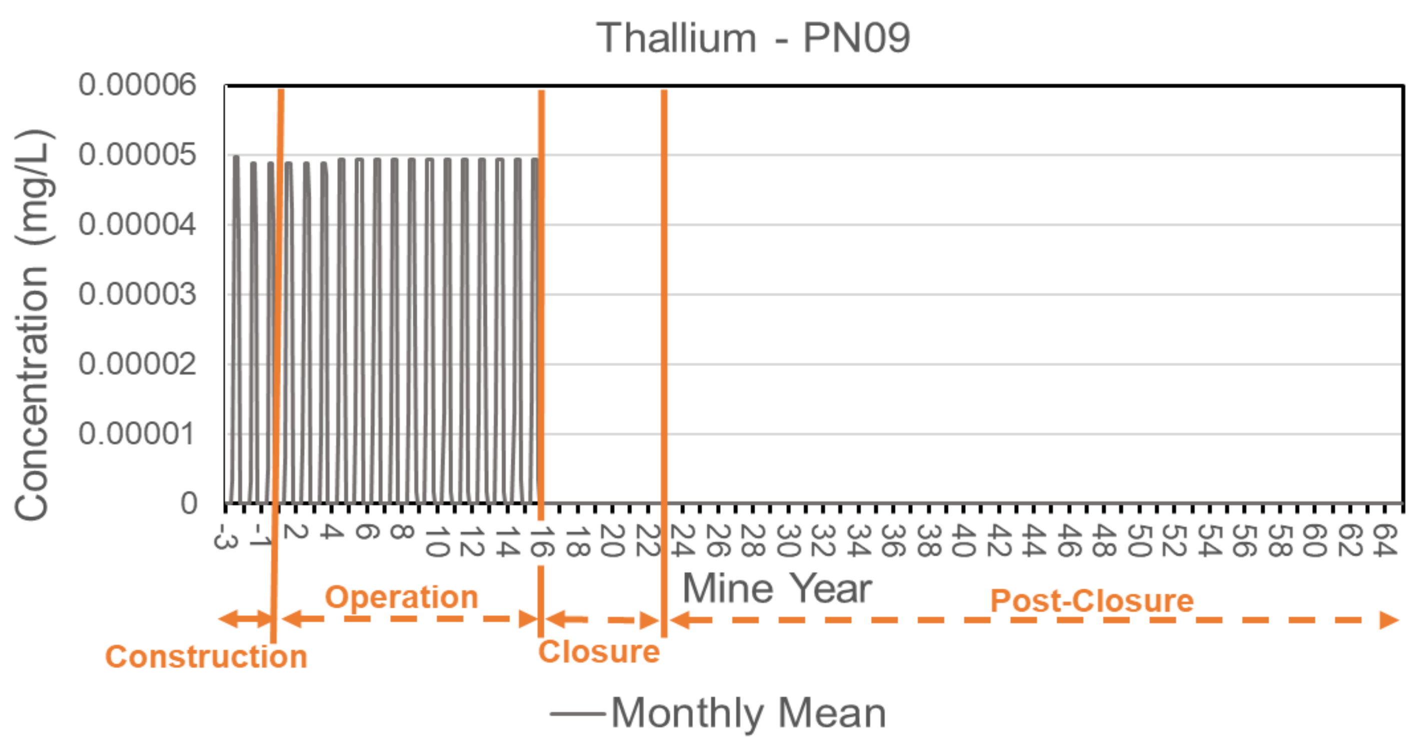

Phosphorus - PN09
Concentration (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Potassium - PN09
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-3
-1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60
62
64
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Selenium - PN09
Concentration (mg/L)
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean


Silver - PN09
Concentration (mg/L)
0.000012
0.00001
0.000008
0.000006
0.000004
0.000002
0
Mine Year
Construction
Operation
Closure
Post-Closure
Monthly Mean





CWQG = Canadian Water Quality Guideline (from CCME 1999)

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines, 1999. Canadian Environmental Quality Guidelines Summary Table, with updates to 2019. Winnipeg, MB, Canada.

Attachment KIA-B: Updated Version of Appendix G of Golder 2022 (Sabina Back River Project, Water and Load Balance Report. Reference No. 21505757-122-R-Rev0-100)

APPENDIX G
Maximum Monthly Averages per Mine Phase at Each Prediction Node for Average Hydrological Conditions

Constituent	Unit	MDMER Discharge Limits	Acute Guidelines	PN04				PN05				PN06				PN08				PN09[a]	
				Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations
Aluminum	mg/L	-	-	0.06	0.069	0.086	0.074	0.015	0.016	0.074	0.025	0.013	0.013	0.013	0.013	0.021	0.021	0.051	0.051	0.053	0.053
Ammonia	mg-N/L	0.5[b]	-	0.0062	0.0049	2.4	0.36	0.0054	0.005	1.3	0.001	0.0054	0.005	0.005	0.005	0.005	0.005	0.0043	0.0043	0.0081	0.005
Antimony	mg/L	-	-	0.000077	0.000082	0.0011	0.00037	0.000052	0.000053	0.00043	0.0002	0.000051	0.000051	0.000051	0.000051	0.000055	0.000055	0.00038	0.00038	0.000073	0.000073
Arsenic	mg/L	0.10	-	0.0014	0.0016	0.0063	0.015	0.0003	0.00031	0.0023	0.0011	0.00024	0.00023	0.00024	0.00024	0.00043	0.00043	0.028	0.028	0.0012	0.0012
Barium	mg/L	-	-	0.0052	0.0052	0.033	0.0079	0.0051	0.0051	0.09	0.034	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0059	0.0059	0.0052	0.0052
Beryllium	mg/L	-	-	0.0002	0.00019	0.00033	0.00022	0.0002	0.0002	0.00028	0.00023	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.00018	0.00017	0.0002	0.0002
Bismuth	mg/L	-	-	0.0005	0.00048	0.004	0.0017	0.0005	0.0005	0.0043	0.0019	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00049	0.00049	0.0005	0.00049
Boron	mg/L	-	29	0.005	0.0048	0.43	0.17	0.005	0.005	0.28	0.1	0.005	0.005	0.005	0.005	0.005	0.005	0.28	0.14	0.005	0.0049
Cadmium	mg/L	-	0.0001-0.0077	0.0000099	0.0000097	0.000054	0.00002	0.000010	0.000010	0.000033	0.000018	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000021	0.000021	0.0000099	0.0000099
Calcium	mg/L	-	-	2.5	2.6	80	13	2.2	2.2	230	81	2.2	2.2	2.2	2.2	2.2	2.2	8.7	8.7	2.5	2.5
Chloride	mg/L	-	640	0.99	0.97	53	13	1.0	1.0	111	185	1.0	1.0	1.0	1.0	0.99	0.99	2.9	2.9	0.99	0.99
Chromium	mg/L	-	-	0.00023	0.00025	0.00059	0.00043	0.00016	0.00016	0.0003	0.00021	0.00015	0.00015	0.00015	0.00015	0.00017	0.00017	0.00081	0.00047	0.00022	0.00022
Cobalt	mg/L	-	-	0.00062	0.00072	0.0079	0.0026	0.00016	0.00017	0.0024	0.001	0.00014	0.00014	0.00014	0.00014	0.00022	0.00022	0.0026	0.0026	0.00055	0.00055
Copper	mg/L	0.10	-	0.0014	0.0015	0.0027	0.0022	0.0014	0.0014	0.0016	0.0015	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0027	0.0027	0.0014	0.0014
Cyanate	mg/L	-	-	0	0	0.79	0.0087	0	0	0.0054	0.000013	0	0	0	0	0	0	0	0	0	0
Fluoride	mg/L	-	-	0.02	0.02	0.039	0.024	0.02	0.02	0.026	0.022	0.02	0.02	0.02	0.02	0.02	0.02	0.024	0.024	0.02	0.02
Free Cyanide	mg/L	0.50	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron	mg/L	-	-	0.073	0.084	0.22	0.1	0.019	0.02	0.11	0.055	0.016	0.016	0.016	0.016	0.025	0.025	0.081	0.082	0.065	0.065
Lead	mg/L	0.08	-	0.000052	0.000052	0.0024	0.00088	0.00005	0.00005	0.0015	0.00055	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00061	0.00029	0.000052	0.000052
Lithium	mg/L	-	-	0.005	0.0048	0.11	0.041	0.005	0.005	0.17	0.066	0.005	0.005	0.005	0.005	0.005	0.005	0.022	0.013	0.005	0.0049
Magnesium	mg/L	-	-	1.4	1.4	9.0	2.5	1.3	1.3	16	6.4	1.3	1.3	1.3	1.3	1.3	1.3	2.6	2.6	1.4	1.4
Manganese	mg/L	-	0.046-15	0.0061	0.0068	0.12	0.036	0.0022	0.0023	0.077	0.03	0.002	0.002	0.002	0.002	0.0027	0.0027	0.065	0.065	0.0055	0.0055
Mercury	mg/L	-	-	0.00001	0.00001	0.000012	0.0000098	0.00001	0.00001	0.000011	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
Molybdenum	mg/L	-	-	0.000071	0.000075	0.0026	0.00074	0.000052	0.000052	0.0014	0.00053	0.000051	0.000051	0.000051	0.000051	0.000054	0.000054	0.00072	0.00072	0.000068	0.000068
Nickel	mg/L	0.25	-	0.0049	0.0052	0.027	0.011	0.0035	0.0035	0.0095	0.0059	0.0034	0.0034	0.0034	0.0034	0.0036	0.0036	0.011	0.011	0.0047	0.0047
Nitrate	mg-N/L	-	124	0.0087	0.0063	1.8	1.4	0.0071	0.0065	1.4	0.95	0.0071	0.0065	0.0065	0.0065	0.0073	0.0065	0.31	0.31	0.012	0.0066
Nitrite	mg-N/L	-	-	0.0011	0.00097	0.029	0.045	0.001	0.0010	0.0067	0.003	0.001	0.0010	0.0010	0.0010	0.001	0.0010	0.076	0.076	0.0013	0.00099
Orthophosphate	mg-P/L	-	-	0.00099	0.00097	0.015	0.0036	0.0010	0.0010	0.006	0.0028	0.0010	0.0010	0.0010	0.0010	0.00099	0.00099	0.00086	0.00086	0.00099	0.00099
Phosphate	mg-P/L	-	-	0	0	0.015	0.0027	0	0	0.0073	0.0025	0	0	0	0	0	0	0	0	0	0
Phosphorus	mg/L	-	-	0.0021	0.0022	0.0061	0.0095	0.0019	0.0019	0.0094	0.017	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.032	0.032	0.0021	0.0021
Potassium	mg/L	-	-	0.34	0.34	25	10	0.34	0.34	17	6.4	0.34	0.34	0.34	0.34	0.34	0.34	14	7.4	0.34	0.34
Selenium	mg/L	-	-	0.00011	0.00011	0.0005	0.00022	0.0001	0.0001	0.00029	0.00017	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00035	0.00035	0.00011	0.00011
Silicon	mg/L	-	-	0.42	0.45	11	3.3	0.29	0.29	3.5	1.5	0.28	0.28	0.28	0.28	0.31	0.31	5.5	5.0	0.4	0.4
Silver	mg/L	-	-	0.00001	0.00001	0.000036	0.000015	0.00001	0.00001	0.00003	0.000017	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.000014	0.000014	0.00001	0.00001
Sodium	mg/L	-	-	0.66	0.65	121	32	0.66	0.66	155	54	0.66	0.66	0.66	0.66	0.66	0.66	0.81	3.6	0.66	0.65
Strontium	mg/L	-	-	0.0094	0.0091	1.4	0.23	0.0094	0.0094	4.7	1.7	0.0094	0.0094	0.0094	0.0094	0.0094	0.0094	0.089	0.049	0.0094	0.0093
Sulphate	mg/L	-	-	5.0	5.1	276	104	4.2	4.2	195	74	4.1	4.1	4.1	4.1	4.3	4.3	32	32	4.9	4.9
TDS	mg/L	-	-	23	22	224	31	23	23	464	330	23	23	23	23	23	23	20	20	23	23
Tellurium	mg/L	-	-	0.002	0.0019	0.0026	0.0019	0.002	0.002	0.0021	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Thallium	mg/L	-	-	0.00005	0.000048	0.00011	0.000065	0.00005	0.00005	0.00013	0.000079	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.000086	0.000064	0.00005	0.000049
Thiocyanate	mg/L	-	-	0	0	0.3	0.0021	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thorium	mg/L	-	-	0	0	0.000081	0.000031	0	0	0.000045	0.000017	0	0	0	0	0	0	0.000035	0.000035	0	0
Tin	mg/L	-	-	0.000099	0.000097	0.0021	0.00086	0.00010	0.00010	0.0012	0.00049	0.00010	0.00010	0.00010	0.00010	0.000099	0.000099	0.0015	0.00077	0.000099	0.000099
Titanium	mg/L	-	-	0.011	0.011	0.017	0.012	0.01	0.01	0.014	0.012	0.01	0.01	0.01	0.01	0.01	0.01	0.013	0.013	0.011	0.011
TOC	mg/L	-	-	4.0	3.9	3.8	3.6	4.0	4.0	3.9	3.9	4.0	4.0	4.0	4.0	4.0	4.0	3.4	3.4	4.0	3.9
Total Cyanide	mg/L	-	-	0.0023	0.0022	0.0035	0.0017	0.0023	0.0023	0.0022	0.00047	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.002	0.002	0.0023	0.0023
TSS	mg/L	15	-	3.0	2.9	2.9	2.7	3.0	3.0	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.6	2.6	3.0	3.0
Uranium	mg/L	-	0.033	0.00001	0.00001	0.0053	0.0023	0.00001	0.00001	0.001	0.00036	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0074	0.0037	0.00001	0.00001
Vanadium	mg/L	-	-	0.000076	0.000081	0.015	0.0061	0.000055	0.000055	0.011	0.0041	0.000054	0.000054	0.000054	0.000054	0.000058	0.000058	0.0071	0.0036	0.000073	0.000073
WAD Cyanide	mg/L	-	-	0	0	0.000027	0.0000082	0	0	0.000017	0.0000061	0	0	0	0	0	0	0	0	0	0
Zinc	mg/L	0.40	0.011-0.13[d]	0.0033	0.0034	0.011	0.0047	0.003	0.003	0.0086	0.0051	0.003	0.003	0.003	0.003	0.0031	0.0031	0.0047	0.0047	0.0033	0.0033
Zirconium	mg/L	-	-	0.0004	0.00039	0.0014	0.00072	0.0004	0.0004	0.00084	0.00056	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0009	0.0009	0.0004	0.00039

(a) PN09 is not active after the Operations (i.e., at the start of Closure Period)

(b) MDMER discharge limit is for un-ionized ammonia. Total ammonia can be used to calculate un-ionized ammonia using f =1 / [10(pKa - pH) + 1] Where, f = fraction of total ammonia that is un-ionized; pKa = dissociation constant. A temperature of 15 °C and a conservative pH of 8.5 was used.

(c) The acute CWQG is hardness dependent. Hardness values are calculated from predicted calcium and magnesium concentrations in the model (Golder 2021), with the range in minimum predicted hardness values from each location being used in this table.

(d) The acute dissolved zinc CWQG is hardness and DOC dependent. The CWQG is based on a DOC of 0.3 mg/L and hardness values are calculated from predicted calcium and magnesium concentrations in the model (Golder 2021), with the range in minimum predicted hardness values from each location being used in this table.

Acute CWQGs for cadmium, manganese and zinc vary over time and by discharge location, depending on predicted hardness. Predicted discharge concentrations of these three metals were not above applicable acute CWQGs (see plots showing acute CWQGs over time and by location in Appendix F).

TDS = total dissolved solids; TSS = total suspended solids; TOC = total organic carbon; DOC = total organic carbon; WAD = weak acid-dissociable; mg/L = milligrams per liter; mg-N/L = milligrams of nitrogen per liter; mg-P/L = milligrams phosphorus per liter; WAD= weak acid dissociable; CWQG = Canadian water quality guideline (CCME 1999).

Attachment KIA-C: Updated Version of Appendix H of Golder 2022 (Sabina Back River Project, Water and Load Balance Report. Reference No. 21505757-122-R-Rev0-100)

APPENDIX H

Maximum Monthly Averages per Mine Phase at Each Prediction Node for 5th and 95th Percentile Hydrological Conditions

Constituent	Unit	MDMER Discharge Limits	Acute Guidelines	PN04				PN05				PN06				PN08				PN09[a]	
				Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations
Aluminum	mg/L	-	-	0.06	0.069	0.085	0.072	0.015	0.016	0.074	0.024	0.013	0.013	0.013	0.013	0.021	0.021	0.051	0.051	0.053	0.053
Ammonia	mg-N/L	0.5[b]	-	0.0061	0.0048	2.2	0.28	0.0053	0.005	0.68	0.0009	0.0053	0.005	0.005	0.005	0.005	0.005	0.0043	0.0043	0.0079	0.005
Antimony	mg/L	-	-	0.000077	0.000082	0.00053	0.0003	0.000052	0.000053	0.00029	0.00015	0.000051	0.000051	0.000051	0.000051	0.000055	0.000055	0.00038	0.00038	0.000073	0.000073
Arsenic	mg/L	0.10	-	0.0014	0.0016	0.0062	0.014	0.0003	0.00031	0.0018	0.00095	0.00024	0.00023	0.00024	0.00024	0.00043	0.00043	0.028	0.028	0.0012	0.0012
Barium	mg/L	-	-	0.0052	0.0052	0.018	0.0071	0.0051	0.0051	0.069	0.029	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0059	0.0059	0.0052	0.0052
Beryllium	mg/L	-	-	0.0002	0.00019	0.00023	0.0002	0.0002	0.0002	0.00024	0.00021	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.00018	0.00017	0.0002	0.0002
Bismuth	mg/L	-	-	0.00049	0.00048	0.0022	0.0012	0.0005	0.0005	0.0021	0.0011	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00049	0.00049	0.0005	0.00049
Boron	mg/L	-	29	0.0049	0.0048	0.24	0.13	0.005	0.005	0.17	0.07	0.005	0.005	0.005	0.005	0.005	0.005	0.28	0.14	0.005	0.0049
Cadmium	mg/L	-	0.0001-0.0077	0.0000099	0.0000097	0.000027	0.000017	0.000010	0.000010	0.000026	0.000016	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000021	0.000021	0.0000099	0.0000099
Calcium	mg/L	-	-	2.5	2.6	43	10	2.2	2.2	174	67	2.2	2.2	2.2	2.2	2.2	2.2	8.7	8.7	2.5	2.5
Chloride	mg/L	-	640	0.99	0.97	50	11	1.0	1.0	111	153	1.0	1.0	1.0	1.0	0.99	0.99	2.9	2.9	0.99	0.99
Chromium	mg/L	-	-	0.00023	0.00025	0.00057	0.0004	0.00016	0.00016	0.00027	0.0002	0.00015	0.00015	0.00015	0.00015	0.00017	0.00017	0.00081	0.00047	0.00022	0.00022
Cobalt	mg/L	-	-	0.00062	0.00072	0.0037	0.0021	0.00016	0.00017	0.0015	0.00073	0.00014	0.00014	0.00014	0.00014	0.00022	0.00022	0.0026	0.0026	0.00055	0.00055
Copper	mg/L	0.10	-	0.0014	0.0015	0.0026	0.0021	0.0014	0.0014	0.0016	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0027	0.0027	0.0014	0.0014
Cyanate	mg/L	-	-	0	0	0.6	0.0038	0	0	0.0000093	0.00001	0	0	0	0	0	0	0	0	0	0
Fluoride	mg/L	-	-	0.02	0.02	0.024	0.022	0.02	0.02	0.023	0.021	0.02	0.02	0.02	0.02	0.02	0.02	0.024	0.024	0.02	0.02
Free Cyanide	mg/L	0.50	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron	mg/L	-	-	0.073	0.084	0.17	0.098	0.019	0.02	0.091	0.05	0.016	0.016	0.016	0.016	0.025	0.025	0.081	0.082	0.065	0.065
Lead	mg/L	0.08	-	0.000052	0.000052	0.0016	0.00066	0.00005	0.00005	0.00093	0.00039	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00061	0.00029	0.000052	0.000052
Lithium	mg/L	-	-	0.0049	0.0048	0.064	0.029	0.005	0.005	0.12	0.047	0.005	0.005	0.005	0.005	0.005	0.005	0.022	0.013	0.005	0.0049
Magnesium	mg/L	-	-	1.4	1.4	4.7	2.1	1.3	1.3	12	5.4	1.3	1.3	1.3	1.3	1.3	1.3	2.6	2.6	1.4	1.4
Manganese	mg/L	-	0.046-15	0.0061	0.0068	0.055	0.029	0.0022	0.0023	0.055	0.022	0.002	0.002	0.002	0.002	0.0027	0.0027	0.065	0.065	0.0055	0.0055
Mercury	mg/L	-	-	0.00001	0.00001	0.000010	0.0000095	0.00001	0.00001	0.00001	0.00001	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.0000057	0.0000057	0.000005	0.000005
Molybdenum	mg/L	-	-	0.000071	0.000075	0.0013	0.00057	0.000052	0.000052	0.0010	0.0004	0.000051	0.000051	0.000051	0.000051	0.000054	0.000054	0.00072	0.00072	0.000068	0.000068
Nickel	mg/L	0.25	-	0.0049	0.0052	0.013	0.0089	0.0035	0.0035	0.0065	0.0048	0.0034	0.0034	0.0034	0.0034	0.0036	0.0036	0.011	0.011	0.0047	0.0047
Nitrate	mg-N/L	-	124	0.0085	0.0063	1.5	1.1	0.0071	0.0065	1.3	0.74	0.007	0.0065	0.0065	0.0065	0.0072	0.0065	0.31	0.31	0.011	0.0065
Nitrite	mg-N/L	-	-	0.0011	0.00097	0.028	0.04	0.001	0.0010	0.0053	0.0026	0.001	0.0010	0.0010	0.0010	0.001	0.00099	0.076	0.076	0.0012	0.00099
Orthophosphate	mg-P/L	-	-	0.00099	0.00097	0.013	0.003	0.0010	0.0010	0.0047	0.0024	0.0010	0.0010	0.0010	0.0010	0.00099	0.00099	0.00086	0.00086	0.00099	0.00099
Phosphate	mg-P/L	-	-	0	0	0.012	0.0022	0	0	0.0054	0.002	0	0	0	0	0	0	0	0	0	0
Phosphorus	mg/L	-	-	0.0021	0.0022	0.006	0.009	0.0019	0.0019	0.0094	0.015	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.032	0.032	0.0021	0.0021
Potassium	mg/L	-	-	0.34	0.34	14	8.1	0.34	0.34	11	4.5	0.34	0.34	0.34	0.34	0.34	0.34	14	7.4	0.34	0.34
Selenium	mg/L	-	-	0.00011	0.00011	0.00035	0.00021	0.0001	0.0001	0.00025	0.00016	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00035	0.00035	0.00011	0.00011
Silicon	mg/L	-	-	0.42	0.45	4.8	2.5	0.29	0.29	2.0	0.99	0.28	0.28	0.28	0.28	0.31	0.31	5.5	5.0	0.4	0.4
Silver	mg/L	-	-	0.00001	0.00001	0.000023	0.000014	0.00001	0.00001	0.000025	0.000015	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.000014	0.000014	0.00001	0.00001
Sodium	mg/L	-	-	0.66	0.65	93	26	0.66	0.66	115	43	0.66	0.66	0.66	0.66	0.66	0.66	0.81	3.6	0.66	0.65
Strontium	mg/L	-	-	0.0093	0.0091	0.74	0.18	0.0094	0.0094	3.6	1.3	0.0094	0.0094	0.0094	0.0094	0.0094	0.0094	0.089	0.049	0.0094	0.0093
Sulphate	mg/L	-	-	5.0	5.1	200	80	4.2	4.2	122	49	4.1	4.1	4.1	4.1	4.3	4.3	32	32	4.9	4.9
TDS	mg/L	-	-	23	22	131	28	23	23	464	276	23	23	23	23	23	23	20	20	23	23
Tellerium	mg/L	-	-	0.002	0.0019	0.0019	0.0018	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Thallium	mg/L	-	-	0.000049	0.000048	0.000074	0.000059	0.00005	0.00005	0.00011	0.000071	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.000086	0.000064	0.00005	0.000049
Thiocyanate	mg/L	-	-	0	0	0.18	0.00093	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thorium	mg/L	-	-	0	0	0.000045	0.000023	0	0	0.000024	0.0000092	0	0	0	0	0	0	0.000035	0.000035	0	0
Tin	mg/L	-	-	0.000099	0.000097	0.0012	0.00067	0.00010	0.00010	0.00071	0.00033	0.00010	0.00010	0.00010	0.00010	0.000099	0.000099	0.0015	0.00077	0.000099	0.000099
Titanium	mg/L	-	-	0.011	0.011	0.012	0.011	0.01	0.01	0.012	0.011	0.01	0.01	0.01	0.01	0.01	0.01	0.013	0.013	0.011	0.011
TOC	mg/L	-	-	4.0	3.9	3.5	3.5	4.0	4.0	3.9	3.9	4.0	4.0	4.0	4.0	4.0	4.0	3.4	3.4	4.0	3.9
Total Cyanide	mg/L	-	-	0.0023	0.0022	0.0027	0.0016	0.0023	0.0023	0.0022	0.00041	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.002	0.002	0.0023	0.0023
TSS	mg/L	15	-	3.0	2.9	2.6	2.6	3.0	3.0	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.6	2.6	3.0	3.0
Uranium	mg/L	-	0.033	0.00001	0.00001	0.0034	0.002	0.00001	0.00001	0.00077	0.0003	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0074	0.0037	0.00001	0.00001
Vanadium	mg/L	-	-	0.000076	0.000081	0.0081	0.0044	0.000055	0.000055	0.0047	0.0019	0.000054	0.000054	0.000054	0.000054	0.000058	0.000058	0.007	0.0036	0.000073	0.000073
WAD Cyanide	mg/L	-	-	0	0	0.000023	0.0000067	0	0	0.000013	0.0000047	0	0	0	0	0	0	0	0	0	0
Zinc	mg/L	0.40	0.011-0.13[d]	0.0033	0.0034	0.0059	0.0042	0.003	0.003	0.0071	0.0045	0.003	0.003	0.003	0.003	0.0031	0.0031	0.0047	0.0047	0.0033	0.0033
Zirconium	mg/L	-	-	0.0004	0.00039	0.00083	0.00062	0.0004	0.0004	0.00061	0.00047	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0009	0.0009	0.0004	0.00039

(a) PN09 is not active after the Operations (i.e., at the start of Closure Period)

(b) MDMER discharge limit is for un-ionized ammonia. Total ammonia can be used to calculate un-ionized ammonia using f =1 / [10(pKa - pH) + 1] Where, f = fraction of total ammonia that is un-ionized; pKa = dissociation constant. A temperature of 15°C and a conservative pH of 8.5 was used.

(c) The CWQG is hardness dependent. Hardness values are calculated from predicted calcium and magnesium concentrations in the model (Golder 2021), with the range in minimum predicted hardness values from each location being used in this table.

(d) The acute dissolved zinc CWQG is hardness and DOC dependent. The CWQG is based on a DOC of 0.3 mg/L and hardness values are calculated from predicted calcium and magnesium concentrations in the model (Golder 2021), with the minimum values being used in this table.

Acute CWQGs for cadmium, manganese and zinc vary over time and by discharge location, depending on predicted hardness. Predicted discharge concentrations of these three metals were not above applicable acute CWQGs (see plots showing acute CWQGs over time and by location in Appendix F).

TDS = total dissolved solids; TSS = total suspended solids; DOC = dissolved organic carbon; TOC = total organic carbon; WAD = weak acid-dissociable; mg/L = milligrams per liter; mg-N/L = milligrams of nitrogen per liter; mg-P/L = milligrams phosphorus per liter; WAD= weak acid dissociable; CWQG = Canadian water quality guideline (CCME 1999).

Maximum Monthly Averages per Mine Phase at Each Prediction Node for 5th and 95th Percentile Hydrological Conditions

Constituent	Unit	MDMER Discharge Limits	Acute Guidelines	PN04				PN05				PN06				PN08				PN09[a]	
				Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations	Closure	Post-Closure	Construction	Operations
Aluminum	mg/L	-	-	0.06	0.069	0.086	0.079	0.015	0.016	0.074	0.027	0.013	0.013	0.013	0.013	0.021	0.021	0.051	0.051	0.053	0.053
Ammonia	mg-N/L	0.5[b]	-	0.0064	0.0049	2.7	0.46	0.0054	0.005	1.5	0.0011	0.0054	0.005	0.005	0.005	0.005	0.005	0.0043	0.0043	0.0085	0.0052
Antimony	mg/L	-	-	0.000077	0.000082	0.0022	0.00047	0.000052	0.000053	0.00061	0.00026	0.000051	0.000051	0.000051	0.000051	0.000055	0.000055	0.00038	0.00038	0.000073	0.000073
Arsenic	mg/L	0.10	-	0.0014	0.0016	0.0063	0.016	0.0003	0.00031	0.0026	0.0013	0.00024	0.00023	0.00024	0.00024	0.00043	0.00043	0.028	0.028	0.0012	0.0012
Barium	mg/L	-	-	0.0052	0.0052	0.075	0.0092	0.0051	0.0051	0.1	0.044	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0059	0.0059	0.0052	0.0052
Beryllium	mg/L	-	-	0.0002	0.00019	0.00047	0.00024	0.0002	0.0002	0.00032	0.00024	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.00018	0.00017	0.0002	0.0002
Bismuth	mg/L	-	-	0.0005	0.00048	0.0091	0.0025	0.0005	0.0005	0.0069	0.0028	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00049	0.00049	0.0005	0.00049
Boron	mg/L	-	29	0.005	0.0048	0.74	0.21	0.005	0.005	0.39	0.15	0.005	0.005	0.005	0.005	0.005	0.005	0.28	0.14	0.005	0.0049
Cadmium	mg/L	-	0.0001-0.0077	0.0000099	0.0000097	0.000097	0.000024	0.000010	0.000010	0.00004	0.000021	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000021	0.000021	0.0000099	0.0000099
Calcium	mg/L	-	-	2.5	2.6	190	16	2.2	2.2	261	107	2.2	2.2	2.2	2.2	2.2	2.2	8.7	8.7	2.5	2.5
Chloride	mg/L	-	640	0.99	0.97	55	17	1.0	1.0	111	246	1.0	1.0	1.0	1.0	0.99	0.99	2.9	2.9	0.99	0.99
Chromium	mg/L	-	-	0.00023	0.00025	0.0006	0.00046	0.00016	0.00016	0.00032	0.00023	0.00015	0.00015	0.00015	0.00015	0.00017	0.00017	0.00081	0.00047	0.00022	0.00022
Cobalt	mg/L	-	-	0.00062	0.00072	0.015	0.0033	0.00016	0.00017	0.0037	0.0015	0.00014	0.00014	0.00014	0.00014	0.00022	0.00022	0.0026	0.0026	0.00055	0.00055
Copper	mg/L	0.10	-	0.0014	0.0015	0.0028	0.0024	0.0014	0.0014	0.0017	0.0015	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0027	0.0027	0.0014	0.0014
Cyanate	mg/L	-	-	0	0	1.2	0.021	0	0	0.18	0.000017	0	0	0	0	0	0	0	0	0	0
Fluoride	mg/L	-	-	0.02	0.02	0.065	0.026	0.02	0.02	0.03	0.024	0.02	0.02	0.02	0.02	0.02	0.02	0.024	0.024	0.02	0.02
Free Cyanide	mg/L	0.50	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron	mg/L	-	-	0.073	0.084	0.23	0.11	0.019	0.02	0.12	0.065	0.016	0.016	0.016	0.016	0.025	0.025	0.081	0.082	0.065	0.065
Lead	mg/L	0.08	-	0.000052	0.000052	0.0037	0.0011	0.00005	0.00005	0.0019	0.00076	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00061	0.00029	0.000052	0.000052
Lithium	mg/L	-	-	0.005	0.0048	0.24	0.056	0.005	0.005	0.23	0.092	0.005	0.005	0.005	0.005	0.005	0.005	0.022	0.013	0.005	0.0049
Magnesium	mg/L	-	-	1.4	1.4	16	3.0	1.3	1.3	18	8.0	1.3	1.3	1.3	1.3	1.3	1.3	2.6	2.6	1.4	1.4
Manganese	mg/L	-	0.046-15	0.0061	0.0068	0.2	0.046	0.0022	0.0023	0.098	0.039	0.002	0.002	0.002	0.002	0.0027	0.0027	0.065	0.065	0.0055	0.0055
Mercury	mg/L	-	-	0.00001	0.00001	0.000017	0.00001	0.00001	0.00001	0.000011	0.00001	0.000005	0.000005	0.000005	0.000005	0.000005	0.000005	0.0000057	0.0000057	0.000005	0.000005
Molybdenum	mg/L	-	-	0.000071	0.000075	0.0046	0.00093	0.000052	0.000052	0.0018	0.0007	0.000051	0.000051	0.000051	0.000051	0.000054	0.000054	0.00072	0.00072	0.000068	0.000068
Nickel	mg/L	0.25	-	0.0049	0.0052	0.05	0.013	0.0035	0.0035	0.014	0.0072	0.0034	0.0034	0.0034	0.0034	0.0036	0.0036	0.011	0.011	0.0047	0.0047
Nitrate	mg-N/L	-	124	0.009	0.0064	2.3	1.6	0.0072	0.0065	1.6	1.2	0.0071	0.0065	0.0065	0.0065	0.0074	0.0065	0.31	0.31	0.012	0.0069
Nitrite	mg-N/L	-	-	0.0011	0.00097	0.029	0.053	0.001	0.0010	0.0075	0.0036	0.001	0.0010	0.0010	0.0010	0.001	0.0010	0.076	0.076	0.0013	0.001
Orthophosphate	mg-P/L	-	-	0.00099	0.00097	0.018	0.0044	0.0010	0.0010	0.0069	0.0033	0.0010	0.0010	0.0010	0.0010	0.00099	0.00099	0.00086	0.00086	0.00099	0.00099
Phosphate	mg-P/L	-	-	0	0	0.018	0.0036	0	0	0.0084	0.0033	0	0	0	0	0	0	0	0	0	0
Phosphorus	mg/L	-	-	0.0021	0.0022	0.0062	0.01	0.0019	0.0019	0.0094	0.023	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.032	0.032	0.0021	0.0021
Potassium	mg/L	-	-	0.34	0.34	42	13	0.34	0.34	24	9.0	0.34	0.34	0.34	0.34	0.34	0.34	14	7.4	0.34	0.34
Selenium	mg/L	-	-	0.00011	0.00011	0.00051	0.00025	0.0001	0.0001	0.00032	0.00019	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.00035	0.00035	0.00011	0.00011
Silicon	mg/L	-	-	0.42	0.45	20	4.3	0.29	0.29	5.5	2.2	0.28	0.28	0.28	0.28	0.31	0.31	5.5	5.0	0.4	0.4
Silver	mg/L	-	-	0.00001	0.00001	0.000057	0.000018	0.00001	0.00001	0.000034	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.000014	0.000014	0.00001	0.00001
Sodium	mg/L	-	-	0.66	0.65	171	39	0.66	0.66	178	72	0.66	0.66	0.66	0.66	0.66	0.66	0.81	3.6	0.66	0.65
Strontium	mg/L	-	-	0.0094	0.0091	3.6	0.3	0.0094	0.0094	5.4	2.2	0.0094	0.0094	0.0094	0.0094	0.0094	0.0094	0.089	0.049	0.0094	0.0093
Sulphate	mg/L	-	-	5.0	5.1	401	132	4.2	4.2	268	102	4.1	4.1	4.1	4.1	4.3	4.3	32	32	4.9	4.9
TDS	mg/L	-	-	23	22	235	36	23	23	464	430	23	23	23	23	23	23	20	20	23	23
Tellerium	mg/L	-	-	0.002	0.0019	0.004	0.002	0.002	0.002	0.0023	0.0021	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Thallium	mg/L	-	-	0.00005	0.000048	0.00017	0.000071	0.00005	0.00005	0.00015	0.000088	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.000086	0.000064	0.00005	0.000049
Thiocyanate	mg-N/L	-	-	0	0	0.56	0.0059	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thorium	mg/L	-	-	0	0	0.00013	0.000039	0	0	0.00007	0.000025	0	0	0	0	0	0	0.000035	0.000035	0	0
Tin	mg/L	-	-	0.000099	0.000097	0.0037	0.0011	0.00010	0.00010	0.0017	0.00069	0.00010	0.00010	0.00010	0.00010	0.000099	0.000099	0.0015	0.00077	0.000099	0.000099
Titanium	mg/L	-	-	0.011	0.011	0.024	0.013	0.01	0.01	0.016	0.012	0.01	0.01	0.01	0.01	0.01	0.01	0.013	0.013	0.011	0.011
TOC	mg/L	-	-	4.0	3.9	4.9	3.8	4.0	4.0	3.9	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.4	3.4	4.0	3.9
Total Cyanide	mg-N/L	-	-	0.0023	0.0022	0.0051	0.0022	0.0023	0.0023	0.0022	0.00053	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.002	0.002	0.0023	0.0023
TSS	mg/L	15	-	3.0	2.9	3.7	2.9	3.0	3.0	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.6	2.6	3.0	3.0
Uranium	mg/L	-	0.033	0.00001	0.00001	0.0068	0.0028	0.00001	0.00001	0.0011	0.00047	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0074	0.0037	0.00001	0.00001
Vanadium	mg/L	-	-	0.000076	0.000081	0.03	0.0084	0.000055	0.000055	0.018	0.0065	0.000054	0.000054	0.000054	0.000054	0.000058	0.000058	0.007	0.0036	0.000073	0.000073
WAD Cyanide	mg-N/L	-	-	0	0	0.000031	0.00001	0	0	0.000021	0.0000081	0	0	0	0	0	0	0	0	0	0
Zinc	mg/L	0.40	0.011-0.13[d]	0.0033	0.0034	0.018	0.0053	0.003	0.003	0.01	0.0057	0.003	0.003	0.003	0.003	0.0031	0.0031	0.0047	0.0047	0.0033	0.0033
Zirconium	mg/L	-	-	0.0004	0.00039	0.0022	0.00083	0.0004	0.0004	0.0011	0.00066	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0009	0.0009	0.0004	0.00039

(a) PN09 is not active after the Operations (i.e., at the start of Closure Period)

(b) MDMER discharge limit is for un-ionized ammonia. Total ammonia can be used to calculate un-ionized ammonia using f =1 / [10(pKa - pH) + 1] Where, f = fraction of total ammonia that is un-ionized; pKa = dissociation constant. A temperature of 15°C and a conservative pH of 8.5 was used.

(c) The CWQG is hardness dependent. Hardness values are calculated from predicted calcium and magnesium concentrations in the model (Golder 2021), with the range in minimum predicted hardness values from each location being used in this table.

(d) The acute dissolved zinc CWQG is hardness and DOC dependent. The CWQG is based on a DOC of 0.3 mg/L and hardness values are calculated from predicted calcium and magnesium concentrations in the model (Golder 2021), with the range in minimum predicted hardness values from each location being us

Acute CWQGs for cadmium, manganese and zinc vary over time and by discharge location, depending on predicted hardness. Predicted discharge concentrations of these three metals were not above applicable acute CWQGs (see plots showing acute CWQGs over time and by location in Appendix F).

TDS = total dissolved solids; TSS = total suspended solids; DOC = dissolved organic carbon, TOC = total organic carbon; WAD = weak acid-dissociable; mg/L = milligrams per liter; mg-N/L = milligrams of nitrogen per liter; mg-P/L = milligrams phosphorus per liter; WAD= weak acid dissociable; CWQG = Canadian water quality guideline (CCME 1999).