Karén Kharatyan
A/Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0

June 8, 2018

RE: Response to Back River Project Type A Water Licence Nunavut Water Board (NWB) Technical Commitment Appendix D to the Prehearing Conference Decision regarding Application for New Type A Water Licence (2AM-BRP----)

Dear Mr. Kharatyan,

Sabina Gold & Silver Corp. (Sabina) is pleased to provide the attached responses to the Pre-Hearing Conference Decision dated May 29, 2018, Appendix D, List of Commitments generated during the Pre-Hearing Conference/Technical Meeting (PHC/TM) held May 1-3, 2018, for Water Licence Application No.: 2AM-BRP----.

As the NWB and interested parties are aware, Sabina commenced initial development works at the Marine Laydown Area (MLA) in March 2018. Sabina intends to provide a memorandum and a further updated site layout for the MLA for consideration on June 25, 2018.

I trust the attached information meets the NWB requirements for response to the List of Commitments for the Type A Water Licence for the Back River Project. Sabina looks forward to the further discussions with all Parties at the upcoming Final Hearing in Cambridge Bay.

Should you have any questions, please do not hesitate to contact me at the below.

Yours truly,

Matthew Pickard
Vice President, Environment and Sustainability
Sabina Gold & Silver Corp.
#1800 – 555 Burrard Street
Box 220
Vancouver, BC V7X 1M9

CC: Dave Baines, NWB

Attachments: Technical Commitment Responses

Sabina
GOLD & SILVER CORP.

The BACK RIVER PROJECT

TYPE A WATER LICENCE
TECHNICAL MEETING COMMITMENT RESPONSES

June 2018
NWB File No. 2AM-BRP----

Submitted to:
Nunavut Water Board
PO Box 119
Gjoa Haven, NU X0B 0C0

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The BACK RIVER PROJECT

Technical Meeting Commitment Responses

Kitikmeot Inuit Association

Interested Party:	KIA	Commitment No.:	WTM-COMMITMENT 3 (KIA-TRC-29)

Post-Technical Meeting Commitment:

Provide discussion of management/treatment options and related cost estimates that ensure water quality in the discharge from flooded pits (MMER) and the downstream receiving environment (CCME and SSWQO) comply with the levels of impact permitted under the NIRB project certificate.

Post-Technical Meeting Response Package:

As stated in Appendix F of the Interim Closure and Reclamation Plan (ICRP; 171005 2AM-BRP----SD26-ICRP-IMLE), water quality predictions were evaluated in all open pits, tailings management facilities, and in predefined locations downstream of the Goose Property. Results were compared to Metal Mining Effluent Regulation (MMER) and Canadian Council of Ministers of the Environment (CCME) water quality guidelines. Water quality predictions indicate that water treatment may be required within the Goose Main Pit, once it becomes the Goose Main Tailings Facility (TF), for TSS, arsenic, and copper.

Water treatment begins in Year 7 in the Goose Main TF. From Year 7 to Year 10, the Goose Main TF water is treated year-round and is recirculated back into the Goose Main TF for use as reclaim water. Once mining is complete in Year 10, water treatment continues during the open water season only from the Goose Main TF, until Year 17, with the Property finally closed in Year 18. The water treatment process is coagulation facilitated by adding ferric sulphate. Flocculent may be added to enhance settling. Goose Main TF is expected to meet discharge requirements in Year 17, which is the year the facility overflows.

With this proposed water treatment strategy, it is predicted that the water quality of open pit and tailings facility overflows at Closure will meet MMER and SSWQO limits, and that long-term water quality (Post-Closure) will meet CCME guidelines in Goose Lake. However, actual water quality conditions will not be known with certainty until passive flooding is complete. The need for water treatment will be ultimately analyzed prior to open pit overflow. Prior to overflow, the water quality will be profiled. If the results indicate that water in the flooded open pit(s) is not suitable for direct discharge, the following alternatives will be considered as contingencies for the treatment of the flooded pit water:

- **Goose Main TF:** treatment will continue to occur through the water treatment plant as per the Operations Phase.
- **Umwelt, Llama, and Echo Flooded Pits**: treatment would occur in-pit. The in-pit treatment options include:
  - **Chemical In-Pit Treatment Option:** through the addition of lime to increase the pH and precipitate out dissolved metals and the addition of ferric sulphate to aid in precipitating arsenic and copper.

It is predicted that a lime and ferric dose rate of 35 mg/L and 5 mg/L, respectively, would be required to meet discharge requirements. For the total volume of the flooded Umwelt, Llama, and Echo pits of 13.8 M-m^3, a total of 508 t of lime and 285 t of ferric sulphate would be required. It has been assumed that the lime and ferric sulphate would be mixed in a temporary mixing tank, and then dispersed centrally into the pit lakes through a small diameter floating HDPE pipe. The mixing tank and pipe would be relocated to provide treatment in each pit if required.

- **Biological In-Pit Treatment Option:** through the addition of Mono-Ammonium Phosphate (MAP) to induce algal blooms, which would then incorporate dissolved metals in the surface waters dragging them to the bottom with settling dead algae.

  A target phosphorus level of 1 ppm in the top 10 m of the water column was selected to stimulate algal growth. A conservative dosage rate of 5 g/m^3 has been assumed. This dosage rate is consistent with dosage rates used at Colomac Mine where biological in pit treatment through MAP application has been successfully implemented. For the top 10 m flooded pits volume of 3.2 M-m^3 (Umwelt, Llama, and Echo), this works out to a required 16,150 kg of MAP.

  It is assumed that the MAP would be distributed by boat over the surface of the pits lake. The boat would be relocated to provide treatment in each pit.

The above treatment(s) will continue until discharge criteria are met, complete passive flooding is achieved, and overflow to the environment occurs. In the case of the Goose Main TF, it has been assumed that treatment will occur in the summer season for a total of 7 years (i.e., Years 11 through 17); this is above the 4 years of year-round treatment during Operations. For Umwelt, Llama, and Echo flooded open pits, it is assumed that a single in-pit treatment at the time of Closure would be adequate. The selection of either chemical treatment or biological treatment would be made based on the actual water chemistry conditions.

Conceptual cost estimates are provided below for the above contingency options; Sabina confirms that water treatment volumes and tasks associated with Table 1 are already included in the ICRP Closure Cost Estimate (171005 2AM-BRP----SD26-ICRPCostEstimate-IMLE); the unit costs for water treatment are currently under discussion with Crown-Indigenous Relations and Northern Affairs (CIRNA) and Kitikmeot Inuit Association (KIA) as part of ongoing Closure Cost discussions.

Table 1: Goose Main TF Water Treatment Conceptual Cost Estimate

Activity/Material	Units	Quantity	Unit Cost	Cost
Treatment with ferric sulphate and lime	m^3	1,070,000	$0.56	$594,599
Pumping (Goose Main TF to WTP and back)	m^3	1,070,000	$0.24	$256,800
Subtotal, Post-Closure Treatment Costs				**$851,399**
Discount rate NPV of post-closure cost, %	3.00%			
Number of years of before start of activity	7			
Net Present Value				**$5,304,457**

Table 2: Chemical In-Pit Treatment - Umwelt, Llama, and Echo (13.8 M-m^3 total volume) - Conceptual Cost Estimate

Activity/Material	Units	Quantity	Unit Cost	Cost
Lime – FOB site	tonne	508	$575.00	$292,342
Ferric Sulphate – FOB site	tonne	285	$1,117.00	$318,844
Mixing Tank	Allow	1	$10,000	$10,000
Pump (small, gas powered)	Allow	1	$5,000	$5,000
Piping	m	500	$36.10	$18,050
Mob/Demob equipment	Allow	1	$5,000.00	$5,000
Subtotal, Post-Closure Treatment Costs				**$649,236**
Discount rate NPV of post-closure cost, %	3.00%			
Number of years of treatment - one batch	0			
Net Present Value				**$649,236**

Table 3: Biological In-Pit Treatment - Umwelt, Llama, and Echo (Top 10 m 3.23 M-m^3) - Conceptual Cost Estimate

Activity/Material	Units	Quantity	Unit Cost	Cost
Mono-ammonium Phosphate (MAP) – FOB site	kg	16,150	$1.00	$16,150
Boat for distributing MAP over pit lake surface	Allow	1	$10,000	$10,000
Subtotal, Post-Closure Treatment Costs				**$26,150**
Discount rate NPV of post-closure cost, %	3.00%			
Number of years of before start of activity - one batch	0			
Net Present Value				**$26,150**

Interested Party: KIA	**Commitment No.:**	**WTM-COMMITMENT 8 (KIA-30)**

Post-Technical Meeting Commitment:

Provide more information regarding Saline Water Management.

Post-Technical Meeting Response Package:

Sabina is providing the attached DRAFT Saline Water Management; Appendix C to the Water Management Plan.

Water Management Plan

Appendix C: Saline Water Management

(DRAFT)

June 2018

BACK RIVER PROJECT
MINE WASTE ROCK MANAGEMENT PLAN

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Revision Log

Version	Date	Section	Page	Revision
1	June 2018	All	All	Addition of Appendix C: Saline Water Management

Acronyms

CCME	Canadian Council of Ministers of the Environment
MAD	Main Application Document
NWB	Nunavut Water Board
Project	Back River Project
Sabina	Sabina Gold & Silver Corp.
SD	Supporting Document
SWM	Saline Water Management
SWP	Saline Water Pond
TF	Tailing Facility
WMP	Water Management Plan

1. Introduction

The Saline Water Management (SWM) is developed as an appendix to the Water Management Plan (WMP; SD-05) to provide additional details related to the management of saline groundwater in compliance with the Type A Water Licence 2AM-BRP----(pending). The WMP outlines the procedures necessary to manage the quantity and quality of water interacting with Project components throughout the Construction, Operations, Closure, and Post-Closure phases of the Project. It includes management practices that reduce the potential for adverse impacts to receiving waters, to aquatic ecosystem, and to fish and fish habitat. The WMP also includes details on the design of the various water management control structures.

In response to commitments made during the Type A Water Licence Technical Hearings held during the first week of May 2018, Sabina is providing a first draft of the SWM with the main purpose of defining the document framework. The SWM will be completed and become an integral part of the WMP as part of the next update of the WMP, which is expected to occur prior to Construction.

As stated in the WMP, Sabina will, pending direction from the Nunavut Water Board (NWB), maintain a saline water management plan which details planned monitoring of thermal conditions and saline water at the Goose Property, and mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the open pit and the underground mines, treatment, and disposal methods. This SWM will include characterization of saline water inflows into the underground mine workings.

2. Scope and Objectives

The main environmental concerns related to saline water are the potential effects of the high salinity water on local water quality, which in turn could potentially affect living organisms that rely on these waters, as well as the downstream system.

The WMP incorporates strategies for saline water management that allow full containment of saline water within the Project site throughout the various phases of the Project to mitigate risk of adversely affecting the natural environment.

The SWM is provided as an addendum to the WMP with the objective of further detailing the saline water management strategies and designs for the Project, including considerations about contingencies, monitoring, and potential adaptive management strategies. The SWM applies to all phases of the Project during which saline water will be managed. The SWM has been written to meet requirements of a Type A Water Licence.

The purpose of the SWM is to:

- outline procedures and processes specific to management of saline water through all phases of the Project, as proposed in the WMP;
- summarize designs of infrastructure dedicated to management of saline water;
- meet relevant laws and regulations;
- detail mitigation (adaptive management) strategies to manage potential adverse environmental effects; and
- define steps that will be taken to monitor potential mitigation measures for success.

Additional details related to the closure and reclamation of saline water management structures can also be found in the Interim Closure and Reclamation Plan (SD-26).

The SWM, as part of the WMP, will be updated as needed to reflect changes in operations and technology. Any updates will be filed with the Annual Report submitted under the Type A Water Licence.

The SWM is divided into the following sections:

- Applicable Legislation and Guidelines (Section 3);
- Saline Water Management Strategy (Section 4);
- Monitoring and Reporting Program (Section 5);
- Quality Assurance/Quality Control Procedures (Section 6);
- Adaptive Management (Section 7); and
- Reclamation (Section 8).

2.1 RELATED DOCUMENTS

Documents within the Application for the Type A Water Licence supporting the SWM include the following:

- SRK Hydrogeological Characterization and Modelling (MAD Appendix F-5);
- Environmental Management and Protection Plan (SD-20);
- Water Management Plan (SD-05);
- Aquatic Effects Management Plan (SD-21);
- Road Management Plan (SD-02);
- Interim Closure and Reclamation Plan (SD-26);
- Quality Assurance / Quality Control Plan (SD-24);
- SRK Hydrology Report (FEIS Volume 2, Appendix V2-7B);
- Water and Load Balance Report (MAD Appendix E-2); and
- Site Wide Water Management Report (MAD Appendix F-1).

3. Applicable Legislation and Guidelines

Specific legislation, regulations, and guidelines related to water management in Canada, and specifically within Nunavut, are summarized in the WMP (SD-05), Table 3-1.

Sabina will also be bound by the terms and conditions of its land use permits to be issued by the Kitikmeot Inuit Association for Inuit Owned Land, and its Type A Water Licence to be issued by the NWB.

4. Saline Water Management Strategy

As defined in the WMP, saline water for the Project is the groundwater that flows into Llama Open Pit (only pit not in permafrost) and the underground workings, refer to Figure A-11 and A-12. A small volume of brine water may be used for drilling in the underground mine workings. This brine water would be recirculated during drilling as much as feasible, with any excess managed synonymously with other saline water from the Project as described below.

This section provides a description of the saline water management strategy throughout the Construction, Operations, and Closure phases of the Project. In summary, the saline water management strategy consists of collecting saline water from Llama Open Pit and the underground mine workings, and temporarily storing this groundwater in a dedicated storage facility until it can be pumped back into the mined-out underground workings and exhausted Llama Open Pit.

4.1 PERMAFROST CHARACTERISTICS AND GROUNDWATER INFLOWS

The Back River Property is located in the continuous permafrost region of the Canadian Arctic. Although permafrost may extend in excess of 400 metres below the ground surface (mbgs), it is expected that some of the underground development will extend below this depth into unfrozen rock and soil. In addition, Llama Open Pit will be located within a through talik underneath Llama Lake.

As part of the Project, a groundwater prediction model was completed to estimate potential groundwater inflows during mining at the Goose Property (MAD Appendix F-5). A summary of the modelled annual groundwater inflows at the Goose Property and corresponding Total Dissolved Solids (TDS) concentrations is provided in Table 4.1-1 and Table 4.1-2, respectively. Note Table 4.1-1 of the WMP is corrected from MAD Appendix F-5 based on response to Technical Comment, WT-KIA-NWB-06.

Table 4.1-1. Goose Property Predicted Yearly Inflow

Year	Flow in m^3/day			
	Umwelt Underground	Llama Underground	Llama Open Pit	Goose Main Underground
-2	0	0	0	0
-1	0	168	0	0
1	0	334	120	0
2	89	350	109[a]	0
3	543	264	72[a]	0
4	440	185	Interpolated	0
5	596	0	Interpolated	0
6	498	0	Interpolated	21
7	405	0	Interpolated	85
8	359	0	Interpolated	77
9	329	0	Interpolated	64
10	156	0	Interpolated	0

Note: a) Corrected from MAD Appendix F-5 based on response to Technical Question WT-KIA-NWB-06

Table 4.1-2. Goose Property Predicted Yearly Concentration in Groundwater Inflows

Year	TDS concentrations in mg/L			
	Umwelt Underground	Llama Underground	Llama Open Pit	Goose Main Underground
-2	0	0	0	0
-1	0	15,533	0	15,533
1	0	17,128	8,758	14,915
2	32,157	21,004	10,888	20,795
3	40,901	21,911	12,000	33,262
4	49,820	22,344	0	41,706
5	58,826	0	0	58,826
6	57,571	0	0	56,413
7	58,198	0	0	53,556
8	58,919	0	0	54,339
9	59,681	0	0	58,511
10	60,224	0	0	60,224

At the Goose Property, groundwater modelling and analysis determined that inflows are expected in Llama Open Pit, Llama Underground, Umwelt Underground, and Goose Main Underground. Llama underground and open pit mining will be developed below Llama Lake within a through talik that is connected to the groundwater system. It is also expected that Llama, Umwelt, and Goose Main underground working will intercept the groundwater system below the basal permafrost layer. The remaining developments (Umwelt Open Pit, Goose Main Open Pit, and Echo Open Pit, and Echo Underground) are not expected to have notable groundwater inflows.

The inflows and concentrations in Table 4.1-1 and Table 4.1-2 were derived from hydrogeological parameters obtained from the results of the field investigation program, including the Westbay Well installed to conduct groundwater quality sampling at the Project. Multiple hypothetical scenarios were modelled to assess the sensitivity of groundwater model predictions to hydraulic conductivity (K) values, the potential presence of fault conduits, lake sediment K values, and permafrost distribution. The hypothetical scenarios were used to contextualize the overall groundwater model in terms of both quantity and quality of water estimated to report to the mine workings.

Groundwater inflows in Table 4.1-1 represent yearly average flows, meaning they are estimated as the total annual inflow volumes equally distributed over 12 months. As such, these inflow volumes do not account for the actual schedule of mining completion in the last year of each open pit facility. If the facilities are completed in the first few months of the production last year, the inflow rates for those months would be higher than the yearly average inflow rates, as the total annual estimated inflow volume would be concentrated in a period of time shorter than 12 months. Linear interpolation was assumed for groundwater flow into Llama Open Pit during pit flooding, ranging from a maximum of 72 m^3/day at an elevation of 165 masl to 0 m^3/day at 385 masl (Water and Load Balance Report, Appendix E-2 of the MAD).

A detailed description of the groundwater prediction model and results through all mine phases can be found in the Hydrogeological Characterization and Modelling Report for the Project (MAD Appendix F-5).

4.2 SALINE WATER MANAGEMENT STRATEGY AND ASSOCIATED CONTROL STRUCTURES

Sabina recognizes that there is a chance that groundwater flow in the mine workings may be dominated by specific fractures or features that are intercepted. This uncertainty exists for all mining projects and is never completely alleviated, which is the reason why structural geology and hydrogeology data are regularly collected from mining operations. The influx of groundwater into a mine is a normal and well understood phenomenon, and is regularly managed by standard operating procedures in operating mines. Sabina is aware of the uncertainty related to fault zones and will take advance actions where feasible to help safely and appropriately manage groundwater inflows reporting to the mine workings. These actions may include use of surface and underground exploration information to identify enhanced permeability that may be intercepted by the mine workings, advancing cover and probe drilling (i.e., exploration drainage holes), and interpretation of groundwater pressure and inflow data when high permeability formations are encountered.

A series of options to manage saline water as it reports to the mine workings was identified and assessed during the development of the site wide water management plan for the Project. These options included, but were not limited to, physical barriers to cut off inflow, temporary and/or permanent storage in dedicated storage facilities, and an array of pumps and sumps to collect and transfer saline water. Potential saline water management options are listed in order of preference (from most preferred or applicable to least preferred or applicable) in Table 4.2-1, along with a discussion of the applicability of each option given the current mine plan.

Table 4.2-1. Saline Water Management Options Considered

Management Option/Location	Discussion of Applicability
Exhausted open pits (Umwelt, Llama, Goose Main, Echo or other open pits)	A possible option if the future pit lake could be managed to support meromictic conditions, resisting turnover due to pit lake geometry, and therefore unlikely to result in a discharge of saline water to local freshwater streams. Currently, Llama Pit is expected to be developed as meromictic, but depending on the developing mine plan, all pits could be considered for the possibility of temporary or permanent saline water storage. In-pit tailings disposal in all pits would be prioritized over disposal of saline water. The use of exhausted open pits, along with mined-out underground workings, provide the most suitable permanent saline water disposal locations; however, the timing of saline water discharges relative to the availability of either as permanent storage may not match.
Closed U/G workings (Umwelt, Llama, Goose Main, Echo or other underground workings)	A possible temporary or final disposal option. It is noted that underground workings are the main source of saline water and could not be used for disposal until mining is completed. The use of mined-out underground workings, along with exhausted open pits, provide the most suitable permanent disposal locations; however, the timing of saline water discharges relative to the availability of either as permanent storage may not match.
Modified natural containment area (Llama Lake or Umwelt Lake)	A modified natural containment area (for example, Llama or Umwelt lakes) could be suitable as a temporary saline water storage area and could be used for permanent saline water storage as long as any overflow meets appropriate discharge criteria. A modified natural containment area is technically feasible and economically viable. Impacts to fish and fish habitat for use of Umwelt Lake and dewatering of Llama Lake have already been assessed (refer to Fish Out Plan [FEIS Volume 10, Chapter 21] for details). No additional impacts to fish or fish habitat would be realized as a result of using Llama or Umwelt lakes as modified natural containment areas. Umwelt Lake is the only natural containment area currently identified that provides the estimated required storage volume (approximately 1.1 M-m^3). Current water management planning identifies Umwelt Lake as the Saline Water Pond; it is the preferred temporary saline water storage area and could be used if inflow volumes are greater than anticipated

(continued)

Table 4.2-1. Saline Water Management Options Considered (completed)

Management Option/Location	Discussion of Applicability
Tailings Storage Facility / Tailings Facility	Supernatant pond water from the active Tailings Storage Facility (TSF) or Tailings Facility (TF) will be reclaimed for the Process Plant. The Process Plant cannot easily tolerate the expected high salinity levels in the saline water, and as such, storing saline water in the active TSF/TF is not the preferred option. However, saline water may be sufficiently diluted in the supernatant pond to temporarily provide storage for limited periods (i.e., months), if required, and not upset the process. In addition, if the groundwater is of better quality than currently predicted, or salinity tolerances in the Process Plant are higher, saline water could be permanently stored with the supernatant pond. Once a TF is no longer used for Process Plant reclaim (i.e., tailings deposition moved to the next TF), the facility could be used to store saline water as long as an appropriate freshwater cover was maintained over existing tailings, and discharge criteria are met for overflows.
Man-made surface containment ponds	Similar to the modified natural containment area, man-made surface containment ponds could be constructed to temporarily or permanently store saline groundwater; this would be at a higher (than other options) cost, and could increase the footprint of the surface disturbance within the Property. The man-made surface containment ponds would be designed and constructed to avoid additional impacts to fish or fish habitat.
Local watercourses following treatment	Saline groundwater could be processed in a reverse osmosis (or similar) water treatment process for discharge to the environment. Saline water treated to meet effluent discharge criteria acceptable to the NWB could be released to a local watercourse. However, such treatment produces a small volume of high salt brine that would require management and disposal.
Transport and disposal to Bathurst Inlet	Should on-site storage volumes be insufficient, saline water, or high salt brine from reverse osmosis treatment, could be transported to Bathurst Inlet and discharged via a diffuser. Should this option be required it is noted that significant additional regulatory requirements (including MMER) may be required.
Physical barriers to cut off groundwater inflow	Current data suggest that permafrost and tight ground conditions will limit the volume of inflows. Use of physical barriers to cut off groundwater inflows prior to it reporting to the mine workings is a high cost measure, especially if used on a large scale, and is therefore not the preferred option for the Project. However, this option will be considered as an adaptive management measure to mitigate local, higher than expected inflows, if encountered.

The availability and applicability of the above options depend upon a number of factors, including timing (when the saline water will be generated relative to when the appropriate storage location is available), actual Project development schedule, the need for prioritizing the disposal of tailings over saline water, and the fact that, unlike solid mine wastes such as tailings or waste rock, saline groundwater can be temporarily stored more easily as it can be moved (i.e., pumped) to its final disposal location with relative ease.

Selection of the available permanent storage location for saline water is a function of current Project timing. As the Llama Pit and Llama underground mines will become available for storage in Year 5, this is the basis for selecting these two locations as permanent storage for saline water. In addition, these locations are close to the temporary saline water storage in the former Umwelt Lake (called the Saline Water Pond [SWP]). The underground workings at Goose Main, Umwelt, and Echo become available in the final year of mining and can be used to store any remaining saline water at that time, if necessary.

Should contingency measures for saline water storage in open pits or other listed storage locations be identified (other than what is currently captured in the mine plan), Sabina intends to provide the NWB at least 60 days' notice prior to implementation with the following: water disposal volumes, disposal timing, maximum pit/storage capacity, effects to pit closure, and appropriate mitigation and monitoring plans.

4.3 SALINE WATER POND DESIGN CRITERIA

The SWP (in the former Umwelt Lake) was selected as the preferred alternative for the temporary storage of Project saline water before permanent storage capacity becomes available in Llama Pit and Llama underground. Details on the SWP design are provided in the Appendix F-1 of the MAD and Section 6 of the WMP.

The SWP will have two containment dams (East and South Containment Dam) connected to diversion berms around the pond to divert non-contact water runoff away from the SWP. The design event for the containment structures was defined based on a qualitative assessment of the risk level associated with overtopping or breaching of the structure. The two SWP containment dams were assigned a “high risk” classification based on the consideration that discharge from these structures in the unlikely event of an overtop/breach would be directly into the environment; this consideration is consistent with overall Project design criteria.

Sabina will be conducting more field characterization studies in support of final design of the SWP, and further characterization, in the form of percolation testing, will be carried out immediately prior to construction of the facility. The information from the field characterization will verify that the design meets the required intent of full containment of the saline water, and will inform Sabina on the need for implementation of additional measures to provide containment of saline water. Information, including geological cross sections, collected in support of final designs of the infrastructure will be provided to the NWB, and any additional information relevant to the design gathered during construction will be documented in the as-built drawings for the facility.

4.4 EXISTING GROUNDWATER MANAGEMENT CONTROL STRUCTURES

There are currently no existing groundwater management control structures in place at the Project.

4.5 SALINE WATER MANAGEMENT SCHEDULE

Table 4.5-1 outlines the timeline for key saline water management activities, including tasks and facilities. A detailed Mine schedule for overall Mine Water Management (e.g., building of culverts, berms, and containment dams) is presented in the WMP (SD05).

During Phase 1 (Construction), Umwelt Lake will be dewatered to construct the SWP. To minimize surface flows towards the SWP, the facility will be isolated by means of diversion berms. The South and East Containment Dams will be constructed in Year -2, as well as the diversion berms around the SWP’s perimeter. The pond will be completed before receiving saline water inflows pumped from the Llama underground development, which will first occur in Year -1.

For Phase 2 (Operations), saline water from the Llama, Umwelt, and Goose Main underground mines, and the Llama Pit, will be collected and pumped to the SWP. In Year 4, saline water from the SWP will be pumped at a rate of 500 m^3/day to the bottom of the partially flooded Llama Reservoir, creating a meromictic (stratified) lake [additional details regarding the Llama Reservoir meromictic system are presented in Appendix F of the Water and Load Balance Report (MAD Appendix E-2)]. In total, just over 1 Mm^3 of saline water will be pumped into the Llama Reservoir over the remaining life of mine. Saline water will also be pumped into the mined-out Llama Underground (Year 5), Goose Main Underground (Year 10), and Umwelt Underground (Year 10).

Following the dewatering of the SWP, sediment in the basin will be tested, and removed if required to meet defined discharge water quality criteria. The containment dams and berms will be breached once water from the SWP area is deemed suitable for discharge.

Table 4.5-1. Overview of Saline Water Management Activities

Activity	Mine Year	Notes
Umwelt Lake is fished out and fully dewatered to Goose Lake to allow for construction of the Saline Water Pond.	-3	Portion of water is treated for TSS.
The Saline Water Pond is constructed.	-2	—
Saline water from Llama Underground mine is pumped to the Saline Water Pond.	-1	—
Saline water from Umwelt Underground mine is pumped to the Saline Water Pond.	1	
Saline water inflow from Goose Main Underground mine is pumped to the Saline Water Pond.	4	—
From Year 4 to Year 9, saline water from the Saline Water Pond will be pumped to the bottom of the partially flooded Llama Reservoir to create a meromictic lake.	4	In total, approximately 1 Mm^3 of saline water will be pumped into the Llama Reservoir.
Saline water is pumped from the Saline Water Pond into the Llama Underground mine.	5	Approximately 325,000 m^3 of saline water will be pumped into the Llama Underground mine.
Dewatering of Saline Water Pond to Llama Pit (Llama Reservoir) is completed.	9	—
All remaining saline water in the Saline Water Pond is pumped to the underground workings of Umwelt and Goose Main.	10	Approximately 800,000 m^3 will be pumped
Decommissioning of Saline Water Pond containment dams and berms	10 to 18	After dewatering of Saline Water Pond to underground workings and Llama Reservoir is complete.

Source: Water Management Plan (SD-05) (2017)

5. Monitoring and Reporting Program

This section presents a summary of the saline water monitoring and reporting programs that will be carried out during Construction and Operations related to mine development water quantity and quality.

As part of effective mine water management, monitoring is important to verify the predicted water quality and quantity trends and conduct adaptive management should differing trends be observed. Monitoring will occur at three levels:

- Regulated discharge monitoring occurring at monitoring points specified in the approved Licence or regulations.
- Verification monitoring carried out for operational and water management purposes by Sabina. This monitoring data will not be reported to the Regulators in the Annual Water Licence Report, but can be provided upon request by the Regulators.
- General monitoring included in the Licence requirements and subject to compliance assessment to confirm sampling was carried out using established protocols, including quality assurance/quality control provisions and addressing identified issues. General monitoring is subject to change as directed by an Inspector, or by the Licensee, subject to approval by the NWB.

All three types of monitoring will be used at the Mine. The WMP presents the conceptual monitoring plan relating to water management during Construction, Operations, and Closure. More detailed information on the planned monitoring programs for the Project are provided in the Environment Management and Protection Plan (SD-20).

5.1 WATER QUANTITY

The volume of saline water being collected and transferred to and from the SWP will be measured using flow meters. This data will be supplemented by periodic seepage surveys which will record visually observed groundwater inflows in the open pits and underground mines. Measured groundwater inflow rates will be compared to model predictions on an annual basis. If significant variations from model predictions are observed, the assumptions behind the analysis will be reviewed and the analysis updated, if required. In addition, updates to the groundwater model may be required based on operational changes as the Project advances.

The prediction node PN10 will illustrate flows downstream of Llama Open Pit and the SWP.

5.2 WATER QUALITY

Saline water quality will be monitored in the SWP to assess the quality of groundwater flowing into Llama Open Pit and the underground mines. Water samples will be analyzed for the following parameters: conductivity, TDS, pH, temperature, major anions, radium 226, dissolved and total metals, and toxicity testing.

The Water Quality Monitoring for the Project (Appendix B – Water Management Plan) provides information on proposed water quality sampling stations to be monitored. Saline water inflows from Llama Pit and underground mines will be monitored. The proposed BRP-11 monitoring station at the SWP will be used monitor the quality of water in pond. Refer to WMP (SD-05) Appendix B, Table B-01, Figures B-01 and B-02 for exact location of monitoring stations.

To understand and plan for treatment requirements at surface, if deemed necessary, water accumulating in sumps underground will also be sampled on a monthly basis prior to recirculation for underground use or pumping to the SWP. Sump water samples will be analyzed for the following parameters: conductivity, TDS, pH, temperature, oil and grease, major anions, radium 226, dissolved and total metals, nitrate and nitrite, and volatile organic compounds (i.e., benzene, xylene, ethylene, and toluene).

Water quality results will be compared to regulated water licence requirements, Metal Mining Effluent Regulations (MMER), Canadian Council of Ministers of the Environment (CCME), and Site-Specific Water Quality Objectives guidelines.

5.3 THERMAL CONDITIONS MONITORING

The potential effect of the underground operations to the permafrost thermodynamics and hydrogeological system will consist of minor local modification of the thermal regime at the vicinity of the underground workings and a mobilization of frozen groundwater into the regional system.

During Operations, the underground workings will be backfilled progressively with waste rock and the groundwater encountered at depth will be pumped to the SWP as surface. At Closure, once mining and backfilling are complete, the saline water stored in the SWP will be pumped into the remaining underground void space. As water saturates the mined out areas, the heat will transfer to the surrounding permafrost and generate local thawing of the frozen ground surrounding the workings. The underground areas will be expected to freeze back where the minimum ground temperature is less than -2°C (above ~350 mbgs depth). However, it is possible that parts of the underground areas will not completely freeze back due to the large latent heat requirements combined with relatively warm permafrost temperatures at depth.

The underground mines are in competent rock and the structural stability of this bedrock does not rely on permafrost. The Project mine design parameters for the permafrost and talik zones are identical demonstrating that the structural integrity of the mines does not rely on presence of permafrost. There are therefore no concerns that permafrost thawing would lead to subsidence at surface. Pending final engineering designs and additional field characterization, Sabina will review and assess the requirements associated with thermal conditions monitoring. Sabina will undertake verification monitoring if needed.

6. Quality Assurance/Quality Control Procedures

Quality Assurance refers to plans or programs that encompass a wide range of internal and external management and technical practices designed to ensure the collection of data of known quality that matches the intended use of the data. Quality Control is a specific aspect of Quality Assurance that refers to the internal techniques used to measure and assess data quality.

Quality Assurance and Quality Control specific guidelines for the Project are provided in the Quality Assurance / Quality Control Plan (SD-24). These guidelines will equally apply to the saline water management structures and the saline water monitoring program.

7. Adaptive Management

The mine design, including the management of saline water, has been carefully prepared taking into consideration the vast database of site characterization data gathered for the Project, coupled with rigorous engineering analysis. Where data were limited, conservative assumptions were consistently applied. While there is a high level of confidence that the plans are viable and realistic, it is understood that mining activities are by nature inherently uncertain. Therefore, additional mitigation or adaptive management may be required as an outcome of monitoring activities described in Section 5. This may include changes to saline water management as a result of operational, engineering, and/or environmental monitoring. Any additional mitigation or adaptive management that is found to be required will be implemented in a timely manner.

Possible upset scenarios, and contingency strategies to address, are outlined Table 7-1.

Table 7-1: Saline Water Contingency Strategies

Possible Scenario	Contingency Strategy
Saline inflow volumes into the mine workings are greater than expected.	Modification and/or adjustment of the mine plan to avoid areas of concern, or to use mined-out underground stopes to provide surge capacity. Additional sump capacity to handle higher than predicted inflows. Pre-grouting of highly conductive structures prior to intersection with the mine workings. Isolation of mining sections with bulkheads to control or minimize mine inflows. If the average long-term groundwater inflows are higher despite these measures, the meromictic lake in the Llama Reservoir has extra capacity for saline water storage.
Water quality in the Saline Water Pond does not meet wildlife guidelines and wildlife (such as migratory waterfowl or caribou) are found to be using the pond or drinking from the pond.	Wildlife will be excluded from the ponds following an adaptive management approach.
Underground mining operations cease prior to the underground deposition of the required volume of saline water from the Saline Water Pond.	Additional storage locations will need to be identified, or treatment to desalinate the water may be required. If necessary, the meromictic lake in the Llama Reservoir has extra capacity for saline water storage.
Chloride sediments are encountered at the bottom of the Saline Water Pond once the saline water has been removed.	Sediments will be excavated and deposited in Goose Main Tailings Facility (TF). Alternatively, the base of the dewatered SWP could be washed down with freshwater and the rinse water will be pumped out. If necessary, this rinsing method would be repeated until the salinity of the rinse water is acceptably low (i.e., chloride concentration of 120 mg/L or less).
Water quality within the re-watered Umwelt Lake does not meet the requirements (section 5.2) at the time of release.	Additional water treatment may be necessary.

This SWM is part of a continually evolving process that relies not only on the efficacy of data collection and analytical results, but is also dependent on feedback from the communities, government, Aboriginal groups, and the public. Having an adaptive and flexible program allows for appropriate and necessary changes to the design of monitoring studies, and the mitigation and monitoring plans. Some changes may come about through the observation of unanticipated effects or inadequacies in the sampling methods to detect measurable effects. Other changes may result from ecological knowledge acquired through working with Aboriginal community members and discussions with Elders, both in the field and through workshops.

The SWM will be reviewed on a regular basis to incorporate lessons learned, major changes to facility operation or maintenance, and environmental monitoring results relating to the management of saline water at the Project. Any updates will be filed with the Annual Report submitted under the Type A Water Licence.

8. Reclamation

The majority of the SWP closure activities will occur as progressive reclamation with the remainder occurring in the Closure Phase. The SWP will be dewatered to multiple locations using separate pumping and pipeline infrastructure at the beginning of Active Closure; these locations include: the bottom of the Llama Reservoir, and the underground mine workings at Umwelt, Llama, and Goose Main.

Once the SWP has been dewatered, sediments will be tested and if the chloride content is considered to be too high to achieve site-specific and/or CCME guidelines for the Protection of Freshwater Aquatic Life when the facility is re-water, it will be removed and placed in the Goose Main TF. Based on average hydraulic conditions, the Goose Main TF will take approximately seven years to fill with water (i.e., the facility is expected to overflow to Goose Lake in Year 17). Therefore, SWP sediments placed in the Goose Main TF will have seven years to settle prior to overflows from the facility are anticipated. This is consider sufficient time for the sediment to settle; however, the water will be tested prior to overflow, and treatment for suspended sediment will be implemented if necessary.

Once the water in the re-watered SWP meets site-specific and/or CCME guidelines for the Protection of Freshwater Aquatic Life, the diversion berms and dams will then be breached allowing Umwelt Lake to re-establish.

Additional details pertaining to reclamation and closure are provided in the Interim Closure and Reclamation Plan (SD-26).

9. References

Canada. 2002. Metal Mining Effluent Regulations. SOR/2002-222.

Canada. 1993. Nunavut *Agreement Act*. S.C. 1993, c. 29.

Canada. 1985. *Fisheries Act*. R.S.C., 1985, c. F-14.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. Natural Resources Canada, Mine Environmental Neutral Drainage Program: Ottawa, ON.

MVLWB/AANDC (Mackenzie Valley Land and Water Board & Aboriginal Affairs and Northern Development Canada). 2013. Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories.

NIRB (Nunavut Impact Review Board). 2013. Guidelines for the Preparation of an Environmental Impact Statement for Sabina Gold & Silver Corp.'s Back River Project. NIRB File No. 12MN036).

Nunavut. 1988. *Environmental Protection Act*. RSNWT (Nu) 1988, c E-7.

NWB (Nunavut Water Board). 2010a. Mining and Milling Supplemental Information Guideline (SIG) for Mine Development (MM3). February 2010.

NWB. 2010b. Miscellaneous Supplemental Information Guideline (SIG) for General Water Works (including crossings, flood control, diversions, and flow alterations) (M1). February 2010.

Sabina (Sabina Gold & Silver Corp.). 2016. Back River Project FEIS Information Request Responses – Part 2, Appendix O. February 2016.

SRK (SRK Consulting (Canada) Inc.). 2015a. Back River Project Water and Load Balance Report. Vancouver.

The BACK RIVER PROJECT

Technical Meeting Commitment Responses

Crown-Indigenous Relations and Northern Affairs Canada

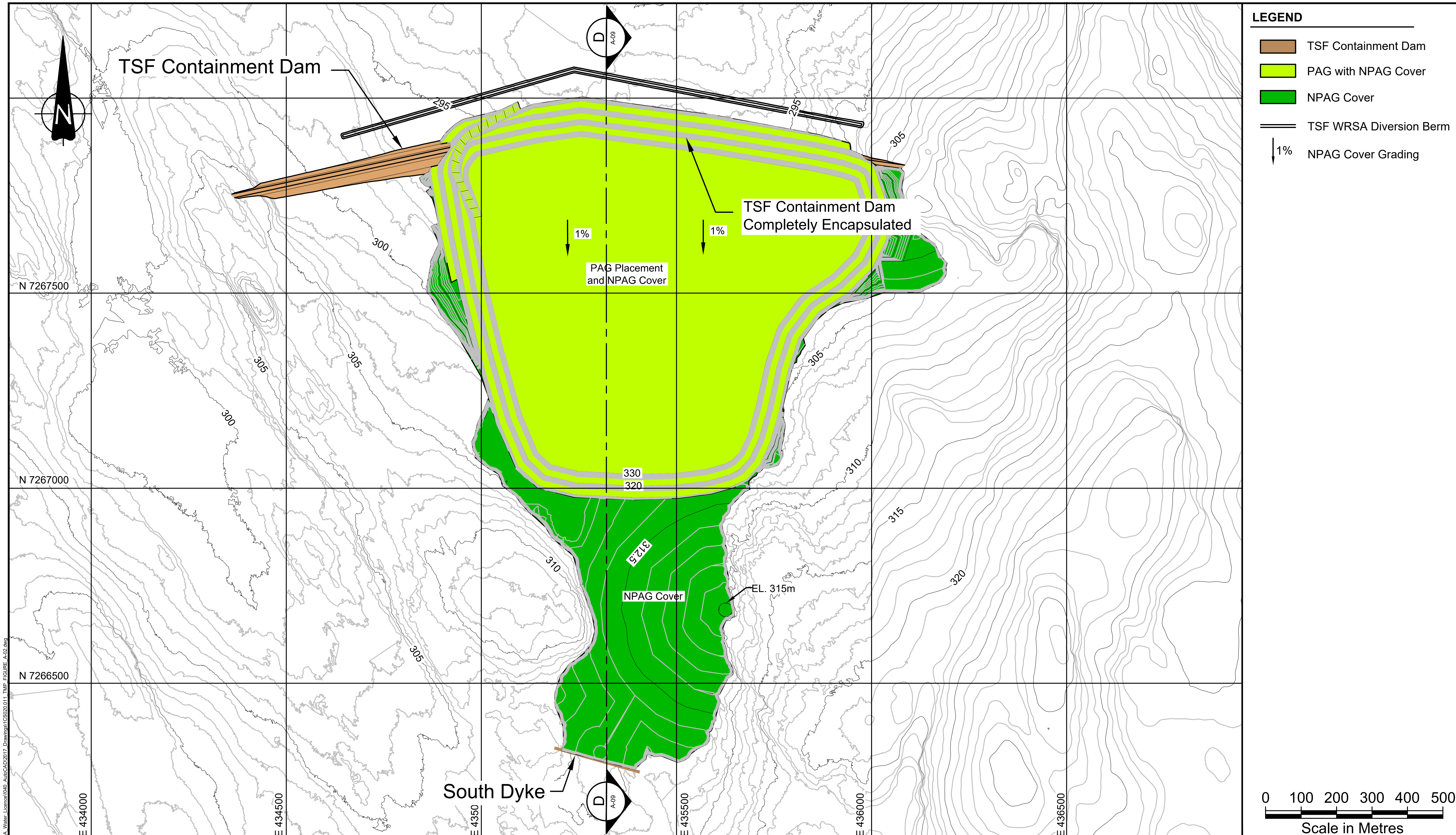
Interested Party:	CIRNA	**Commitment No.:**	**WTM-COMMITMENT 10 (INAC-TRC-2)**

Post-Technical Meeting Commitment:

Update to the drawings in the Tailings Management Plan (TMP) to show the grading and drainage of the TSF WRSA towards the TSF WRSA Pond.

Post-Technical Meeting Response Package:

Sabina is including two updated drawings for the Tailings Management Plan (171005 2AM-BRP----SD09-TailingsMgmtPlan-IMLE). These two drawings, Figure A-02 and A-09, show the grading and drainage away from the TSF Main Containment Dam and, ultimately, towards the TSF WRSA Pond.



DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	CHK'D	APP'D	DATE	NO.	DESCRIPTION	CHK'D	APP'D	DATE
							C	ISSUED FOR PERMIT	CP	EMR	18/06/04
							B	ISSUED FOR PERMIT	CP	EMR	17/08/29
							A	ISSUED FOR PERMIT	CP	EMR	16/05/26

REFERENCE DRAWINGS

REVISIONS

Original Drawings
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DESIGN: CP | DRAWN: VJG | REVIEWED: EMR
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FILE NAME: 1CS020.011_TMP_FIGURE_A-02.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.011, Task 500

TAILINGS MANAGEMENT PLAN

TSF Containment Area
Plan View
Year 6

REVISION NO. C

SHEET 2 OF 9

FIGURE NO. A-02

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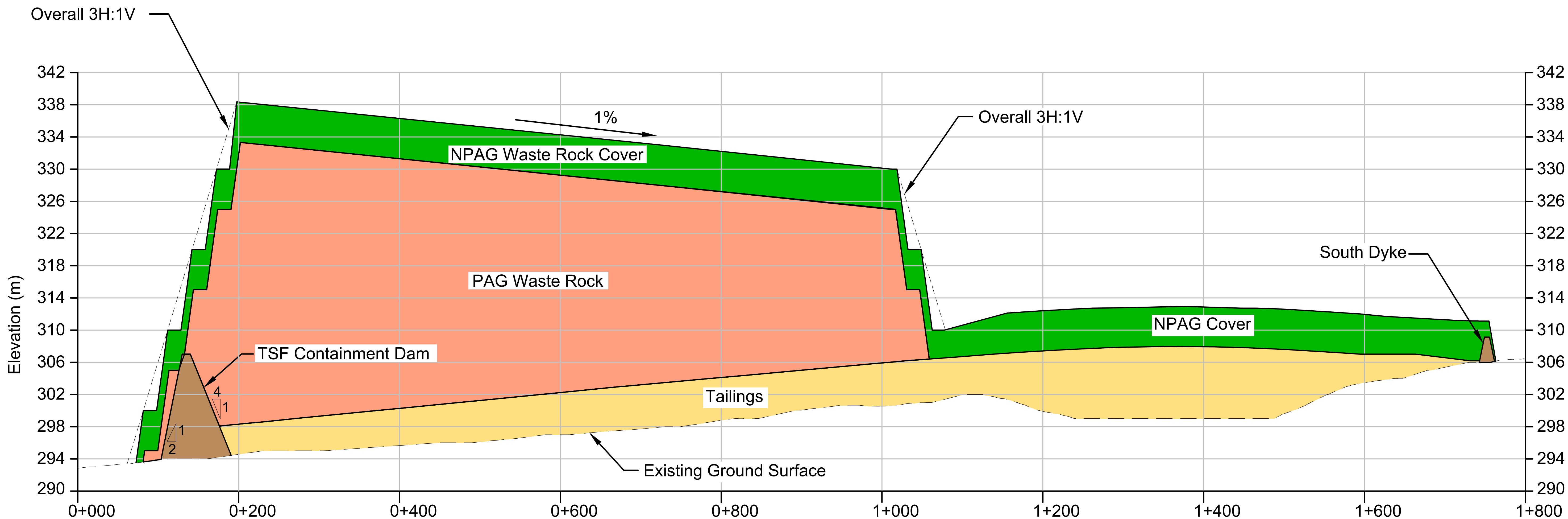

DD A-02 TYPICAL TSF WRSA CROSS-SECTION

10x Exaggeration

0 40 80 120 160 200
Scale in Metres
(Horizontal)

0 4 8 12 16 20
Scale in Metres
(Vertical)

LEGEND

- TSF Containment Dam
- Tailings
- PAG Waste Rock
- NPAG Waste Rock Cover

DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	CHK'D	APP'D	DATE	NO.	DESCRIPTION	CHK'D	APP'D	DATE
–	–										
							C	ISSUED FOR PERMIT	CP	EMR	18/06/04
							B	ISSUED FOR PERMIT	CP	EMR	17/08/31
		–	–				A	ISSUED FOR PERMIT	CP	EMR	16/05/26
REFERENCE DRAWINGS		REVISIONS									

Original Drawings
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FILE NAME: 1CS020.011_TMP_FIGURE_A-09.dwg

Sabina GOLD & SILVER CORP.

BACK RIVER PROJECT

SRK JOB NO.: 1CS020.011, Task 500

TAILINGS MANAGEMENT PLAN

Typical TSF WRSA Cross-Section
Section DD
Year 6

REVISION NO. C | SHEET 9 OF 9 | FIGURE NO. A-09

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Interested Party:	CIRNA	Commitment No.:	WTM-COMMITMENT 11 (INAC-TRC-3)

Post-Technical Meeting Commitment:

Provide Post-Technical Meeting Response Package which provides additional details on the sizing and total capacity of the Primary Pond that confirms that the Primary Pond is adequately and appropriately sized.

Post-Technical Meeting Response Package:

The Primary Pond is an event pond that will be located between Umwelt waste rock storage area (WRSA) and Llama WRSA. The Primary Pond will provide temporary collection of contact water drainage from portions of Umwelt WRSA and Llama WRSA, as well as contact water pumped from a series of other contact water ponds, as shown in Table 6.3-2 provided in Technical Comment Response WT-INAC-TRC-3 (April 2018). Water collected in the Primary Pond will be pumped to the Tailing Storage Facility (TSF) or the Umwelt Tailings Facility (TF) for re-use in the mining process (to the extent practicable) or for permanent storage.

Being an event pond, the Primary Pond will be operated normally empty or with minimal water storage. Based on a qualitative risk assessment, the Primary Pond was assigned a medium risk level (See Table 6.3-2) due to the presence of water infrastructure located downstream of the Primary Pond (Umwelt Pit). According to this risk classification, the 50-year, 24-hour storm event over snowmelt was considered for sizing the Primary Pond. The inflow volume reporting to Primary Pond from the direct catchment during this design event is to be contained in the pond while providing a minimum freeboard of 0.5 m (see Table 6.2-2 of the Water Management Plan [WMP]; 171005 2AM-BRP----SD05-WaterMgmtPlan_IMLE).

The total volume draining to the Primary Pond from the direct catchment during a 50-year, 24-hour storm over snowmelt is estimated to be approximately 42,000 m^3.

During or immediately after a storm event, it is to be expected the Primary Pond will receive pumped contact water from other contact water ponds, as listed in Table 6.3-2. The design of the Primary Pond accounted for these inflows extending for a duration of 2 days after the design storm, at a rate equivalent to the pumping capacities installed in the ponds reporting to the Primary Pond (see Table 6.4-1 of the WMP). Conservatively assuming that no pumping out of the Primary Pond will occur during the design storm and the following 2 days, the maximum volume of water expected to accumulate in the Primary Pond during the 50-year, 24-hour storm event on snowmelt and the following 2 days, is estimated to be approximately 110,000 m^3.

The elevation-storage curve for the Primary Pond is provided in Figure 1. As shown, a volume of 110,000 m^3 would be contained in Primary Pond to a water elevation of 310.5 metres above mean sea level (m.a.m.s.l.). This elevation represents the minimum Full Supply Level (FSL) for the Primary Pond, resulting in the top of the impervious liner needing to extend to an elevation of 311.0 m.a.m.s.l. to provide a minimum freeboard of 0.5 m.

As shown in Figure 1, the topographical conditions in the area of the Primary Pond are such that, above elevation of 310 m.a.m.s.l., small increases in water level provide large increases in storage capacity in the Primary Pond. By setting the elevation of the top of the impervious liner 1 m above the minimum required elevation, to an elevation of 312 m.a.m.s.l., the design provides additional contingency storage capacity in the Primary Pond of approximately 130,000 m^3; this is in additional to the above the design storm inflow volume plus 2 days of pumped inflows [110,000 m^3] while maintaining 0.5 m freeboard. This is the design that Sabina has proposed and shown in Figure A-31 of the WMP, submitted in Type A Water Licence Information Request response, KIA-IR3.

The 24-hour Probable Maximum Precipitation (PMP) for the Goose site was estimated to be 221 mm (SRK 2015). The total direct catchment area reporting to the Primary Pond is estimated to be approximately 0.77 km^2. Based on the Soil Conservation Service (SCS) curve numbers used for the Goose site and the total volume reporting to Primary Pond from direct catchment during the PMP, 24-hour storm is estimated to be approximately 150,000 m^3. Even in the very unlikely scenario of the PMP, 24-hour storm occurring within 2 days following a 50-year, 24-hour storm, the Primary Pond would allow full containment of the PMP, 24-hour event to a max water elevation of 311.7 m.a.m.s.l. (30 cm below the top of the impervious liner).

It is also noted that operationally Sabina will be able to actively monitor levels during a storm event and will have the ability to either control inflow of pumped contact water from other contact water ponds, or commence pumping early to further manage water levels within the Primary Pond.

Based on these considerations the design of the Primary Pond is considered adequate to mitigate risk of failure of the Primary Pond due to overtopping.

<u>Reference:</u>

SRK (SRK Consulting (Canada) Inc.). 2015. Back River Project – Hydrology Report. Prepared for Sabina Gold & Silver Corp. April 2015.

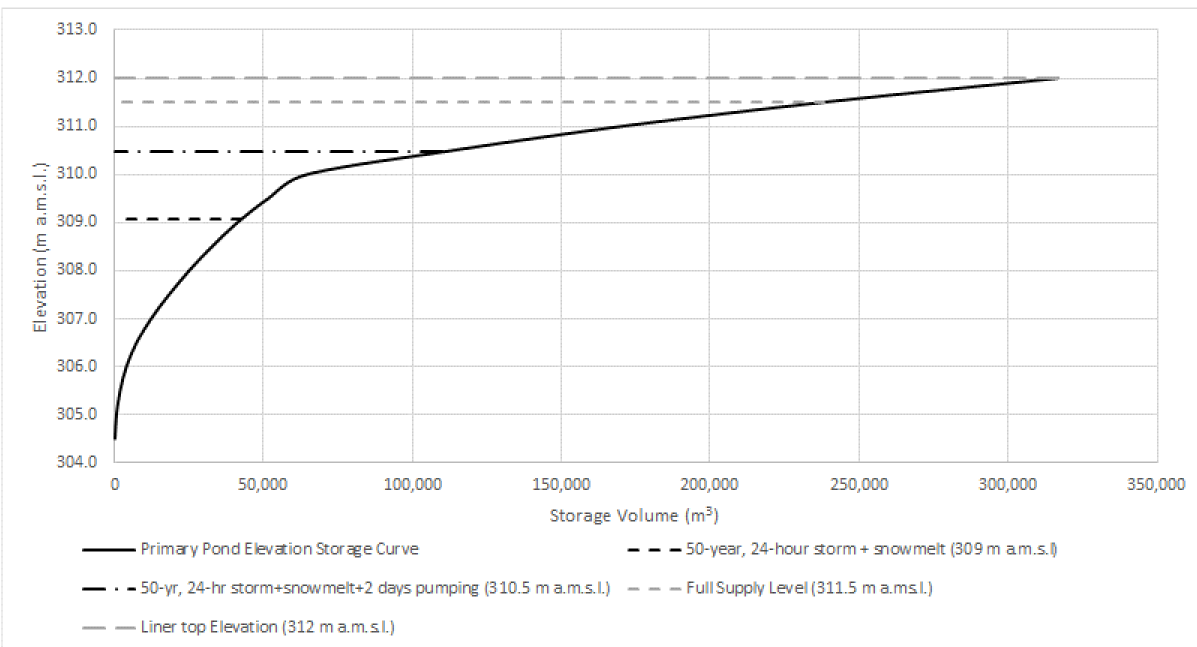

Figure 1: Primary Pond Elevation-Storage Curve with Key Elevations

Interested Party:	CIRNA	Commitment No.:	WTM-COMMITMENT 12 (INAC-TRC-5)

Post-Technical Meeting Commitment:

Provide detailed cross sections and seepage analysis to confirm environmental containment of the Saline Water Pond.

Post-Technical Meeting Response Package:

Sabina is providing the attached Saline Water Pond (SWP) Perimeter Seepage Analysis Memo; this memo includes detailed cross sections and seepage analysis of the SWP to confirm environmental containment.

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Memo

To:	Catherine Paul	**Client:**	Sabina Gold & Silver Corp.
From:	Osvaldo N. Ledesma Erick Lino	**Project No:**	1CS020.011
Reviewed By:	Arcesio Lizcano, PhD Maritz Rykaart, PhD, PEng	**Date:**	May 29, 2018
Subject:	Back River Project: Saline Water Pond Perimeter Seepage Analysis		

1 Introduction

1.1 Context

The Saline Water Pond (SWP) is expected to temporarily store saline groundwater over a period of about ten years. The amount of water being stored will gradually increase over time, reaching a peak volume of about 1.1 Mm^3 by Year 10. The SWP would be located over the current extent of Umwelt Lake. Umwelt Lake would be drained prior to the storage of saline groundwater, and two containment dams (East Containment Dam and South Containment Dam) will be constructed to increase the storage capacity in Umwelt Lake to the desired design capacity. Non-contact water diversion berms will be constructed between the containment dams to minimize inflow of natural runoff. The containment dams will be frozen foundation dams, with geosynthetic (High Density Polyethylene) liners keyed into underlying permafrost (and/or bedrock) to ensure environmental containment (SRK 2015a). The diversion berms will be a minimum of 2.0 m thick to ensure preservation of permafrost, which means that the active layer beneath these structures will aggrade into the berms effectively creating a seal around the perimeter of the SWP (SRK 2015a).

Umwelt Lake is located in a natural depression and is a shallow lake that has been confirmed to not have a through talik, however, it does have a small closed talik (SRK 2015b). Thermal modeling has been completed confirming that during the operational phase of the SWP, the extent of the closed talik beneath Umwelt Lake will increase in size to reach a maximum depth of 9.0 m. Similarly, thermal analysis has confirmed that the frozen foundation containment dams will ensure environmental containment throughout the design life of the SWP (SRK 2015c).

1.2 Objective

During the May 2018 Technical Meetings in Cambridge Bay, reviewers questioned the likelihood of surficial seepage around the perimeter of the SWP in areas where engineered containment dams are not planned. This memo provides technical details to address these concerns, and provide context as to where, and what quantities of surficial seepage may be encountered.

2 Conceptual Model

The Project site is located in cold continuous permafrost, with an active layer that seasonally thaws to a depth of between 1.0 and 2.4 m. Therefore, there is no groundwater table and any surficial seepage from ponds are limited to seasonal flow within the active layer. The Umwelt Lake basin area ground profile consists of variable overburden overlying competent bedrock. Typically, based on drill holes completed in the proposed containment dam areas, bedrock is about 6.5 m below ground (SRK 2015d).

The natural water level in Umwelt Lake is at elevation 299.0 m. The Year-10 full supply level of the SWP will be at elevation 301.0 m, which is 2.0 m above the original lake elevation. Figure 01 shows the SWP area complete with the two containment dams and the perimeter diversion berms.

In order to determine potential seepage pathways from the SWP outside of the containment dams, the following conservative assumptions were made:

- Constant active layer thickness of 2.4 m; and
- Constant overburden thickness of 6.5 m.

Based on these assumptions, ground elevations of 303.4 m and 307.5 m indicate locations of natural seepage barriers due to permafrost and bedrock respectively, as illustrated in Figure 01. Key cross-sections (sections) illustrated in Figures 02 through 05 demonstrate how these natural seepage barriers would function.

In accordance with this assessment of physical ground conditions, there are three areas along the perimeter of the SWP where surficial seepage may occur. These are illustrated in Figure 01, and correspond to sections 2, 4, and 5.

3 Seepage Analysis

Steady state seepage outflow through sections 2, 4, and 5 was conservatively calculated using Darcy's equation for flow through a porous media. All calculations assume water flow through a thawed soil layer with a constant thickness of 2.4 m, for water levels in the SWP ranging from 299.0 to 301.0 m elevation. A constant hydraulic conductivity of 1.0E-05 m/s was assumed for the thawed overburden soil (SRK 2015a). Calculation details are included in Appendix A of this memo, and results are summarized in Table 1.

Table 1. Steady State Perimeter Outflow Seepage (m^3/day) from SWP

Section	SWP Water Elevation					Flow Travel Time (days)
	299.0	299.5	300.0	300.5	301.0	
2	0	0.4	0.8	1.3	1.9	336
4 (Uncorrected)	1.5	1.7	1.9	2.0	2.2	810
5 (Uncorrected)	3.6	4.0	4.4	4.9	5.3	810
4 (Corrected)	0	0.2	0.4	0.6	0.7	810
5 (Corrected)	0	0.5	0.9	1.3	1.8	810

For sections 4 and 5, the uncorrected results are the theoretical calculated values; however, since Umwelt Lake is at elevation 299.0 m, and there is currently no evidence of surficial seepage in these areas, the analysis was corrected to assume zero flow at elevation 299.0 and only the differential flow to elevation 301.0 m is considered potentially plausible.

The results presented in Table 1 illustrate the maximum upper bound of seepage that may occur along three sections (or zones) of the perimeter of the SWP. These flows are unlikely to ever materialize for the following reasons:

- The flow travel time as illustrated in Table 1 is between 11 and 31 months. Flow travel was calculated conservatively for a unit hydraulic gradient. Summer conditions, with a fully developed active layer thickness exist for only about 4 months of the year (with the maximum thickness lasting less than 1 month) and therefore even if flow was to occur, it would take at least 3 to 8 years to manifest itself under unit gradient conditions. In reality, the hydraulic gradient is around three orders of magnitude lower, which means the likelihood of seepage flow ever emerging is in the decadal scale, if even possible;

- The active layer thickness is not constant; it is variable based on actual ground conditions (between 1.0 and 2.4 m), and seasonally variable. Therefore, actual flows, should they occur, is expected to be significantly less (e.g., with an active layer thickness of 1.0 m the section 2 flow at elevation 301.0 m reduces to 1.1 m^3/day). The section 4 corrected seepage reduces to 0.3 m^3/day and section 5 corrected seepage reduces to 0.7 m^3/day);

- The effect of the active layer aggrading into the perimeter diversion berms has not been considered in the analysis. This may result in a barrier to flow at the diversion berms, especially if these areas were intentionally saturated during SWP construction; and

- The hydraulic conductivity assumed for the analysis assumes no ice saturation, and it is known that considerable ice saturation exists which will result in lower hydraulic conductivities and thus possible orders of magnitude lower flow.

Seepage from section 2, should it occur, is of no concern as such seepage would drain towards Llama Reservoir and therefore will be within the contact water containment system of the Project. Seepage from zones 4 and 5, should it occur, would be of concern as it would drain towards Goose Lake. Mitigation strategies to preclude such flow could include extension of the South and East Containment Berms, or upgrading of the diversion berms to ensure environmental containment.

However, given the low likelihood of this flow ever materializing, a more prudent approach would be to conduct thermal monitoring along zones 4 and 5, immediately downstream of the diversion berms, to observe for changing conditions which may suggest advancement of a seepage front. Should such changes be observed, based on the seepage travel time, there would be years to implement appropriate mitigation measures.

4 References

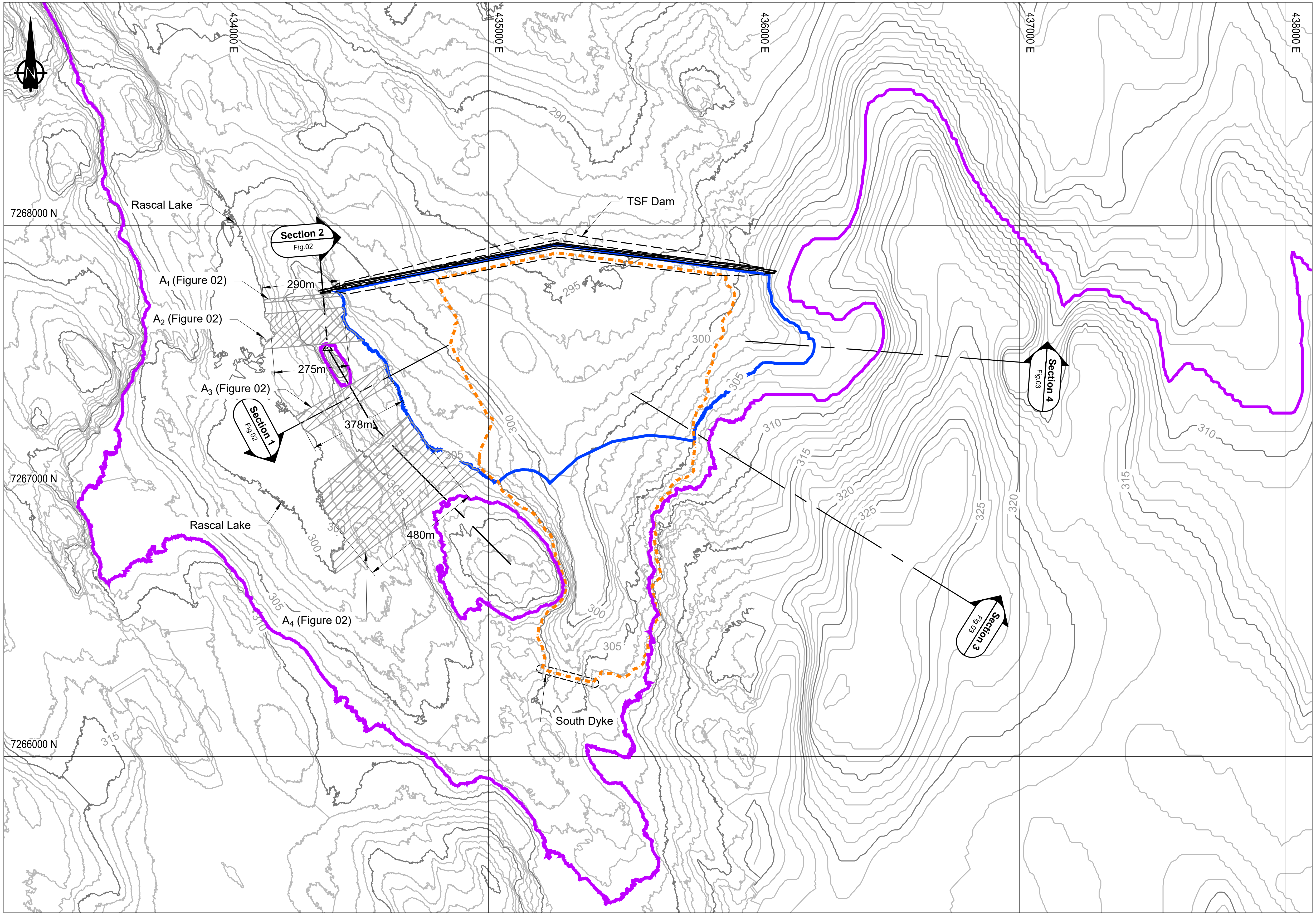
SRK Consulting (Canada) Inc., 2015a. Back River Project Site-Wide Water Management Report. Prepared for Sabina Gold & Silver Corp. September 2015.

SRK Consulting (Canada) Inc., 2015b. Hydrogeological Characterization and Modeling Report of the Proposed Back River Project. Prepared for Sabina Gold & Silver Corp. October 2015.

SRK Consulting (Canada) Inc., 2015c. Back River Project Site-Wide Water Management Report - Appendix C: Saline Water Pond Containment Dams Thermal Modeling. Prepared for Sabina Gold & Silver Corp. September 2015

SRK Consulting (Canada) Inc., 2015d. Back River Property Geotechnical Properties Report. Prepared for Sabina Gold & Silver Corp. November 2015.

Figures



LEGEND

- TSF Dam
- Tailings Ultimate Boundary
- Water Ultimate Boundary El.305.0m
- Natural Barrier El. 308.0m
- Seepage Area

NOTES

1. Contours shown at 1m interval.

REFERENCE

1. NAD83 UTN Zone 13
2. NTS Mapsheet: 076

0m 100 200 300 400 500 600

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SRK JOB NO.: 1CS020.011.1100

FILE NAME: Extended Goose Contours.dwg

Sabina GOLD & SILVER CORP.

Back River Project

Environmental Containment Analysis

Tailings Storage Facility
Plan View

DATE:	APPROVED:	FIGURE:
May 2018	MR	01

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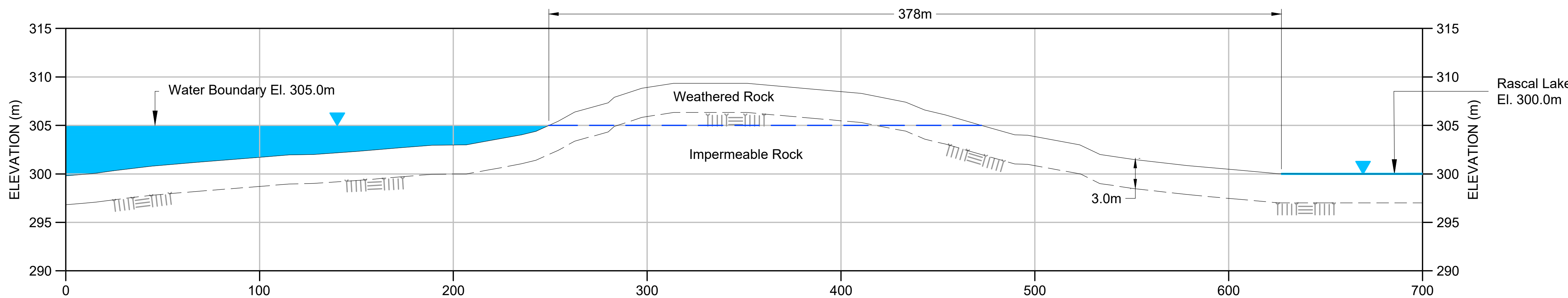
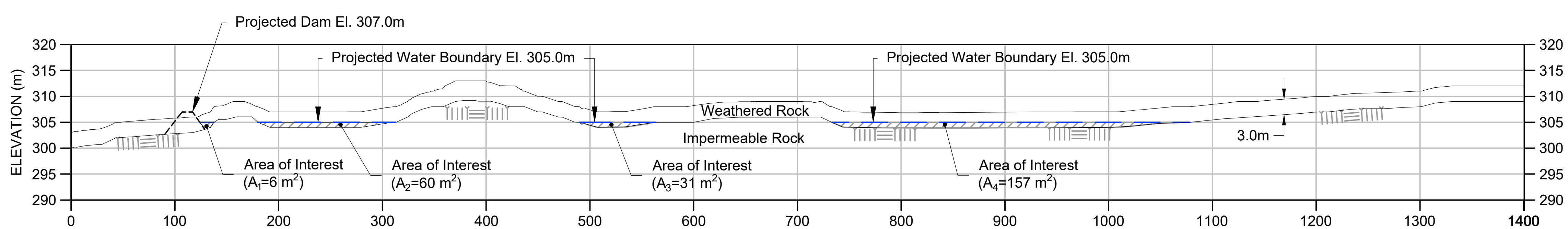


Section 1

Five Times Vertical Exaggeration



Section 2

Five Times Vertical Exaggeration

srk consulting	Sabina GOLD & SILVER CORP.	Environmental Containment Analysis
		Tailings Storage Facility Sections 1 and 2
1CS020.011.1100	Back River Project	DATE: May 2018 / APPROVED: MR / FIGURE: 02
Extended Goose Contours.dwg		

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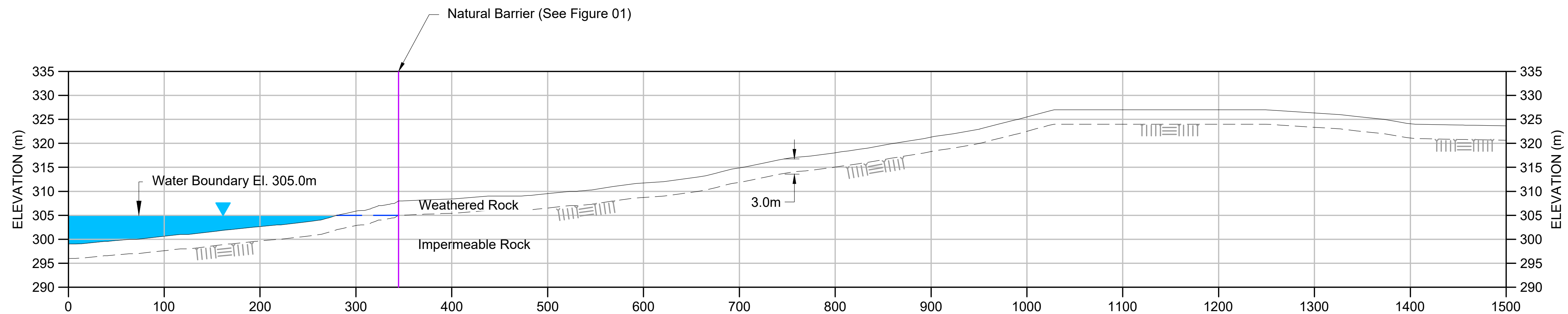

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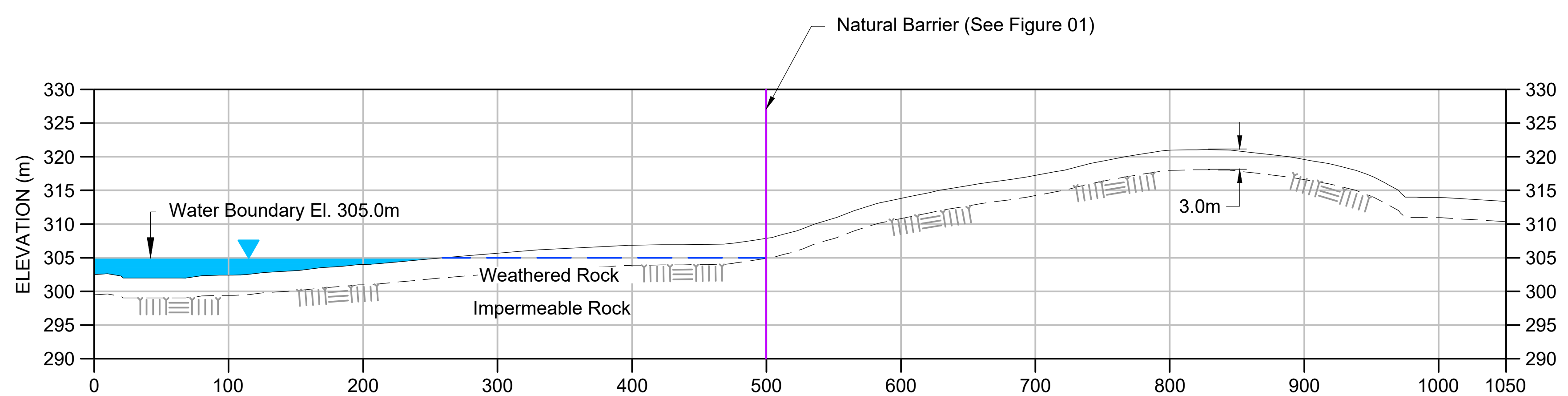
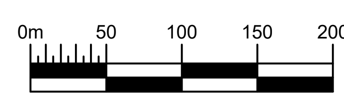


Section 4



Five Times Vertical Exaggeration

srk consulting	Sabina GOLD & SILVER CORP.	Environmental Containment Analysis
1CS020.011.1100		Tailings Storage Facility Section 3 and 4
Extended Goose Contours.dwg	Back River Project	DATE: May 2018 / APPROVED: MR / FIGURE: 03

Appendix A – Seepage Calculation

Introduction

Surficial seepage along the perimeter of the Saline Water Pond (SWP) can only occur through the active layer. Under these conditions, there are two possible scenarios for the seepage flow as shown in Figure A below:

- Flow through the ground with a sloping surface from a high elevation (e.g., the full supply level of the SWP) to a lower ground water elevation (Figure A, Inset 1). This is the case for sections 4 and 5 in Figure 04; or
- Flow through the ground with a horizontal surface from a high elevation (e.g., the SWP at full supply level) to a lower elevation (e.g., water level at the natural reservoir close to the SWP) (Figure A, Inset 2). This can be the case of seepage through section 2 in Figure 02.

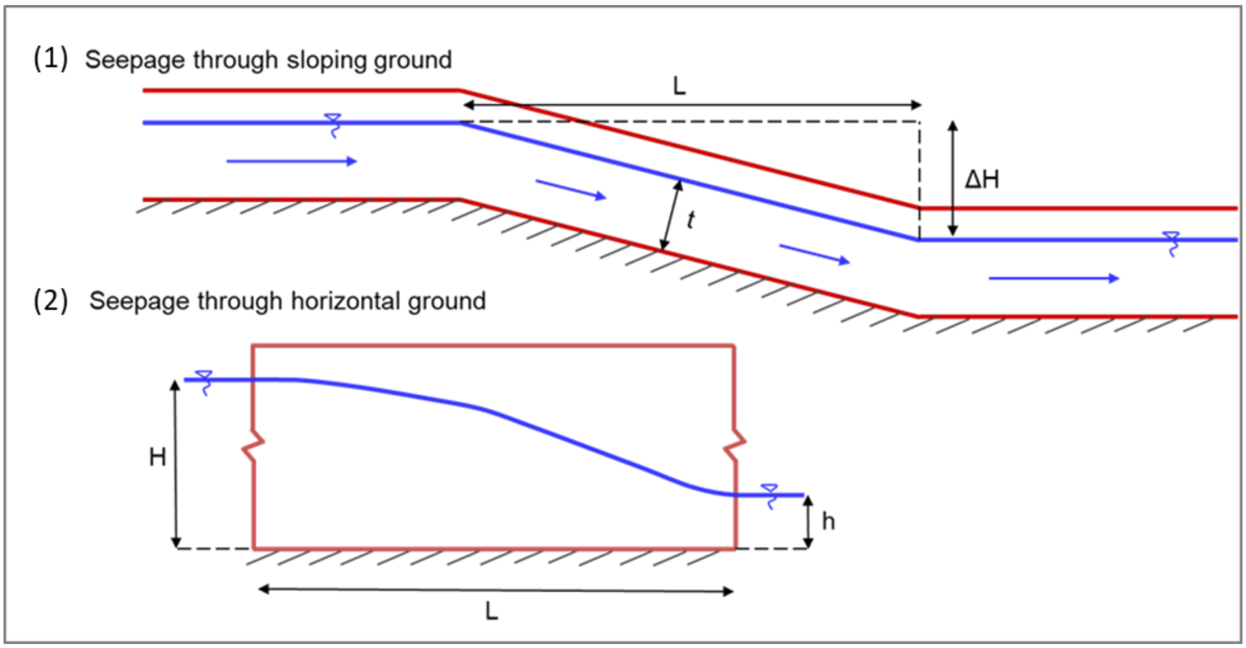


Figure A. Seepage flow scenarios.

Calculations

In the case of flow through a sloped terrain, total seepage per unit width q_s can be determined by:

$$q_s = k \cdot \frac{\Delta H}{L} \cdot t \qquad (1)$$

Figure A, Inset 1 includes the variables of Equation (1). ΔH would be the height water difference between the reservoir level and the lower reception point, and t is the height of the ground water surface above the impermeable layer.

In the case of horizontal flow, seepage q_h per unit width can be calculated as follows:

$$q_h = k \cdot \frac{(H^2 - h^2)}{2L} \quad (2)$$

Figure A, Inset 2 includes the variables of Equation (2). H would be the water height above the impermeable layer at the SWP, h is the water height above the impermeable layer at a natural reservoir, L is the distance between the exit surface at the SWP and the entrance point at the natural reservoir, and k is the hydraulic conductivity of the thawed active layer.

Geotechnical Parameters

The only geotechnical parameter relevant for these calculations is the saturated hydraulic conductivity of the thawed active layer. The adopted value is $k = 1.0 \times 10^{-5}$ m/s (171005 2AM-BRP----MAD App F-5_HydrogCharactModelRpt-IMLE).

Flow through Cross Section 1 with Horizontal Ground Surface

The geometrical parameters required to calculate seepage through section 2 are shown in Figure 01. It is assumed that the natural water level is 299.0 m, (i.e., the water level at the Umwelt Lake). Also, the top elevation of the impermeable layer was adopted 2.4 m below the ground water level. Table A1 shows a summary of the calculations.

Table A1. Seepage Calculation Summary, Section 2.

K [m/s]	H [m]	h [m]	L [m]	q [m^3/d/m]	Seepage width [m]	Total seepage [m^3/d]
1.0 E-5	4.4	2.4	290.0	0.020	95.0	1.9

Flow through Cross Sections 4 and 5 with Sloping Ground Surface

Geometrical parameters required to calculate seepage through sections 4 and 5 are shown in Figure 01. It is assumed that the permeable layer (active layer) has a constant thickness of 2.4 m, equal to the height of the groundwater above the permafrost assumed impermeable. Table A2 shows a summary of the calculations.

Table A2. Seepage Calculation Summary, Sections 4 and 5.

Section	k [m/s]	ΔH [m]	L [m]	t [m]	q [m^3/d/m]	Seepage width [m]	Total seepage [m^3/d]
4	1.0 E-5	6.0 (301.0 – 295.0)	700	2.4	0.018	125	2.2
5	1.0 E-5	6.0 (301.0 – 295.0)	700	2.4	0.018	300	5.3

Interested Party:	CIRNA	**Commitment No.:**	**WTM-COMMITMENT 13 (INAC-TRC-6)**

Post-Technical Meeting Commitment:

Provide detailed cross sections and seepage analysis to confirm environmental containment of the Tailings Storage Facility.

Post-Technical Meeting Response Package:

Sabina is providing the attached Tailings Storage Facility (TSF) Perimeter Seepage Analysis Memo; this memo includes detailed cross-sections and seepage analysis of the TSF to confirm environmental containment.

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F: +1.604.687.5532
vancouver@srk.com
www.srk.com

Memo

To:	Catherine Paul	**Client:**	Sabina Gold & Silver Corp.
From:	Osvaldo N. Ledesma Erick Lino	**Project No:**	1CS020.011
Reviewed By:	Arcesio Lizcano, PhD Maritz Rykaart, PhD, PEng	**Date:**	June 7, 2018
Subject:	Back River Project: Tailings Storage Facility Perimeter Seepage Analysis		

1 Introduction

1.1 Context

The Tailings Storage Facility (TSF) is expected to store approximately 3.2 Mm^3 of tailings over a period of about two years. In addition, the TSF will be used for water storage throughout the life of the Project to a full supply level of 305.0 m. Environmental containment for the TSF is provided by a frozen foundation dam which includes a geosynthetic (High Density Polyethylene) liner keyed into underlying permafrost. Thermal modeling has confirmed that this dam will perform for the design life of the structure (SRK 2015a).

1.2 Objective

During the May 2018 Technical Meetings in Cambridge Bay, reviewers questioned the likelihood of surficial seepage around the perimeter of the TSF in areas where engineered containment dams are not planned. This memo provides technical details to address these concerns, and provide context as to where, and what quantities of surficial seepage may be encountered.

2 Conceptual Model

The Project site is located in cold continuous permafrost, with an active layer that seasonally thaws to a depth of between 1.0 and 2.4 m. Therefore, there is no groundwater table and any surficial seepage from ponds are limited to seasonal flow within the active layer. Geotechnical site characterization in the form of drilling has however confirmed that in select locations, in the vicinity of the TSF, there may be weathered bedrock to depths of 2.0 to 3.0 m which may act as seepage pathways (SRK 2015a).

Figure 01 shows a plan view of the TSF area complete with the TSF containment dam (North Dam) and South Dyke. Perimeter seepage could occur in areas where weathered bedrock is present at elevations below elevation 305.0 m.

In order to determine potential seepage pathways from the TSF perimeter, the following assumptions were made:

- Constant active layer thickness of 2.4 m; and
- Constant weathered bedrock layer of 3.0 m.

Based on these assumptions, a ground elevation of 308.0 m indicates locations of natural seepage barriers due to bedrock, as illustrated in Figure 01. Note the active layer thickness is not considered because the weathered zone exceeds the active layer thickness and becomes the governing factor in this assessment. Key cross- and long-sections illustrated in Figures 02 and 03 demonstrate how these natural seepage barriers would function.

In accordance with this assessment of physical ground conditions, surficial seepage from the TSF can only occur along cross-section 1, as illustrated in Figure 01 and 02. However, when looking at long-section 2, also illustrated in Figure 02, seepage along this front is not continuous, but would occur along four distinct areas (A_1, A_2, A_3 and A_4). Should seepage from these areas materialize it could emerge in Rascal Lake downgradient from the TSF at elevation 300.0 m.

3 Seepage Analysis

Steady state seepage outflow through long-section 2 was conservatively calculated using Darcy's equation for flow through a porous media. All calculations assume water flow through a weathered bedrock layer with a constant thickness of 3.0 m, for water levels in the TSF ranging from 304.5 to 305.0 m elevation. A constant hydraulic conductivity of 5.0E-05 m/s was assumed for the weathered bedrock (SRK 2015b). Calculation details are included in 0 of this memo, and results are summarized in Table 1.

Table 1. Steady State Outflow Seepage (m^3/day) from the TSF

Elevation	Exposed Seepage Surface Area [m^2]	Total Seepage Outflow [m^3/day]
304.5	222.6	1.1
305.0	254.0	1.4

The results presented in Table 1 illustrate the maximum upper bound of seepage that may occur along long-section 2 of the perimeter of the TSF. These flows are unlikely to ever materialize for the following reasons:

- The flow travel time from the TSF to Rascal Lake, should it occur, assuming a hydraulic gradient of 1.0 for the four areas in question range between 21 and 36 months. Summer conditions, with a fully developed active layer thickness exist for only about 4 months of the year (with the maximum thickness lasting less than 1 month) and therefore even if flow was to occur, it would take between 5.0 and 9.0 years to manifest itself. In reality, the hydraulic gradient is at least three orders of magnitude lower, which means the actual flow travel time is in the decadal scale and unlikely to ever be observed;

- The weathered rock zone thickness is not constant and the likelihood of continuous flow paths as a result of weathering is improbable as these are random unconnected discontinuities. Therefore, actual flows, should they occur is expected to be significantly less than calculated;
- The hydraulic conductivity assumed for the analysis assumes no ice saturation, and it is known that considerable ice saturation exist which will result in lower hydraulic conductivities and thus possible orders of magnitude lower flow.

Seepage along long-section 2, should it occur, would be of concern as it would drain towards Rascal Lake, although as stated it would take decades and is unlikely to ever realize. Mitigation strategies to preclude such flow could include mitigation in the form of rock grouting, or revising the TSF layout so the pond would be on the eastern extremity of the TSF to ensure environmental containment.

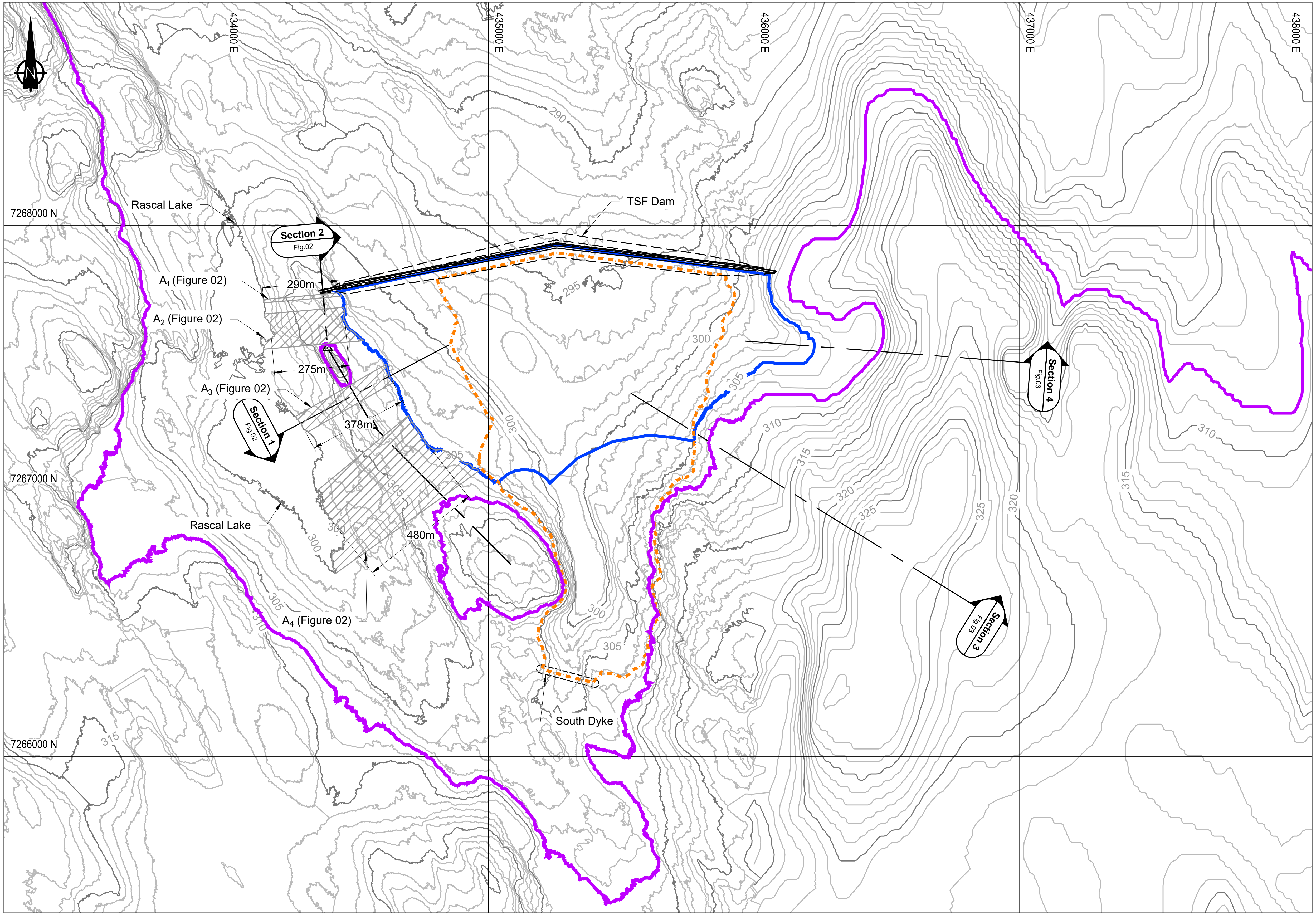
However, given the low likelihood of this flow ever materializing, a more prudent approach would be to conduct thermal monitoring along long-section 2, within the areas of concern to observe for changing conditions which may suggest advancement of a seepage front. Should such changes be observed, based on the seepage travel time there would be years to implement appropriate mitigation measures.

4 References

SRK Consulting (Canada) Inc., 2015a. Tailings Management System Design Report. Back River Property, Nunavut, Canada. Prepared for Sabina Gold & Silver Corp. October 2015.

SRK Consulting (Canada) Inc., 2015b. Hydrogeological Characterization and Modeling Report of the Proposed Back River Project. Prepared for Sabina Gold & Silver Corp. October 2015.

Figures



LEGEND

- TSF Dam
- Tailings Ultimate Boundary
- Water Ultimate Boundary El.305.0m
- Natural Barrier El. 308.0m
- Seepage Area

NOTES

1. Contours shown at 1m interval.

REFERENCE

1. NAD83 UTN Zone 13
2. NTS Mapsheet: 076

0m 100 200 300 400 500 600

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Environmental Containment Analysis

Tailings Storage Facility
Plan View

SRK JOB NO.: 1CS020.011.1100	Back River Project	DATE: May 2018
FILE NAME: Extended Goose Contours.dwg		APPROVED: MR
		FIGURE: 01

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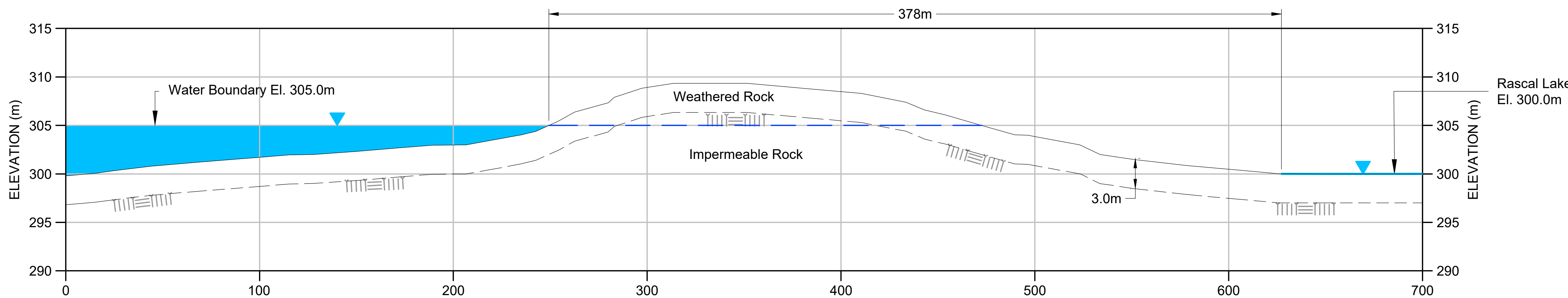
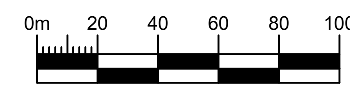


Section 1



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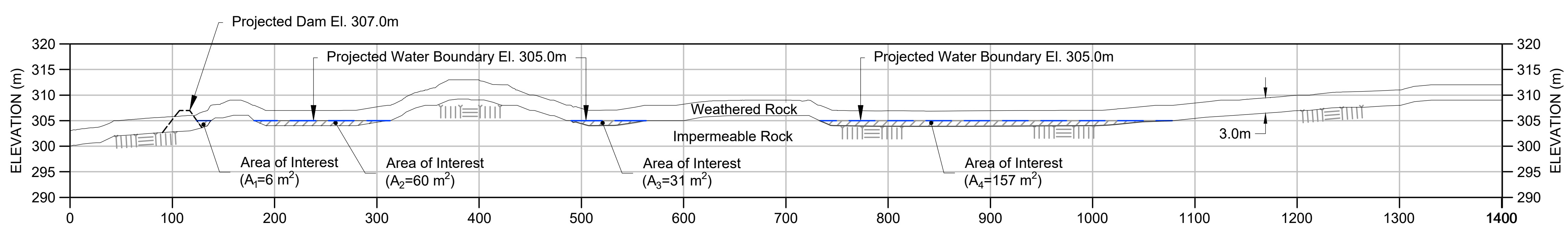

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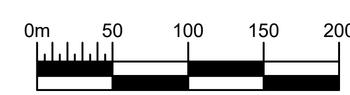

Five Times Vertical Exaggeration

srk consulting	Sabina GOLD & SILVER CORP.	Environmental Containment Analysis
		Tailings Storage Facility Sections 1 and 2
1CS020.011.1100	Back River Project	DATE: May 2018 / APPROVED: MR / FIGURE: 02
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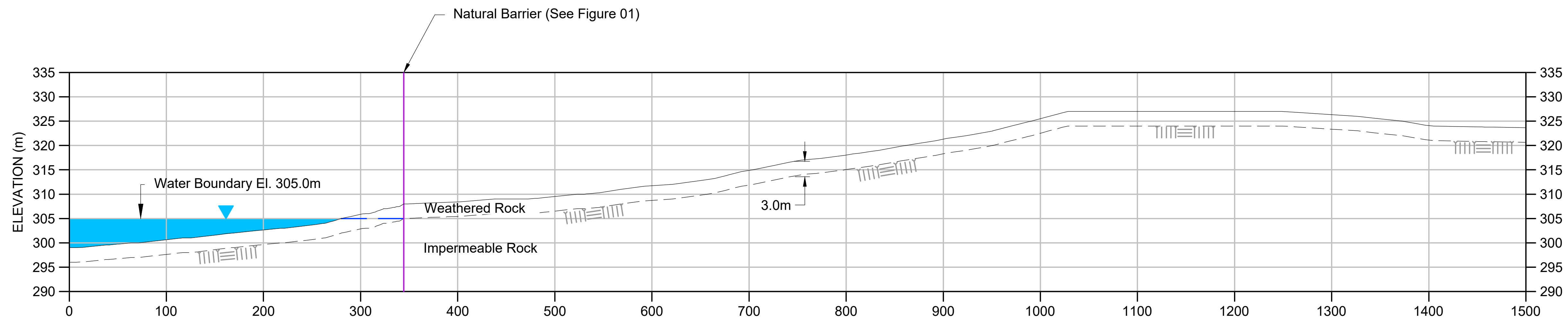

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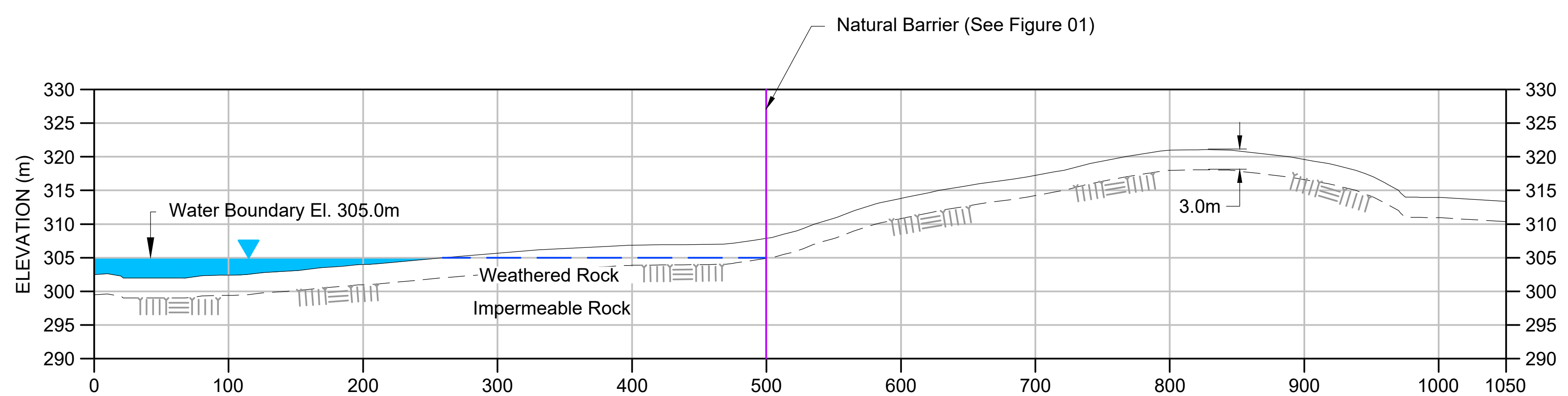

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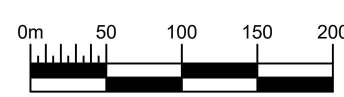

Five Times Vertical Exaggeration

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Environmental Containment Analysis

Tailings Storage Facility
Section 3 and 4

1CS020.011.1100

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Back River Project

DATE:	APPROVED:	FIGURE:
May 2018	MR	03

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Appendix A – Seepage Calculation

Introduction

Water seepage along the perimeter of the Tailings Storage Facility (TSF) can only occur through the weathered rock layer. Under these conditions, there are two possible flow scenarios as shown in Figure A below:

- Flow through the ground with a sloping surface from a high elevation (e.g., the full supply level of the TSF) to a lower ground water elevation (Figure A, Inset 1). This is the case for section1 in Figure 02; or
- Flow through the ground with a horizontal surface from a high elevation (e.g., the TSF at full supply level) to a lower elevation (e.g., water level at Rascal Lake) (Figure A, Inset 2). This case does not exist for the TSF.

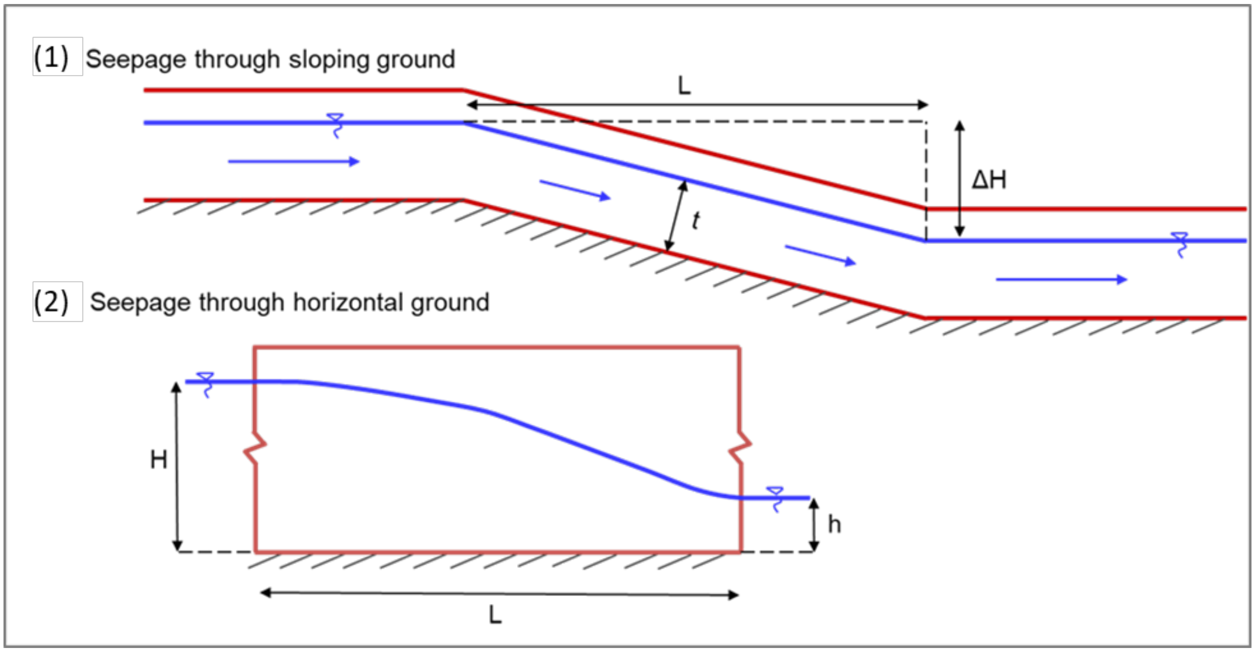


Figure A. Seepage flow scenarios.

Calculations

In the case of horizontal flow, seepage q_h per unit width can be calculated as follows:

$$q_h = k \cdot \frac{(H^2 - h^2)}{2L} \quad (1)$$

Figure A, Inset 2 includes the variables of Equation (1) where H is the water height above the impermeable layer at the TSF, h is the natural water height above the impermeable layer at a natural reservoir, L is the distance between the exit surface at the TSF and the entrance point at the natural reservoir, and k is the hydraulic conductivity of the weathered bedrock layer.

In the case of flow through a sloped terrain, total seepage per width unit q_s can be calculated as follows:

$$q_s = k \cdot \frac{\Delta H}{L} \cdot t \qquad (2)$$

Figure A, Inset 1 includes the variables of Equation (2) where ΔH is the height difference between the reservoir level (TSF) and the lower receptor point (Rascal Lake), and t is the height of the water table above the impermeable layer. When considering the area of the section where the water flows, Equation (2) can be rewritten as:

$$q_s = k \cdot \frac{\Delta H}{L} \cdot A \qquad (3)$$

Geotechnical Parameters

The only geotechnical parameter that is relevant to these calculations is the hydraulic conductivity of the weathered bedrock layer. This value ranges between 1.0×10^{-11} and 6.0×10^{-6} (171005 2AM-BRP----MAD App F-5_HydrogCharactModelRpt-IMLE). The selected value, based on engineering judgement is $k = 5.0 \times 10^{-6}$ m/s.

The geometric parameters required to calculate seepage through long-section 2 are shown in Figures 01 and 02, while Table A1 shows a summary of the calculations.

Table A1. Seepage Calculation Summary, Section 1

<table>
<tr><th>Area</th><th>k [m/s]</th><th>ΔH [m]</th><th>L [m]</th><th>A [m^2]</th><th>Total seepage [m^3/d]</th></tr>
<tr><td>A_1</td><td rowspan="5">5.0 E-6</td><td rowspan="5">4.5 (304.5 – 300.0)</td><td>290.0</td><td>6.0</td><td>0.04</td></tr>
<tr><td>A_2</td><td>275.0</td><td>60.0</td><td>0.47</td></tr>
<tr><td>A_3</td><td>378.0</td><td>31.0</td><td>0.18</td></tr>
<tr><td>A_4</td><td>480.0</td><td>157.0</td><td>0.71</td></tr>
<tr><td>Total</td><td>n/a</td><td>254.0</td><td>1.40</td></tr>
<tr><td>A_1</td><td rowspan="5">5.0 E-6</td><td rowspan="5">5.0 (305.0 – 300.0)</td><td>290.0</td><td>3.6</td><td>0.02</td></tr>
<tr><td>A_2</td><td>275.0</td><td>49.0</td><td>0.35</td></tr>
<tr><td>A_3</td><td>378.0</td><td>17.0</td><td>0.09</td></tr>
<tr><td>A_4</td><td>480.0</td><td>153.0</td><td>0.62</td></tr>
<tr><td>Total</td><td>n/a</td><td>222.6</td><td>1.08</td></tr>
</table>

Note:

The areas considered in the flow estimation are shown in Figure 02

Interested Party:	CIRNA	**Commitment No.:**	**WTM-COMMITMENT 14 (INAC-TRC-27)**

Post-Technical Meeting Commitment:

Commits to conduct a comparison of other active revegetation planning at Northern mine sites

Post-Technical Meeting Response Package:

Table 1 provides a comparison of other active revegetation planning at Northern mine sites

Table 1: Comparison of Active Revegetation Planning at Northern Mine Sites

Mine Site ***Owner*** **Region**	**Current Phase of Project** ***Mine Closure Projected Date***	**Revegetation Plan Summary** **Interim Closure Summary/Commitments**	**Restrictions Identified**	**References**
Polaris Mine *Teck Metals Ltd.* Little Cornwallis Island, Qikiqtani Region, NU	Post-Closure *September 2002*	Donald (2005) provided a summary of the reclamation for Polaris Mine. The vegetation at Polaris was classified as Arctic Tundra and it was identified as located in a "bare" area with scarce vegetation, low biological sensitivity, and low potential for wildlife use. Teck claimed that there was little to no vegetation present prior to mine construction. The proposed reclamation programs included recontouring close to the original topography and restoration of natural drainage paths.	It was not possible to remove all traces of land disturbance due to permafrost.	Donald, B.J. (2005). Polaris Mine – A Case Study of Reclamation in the High Arctic. British Columbia Mine Reclamation Symposium https://open.library.ubc.ca/cIRcle/collections/59367/items/1.0042473
Nanisivik *Breakwater Resources* Baffin Island, NU	Post-Closure *2002*	In the 2002 Closure and Reclamation Plan, Breakwater stated that 96.5% of the area was identified to have sparse vegetation prior to mining. Vegetation damage due to borrow source activity was identified as "not conspicuously different from their surroundings" and only recontouring was considered as a reclamation activity. BGC presentation dated 2015, claimed that "Revegetation is not necessary" and post-closure disturbed areas will resemble natural surroundings.	N/A	CanZinco Lt. (2002). Nanisivik Mine-Closure and Reclamation Plan – Volume 1 of 2. ftp://ftp.nwb-oen.ca/registry/1%20INDUSTRIAL/1A/1AR%20-%20Remediation/1AR-NAN1419/3%20TECH/10%20A%20and%20R%20(J)/2002%20Renewal/020307NWB1NAN9702%20vol1text-ILAE.pdf BGC (2015). Presentation Nanisivik Mine – Closure Design and Performance Monitoring. RPIC Federal Contaminated Site Regional Workshop. http://www.rpic-ibic.ca/documents/2015_FCS_RW/Presentations/4-Cassie_FINAL.pdf
Mary River *Baffinland* Baffin Island, NU	Operations *2040*	In the 2016 Interim Closure and Reclamation Plan, Baffinland committed to develop a progressive revegetation program for disturbed areas that are no longer required for operations. The progressive revegetation program is planned to incorporate measures for the use of test plots, reseeding, and replanting of native plants, and management plans for erosion control established for the Project. The objective of the reclamation research program is to identify methods to successfully achieve a sustainable vegetation cover, and the ability of a vegetation cover to enhance physical stability and/or achieve the desired aesthetic conditions for the project site at closure. The research is planned to commence in 2018 and the objective is to determine the most effective substrates and the group and individual native species able to establish and survive. Baffinland also conducted a review of baseline revegetation data collection. The findings indicate that approximately 20 plots were historically established on old road surfaces, pads, and other disturbed sites in the past. In the 2014 Exploration Closure and Reclamation Plan, Baffinland committed to promote the growth of vegetation by ripping, grading, or scarifying disturbed surfaces to meet the natural topography.	Low capacity for soil to retain moisture. Abundant surface water ponding.	Baffinland (2017). Baffinland Iron Mines 2016 Annual Report to the Nunavut Impact Review Board. http://www.baffinland.com/downloadocs/2016-nirb-annual-report-for-the-mary-river-project_2017-11-01-55.pdf Baffinland (2014). Exploration Closure and Reclamation Plan. Rev. 1 http://www.baffinland.com/downloadocs/baf-ph1-830-p16-0038-r1---exploration-closure-and-reclamation-plan_2017-01-29-17.pdf
Meliadine *Agnico Eagle* Kivalliq Region, NU	Construction *2035*	Agnico Eagle committed in the 2015 Updated Technical Report to allow the waste rock storage facility to naturally revegetate and ditches and ponds to be scarified to allow revegetation and natural drainage.	Poor growth medium.	Agnico Eagle (2015). Updated Technical Report on Meliadine Gold Project. https://s21.q4cdn.com/374334112/files/doc_downloads/operations/meliadine/Feb-11-2015-Meliadine-Technical-Report.pdf
Meadowbank *Agnico Eagle* Kivalliq Region, NU	Operations *2020*	Agnico Eagle committed in the 2008 Closure and Reclamation Plan to consult with the Nunavut Water Board and the Kivalliq Inuit Association as well as other northern mine's (e.g., Ekati and Diavik) revegetation strategies and experiences. Some of the revegetation strategies discussed throughout the report included scarifying surfaces, re-contouring, and seeding with native plant species to encourage a natural succession of indigenous plant species. A layer of ultramafic capping rock is also proposed to be placed on rock slopes to ensure long-term revegetation succession.	Lack of available local soils. Lack of a source of seed for native plants and Arctic growing conditions.	Agnico Eagle (2008). Meadowbank Water Licenses 8BC-TEH0809 and 2AM-MEA0815. ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-MEA1525%20Agnico/3%20TECH/10%20A%20and%20R%20(J)/080904%202AM-MEA0815%20Closure%20and%20Reclamation%20Plan%20Development%20Phase-ILAE.pdf

Mine Site *Owner* Region	Current Phase of Project *Mine Closure Projected Date*	Revegetation Plan Summary Interim Closure Summary/Commitments	Restrictions Identified	References
Whale Tail *Agnico Eagle* Kivalliq Region, NU	Pre-Development *2022*	Agnico Eagle, committed in the 2017 Final Hearing Report to initiate design and implementation of revegetation studies to gain a better understanding of applicable reclamation strategies at similar northern mines. However, the duration of the Whale Tail project is too short for meaningful revegetation research to be accomplished for the specific site.	2017 Technical Report reported large scale revegetation considered unfeasible due to lack of seed material. Lack of available organic soil and short cold growing seasons make revegetation challenging.	Agnico Eagle (2018). Technical Report on the Mineral Resources and Mineral Reserves at Meadowbank Gold Complex including the Amaruq Satellite Mine Development. https://s21.q4cdn.com/374334112/files/doc_downloads/operations/meadowbank/Meadowbank-Technical-Report-Feb-14-2018-Final-poasted-on-Sedar.pdf Nunavut Impact Review Board (2017). Final Hearing Report. NIRB File No. 16MN056. https://www.scribd.com/document/363953331/NIRB-Whale-Tail-Pit-Project-Final-Hearing-Report
Doris North Mine *TMAC Resources* Kitikmeot Region, NU	Operation *2021*	In the 2015 Interim Closure and Reclamation plan, TMAC committed to revegetate with active seeding in areas with suitable soil substrate. Active revegetation of rock fill pads was considered impractical because they cannot support vegetation however it was expected that lichen would naturally revegetate on a timescale of decades. TMAC also recommended in the post-closure monitoring and maintenance plan to hire an Arctic vegetation specialist to confirm suitability of the revegetation efforts at post-closure with subsequent inspections.	Improper growth medium at rock fill pads.	TMAC Resources (2015). Doris North Mine – Interim Closure and Reclamation Plan. ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-DOH1323%20TMAC/3%20TECH/10%20A%20and%20R%20(L)/2016/160211%202AM-DOH1323%20P5-2%20Interim%20Closure%20Plan%20June%202015%203%20of%204-ILAE%20(3).pdf
Lupin Mine *Lupin Mines Incorporated* Kitikmeot Region, NU	Inactive and in care and maintenance since February 2005 *Planning for final closure (FCRP) underway for 2021*	The 2017 Interim Abandonment and Restoration Plan discusses closure revegetation commitments for covered tailings and abandoned roadways. The esker deposit which is the major source of material planned to be used for the reclamation activities, lacks the organic/nutrient content for vegetation establishment. The procedure of scarifying reclaimed surfaces and contouring to provide proper drainage patterns and avoid ponding has successfully enhanced natural plant growth at Lupin (especially for native plants). It has been demonstrated that rough surfaces enhanced seed entrapment, moisture retention, and wind protection. Sod transplanting was discussed as a potential method of revegetation at Lupin, but it was concluded that placement of sod on a site with minimal growth medium does not justify removing it from its established area.	Lack of growth medium, unavailable soil amendments.	Lupin Mines Incorporated (2017). Interim Abandonment and Restoration Plan. ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-LUP1520%20LMI/3%20TECH/10%20A%20and%20R%20(I)/2017/170810%202AM-LUP1520-IARP_Updated-ILAE.pdf
Kiggavik Project *AREVA Resources Canada Inc.* Kivalliq region, NU	Environmental Assessment *Suspended*	In the Preliminary Decommissioning Plan dated September 2014, AREVA committed to implement progressive reclamation at earliest possible and conduct studies on mine rock test plots during the operations phase to evaluate methods of revegetation. The results of test plots were planned to be used to determine an optimal seed/planting mix and optimal use of fertilizers to encourage natural succession. Field observations at former drill sites at the Kiggavik exploration project indicated that a small number of native plants (e.g., polar grass, dwarf birch, Bigelow's sedge, arctic willow, and tea leaf willow) tend to dominate during natural revegetation. AREVA has also gained valuable revegetation experience from its Cluff Lake Project, located in north-western Saskatchewan. The most successful planting method at Cluff Lake Project included drill seeding with subsequent fertilization.	Tundra soils are considerably nutrient poor (especially in nitrogen and phosphorous). Seeded areas failed.	AREVA (2014). Final Environmental Impact Statement – Tier 3 Technical Appendix 2R – Preliminary Decommissioning Plan. ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-KIG----%20Areva/1%20APPLICATION/Management%20Plans/2R%20-%20Preliminary%20Decommissioning%20Plan.pdf
Jericho Diamond Mine *Tahera Diamond Corporation* NU	Mining ceased 2008, abandoned, Care Custody Control INAC. *Remediation began in 2017*	The 2004 Abandonment and Restoration Plan included commitments to look for a cooperative approach with Ekati, Diavik, and Snap Lake diamond mines to exchange reclamation research results in Arctic environments and develop reclamation trials throughout the mine life. The main revegetation strategy proposed to use undisturbed islands as a seed sources for reclamation as demonstrated by Bittman (1995) and preliminary trials at Ekati Diamond Mine (Reid, 2002). Tahera proposed to provide soil conditions similar to pre-disturbance conditions to encourage revegetation with native species, retard wind and water erosion, and design rehabilitation covers to minimize negative effects to the active layer (permafrost) and prevent melting of ice lenses that can lead to slumping and erosion.	The availability of native Arctic vegetation, except for natural seed sources, is extremely limited. Caribou and arctic hares grazing and trampling could be problematic.	Tahera Diamond Corporation (2004). Abandonment and Restoration Plan. ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-JER1119%20Shear/1%20APPLICATION/2004%20New%20Application/040826NWB1JER----%20Appendix%20A%20AMEC%20A%20and%20R%20Plan.pdf

Mine Site ***Owner*** **Region**	**Current Phase of Project** ***Mine Closure Projected Date***	**Revegetation Plan Summary** **Interim Closure Summary/Commitments**	**Restrictions Identified**	**References**
Ekati Diamond Mine *BHP Diamonds Inc.* Lac de Gras, NT	Operations *2050*	The 1998 Reclamation Plan included commitments to research the proposed revegetation programs during progressive reclamation activities. The proposed revegetation programs included revegetation of temporary or permanent stockpiled materials (i.e., lake sediment, till, and topsoil) generated during mining activities, revegetation of kimberlite tailings mine waste facilities, revegetation of contoured/closed laydown areas, and revegetation of engineered channels to improve establishment of fish habitat. The Ekati Reclamation Research Program started during the exploration phase of the Project in 1995. The revegetation research program includes testing of a variety of amendments (i.e., fertilizers, lake sediment, peat or sewage sludge) to promote growth on mine soil and kimberlite tailings, identifying the most successful plant species (i.e., graminoids, forbs, and shrubs) in establishing on mine disturbed areas and evaluating various planting techniques (i.e., cuttings, transplants, seeding, sprigging). Monitoring of substrate and vegetation has aided BHPB to identify the native species with higher potential for recovery after mine closure and the most favorable conditions for natural colonization.	Kimberlite's low capacity to retain soil moisture and plant nutrients. Grazing presents a limiting factor on the establishment and maintenance of seeded and native plant cover. Soils with high salinity. Species competition.	ABR Inc. – Environmental Research & Services. (2001 and 2002). Ekati Diamond Mine Revegetation Research Project. Report prepared for BHP Billiton Ltd. Harvey Martens & Associates Inc. (2001). Ekati Diamond Mine Processed kimberlite tailings Reclamation Research Program. Report prepared for BHP Billiton Ltd. Burton, Neil. (2001). Ekati Diamond Mine Processed kimberlite tailings vegetation research. Report prepared for BHP Billiton Ltd.
Giant Mine *Miramar Mining Corporation* Yellowknife, NT	Care Custody Control INAC *Abandoned in 2004* *Permanent closure measures underway*	Forested site near Yellowknife – not analogous to Back River.		
Con Mine *Newmont Mining Corporation* NT	Post-Closure *2003*	Forested site near Yellowknife – not analogous to Back River.		
Diavik Diamond Mine *Rio Tinto and Dominion* North Slave Region, NT	Operations *2030*	The 2004 Revegetation of Disturbed Site at Diavik Mine Report provides details of the research plots established in the summer of 2004. The trials included assessing the revegetation effectiveness for various substrate treatments (i.e., glacial till, fine processed kimberlite, till mix with kimberlite, and no substrate addition), amendment treatments (i.e., inorganic fertilizer, topsoil or sewage sludge), seeding treatments, and plant species (i.e., grasses, forbs, bryophytes, and shrubs). Soil moisture and soil temperature sensors were installed at the centre of the plots and soil samples were collected at each plot for lab testing.	Kimberlite may have a negative effect on plant growth due to its physical and chemical properties. Till treatment was eliminated from the experimental design as it would not be an appropriate substrate capable of supporting plant growth.	Naeth et al. (2004). Revegetation of disturbed sites at Diavik Diamond Mine, NWT. – 2004 Annual Report. http://registry.mvlwb.ca/Documents/N7L2-1645/K-RegrowthResearch.pdf
Snap Lake *De Beers Canada Inc.* NT	Care and Maintenance *2015*	The 2013 Interim Mine Closure & Reclamation Plan included commitments to conduct research focused on development of methods to successfully achieve a sustainable vegetation cover, and the ability of a vegetation cover to enhance physical stability and/or achieve the desired aesthetic conditions for the project site at closure. The research plan also included to carry out a literature review revegetation programs of the disturbed areas in northern climates and establishment of test plots for each ecological land classification units with the project area.	Slow rates or unsuccessful revegetation. Potential adverse impacts to physical stability of surficial soils, unacceptable concentrations of chemicals in vegetation at the North Pile.	Arktis Solutions (2013). Snap Lake Mine – Interim Mine Closure and Reclamation Plan. http://registry.mvlwb.ca/Documents/MV2011L2-0004/MV2011L2-0004%20-%20De%20Beers%20Snap%20Lake%20-%20Interim%20Closure%20and%20Reclamation%20Plan%20-%20Version%203.2%20-%20Jul11-13.pdf

Sabina
GOLD & SILVER CORP.

The BACK RIVER PROJECT

Technical Meeting Commitment Responses

Environment and Climate Change Canada

Interested Party: ECCC	**Commitment No.:**	**WTM-COMMITMENT 15 (ECCC-TC-2)**

Post-Technical Meeting Commitment:

To identify contingency measures to mitigate potential/TSS issues when re-watering the SWP to address water quality issues prior to reconnection to surface waters.

Post-Technical Meeting Response Package:

The Saline Water Pond (SWP) will be formed during the Project Construction Phase as an expansion of the storage capacity available in the natural basin area of the Umwelt Lake that will be obtained through the construction of two small containment structures: the South Containment Dam and the East Containment Dam. Diversion berms will also be constructed around the SWP to divert runoff from natural catchments away from the SWP.

The water volume (and water level) in the SWP is predicted to increase during the early years of Operations, reaching a maximum water volume/level at approximately Year 5 of Operations. The SWP water volume is predicted to remain in the upper 50% of the storage capacity of the SWP until the SWP is fully dewatered to the underground facilities. The dewatering is predicted to be completed by the end of Operations, prior to beginning of closure activities (Year 11). Additional details are provided in the water and load balance model (171005 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE).

As mentioned above, once the SWP has been dewatered, the sediments in the basin of the SWP will be tested. If chloride sediments are encountered at the bottom of the lake, the basin of the dewatered SWP may be excavated (excavated sediments deposited in the Goose Main Tailings Facility), or alternatively the sediments will be rinsed with freshwater until salinity of the rinse water is acceptable.

The excavation and/or rinsing of the SWP sediments will occur during the Closure Phase of Project and while the SWP containment dams are in place. Only when Umwelt Lake has been re-watered and the water quality has been verified will the SWP containment dams be breached. It is noted, that the re-watering of SWP is termed re-watering of Umwelt lake to add additional clarity to our response.

The re-watering of the Umwelt Lake may have the potential to result in generation of TSS laden water as follows:

- The Umwelt Lake shoreline and natural ground between the shoreline and the diversion berms and containment dams will remain underwater throughout the Operations Phase. These flooded areas may generate TSS laden runoff during initial stages of re-watering of the SWP.
- The excavation of SWP sediment may disturb the natural lakebed sediment layer, which in turn may result in TSS laden runoff during initial stages of re-watering of the SWP.

The following strategies and contingencies to mitigate potential TSS issues when re-watering Umwelt Lake and prior to reconnection to surface waters are either included, or could be included, in the Project water management and closure concepts:

- As mentioned above, dewatering of the SWP will be completed before the beginning of the Closure Phase. It is expected that it will take less than one year to re-water Umwelt Lake based on the water and load balance model (171005 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE). This will allow the potential use of the full Closure Phase (i.e., up to 8 years), if required, to implement strategies to mitigate TSS concentrations at the point of discharge of the re-watered Umwelt Lake to the environment. The Goose Main TF provides contingency storage capacity (see Figure 6-5 of water and load balance model [171005 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE]) until water quality in the re-watered Umwelt Lake is deemed suitable for discharge.
- Two options could be considered for the removal of chloride-laden sediment from the bottom of the SWP (i.e., sediment removal through excavation, and rinsing). Option selection (or combination of the two options) will be determined based on actual conditions encountered at the bottom of the SWP at the end of dewatering, including considerations for mitigating risk of generation of TSS laden water. That is, the rinsing option might be preferable if it is identified that potential disturbance of lakebed sediments during excavation might pose too high a risk to the environment with respect to TSS generation during re-watering.
- Progressive breaching of the diversion berms around the SWP could be implemented to control the rate of runoff from undisturbed ground draining to the SWP, and thereby reduce the potential TSS concentration in the SWP.
- Rockfill material could be placed at the bottom of the SWP or on the flooded natural ground areas to mitigate TSS generation during re-watering; all or some of the material could be sourced from the diversion berms around the SWP.

Interested Party:	ECCC	Commitment No.:	WTM-COMMITMENT 16 (ECCC-TC-1)

Post-Technical Meeting Commitment:

Sabina will re-issue the water qualities predictions table to address the questions raised by ECCC (Supplemental Response Package, Appendix A: Load Balance Update to Support the Type A Water Licence, Appendix 2, Attachment Tables 1-A and 1-B)

Post-Technical Meeting Response Package:

Sabina is providing the revised Load Balance Update in Support the Type A Water Licence to address questions raised by ECCC.

TECHNICAL MEMORANDUM

DATE June 8, 2018 1776921_030_TM_WO-006_Rev3

TO Merle Keefe
Sabina Gold & Silver Corp.

CC Catherine Paul

FROM Thais Lamana, Shayna Dzilums, and Kristin Salzsauler **EMAIL** Kristin_Salzsauler@golder.com

LOAD BALANCE UPDATE IN SUPPORT OF THE TYPE A WATER LICENCE; BACK RIVER PROJECT

1.0 INTRODUCTION

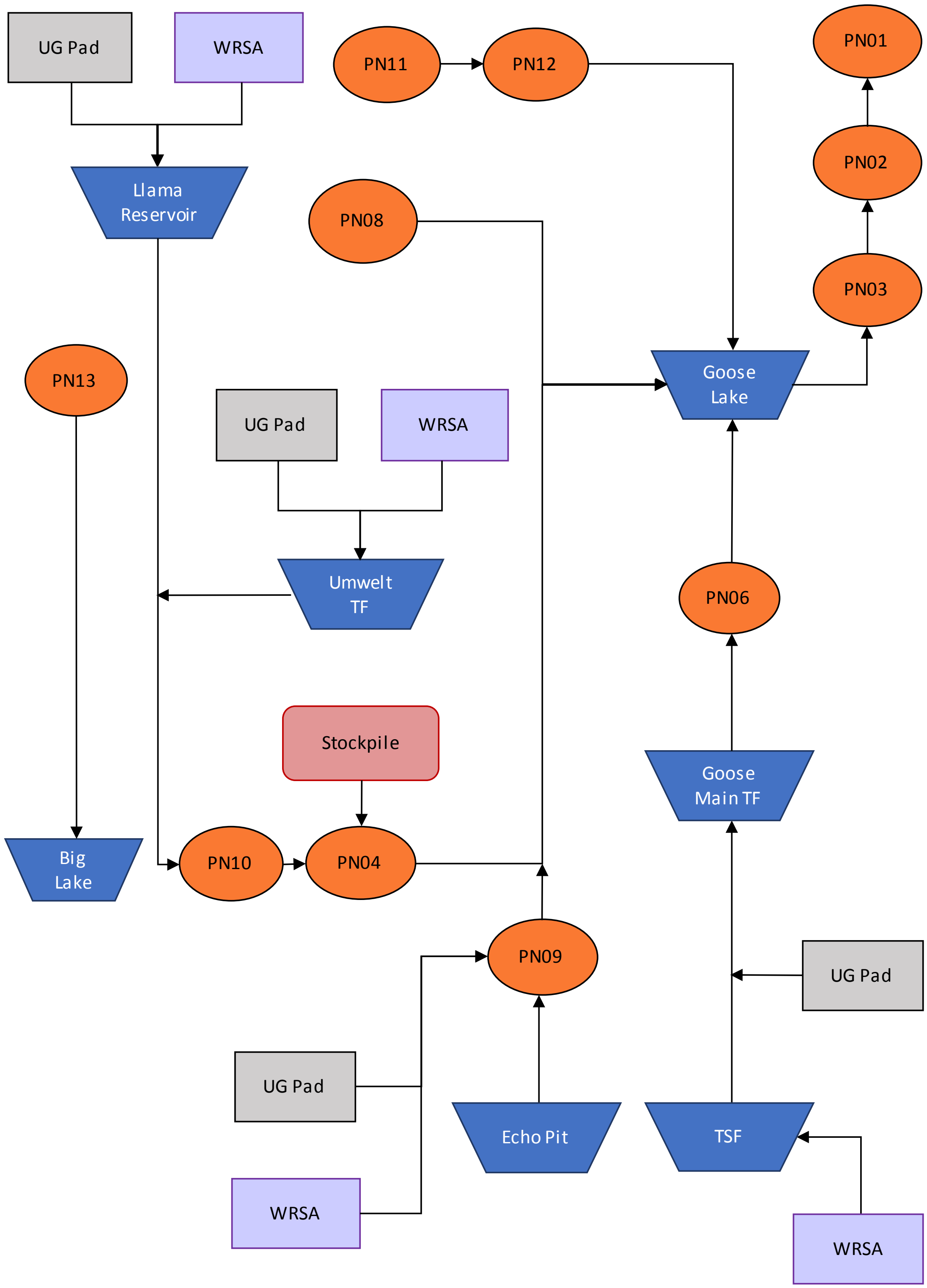
At the request of Sabina Gold & Silver Corp. (Sabina), Golder Associates Ltd. (Golder) completed an update of the load balance module in the Water and Load Balance Model (Model) for the Back River Project (Project). The model is comprised by two individual modules, the water balance and load balance that are directly linked in the model framework. The model update is a requirement of the Final Environmental Impact Statement (FEIS) and FEIS Addendum Project Certificate (170601-12MN036-FHA EX 45-Recommended PC Terms and Conditions Committments-IA2E), item INAC-C-1. Sabina committed to working with Crown-Indigenous Relations and Northern Affairs Canada (CIRNA), Environment and Climate Change Canada (ECCC), and the Kitikmeot Inuit Association (KIA) prior to the Nunavut Water Board Type A Water Licence review meeting to revise the Water and Load Balance Model. Updates were made to the load balance module that was presented in Appendix F-7 of the Type A Water Licence Application for the Project (Golder 2017; 171005 2AM-BRP----MAD App F-7_TechReview-IMLE) to address information requests outlined in Appendix 1 of this memorandum.

This Technical Memorandum, which has been updated to address Technical Meeting Commitment No. 16 made during the Technical Meeting for Water Licence No. 2AM-BRP, includes an overview of the existing Water and Load Balance Model, a summary of model updates, methods, and key results. Model limitations and a discussion of results are also provided.

2.0 OVERVIEW OF BACK RIVER PROJECT WATER AND LOAD BALANCE MODEL

Golder was provided a copy of the Water and Load Balance model prepared for the Back River Project FEIS (SRK 2015a). The Water and Load Balance Model Report (SRK 2015b; 171005 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE) presents a detailed description of the model, which was developed to optimize the water management strategy, optimize the tailings deposition schedule, and evaluate water treatment goals for the Project to meet water quality guidelines. The objective of the load balance module is to predict water quality at the Goose Property and the effect to downstream receptors. The load balance module is based on mass balance principles, and incorporates available data for hydrology, mining and production schedules, water management plans, water chemistry, and source load inputs. Water quality predictions were developed for all open pits, tailings management facilities, and specific locations downstream of the Goose Property (Figure 2-1).

Figure 2-1: Model Nodes according to the Closure Water Balance (adapted from SRK 2015b)



The water balance module tracks all inputs, outputs, and storage at the key Project facilities. Water inputs include groundwater inflows from taliks within the Llama underground development and Llama open pit, Umwelt underground development, and Goose Main underground development; and precipitation. Outflows include Project discharges, including treated effluent, pit overflows to downstream receptors, and seepage, as well as evaporation. The water balance module accounts for water storage within the open pit and underground developments, and voids in tailings and waste rock.

Loading rates were calculated in the load balance module for each inflow in the water balance. Loadings and concentrations were calculated for each mine component, either as a direct loading from a defined source term, or a linked loading from a reservoir (e.g., open pit or lake) reporting from another facility. The main source terms include background surface water quality; groundwater inflows; geochemical source terms for waste rock and tailings contact water developed using a combination of humidity cell test data, geochemical modelling, and existing data from nearby similar mine sites; process water effluent; and sewage treatment plant (STP) treated effluent water. Geochemical source terms were derived based on average hydrological conditions.

The load balance module accounts for the effect of release of nitrogen species from blasting residuals, and nitrogen species in sewage treatment plant (STP) effluent. Nitrogen concentrations were modelled conservatively and assume no changes due to degradation of nitrogen species. Cryoconcentration (exclusion of parameters from ice) is conservatively assumed to occur during the winter months. Lastly, degradation rates of cyanide species were also accounted for in the model using data from an analogous Northern mine.

The Water and Load Balance Model was run on a daily time step from Year -2 to Year 42, which allowed for the development and evaluation of steady-state conditions in pits and downstream receptors. The water balance was run as a Monte Carlo simulation (i.e., stochastic model) using probability distribution functions developed for the Project. Water quality predictions were generated from the load balance using deterministic model runs and average hydrological conditions; for consistency, with geochemical source terms were also generated assuming average hydrological conditions.

The model results were used to evaluate water treatment requirements. A key assumption of the Water and Load Balance Model is that containment will not be breached until water quality is acceptable to meet receiving environment requirements. During the Construction Phase, Llama Lake and Umwelt Lake will be dewatered to allow for storage of contact water (Llama Lake) and saline groundwater (Umwelt Lake). In this phase, water from Llama Lake will be treated for total suspended solids (TSS) and arsenic (As) prior to discharge to Goose Lake during the open water season (Year -2, Q2 & Q3). All water dewatered from Umwelt Lake will also be pumped to Goose Lake; 50% of the total volume will be discharged directly, and the other 50% will be treated for TSS prior to discharge during the open water season (Year -2, Q2 & Q3). During the Operations Phase, water from the Goose Main Tailings Facility (TF) will be circularly treated year round to reduce TSS, As, and copper (Cu) concentrations (Year 7, Q4 to Year 10, Q2). During the Closure Phase, water from Goose Main TF will be treated during the open water season for TSS, As, and Cu (Year 10, Q2 to Year 16, Q1). Water treatment during Construction will involve clarification and ferric chloride addition; treated water will be pumped to Goose Lake. During Operations and Closure, water treatment will include oxidation of cyanide using hydrogen peroxide, and ferric chloride addition. Treated water will be pumped back to the Goose Main TF.

The results from the load balance module were compared to the following guidelines:

- Metal and Diamond Mine Effluent Regulations (MDMER 2018) which represent the amended Metal Mine Effluent Regulations (MMER, 2006)
- Canadian Council of Minsters for the Environment (CCME) water quality guidelines (CCME 1999)
- BC Ministry of Environment (MOE) water quality guidelines for sulphate (SO4) (BC MOE 2017)
- Site-specific water quality objectives (SSWQOs) developed for arsenic (As) and copper (Cu)

2.1 Third Party Review

Golder (2017) completed a third party review of the Water and Load Balance Model as part of the Type A Water Licence application submission. During this review, Golder identified inconsistencies between the GoldSim model (SRK 2015b) and supporting documentation which were addressed through an update to the load balance module. These updates resulted in minor changes to the key load balance module results presented in SRK (2015a), with effectively no impact on the Project-wide water management strategy and sizing of water management infrastructure. Results of the update completed as part of the review are presented in Golder (2017) and were submitted as part of the Type A Water Licence Application.

As part of this review, Golder noted that source concentrations developed for Project contact waters represent dissolved metal concentrations and, as stated in SRK (2015a), do not account for additional loading that may result from total suspended sediments (particularly for aluminum (Al) and iron (Fe)). Many of the source inputs are expected to have negligible particulate associated with them (e.g., groundwater flows and runoff from pit walls and waste rock), or will have limited potential for particulate to reach the receiving environment due to Project design features (e.g., planned active water treatment, passive water treatment in sediment ponds, limited potential for sediment resuspension in pits and tailings facilities).

3.0 LOAD BALANCE MODULE

3.1 Overview

The Type A Water Licence load balance module updates were made using the Version 11 of the GoldSim model[1] (Golder 2017), which is an updated version of the Water and Load Balance Model discussed in Appendix E-2 of the Type A Water Licence Application for the Project (SRK 2015a; SRK 2015b). The following assumptions are key to the model:

- Input concentrations less than the analytical detection limit were assumed to equal the analytical detection limit.
- Nitrogen species were modelled conservatively, and no degradation was assumed.
- Total dissolved solid and hardness calculations were calculated using modeled concentrations of the component parameters (discussed below).

3.2 Updates

The load balance module updates were made based on information requests received prior to the Technical Meeting for Water Licence No. 2AM-BRP, outlined in Appendix 1. No model updates were made after the Water License Technical Meeting. The load balance module updates included:

[1] FEIS_Goose_Rev17G_spb_kpw_SAB_withresults - WQ_UPDATE_Original.gsm

- Incorporation of the total metals fraction to evaluate the effect of suspended solids on the total parameter concentrations in mine discharges during Construction, Operations, Closure, and Post-Closure.
- Incorporation of total metal concentrations for downstream water quality using baseline water quality results (Sabina 2015), to evaluate total metal concentrations in receiving environment during Construction, Operations, Closure, and Post-Closure.
- Nitrogen species concentrations were updated in sewage treatment plant effluent to the following values:
  - Nitrate (NO_3) = 22 mg-N/L
  - Nitrite (NO_2) = 0.5 mg-N/L
  - Ammonia (NH_3) = 8 mg-N/L

Additional refinements to the model included the following:

- Lower bound limits equivalent to background water quality inputs were applied to water quality predictions when these were lower than the background water quality.
- Total dissolved solids concentrations (C_{TDS}) in milligrams/litre (mg/L) were estimated from the sum of all modelled major ion concentrations as per Equation 1.

$$C_{TDS} = C_{Ca} + C_{Mg} + C_K + C_{Na} + \left(\frac{C_{Alkalinity}}{50}\right) \cdot 61 + C_{SO_4} + C_{NO_3} + C_{Cl} \qquad (1)$$

Where: C= concentration, Ca = Calcium, Mg = magnesium, K = potassium, Na = sodium, SO_4 = sulphate, Cl = chloride

- Hardness was calculated based on predicted calcium (Ca) and magnesium (Mg) concentrations, as per Equation 2. All hardness related guidelines refer to the calculated hardness values.

$$C_{Hardness} = 2.5C_{Ca} + 4.11\ C_{Mg} \qquad (2)$$

No other changes to the mine plan or water balance module were made to the load balance as part of this model update. Furthermore, source term inputs for waste rock, overburden, and tailings presented in SRK (2015a) were used without any modifications or updates.

3.2.1 Estimation of Total Metal Concentrations

Total metal concentrations for Project discharges were estimated by adding a calculated particulate fraction to the dissolved concentration results from the model. Total loads were calculated for contact water for all mine facilities (pads, roads, waste rock piles, tailings management facilities) assuming the discharge from each facility will meet the MDMER TSS discharge limit (15 mg/L). The particulate concentration of each element was developed as follows:

- The relative proportions of each waste rock lithology produced at each pit were calculated based on the total tonnage of waste volume presented in Table 2-2 of the Geochemical Characterization Report (SRK 2015c; 171005 2AM-BRP----MAD App E-3_GeochemCharactRpt-IMLE). Lower greywacke (LGW) and deep iron formation (DIF) proportions were combined to reflect the distribution of samples as summarized in Table 5-1 of SRK (2015c).

- The water balance module was reviewed to identify the source of runoff at each facility, as seepage water will not be a significant source of particulate. When tailings runoff was a key source of TSS, the solid phase composition of tailings was used to assign the chemical composition of TSS. When waste rock was a key source of TSS, the solid phase composition of waste rock was used to assign the chemical composition of TSS.
- The available data on solid phase geochemistry of each rock type at each deposit were reviewed. The input for modeled constituents was defined using the average of samples collected for each rock type at each deposit, as presented in Appendix E2: Statistical Summary of SRK (2015c). In the absence of data for a specific lithology at a given deposit, the overall average calculated based on all samples of that rock type collected at the Goose Property was used to define its elemental composition.
- Using the solid phase geochemistry data and the relative proportions of each rock-type, the weighted average was calculated to define the chemical composition of the TSS associated with waste rock produced by each pit. For pads and roads, the weighted average was calculated using the relative proportion of each rock type for the entire Goose Property and the overall average composition for each rock type based on all samples of that rock type collected at the Goose Property.
- Tailings were defined by using the average of the solid phase geochemistry results for the composite samples used to develop the tailings source terms (SRK 2015c), specifically KM4030-147 TAILS, BR-TAIL-02, and BR-TAIL-03.
- The product of the weighted average (expressed as micrograms/gram or µg/g), and the TSS concentration discharge limit (set to 15 mg/L), defined the concentration of each modeled constituent associated to the TSS load. The TSS load was then added to the dissolved fraction load to estimate metal concentrations for the fraction.

3.2.2 Incorporation of 2017 Monitoring Data

In Technical Comment WT-KIA-NWB-27 (see Appendix 1), KIA requested that Sabina incorporate the 2017 monitoring dataset to evaluate fall and freshet conditions. This data has not yet been incorporated into the surface water quality inputs; it is understood that Sabina will collect additional surface water baseline data in 2018, including data to further characterize seasonal variability. Sabina has committed to updating the Water and Load Balance Model using all available baseline data, including data that will be collected in 2017 and 2018, prior to the initiation of dewatering to verify the water quality criteria for discharge are appropriate.

The existing surface water inputs to the load balance module are considered appropriate. The background water quality dataset used to develop the model inputs consists of data collected at the Project between 1993 and 2013 during the freshet, summer and fall seasons. As outlined in SRK 2015b, seasonal water quality trends were evaluated for select parameters, including alkalinity, As, cadmium (Cd), calcium (ca), chloride (Cl), copper (Cu), iron (Fe), nickel (Ni), sulphate (SO4), and zinc (Zn). Seasonal variation was not identified for any of the parameters; therefore, annual water quality medians were used for inputs to the load balance module (SRK 2015a).

3.3 Screening Criteria

The results of the load balance were compared against three applicable guidelines outlined in Table 3-1. The complete analyte list and comparison criteria for the water quality results are provided in Appendix 2, Attachment 1A and 1B of this memo. The water quality screening criteria listed in Table 3-1 are referred to as the "reference criteria" in this memorandum.

Table 3-1: Water Quality Screening Criteria

Water Quality Criteria	Guideline Description
Canadian Council of Ministers of the Environment (CCME 1999)	Water Quality Guidelines for the Protection of Aquatic Life, Freshwater, Long-Term (Chronic)
Metal Mining Effluent Regulations (MDMER 2018)	Schedule 4 (Authorized limits of deleterious substances)[a]
BC MOE water quality guidelines (BC MOE 2017)	British Columbia approved water quality guideline for SO_4
Site-Specific Water Quality Objectives	Numerical concentrations set out for Site conditions

a Water quality was screened against Column 2, Maximum Authorized Monthly Mean Concentration

MDMER and BC MOE were applied to Goose Property model nodes, and MDMER, BC MOE, and CCME/SSWQO were used to screen water quality model results for receiving environment model nodes. All hardness-based criteria were calculated based on the model calculated hardness (see Equation 2 of Section 3.2) associated with a specific data point.

In review of the results presented in SRK (2015b), it was noted that some MMER (2006) and CCME criteria were presented inaccurately. In addition, some MMER values have been replaced based on the revised amendments to MDMER (MDMER 2018). These criteria have been addressed in this memorandum. Table 3-2 summarizes the parameters that were subject to revision. Site-specific guidelines remained the same and are not included in the table below.

Table 3-2: Summary of updates to Water Quality Screening Criteria

Parameter [mg/L]	SRK (2015b)	This Memorandum	SRK (2015b)	This Memorandum
	CCME (1999)		MMER (2006)	MDMER (2018)
Cyanide	**-**	**0.0050**	1.0	**0.50**
Ammonia	**-**	**4.3[a]**	6.0	**0.50**
Nitrite	**0.080**	**0.060**	-	-
Arsenic	0.0050	0.0050	**0.050**	**0.30**
Chromium	-	0.0010	**-**	**-**
Copper	-	-	**0.30**	**0.30**
Lead	-	-	**0.20**	**0.10**
Nickel	-	-	**0.50**	**0.50**
Silver	**0.00010**	**0.00025**	**-**	**-**
Zinc	-	-	**0.50**	**0.50**

a Unionized ammonia guideline is pH and temperature dependent; this guideline was based on the maximum pH (7.48) and maximum temperature (17.1 °C) recorded in the Goose Lake from August 2017.

Bolded and underlined values indicate a change in criterion for the identified parameter.

4.0 RESULTS

Monthly average water quality predictions were completed for dissolved and total metal concentrations at all open pits, tailings management facilities, and downstream prediction points. The model nodes are presented in Figure 2-1, which presents the Closure Phase water management strategy for simplification. The objective of this section is to identify the constituents of potential concern (COPC) for each modeling node. Parameters are identified as a COPC when predicted concentrations are greater than the applicable water quality criteria.

Appendix 2, Attachment 1A and 1B present a statistical summary of the absolute monthly maximum concentrations, long-term monthly average, and Closure maximum monthly concentrations for both dissolved and total metal concentrations in order to understand the extent of change in concentration with the addition of total suspended solids. Appendix 2, Attachment 2 presents concentration trends of COPCs by location.

4.1 Receiving Environment

The receiving environment prediction nodes (PN) comprised by the model domain are shown in Figures B-1 to B-6 in the Appendix-B of SRK (2015a) report. Based on the current model update, the water quality results in the receiving environment can be characterized as follows:

- Prediction nodes PN08, PN11, PN12, and PN13 are unaffected by Project infrastructure and predictions are identical to the background source water quality. The results for these nodes are grouped as one statistical summary in Appendix 2, Attachment 1A.

- Concentration inputs for mercury (Hg) are equal to the analytical detection limit. Therefore, predicted Hg concentrations reflect the analytical detection limit. For consistency, Hg is highlighted as exceeding the CCME criteria in Appendix 2; however, it is unlikely to be a COPC.
- The addition of the particulate fraction did not produce any substantial change from the dissolved concentrations for most parameters, with exception of aluminum (Al) and iron (Fe). Arsenic (Cu), chromium (Cr), copper (Cu), phosphorous (P), vanadium (V), and titanium (Ti) also had a small overall increase in concentration owing to the addition of the particulate fraction. Calcium and magnesium also comprise an important part of the suspended solids chemical composition, but the contribution from the particulate fraction is negligible in comparison to the dissolved concentration of these parameters.

4.1.1 Goose Lake and Downstream Model Nodes

Receiving environment model prediction nodes downstream of Goose Lake include PN03, PN02, and PN01. Model results for these nodes are summarized in Appendix 2, Attachment 1A. Figures presenting concentration trends of key COPCs for these nodes are presented in Appendix 2, Attachment 2.

Goose Lake

Figure 2-1 summarizes the key inflows to, and outflows from, Goose Lake. Parameters that exceed the reference criteria in Goose Lake include:

- Total Al
- Dissolved and total As
- Total Cr
- Dissolved and total Cu
- Total Fe

Total and dissolved As and Cu surpass the applicable guidelines (SSWQO) following the overflow of the Goose Main TF into the receiving environment. This overflow commences in the Closure Phase (Year 18 of the mine life). Total Al, total Cr, and total Fe exceed the reference criteria for the duration of the Post-Closure Phase.

PN03

As outlined in Figure 2-1, PN03 is located further downstream of the Goose Lake assessment node. The projected concentration trends at these locations are similar, the only difference being a flow rate of 0 m^3/s at PN03 during the winter months, during which no water quality predictions were derived. Parameters that exceed the reference criteria at PN03 include:

- Total Al
- Total Fe

Similar to Goose Lake, the exceedances at PN03 begin after Year 18, following the overflow of the Goose Main TF.

PN02

PN02 is located downstream of assessment location PN03. The projected concentrations trends are similar to PN03; however, predicted concentrations decrease relative to PN03 as a result of an increase in the relative proportion of natural runoff. Parameters that exceed the reference criteria at PN02 include:

- Total Al

The exceedance at PN02 begins after Year 18 and exceed the reference criteria for the duration of the Post-Closure Phase.

PN01

PN01 is located downstream of assessment location PN02 and is the farthest downstream node from the Project. Water quality modeling results suggest that at PN01 a large assimilative capacity occurs. In addition, no COPC's were flagged at this location. Therefore, effects from the Project discharge are expected to be minimal on water quality at this node.

4.1.2 Model Nodes Upstream of Goose Lake

Model nodes upstream of Goose Lake include PN10, PN04, PN09, and PN06. Model results for these nodes are summarized in Appendix 2, Attachment 1A. Figures presenting concentration trends of key COPCs at these nodes are presented in Appendix 2, Attachment 2.

PN10

The PN10 assessment node is located upstream of Goose Lake. Natural runoff is the primary incoming flow to this node during the Operations Phase. During the Closure (after Year 10) and Post-Closure phases (after Year 18), PN10 also receives water from the Llama Reservoir, the Umwelt TF, and the Saline Water Pond. Parameters that exceed the reference criteria at PN10 include:

- Cl
- Total Al
- Dissolved and total As
- Total Cr
- Dissolved and total Fe

The exceedances at PN10 begin after Year 12, during the Closure and continue throughout the Post-Closure period. Discharge from the Llama Reservoir and Saline Water Pond effect Cl concentrations. Total Al, total Cr and dissolved and total Fe exceed the CCME criteria. Dissolved and total As exceeds the SSWQO for the duration of the Post-Closure period.

PN04

PN04 is located downstream of assessment location PN10 and flows to Goose Lake. During the Operations Phase, the primary contributing flow to this location consists of a combination of runoff flows from roads, and undisturbed areas. At Closure and throughout Post-Closure phases, PN04 also receives flow from the ore stockpile, the Llama Reservoir, the Umwelt TF and the Saline Water Pond. The relative flow contribution from these facilities to the total incoming flow at PN04 is lower in comparison to PN10. Parameters that exceed the reference criteria at PN04 include:

- Cl
- NO_2
- Total Al
- Dissolved and total As
- Total Fe

With the exception of Cl and NO_2, exceedances at PN04 begin in the Closure (after Year 10) and Post-Closure periods (after year 18) periods. Chloride concentrations are a function of flow from PN10, which receives water from the Llama Reservoir and Saline Water Pond. Total Al and Fe exceed the reference criteria for the Post-Closure Phase. Total and dissolved As exceed the SSWQO during the initial Closure period, but are less than the SSWQO during Post-Closure.

PN09

PN09 is located downstream of the Echo Pit. During the Operations Phase, the main contributing flows to this node consist of a combination of runoff from roads with natural runoff from undisturbed areas. At Closure and Post-Closure, this location also receives direct discharge from the Echo Pit and the Echo WRSA, both contributing to the overall increase of simulated concentrations. Parameters that exceed the reference criteria at PN09 include:

- NO_2
- Total Al
- Dissolved and total As
- Total Cr
- Total Fe

With the exception of NO_2, exceedances at PN09 begin in the Closure (after Year 10) and Post-Closure (after Year 18) phases. Dissolved and total As exceeds the SSWQO between Year 9 and Year 14, and decreases to concentrations less than the SSWQO in the Post-Closure Phase. Total Al, Cr, and Fe exceed the CCME criteria during the Post-Closure Phase.

PN06

Main incoming flows to this location consist of natural runoff and road runoff during Operations, and additional discharge from the Goose Main TF and discharge from the Tailings Storage Facility (TSF) during Closure and Post-Closure. Parameters that exceed the reference criteria at PN06 include:

- NO_2
- Dissolved and total Al
- Dissolved and total As

- Total Cr
- Dissolved and total Cu
- Total Fe
- Dissolved and total Se
- Dissolved and total Ag

Exceedances at this location begin at Year 18, following the overflow of the Goose Main TF. Dissolved As and Cu concentrations exceed the SSWQO at the time of the initial discharge, and decrease to long-term concentrations less than the SSWQO. Total Al, total Cr, and total Fe exceed the reference criteria for the duration of the Post-Closure Phase.

4.2 Goose Property Modelling Nodes

Goose Property model nodes include the Umwelt TF, Llama Reservoir, Goose Main TF, Echo Pit, and the TSF. Model results for these nodes are summarized in Appendix 2, Attachment 1B. Water quality model results were compared to the MDMER regulations, and to the BC MOE guideline for SO_4.

Umwelt Open Pit and Tailings Facility

The Umwelt open pit will be mined between Year -2 and Year 2, and underground mining will take place between Year 2 and Year 10.

The contact water collected in Umwelt open pit will be dewatered to Llama Lake until milling begins (Year -1), when water will then be pumped to the TSF. After the completion of open pit mining in Year 2, the open pit will become the Umwelt TF and will be used for mine water storage from the Llama open pit, and tailings deposition. Water will be reclaimed to the Goose Process Plant. Tailings will be deposited until the solids are at an elevation 5 meters below the discharge elevation over a period of approximately 4 years (through Year 6). After the completion of the Goose Main open pit, excess water from the Umwelt TF will be transferred to the Goose Main TF (Year 7). A 5-m water cover will be maintained in the Umwelt TF at Closure.

Some exceedances of the MDMER regulations and to the BC MOE guideline for SO_4 were noted during Operations, but during this phase, water will be not be discharged prior to treatment. Water in the Umwelt TF meets the reference values during the Closure and Post Closure phases.

Llama Open Pit and Reservoir Facility

The Llama open pit will be developed and mined between Year 1 and Year 3, and underground mining will take place concurrently between Year 1 and Year 4. The open pit will be developed in an open talik; groundwater inflows will be encountered during mining. Groundwater dewatered from the Llama open pit and underground will be pumped to the TSF until Year 2; beyond Year 2, water will be pumped to the Umwelt TF.

Following the completion of open pit mining, the Llama open pit will become the Llama Reservoir, and will be used for storage of site-wide contact water and saline groundwater. Hydrodynamic modelling of the Llama Reservoir confirmed that meromixis will occur (SRK 2015b); however, for the purpose of the load balance module, the reservoir was conservatively assumed to be completely mixed. At Closure, excess water from Llama Reservoir will be routed to Goose Lake.

Water in the Llama Reservoir meets the MDMER regulations with exception to ammonia, which exceeds the guideline during the Operations Phase; however, during this phase, water will not be discharged prior to treatment. Sulphate did not exceed the BC MOE guideline during any phase of the Project.

Goose Main Open Pit and Tailings Facility (Goose Main TF)

The Goose Main open pit will be mined between Year 2 and Year 6, and underground mining will take place between Year 5 and Year 9. After Year 6, the open pit will become the Goose Main TF. Inflows to Goose Main Pit will be pumped to the TSF until Year 2, followed by the Umwelt TF. The Goose Main TF will also serve as storage for process water and site-wide contact water. During Operations and Closure, water from the Goose Main TF will be treated and re-circulated back to Goose Main TF until discharge criteria are met.

Some exceedances of the MDMER regulations and to the BC MOE guideline for SO_4 were noted during Operations, but during this phase, water will not be discharged prior to treatment. Water in the Goose Main TF meets the reference values during Closure and Post Closure phases.

Echo Pit

The Echo open pit will be developed and mined between Year 4 and 5; underground mining will take place between Year 6 and 9. The Echo pit will be continuously dewatered, allowing for the recovery of the crown pillar. During Operations, water will be pumped from the Echo Pit to the Umwelt TF until Year 6, followed by the Goose Main TF until the end of mining. When underground mining is complete (Year 9), the Echo open pit will be allowed to passively flood.

Water in the Echo Pit meets the MDMER regulations, and to the BC MOE guideline for SO_4 at all phases of the Project.

Tailings Storage Facility (TSF)

The TSF will be active between Year -1 and Year 2. The TSF will also be used to store site-wide contact water, mill process water, and saline groundwater from the Llama open pit. Supernatant water from the TSF will be continuously reclaimed to the Goose Process Plant following tailings deposition.

At Closure, the TSF will be covered with waste rock and converted to a waste rock storage area (called TSF WRSA). A portion of the TSF footprint will be used for contact water storage until the end of the Closure Phase (TSF WRSA Pond).

Some exceedances of the MDMER regulations and to the BC MOE guideline for SO_4 were noted during Operations, but during this phase, water will not be discharged prior to treatment. Water in the Goose Main TF meets the reference values during Closure and Post Closure phases.

5.0 MODEL LIMITATIONS

The model results presented in this Technical Memorandum are based on the general assumptions listed in SRK (2015b), including the mine plan, water management plan, and input data. Given the complex interplay of climate, the geochemical nature of the rock materials, and the physical characteristics of the mine facilities, several simplifying and conservative assumptions were included in the load balance module. The water quality predictions presented in this memo reflect these assumptions. While it is believed that the modelling approach and resulting water quality predictions presented herein are consistent with industry practices and appropriate for evaluating potential impacts associated with the Project, actual contact water quality during Construction, Operations, Closure, and Post-Closure may differ from the predictions presented.

Actual water quality will largely depend on the mine plan and management practices followed during mining, and on-site conditions related to water movement and chemical loading. In that respect, the extent to which actual dissolution of rock particles in waste rock storages areas, and the subsequent release of chemical constituents into drainage water will affect water quality, will depend on the volume of water infiltrating into the waste rock storage areas, the contact surface between water and rock, the dissolution kinetics under site conditions, and the internal characteristics of the WRSAs themselves (e.g., temperature, degree of saturation, presence of ice). This, in turn, will depend largely on climate; particularly the amount of precipitation and evaporation, and the ambient air temperature. In wet years, for example, larger volumes of water may enter waste rock storage areas and result in the mobilization of greater volumes of mineral dissolution products than in drier years. Likewise, the presence of permafrost and/or ice within the rock voids may inhibit water movement and the mobilization of dissolution products in drainage reporting from these facilities. The use of drilling brines or underground development and saline groundwater production could require different handling procedures for drainage.

Specific to TSS, high levels of TSS are often correlated with discrete events that occur over shorter intervals. Depending on site-specific hydrological conditions and controls, and the resultant TSS load, total concentrations at specific points of interest could be higher or lower than the results presented here. Furthermore, this model does not include factors that will mitigate TSS, such as settling times.

Given the above, the mine site contact water flow volumes and quality will need to be monitored throughout the mine life, and the management of contact water will need to be adaptive.

6.0 CONCLUSIONS

Water quality predictions were updated to address information requests from KIA, CIRNA, and ECCC during the FEIS and Type A Water Licence Review (Appendix 1). The FEIS load balance model served as the basis for the prediction update (SRK 2015a; Golder 2017). Water quality predictions were evaluated in all open pits, tailings management facilities, and predefined locations downstream of the Goose Property. Results were compared to BC MOE guidelines and MDMER (final discharge points at the Goose Property), and CCME, BC MOE, and SSWQOs (receiving environment) guidelines.

Overall, the updates performed to the Water and Load Balance Model resulted in minor changes to the key water balance module results presented in the FEIS with effectively no impact on Project-wide water management strategy and sizing of water management infrastructure. Post-Closure water quality estimates for the TSF, Llama Reservoir, Umwelt TF, Goose Main TF and Echo Open Pit overflows at Closure are expected to meet the MDMER requirements. Water quality predictions do not indicate exceedances of the SSWQO for As or Cu in Goose Lake during the long-term, but do exceed during the initial stages of the Post-Closure phase, when the Goose Main TF begins to discharge to Goose Lake.. Sulphate did not exceed the BC MOE guideline during any phase of the Project in the receiving environment.

7.0 CLOSURE

We trust that this Technical Memorandum meets your current needs. Should you have any questions, please do not hesitate to contact the undersigned.

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Attachments: Appendix 1. Information Requests
Appendix 2. Complete Analyte List and Comparison Criteria for the Water Quality Results

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SRK. 2015b. Back River Project Water and Load Balance Report, dated October 2015.

SRK. 2015c. Geochemical Characterization in Support of the Final Environmental Impact Statement (FEIS) for the Back River Project, Nunavut, dated November 2015.

APPENDIX 1

Information Requests

IR No.	Source	Review Comment	Sabina Response
INAC-C-1			
¡ KIA-IR12:		¡ Provide further clarification as to the observed inconsistent use of the terms dissolved versus total in the above referenced documents.	The water quality model described in the Water and Load Balance Report (App E-2 of the MAD; 171002 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE) relied on load balance source terms calculated using the results of groundwater quality monitoring, surface water quality monitoring, and geochemical assessment.
		¡ If source terms are derived primarily from dissolved metal concentrations, comment on whether 'upper bound source concentrations' (noted in Section 7.3 of the Geochemical Characterization Report - App E-3 of the MAD) were used in a sensitivity analysis to capture the potential underestimation of additional loading (which was noted in Section 7.1 of the Geochemical Characterization Report – App E-3 of the MAD).	The model inputs were derived using dissolved concentrations. The model results (i.e., dissolved concentrations) were compared to CCME and MMER total concentration guidelines. This approach assumes that the predicted water quality has a negligible particulate component (i.e., total suspended sediments). Dissolved concentrations do not account for additional loading that may result from total suspended sediments, particularly for aluminum and iron.
		¡ Indicate how new monitoring results will be used to update model predictions.	
			Using the dissolved concentration inputs to the water quality model, there is limited potential for concentrations to exceed available guidelines as the constituent concentrations in process water are not expected to exceed guidelines. Many of the source inputs are expected to have negligible particulate (e.g., groundwater flows and runoff from pit walls and waste rock). Furthermore, there is limited potential for particulate to reach the receiving environment due to Project design features (e.g., planned active water treatment, passive water treatment in sediment ponds, limited potential for sediment resuspension in pits and tailings facilities).
			As outlined in Section 9.1 of App E-2 of the MAD (171002 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE), the base case source terms formed the basis of the water quality predictions. Sensitivity analyses were performed by modifying arsenic input concentrations (multiplying base case concentrations by factors of 2 and 0.5), runoff coefficients, and groundwater inputs. "Upper bound source concentrations" (Section 7.3 of the Geochemical Characterization Report - App E-3 of the MAD; 171002 2AM-BRP----MAD App E-3_GeochemCharactRpt-IMLE) were not used in a sensitivity analysis.
			As part of the final engineering design phase, water quality predictions will be updated to reflect the final Project design. Water quality source terms derived using groundwater and surface water quality monitoring data will be re-evaluated in the context of information collected since the submission of the Type A Water Licence Application. Geochemical source terms will be considered in the context of additional tailings geochemical test results. Lastly, the water quality predictions will be updated to include dissolved and particulate fractions.
			Sabina is committed to working in conjunction with the ECCC, INAC, and KIA prior to the technical meeting associated with the NWB Type A Water Licence review process to revise the water and load balance and set an appropriate timeline for revision.
¡ ECCC-IR-6:		¡ *ECCC recommends that the Proponent confirm whether the treatment effluent water quality model predictions used the erroneous input values for nitrite.*	Sabina confirms that the erroneous concentration of 30 mg/L of Nitrite was used in the water and load balance and Sabina commits to revising parameter concentration in next revision of the water and load balance. Sabina is committed to working in conjunction with the ECCC, INAC, and KIA prior to the technical meeting associated with the NWB Type A Water Licence review process to revise the water and load balance and set an appropriate timeline for revision.
WT-KIA-NWB-27		We again request the proponent commit to collect additional baseline water quality data from the lakes in the Project area during freshet and fall as confirmed by measurements of higher flow, prior to construction. Sabina should commit to use this data to update the water and load balance model. The Proponent will ensure sampling is an appropriate and accurate representation of at least one (1) full year of seasonal data.	At KIA's request, Sabina undertook additional seasonal baseline water quality characterization in 2017 and plans further baseline data collection in 2018. In advance of 2017 sampling, on July 30, 2017, the KIA was provided with an outline of the intended seasonal water quality baseline sampling for review and comment. Supplementary baseline sampling included both lake and stream sampling in August and September (i.e., fall) and included both Goose Lake and Goose Outflow. A summary of the locations and dates sampled, as well as the data to be collected, were included with this submission.
		The occurrence of freshet should be confirmed with on-site meteorological and flow measurements. If the results diverge from those presented in the 2015 Water and Load balance report, we request that Sabina provide additional water treatment options as necessary.	In 2018, Sabina will collect additional baseline data at proposed AEMP sites, including data to further characterize seasonal variability. Goose Lake, as well as the Reference Lake B, will be sampled in April (i.e., winter), as well as monthly during the open water season in July, August, and September (i.e., fall). Goose Outflow and the reference outflow will also be sampled monthly during the stream open water season; namely, June (i.e., freshet), July, August, and September.
		We further request that Sabina present monthly outputs for Goose Lake water quality and prediction nodes (PN) 01 through 13 to assist reviewers in determining when site water quality will comply with CCME water quality objectives for the protection of aquatic life and when Goose Lake will return to the baseline trophic level. Monthly outputs should be provided using the updated dataset.	To clarify, although streams can be sampled during freshet (June), representative lake water quality samples cannot be collected during freshet due to the difference in melt timing of the streams and lakes. In the Back River region, freshet (defined as peak stream flows) occurs in June, as the streams receive snow meltwater and progressively become ice free. During this month, lakes still remain covered by ice, with initial meltwater being deposited on the ice surface and eventually into the lakes as the shorelines melt; this seasonal melt usually begins near the point of entry of inflow drainages. During this time, lakes are not accessible; the ice surface is variably thinning, weakening, separating from shore, and progressively breaking apart preventing safe access. In contrast to streams, lakes generally only become ice-free in mid-July, at which time lake water sampling is again possible.
			Sabina commits to updating the Water and Load Balance Model using all available baseline data, including data that will be that collected in 2018, prior to the initiation of dewatering to ensure the water quality criteria for discharge are appropriate.
			Sabina highlights current model results for monthly outputs for Goose Lake water quality and prediction nodes (PN) 01 through 13 were provided in the Type A Water Licence Application. These results are provided in Appendix G of the Water and Load Balance Report (171002 2AM-BRP----MAD App E-2_WaterLoadBalanceRpt-IMLE) and updated results in Attachment 2 of the Technical Review of Water, Waste Rock, and Tailings Management/Design (171002 2AM-BRP----MAD App F-7_TechReview-IMLE).

APPENDIX 2

Complete Analyte List and Comparison Criteria for the Water Quality Results

Attachment 1A
Water Quality Results - Prediction Nodes

	Unit	Guidelines			Goose Background Source	PN01					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	15	5.5	14	15	5.5	14
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	2.2	2.0	2.2	2.2	2.0	2.2
Total dissolved solids	mg/L	-	-	-	23	16	12	16	16	12	16
Total suspended solids	mg/L	-	-	-	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	-	-	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Major Ions											
Chloride	mg/L	120	-	-	1.0	1.9	1.0	1.8	1.9	1.0	1.8
Cyanide	mg/L	0.0050	-	-	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	128 - 429[(a)]	-	4.1	5.3	4.2	5.3	5.3	4.2	5.3
Free cyanide	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	-	-	0.0010	0.0011	0.0010	0.0011	0.0011	0.0010	0.0011
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	0.015	0.0065	0.015	0.015	0.0065	0.015
Nitrite	mg-N/L	0.060	-	-	0.0010	0.0015	0.0010	0.0015	0.0015	0.0010	0.0015
Total ammonia	mg-N/L	1.6[(b)]	-	-	0.0050	0.0068	0.0050	0.0050	0.0068	0.0050	0.0050
Metals											
Aluminum	mg/L	0.0050 - 0.10[(c)]	-	-	0.011	0.012	0.011	0.012	0.014	0.014	0.014
Antimony	mg/L	-	-	-	0.000050	0.00014	0.000051	0.00014	0.00014	0.000051	0.00014
Arsenic	mg/L	0.0050	-	0.010	0.00020	0.00034	0.00026	0.00034	0.00035	0.00027	0.00035
Barium	mg/L	-	-	-	0.0051	0.0057	0.0051	0.0055	0.0057	0.0051	0.0055
Beryllium	mg/L	-	-	-	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
Bismuth	mg/L	-	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
Boron	mg/L	1.5	-	-	0.0050	0.0054	0.0050	0.0052	0.0054	0.0050	0.0052
Cadmium	mg/L	0.00011 - 0.077[(d)]	-	-	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
Calcium	mg/L	-	-	-	2.1	4.0	2.2	3.3	4.0	2.2	3.3
Chromium	mg/L	0.0010	-	-	0.00015	0.00015	0.00015	0.00015	0.00016	0.00016	0.00016
Cobalt	mg/L	-	-	-	0.00012	0.00019	0.00012	0.00019	0.00019	0.00012	0.00019
Copper	mg/L	0.0020 - 0.0040[(e)]	-	0.0046	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Iron	mg/L	0.30	-	-	0.014	0.015	0.014	0.015	0.023	0.021	0.023
Lead	mg/L	0.0010 - 0.0070 [(f)]	-	-	0.000050	0.000051	0.000050	0.000051	0.000051	0.000050	0.000051
Lithium	mg/L	-	-	-	0.0050	0.0057	0.0050	0.0054	0.0057	0.0050	0.0054
Magnesium	mg/L	-	-	-	1.3	1.4	1.3	1.4	1.4	1.3	1.4
Manganese	mg/L	-	-	-	0.0019	0.0022	0.0019	0.0022	0.0022	0.0020	0.0022
Mercury	mg/L	0.000026	-	-	0.000010	0.000010	0.000010	0.000010	0.000011	0.000010	0.000011
Molybdenum	mg/L	0.073	-	-	0.000050	0.00022	0.000053	0.00022	0.00022	0.000053	0.00022
Nickel	mg/L	0.025 - 0.15 [(g)]	-	-	0.0033	0.0034	0.0033	0.0034	0.0034	0.0033	0.0034
Phosphorus	mg/L	-	-	-	0.0039	0.0041	0.0039	0.0041	0.0041	0.0039	0.0041
Potassium	mg/L	-	-	-	0.34	0.39	0.34	0.39	0.39	0.34	0.39
Selenium	mg/L	0.0010	-	-	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Silicon	mg/L	-	-	-	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	0.00025	-	-	0.000010	0.000011	0.000010	0.000011	0.000011	0.000010	0.000011
Sodium	mg/L	-	-	-	0.66	1.4	0.69	1.2	1.4	0.69	1.2
Strontium	mg/L	-	-	-	0.0094	0.046	0.011	0.031	0.046	0.011	0.031
Tellurium	mg/L	-	-	-	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	0.00080	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Tin	mg/L	-	-	-	0.00010	0.00010	0.000100	0.00010	0.00010	0.000100	0.00010
Titanium	mg/L	-	-	-	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Uranium	mg/L	0.015	-	-	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
Vanadium	mg/L	-	-	-	0.000053	0.000059	0.000053	0.000059	0.000064	0.000057	0.000064
Zinc	mg/L	0.030	-	-	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030
Zirconium	mg/L	-	-	-	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

[(1)] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[(a)] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[(b)] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[(c)] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[(d)] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (µg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[(e)] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (µg/L) = 0.2 * $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[(f)] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (µg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[(g)] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (µg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[(B)] = concentration is higher than the BC MOE (2017) guideline.

[(C)] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

[(S)] = concentration is higher than the site-specific guideline guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

\- = no guideline or no data.

Prepared: TL
Reviewed: KS
Approved: KS

GOLDER

	Unit	Guidelines			Goose Background Source	PN02					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	169	12	114	169	12	114
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	8.6	4.4	8.6	8.6	4.4	8.6
Total dissolved solids	mg/L	-	-	-	23	136	28	136	136	28	136
Total suspended solids	mg/L	-	-	-	3.0	3.3	3.1	3.2	3.3	3.1	3.2
Total organic carbon	mg/L	-	-	-	4.0	4.4	4.1	4.3	4.4	4.1	4.3
Major Ions											
Chloride	mg/L	120	-	-	1.0	28	2.5	24	28	2.5	24
Cyanide	mg/L	0.0050	-	-	0.00054	0.00059	0.00054	0.00054	0.00059	0.00054	0.00054
Sulphate	mg/L	-	128 - 429[(a)]	-	4.1	41	10	41	41	10	41
Free cyanide	mg/l	-	-	-	0.0010	0.0011	0.0010	0.0011	0.0011	0.0010	0.0011
Cyanide - wad	mg/l	-	-	-	0.0010	0.0048	0.0010	0.0048	0.0048	0.0010	0.0048
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	0.29	0.0088	0.28	0.29	0.0088	0.28
Nitrite	mg-N/L	0.060	-	-	0.0010	0.017	0.0011	0.017	0.017	0.0011	0.017
Total ammonia	mg-N/L	1.6[(b)]	-	-	0.0050	0.066	0.0050	0.0050	0.066	0.0050	0.0050
Metals											
Aluminum	mg/L	0.0050 - 0.10[(c)]	-	-	0.011	0.031	0.020	0.031	**0.11**[(C)]	0.089	**0.11**[(C)]
Antimony	mg/L	-	-	-	0.000050	0.0029	0.00011	0.0029	0.0029	0.00011	0.0029
Arsenic	mg/L	0.0050	-	0.010	0.00020	0.0046	0.0023	0.0046	0.0049	0.0025	0.0049
Barium	mg/L	-	-	-	0.0051	0.027	0.0062	0.018	0.027	0.0065	0.018
Beryllium	mg/L	-	-	-	0.00020	0.00022	0.00020	0.00022	0.00023	0.00021	0.00023
Bismuth	mg/L	-	-	-	0.00050	0.00070	0.00051	0.00062	0.00070	0.00051	0.00062
Boron	mg/L	1.5	-	-	0.0050	0.019	0.0057	0.014	0.019	0.0057	0.014
Cadmium	mg/L	0.00011 - 0.077[(d)]	-	-	0.000010	0.000019	0.000013	0.000019	0.000019	0.000013	0.000019
Calcium	mg/L	-	-	-	2.1	60	6.5	39	60	6.5	39
Chromium	mg/L	0.0010	-	-	0.00015	0.00021	0.00015	0.00021	0.00052	0.00042	0.00052
Cobalt	mg/L	-	-	-	0.00012	0.0023	0.00015	0.0023	0.0023	0.00019	0.0023
Copper	mg/L	0.0020 - 0.0040[(e)]	-	0.0046	0.0014	0.0021	0.0016	0.0021	0.0022	0.0017	0.0022
Iron	mg/L	0.30	-	-	0.014	0.056	0.025	0.056	0.29	0.23	0.29
Lead	mg/L	0.0010 - 0.0070[(f)]	-	-	0.000050	0.000093	0.000051	0.000093	0.00011	0.000068	0.00011
Lithium	mg/L	-	-	-	0.0050	0.030	0.0062	0.019	0.030	0.0062	0.019
Magnesium	mg/L	-	-	-	1.3	5.1	1.7	4.1	5.1	1.7	4.1
Manganese	mg/L	-	-	-	0.0019	0.013	0.0041	0.012	0.013	0.0050	0.013
Mercury	mg/L	0.000026	-	-	0.000010	0.000013	0.000011	0.000013	**0.000036**[(C)]	**0.000030**[(C)]	**0.000036**[(C)]
Molybdenum	mg/L	0.073	-	-	0.000050	0.0051	0.00017	0.0051	0.0051	0.00017	0.0051
Nickel	mg/L	0.025 - 0.15[(g)]	-	-	0.0033	0.0065	0.0047	0.0065	0.0065	0.0048	0.0065
Phosphorus	mg/L	-	-	-	0.0039	0.011	0.0040	0.011	0.013	0.0057	0.013
Potassium	mg/L	-	-	-	0.34	2.2	0.38	2.2	2.2	0.40	2.2
Selenium	mg/L	0.0010	-	-	0.00010	0.00027	0.00014	0.00027	0.00027	0.00014	0.00027
Silicon	mg/L	-	-	-	0.28	0.32	0.28	0.32	0.32	0.28	0.32
Silver	mg/L	0.00025	-	-	0.000010	0.000047	0.000011	0.000047	0.000047	0.000011	0.000047
Sodium	mg/L	-	-	-	0.66	25	1.9	19	25	1.9	19
Strontium	mg/L	-	-	-	0.0094	1.2	0.067	0.67	1.2	0.067	0.67
Tellurium	mg/L	-	-	-	0.0020	0.0022	0.0020	0.0022	0.0022	0.0020	0.0022
Thallium	mg/L	0.00080	-	-	0.000050	0.000070	0.000051	0.000062	0.000070	0.000051	0.000062
Tin	mg/L	-	-	-	0.00010	0.00014	0.00010	0.00014	0.00014	0.00010	0.00014
Titanium	mg/L	-	-	-	0.010	0.011	0.010	0.011	0.015	0.013	0.015
Uranium	mg/L	0.015	-	-	0.000010	0.000014	0.000010	0.000012	0.000016	0.000014	0.000016
Vanadium	mg/L	-	-	-	0.000053	0.00025	0.000059	0.00025	0.00040	0.00019	0.00040
Zinc	mg/L	0.030	-	-	0.0030	0.0045	0.0034	0.0044	0.0045	0.0035	0.0045
Zirconium	mg/L	-	-	-	0.00040	0.00044	0.00041	0.00044	0.00044	0.00041	0.00044

Notes:

[(1)] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[(a)] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[(b)] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[(c)] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[(d)] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[(e)] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = 0.2 * $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[(f)] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[(g)] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[(B)] = concentration is higher than the BC MOE (2017) guideline.
[(C)] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.
[(S)] = concentration is higher than the site-specific guideline guideline.
Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.
\- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	PN03					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	341	18	217	341	18	217
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	15	6.8	15	15	6.8	15
Total dissolved solids	mg/L	-	-	-	23	267	45	258	267	45	258
Total suspended solids	mg/L	-	-	-	3.0	3.9	3.1	3.5	3.9	3.1	3.5
Total organic carbon	mg/L	-	-	-	4.0	5.2	4.1	4.6	5.2	4.1	4.6
Major Ions											
Chloride	mg/L	120	-	-	1.0	58	4.0	47	58	4.0	47
Cyanide	mg/L	0.0050	-	-	0.00054	0.00070	0.00054	0.00054	0.00070	0.00054	0.00054
Sulphate	mg/L	-	128 - 429[a]	-	4.1	78	16	78	78	16	78
Free cyanide	mg/l	-	-	-	0.0010	0.0013	0.0010	0.0012	0.0013	0.0010	0.0012
Cyanide - wad	mg/l	-	-	-	0.0010	0.0085	0.0010	0.0085	0.0085	0.0010	0.0085
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	0.65	0.011	0.54	0.65	0.011	0.54
Nitrite	mg-N/L	0.060	-	-	0.0010	0.034	0.0013	0.032	0.034	0.0013	0.032
Total ammonia	mg-N/L	1.6[b]	-	-	0.0050	0.14	0.0050	0.0050	0.14	0.0050	0.0050
Metals											
Aluminum	mg/L	0.0050 - 0.10[c]	-	-	0.011	0.050	0.028	0.050	**0.21**[C]	**0.17**[C]	**0.21**[C]
Antimony	mg/L	-	-	-	0.000050	0.0058	0.00018	0.0058	0.0058	0.00018	0.0058
Arsenic	mg/L	0.0050	-	0.010	0.00020	**0.0089**[C]	0.0044	**0.0089**[C]	**0.0095**[C]	0.0050	**0.0095**[C]
Barium	mg/L	-	-	-	0.0051	0.051	0.0073	0.031	0.051	0.0079	0.031
Beryllium	mg/L	-	-	-	0.00020	0.00026	0.00021	0.00023	0.00026	0.00022	0.00026
Bismuth	mg/L	-	-	-	0.00050	0.00091	0.00052	0.00073	0.00091	0.00052	0.00073
Boron	mg/L	1.5	-	-	0.0050	0.035	0.0064	0.023	0.035	0.0064	0.023
Cadmium	mg/L	0.00011 - 0.077[d]	-	-	0.000010	0.000028	0.000015	0.000028	0.000028	0.000015	0.000028
Calcium	mg/L	-	-	-	2.1	123	11	76	123	11	76
Chromium	mg/L	0.0010	-	-	0.00015	0.00027	0.00016	0.00027	0.00088	0.00069	0.00088
Cobalt	mg/L	-	-	-	0.00012	0.0045	0.00017	0.0045	0.0045	0.00027	0.0045
Copper	mg/L	0.0020 - 0.0040[e]	-	0.0046	0.0014	0.0027	0.0018	0.0027	0.0030	**0.0021**[C]	0.0030
Iron	mg/L	0.30	-	-	0.014	0.098	0.036	0.098	**0.56**[C]	**0.45**[C]	**0.56**[C]
Lead	mg/L	0.0010 - 0.0070 [f]	-	-	0.000050	0.00014	0.000053	0.00014	0.00018	0.000087	0.00018
Lithium	mg/L	-	-	-	0.0050	0.057	0.0075	0.034	0.057	0.0075	0.034
Magnesium	mg/L	-	-	-	1.3	9.1	2.1	7.0	9.1	2.1	7.0
Manganese	mg/L	-	-	-	0.0019	0.025	0.0064	0.021	0.025	0.0082	0.023
Mercury	mg/L	0.000026	-	-	0.000010	0.000016	0.000012	0.000016	**0.000061**[C]	**0.000051**[C]	**0.000061**[C]
Molybdenum	mg/L	0.073	-	-	0.000050	0.010	0.00030	0.010	0.010	0.00030	0.010
Nickel	mg/L	0.025 - 0.15 [g]	-	-	0.0033	0.0096	0.0062	0.0096	0.0096	0.0063	0.0096
Phosphorus	mg/L	-	-	-	0.0039	0.018	0.0041	0.018	0.022	0.0075	0.022
Potassium	mg/L	-	-	-	0.34	4.1	0.43	4.1	4.1	0.47	4.1
Selenium	mg/L	0.0010	-	-	0.00010	0.00043	0.00018	0.00043	0.00043	0.00018	0.00043
Silicon	mg/L	-	-	-	0.28	0.37	0.29	0.37	0.37	0.29	0.37
Silver	mg/L	0.00025	-	-	0.000010	0.000084	0.000012	0.000084	0.000084	0.000013	0.000084
Sodium	mg/L	-	-	-	0.66	50	3.1	37	50	3.1	37
Strontium	mg/L	-	-	-	0.0094	2.4	0.13	1.3	2.4	0.13	1.3
Tellurium	mg/L	-	-	-	0.0020	0.0026	0.0021	0.0023	0.0026	0.0021	0.0023
Thallium	mg/L	0.00080	-	-	0.000050	0.000091	0.000052	0.000073	0.000091	0.000053	0.000073
Tin	mg/L	-	-	-	0.00010	0.00018	0.00010	0.00017	0.00018	0.00010	0.00017
Titanium	mg/L	-	-	-	0.010	0.013	0.010	0.012	0.020	0.016	0.019
Uranium	mg/L	0.015	-	-	0.000010	0.000018	0.000010	0.000015	0.000023	0.000018	0.000023
Vanadium	mg/L	-	-	-	0.000053	0.00044	0.000065	0.00044	0.00074	0.00034	0.00074
Zinc	mg/L	0.030	-	-	0.0030	0.0062	0.0038	0.0058	0.0062	0.0041	0.0061
Zirconium	mg/L	-	-	-	0.00040	0.00052	0.00041	0.00047	0.00052	0.00041	0.00047

Notes:

[1] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[a] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[b] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[c] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[d] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[e] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = 0.2 * $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[f] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[g] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[B] = concentration is higher than the BC MOE (2017) guideline.

[C] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

[S] = concentration is higher than the site-specific guideline guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

\- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	PN04					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	1,391	44	540	1,391	44	540
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	12	11	12	12	11	12
Total dissolved solids	mg/L	-	-	-	23	1,076	95	412	1,076	95	412
Total suspended solids	mg/L	-	-	-	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	-	-	4.0	4.1	4.0	4.1	4.1	4.0	4.1
Major Ions											
Chloride	mg/L	120	-	-	1.0	**253**[C]	12	87	**253**[C]	12	87
Cyanide	mg/L	0.0050	-	-	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	128 - 429[a]	-	4.1	60	26	34	60	26	34
Free cyanide	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	-	-	0.0010	0.0016	0.0010	0.0012	0.0016	0.0010	0.0012
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	1.6	0.018	0.12	1.6	0.018	0.12
Nitrite	mg-N/L	0.060	-	-	0.0010	**0.081**[C]	0.0016	0.0076	**0.081**[C]	0.0016	0.0076
Total ammonia	mg-N/L	1.6[b]	-	-	0.0050	0.99	0.0050	0.0053	0.99	0.0050	0.0053
Metals											
Aluminum	mg/L	0.0050 - 0.10[c]	-	-	0.011	0.049	0.044	0.048	**0.18**[C]	**0.17**[C]	**0.18**[C]
Antimony	mg/L	-	-	-	0.000050	0.00075	0.00028	0.00046	0.00075	0.00028	0.00046
Arsenic	mg/L	0.0050	-	0.010	0.00020	**0.011**[C, S]	**0.0082**[C]	**0.0094**[C]	**0.011**[C, S]	**0.0089**[C]	**0.010**[C]
Barium	mg/L	-	-	-	0.0051	0.20	0.013	0.074	0.20	0.014	0.076
Beryllium	mg/L	-	-	-	0.00020	0.00022	0.00020	0.00020	0.00024	0.00022	0.00023
Bismuth	mg/L	-	-	-	0.00050	0.0019	0.00053	0.00096	0.0019	0.00053	0.00097
Boron	mg/L	1.5	-	-	0.0050	0.13	0.0100	0.049	0.13	0.0100	0.050
Cadmium	mg/L	0.00011 - 0.077[d]	-	-	0.000010	0.000042	0.000020	0.000028	0.000042	0.000020	0.000029
Calcium	mg/L	-	-	-	2.1	535	30	192	535	30	194
Chromium	mg/L	0.0010	-	-	0.00015	0.00034	0.00015	0.00021	0.00082	0.00065	0.00073
Cobalt	mg/L	-	-	-	0.00012	0.00082	0.00021	0.00041	0.00084	0.00030	0.00050
Copper	mg/L	0.0020 - 0.0040[e]	-	0.0046	0.0014	0.0025	**0.0021**[C]	0.0024	0.0027	**0.0023**[C]	0.0026
Iron	mg/L	0.30	-	-	0.014	0.17	0.060	0.099	**0.56**[C]	**0.44**[C]	**0.50**[C]
Lead	mg/L	0.0010 - 0.0070 [f]	-	-	0.000050	0.00020	0.000054	0.000098	0.00021	0.000086	0.00013
Lithium	mg/L	-	-	-	0.0050	0.23	0.014	0.085	0.23	0.014	0.085
Magnesium	mg/L	-	-	-	1.3	35	3.4	13	35	3.4	14
Manganese	mg/L	-	-	-	0.0019	0.098	0.012	0.040	0.098	0.014	0.043
Mercury	mg/L	0.000026	-	-	0.000010	0.000013	0.000013	0.000013	**0.000052**[C]	**0.000049**[C]	**0.000052**[C]
Molybdenum	mg/L	0.073	-	-	0.000050	0.0024	0.00052	0.0012	0.0024	0.00052	0.0012
Nickel	mg/L	0.025 - 0.15 [g]	-	-	0.0033	0.0095	0.0088	0.0093	0.0096	0.0089	0.0094
Phosphorus	mg/L	-	-	-	0.0039	0.012	0.0041	0.0065	0.014	0.0075	0.010
Potassium	mg/L	-	-	-	0.34	8.5	0.65	3.2	8.5	0.69	3.3
Selenium	mg/L	0.0010	-	-	0.00010	0.00044	0.00025	0.00034	0.00044	0.00025	0.00034
Silicon	mg/L	-	-	-	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	0.00025	-	-	0.000010	0.000045	0.000014	0.000024	0.000045	0.000014	0.000025
Sodium	mg/L	-	-	-	0.66	222	9.8	78	222	9.8	79
Strontium	mg/L	-	-	-	0.0094	11	0.45	3.7	11	0.45	3.7
Tellurium	mg/L	-	-	-	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	0.00080	-	-	0.000050	0.00019	0.000053	0.000096	0.00019	0.000054	0.000098
Tin	mg/L	-	-	-	0.00010	0.00038	0.00011	0.00019	0.00038	0.00011	0.00019
Titanium	mg/L	-	-	-	0.010	0.013	0.010	0.010	0.018	0.016	0.017
Uranium	mg/L	0.015	-	-	0.000010	0.000038	0.000011	0.000019	0.000042	0.000018	0.000026
Vanadium	mg/L	-	-	-	0.000053	0.0012	0.000095	0.00044	0.0013	0.00034	0.00069
Zinc	mg/L	0.030	-	-	0.0030	0.013	0.0046	0.0074	0.013	0.0049	0.0078
Zirconium	mg/L	-	-	-	0.00040	0.00041	0.00040	0.00041	0.00041	0.00040	0.00041

Notes:

[1] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[a] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[b] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[c] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[d] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[hardness]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[e] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = 0.2 * $e^{\{0.8545[\ln(hardness)]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[f] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(hardness)]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[g] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(hardness)]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[B] = concentration is higher than the BC MOE (2017) guideline.

[C] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

[S] = concentration is higher than the site-specific guideline guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	PN06					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	158	12	145	158	12	145
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	42	8.6	38	42	8.6	38
Total dissolved solids	mg/L	-	-	-	23	564	42	492	564	42	492
Total suspended solids	mg/L	-	-	-	3.0	3.1	3.0	3.1	3.1	3.0	3.1
Total organic carbon	mg/L	-	-	-	4.0	4.2	4.1	4.2	4.2	4.1	4.2
Major Ions											
Chloride	mg/L	120	-	-	1.0	100	1.1	86	100	1.1	86
Cyanide	mg/L	0.0050	-	-	0.00054	0.00055	0.00054	0.00055	0.00055	0.00054	0.00055
Sulphate	mg/L	-	128 - 429[a]	-	4.1	282	22	246	282	22	246
Free cyanide	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	-	-	0.0010	0.034	0.0010	0.029	0.034	0.0010	0.029
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	2.2	0.0091	1.9	2.2	0.0091	1.9
Nitrite	mg-N/L	0.060	-	-	0.0010	**0.13[(C)]**	0.0011	**0.11[(C)]**	**0.13[(C)]**	0.0011	**0.11[(C)]**
Total ammonia	mg-N/L	1.6[b]	-	-	0.0050	0.24	0.0050	0.0072	0.24	0.0050	0.0072
Metals											
Aluminum	mg/L	0.0050 - 0.10[c]	-	-	0.011	**0.11[(C)]**	0.033	0.099	**0.40[(C)]**	**0.32[(C)]**	**0.38[(C)]**
Antimony	mg/L	-	-	-	0.000050	0.025	0.00021	0.022	0.025	0.00021	0.022
Arsenic	mg/L	0.0050	-	0.010	0.00020	**0.023[(C, S)]**	**0.0057[(C)]**	**0.020[(C, S)]**	**0.024[(C, S)]**	**0.0070[(C)]**	**0.022[(C, S)]**
Barium	mg/L	-	-	-	0.0051	0.0090	0.0052	0.0085	0.010	0.0062	0.0099
Beryllium	mg/L	-	-	-	0.00020	0.00021	0.00020	0.00021	0.00023	0.00023	0.00023
Bismuth	mg/L	-	-	-	0.00050	0.00052	0.00051	0.00052	0.00052	0.00051	0.00052
Boron	mg/L	1.5	-	-	0.0050	0.015	0.0051	0.013	0.015	0.0051	0.014
Cadmium	mg/L	0.00011 - 0.077[d]	-	-	0.000010	0.000051	0.000016	0.000046	0.000051	0.000016	0.000048
Calcium	mg/L	-	-	-	2.1	50	6.2	44	50	6.2	45
Chromium	mg/L	0.0010	-	-	0.00015	0.00048	0.00015	0.00044	**0.0016[(C)]**	**0.0012[(C)]**	**0.0015[(C)]**
Cobalt	mg/L	-	-	-	0.00012	0.019	0.00018	0.016	0.019	0.00037	0.017
Copper	mg/L	0.0020 - 0.0040[e]	-	0.0046	0.0014	**0.0044[(C)]**	0.0019	**0.0041[(C)]**	**0.0049[(C, S)]**	**0.0024[(C)]**	**0.0046[(C)]**
Iron	mg/L	0.30	-	-	0.014	0.24	0.039	0.21	**1.1[(C)]**	**0.87[(C)]**	**1.0[(C)]**
Lead	mg/L	0.0010 - 0.0070 [f]	-	-	0.000050	0.00033	0.000051	0.00029	0.00039	0.00012	0.00036
Lithium	mg/L	-	-	-	0.0050	0.0052	0.0051	0.0052	0.0052	0.0051	0.0052
Magnesium	mg/L	-	-	-	1.3	8.7	1.8	7.8	8.7	2.0	8.0
Manganese	mg/L	-	-	-	0.0019	0.033	0.0060	0.029	0.036	0.010	0.034
Mercury	mg/L	0.000026	-	-	0.000010	0.000024	0.000012	0.000022	**0.00010[(C)]**	**0.000090[(C)]**	**0.000099[(C)]**
Molybdenum	mg/L	0.073	-	-	0.000050	0.044	0.00037	0.038	0.044	0.00038	0.038
Nickel	mg/L	0.025 - 0.15 [g]	-	-	0.0033	0.018	0.0067	0.016	0.018	0.0071	0.017
Phosphorus	mg/L	-	-	-	0.0039	0.061	0.0040	0.053	0.066	0.011	0.061
Potassium	mg/L	-	-	-	0.34	13	0.35	11	13	0.41	12
Selenium	mg/L	0.0010	-	-	0.00010	**0.0011[(C)]**	0.00021	0.00097	**0.0011[(C)]**	0.00021	0.00099
Silicon	mg/L	-	-	-	0.28	0.44	0.28	0.42	0.44	0.28	0.42
Silver	mg/L	0.00025	-	-	0.000010	**0.00031[(C)]**	0.000012	**0.00027[(C)]**	**0.00031[(C)]**	0.000013	**0.00028[(C)]**
Sodium	mg/L	-	-	-	0.66	56	0.71	49	56	0.71	50
Strontium	mg/L	-	-	-	0.0094	0.12	0.0096	0.11	0.12	0.0096	0.11
Tellurium	mg/L	-	-	-	0.0020	0.0021	0.0020	0.0021	0.0021	0.0020	0.0021
Thallium	mg/L	0.00080	-	-	0.000050	0.000052	0.000051	0.000052	0.000052	0.000051	0.000052
Tin	mg/L	-	-	-	0.00010	0.00021	0.00010	0.00020	0.00021	0.00010	0.00020
Titanium	mg/L	-	-	-	0.010	0.010	0.010	0.010	0.023	0.022	0.022
Uranium	mg/L	0.015	-	-	0.000010	0.000010	0.000010	0.000010	0.000025	0.000025	0.000025
Vanadium	mg/L	-	-	-	0.000053	0.0013	0.000054	0.0011	0.0018	0.00061	0.0017
Zinc	mg/L	0.030	-	-	0.0030	0.0059	0.0038	0.0056	0.0064	0.0044	0.0063
Zirconium	mg/L	-	-	-	0.00040	0.00042	0.00041	0.00042	0.00042	0.00041	0.00042

Notes:

[1] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[a] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[b] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[c] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[d] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[e] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = 0.2 * $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[f] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[g] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[(B)] = concentration is higher than the BC MOE (2017) guideline.
[(C)] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.
[(S)] = concentration is higher than the site-specific guideline guideline.
Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.
\- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	PN09					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	22	9.7	20	22	9.7	20
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	7.5	6.0	6.5	7.5	6.0	6.5
Total dissolved solids	mg/L	-	-	-	23	41	28	30	41	28	30
Total suspended solids	mg/L	-	-	-	3.0	3.1	3.0	3.1	3.1	3.0	3.1
Total organic carbon	mg/L	-	-	-	4.0	4.1	4.0	4.1	4.1	4.0	4.1
Major Ions											
Chloride	mg/L	120	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cyanide	mg/L	0.0050	-	-	0.00054	0.00055	0.00054	0.00055	0.00055	0.00054	0.00055
Sulphate	mg/L	-	128 - 429[a]	-	4.1	20	12	13	20	12	13
Free cyanide	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	2.3	0.0075	0.073	2.3	0.0075	0.073
Nitrite	mg-N/L	0.060	-	-	0.0010	**0.11**[C]	0.0010	0.0043	**0.11**[C]	0.0010	0.0043
Total ammonia	mg-N/L	1.6[b]	-	-	0.0050	1.4	0.0056	0.046	1.4	0.0056	0.046
Metals											
Aluminum	mg/L	0.0050 - 0.10[c]	-	-	0.011	0.049	0.036	0.040	**0.23**[C]	**0.22**[C]	**0.23**[C]
Antimony	mg/L	-	-	-	0.000050	0.00024	0.00018	0.00020	0.00024	0.00018	0.00020
Arsenic	mg/L	0.0050	-	0.010	0.00020	**0.010**[C]	**0.0057**[C]	**0.0065**[C]	**0.011**[C, S]	**0.0064**[C]	**0.0071**[C]
Barium	mg/L	-	-	-	0.0051	0.0053	0.0052	0.0053	0.0056	0.0055	0.0055
Beryllium	mg/L	-	-	-	0.00020	0.00021	0.00020	0.00021	0.00021	0.00021	0.00021
Bismuth	mg/L	-	-	-	0.00050	0.00051	0.00050	0.00051	0.00051	0.00050	0.00051
Boron	mg/L	1.5	-	-	0.0050	0.0051	0.0050	0.0051	0.0051	0.0050	0.0051
Cadmium	mg/L	0.00011 - 0.077[d]	-	-	0.000010	0.000025	0.000019	0.000020	0.000025	0.000020	0.000021
Calcium	mg/L	-	-	-	2.1	5.5	4.6	4.9	5.5	4.6	4.9
Chromium	mg/L	0.0010	-	-	0.00015	0.00015	0.00015	0.00015	**0.0011**[C]	**0.0011**[C]	**0.0011**[C]
Cobalt	mg/L	-	-	-	0.00012	0.00023	0.00019	0.00020	0.00037	0.00036	0.00036
Copper	mg/L	0.0020 - 0.0040[e]	-	0.0046	0.0014	0.0018	0.0017	0.0018	**0.0022**[C]	**0.0021**[C]	**0.0022**[C]
Iron	mg/L	0.30	-	-	0.014	0.082	0.056	0.061	**0.47**[C]	**0.46**[C]	**0.47**[C]
Lead	mg/L	0.0010 - 0.0070 [f]	-	-	0.000050	0.000051	0.000050	0.000051	0.000099	0.000097	0.000099
Lithium	mg/L	-	-	-	0.0050	0.0051	0.0050	0.0051	0.0051	0.0050	0.0051
Magnesium	mg/L	-	-	-	1.3	1.9	1.7	1.8	1.9	1.8	1.9
Manganese	mg/L	-	-	-	0.0019	0.013	0.0089	0.0098	0.015	0.012	0.012
Mercury	mg/L	0.000026	-	-	0.000010	0.000011	0.000011	0.000011	**0.000068**[C]	**0.000066**[C]	**0.000068**[C]
Molybdenum	mg/L	0.073	-	-	0.000050	0.00025	0.00020	0.00022	0.00025	0.00022	0.00024
Nickel	mg/L	0.025 - 0.15 [g]	-	-	0.0033	0.013	0.0090	0.0098	0.013	0.0095	0.010
Phosphorus	mg/L	-	-	-	0.0039	0.0040	0.0039	0.0040	0.0088	0.0086	0.0088
Potassium	mg/L	-	-	-	0.34	0.35	0.34	0.35	0.36	0.36	0.36
Selenium	mg/L	0.0010	-	-	0.00010	0.00017	0.00015	0.00016	0.00017	0.00016	0.00016
Silicon	mg/L	-	-	-	0.28	0.29	0.28	0.29	0.29	0.28	0.29
Silver	mg/L	0.00025	-	-	0.000010	0.000011	0.000011	0.000011	0.000012	0.000012	0.000012
Sodium	mg/L	-	-	-	0.66	0.68	0.67	0.68	0.68	0.67	0.68
Strontium	mg/L	-	-	-	0.0094	0.0097	0.0095	0.0097	0.0097	0.0095	0.0097
Tellurium	mg/L	-	-	-	0.0020	0.0021	0.0020	0.0021	0.0021	0.0020	0.0021
Thallium	mg/L	0.00080	-	-	0.000050	0.000051	0.000050	0.000051	0.000051	0.000050	0.000051
Tin	mg/L	-	-	-	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
Titanium	mg/L	-	-	-	0.010	0.010	0.010	0.010	0.016	0.016	0.016
Uranium	mg/L	0.015	-	-	0.000010	0.000010	0.000010	0.000010	0.000021	0.000021	0.000021
Vanadium	mg/L	-	-	-	0.000053	0.000054	0.000053	0.000054	0.00042	0.00041	0.00042
Zinc	mg/L	0.030	-	-	0.0030	0.0050	0.0042	0.0044	0.0052	0.0048	0.0049
Zirconium	mg/L	-	-	-	0.00040	0.00041	0.00040	0.00041	0.00041	0.00040	0.00041

Notes:

[1] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[a] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[b] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[c] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[d] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[hardness]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[e] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = 0.2 * $e^{\{0.8545[\ln(hardness)]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[f] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(hardness)]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[g] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(hardness)]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[B] = concentration is higher than the BC MOE (2017) guideline.

[C] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

[S] = concentration is higher than the site-specific guideline guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	PN10					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	3,962	98	1,364	3,962	98	1,364
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	23	21	22	23	21	22
Total dissolved solids	mg/L	-	-	-	23	2,968	200	1,037	2,968	200	1,037
Total suspended solids	mg/L	-	-	-	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	-	-	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Major Ions											
Chloride	mg/L	120	-	-	1.0	**2,957**(c)	28	**226**(c)	**2,957**(c)	28	**226**(c)
Cyanide	mg/L	0.0050	-	-	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	128 - 429(a)	-	4.1	130	51	66	130	51	66
Free cyanide	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	-	-	0.0010	0.0025	0.0010	0.0014	0.0025	0.0010	0.0014
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	0.77	0.033	0.29	0.77	0.033	0.29
Nitrite	mg-N/L	0.060	-	-	0.0010	0.045	0.0025	0.017	0.045	0.0025	0.017
Total ammonia	mg-N/L	1.6(b)	-	-	0.0050	0.024	0.0050	0.0053	0.024	0.0050	0.0053
Metals											
Aluminum	mg/L	0.0050 - 0.10(c)	-	-	0.011	0.083	0.075	0.081	**0.37**(c)	**0.36**(c)	**0.37**(c)
Antimony	mg/L	-	-	-	0.000050	0.0018	0.00051	0.00095	0.0018	0.00051	0.00095
Arsenic	mg/L	0.0050	-	0.010	0.00020	**0.021**(C, S)	**0.016**(C, S)	**0.018**(C, S)	**0.023**(C, S)	**0.018**(C, S)	**0.020**(C, S)
Barium	mg/L	-	-	-	0.0051	0.54	0.024	0.18	0.54	0.026	0.19
Beryllium	mg/L	-	-	-	0.00020	0.00023	0.00020	0.00020	0.00032	0.00024	0.00027
Bismuth	mg/L	-	-	-	0.00050	0.0042	0.00058	0.0017	0.0042	0.00058	0.0017
Boron	mg/L	1.5	-	-	0.0050	0.35	0.017	0.12	0.35	0.017	0.12
Cadmium	mg/L	0.00011 - 0.077(d)	-	-	0.000010	0.000089	0.000029	0.000048	0.000090	0.000029	0.000049
Calcium	mg/L	-	-	-	2.1	1,436	66	492	1,436	66	492
Chromium	mg/L	0.0010	-	-	0.00015	0.00067	0.00016	0.00031	**0.0017**(c)	**0.0013**(c)	**0.0014**(c)
Cobalt	mg/L	-	-	-	0.00012	0.0019	0.00030	0.00082	0.0021	0.00049	0.00100
Copper	mg/L	0.0020 - 0.0040(e)	-	0.0046	0.0014	0.0038	**0.0030**(c)	0.0034	**0.0043**(c)	**0.0035**(c)	0.0039
Iron	mg/L	0.30	-	-	0.014	**0.39**(c)	0.099	0.19	**1.2**(c)	**0.97**(c)	**1.1**(c)
Lead	mg/L	0.0010 - 0.0070 (f)	-	-	0.000050	0.00044	0.000058	0.00018	0.00051	0.00013	0.00025
Lithium	mg/L	-	-	-	0.0050	0.62	0.027	0.21	0.62	0.027	0.21
Magnesium	mg/L	-	-	-	1.3	91	6.1	32	91	6.3	33
Manganese	mg/L	-	-	-	0.0019	0.26	0.023	0.096	0.26	0.027	0.100
Mercury	mg/L	0.000026	-	-	0.000010	0.000017	0.000016	0.000016	**0.00010**(c)	**0.000099**(c)	**0.00010**(c)
Molybdenum	mg/L	0.073	-	-	0.000050	0.0062	0.0011	0.0027	0.0062	0.0011	0.0027
Nickel	mg/L	0.025 - 0.15 (g)	-	-	0.0033	0.014	0.013	0.014	0.015	0.014	0.014
Phosphorus	mg/L	-	-	-	0.0039	0.025	0.0042	0.011	0.033	0.012	0.019
Potassium	mg/L	-	-	-	0.34	22	1.1	7.7	22	1.2	7.8
Selenium	mg/L	0.0010	-	-	0.00010	0.00091	0.00043	0.00061	0.00091	0.00043	0.00061
Silicon	mg/L	-	-	-	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	0.00025	-	-	0.000010	0.00010	0.000018	0.000044	0.00010	0.000020	0.000046
Sodium	mg/L	-	-	-	0.66	597	23	201	597	23	201
Strontium	mg/L	-	-	-	0.0094	29	1.1	9.6	29	1.1	9.6
Tellurium	mg/L	-	-	-	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	0.00080	-	-	0.000050	0.00042	0.000058	0.00017	0.00043	0.000059	0.00017
Tin	mg/L	-	-	-	0.00010	0.00086	0.00012	0.00034	0.00086	0.00012	0.00034
Titanium	mg/L	-	-	-	0.010	0.017	0.010	0.011	0.030	0.023	0.025
Uranium	mg/L	0.015	-	-	0.000010	0.000085	0.000012	0.000034	0.000100	0.000027	0.000050
Vanadium	mg/L	-	-	-	0.000053	0.0030	0.00015	0.0010	0.0036	0.00071	0.0016
Zinc	mg/L	0.030	-	-	0.0030	0.029	0.0062	0.014	0.030	0.0068	0.014
Zirconium	mg/L	-	-	-	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

(1) = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

(a) = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

(b) = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

(c) = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

(d) = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

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(f) = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

(g) = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

(B) = concentration is higher than the BC MOE (2017) guideline.

(C) = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

(S) = concentration is higher than the site-specific guideline guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	PN08, PN11, PN12 & PN13					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	11	5.4	11	11	5.4	11
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Total dissolved solids	mg/L	-	-	-	23	23	23	23	23	23	23
Total suspended solids	mg/L	-	-	-	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	-	-	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Major Ions											
Chloride	mg/L	120	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cyanide	mg/L	0.0050	-	-	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	128 - 429[a]	-	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Free cyanide	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065
Nitrite	mg-N/L	0.060	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010
Total ammonia	mg-N/L	1.6[b]	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Metals											
Aluminum	mg/L	0.0050 - 0.10[c]	-	-	0.011	0.011	0.011	0.011	0.011	0.011	0.011
Antimony	mg/L	-	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Arsenic	mg/L	0.0050	-	0.010	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
Barium	mg/L	-	-	-	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051	0.0051
Beryllium	mg/L	-	-	-	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020	0.00020
Bismuth	mg/L	-	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
Boron	mg/L	1.5	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Cadmium	mg/L	0.00011 - 0.077[d]	-	-	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
Calcium	mg/L	-	-	-	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Chromium	mg/L	0.0010	-	-	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015	0.00015
Cobalt	mg/L	-	-	-	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012	0.00012
Copper	mg/L	0.0020 - 0.0040[e]	-	0.0046	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014
Iron	mg/L	0.30	-	-	0.014	0.014	0.014	0.014	0.014	0.014	0.014
Lead	mg/L	0.0010 - 0.0070 [f]	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Lithium	mg/L	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Magnesium	mg/L	-	-	-	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Manganese	mg/L	-	-	-	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019	0.0019
Mercury	mg/L	0.000026	-	-	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
Molybdenum	mg/L	0.073	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Nickel	mg/L	0.025 - 0.15 [g]	-	-	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
Phosphorus	mg/L	-	-	-	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039	0.0039
Potassium	mg/L	-	-	-	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Selenium	mg/L	0.0010	-	-	0.00010	0.00010	0.000100	0.00010	0.00010	0.000100	0.00010
Silicon	mg/L	-	-	-	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	0.00025	-	-	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
Sodium	mg/L	-	-	-	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Strontium	mg/L	-	-	-	0.0094	0.0094	0.0094	0.0094	0.0094	0.0094	0.0094
Tellurium	mg/L	-	-	-	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	0.00080	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Tin	mg/L	-	-	-	0.00010	0.00010	0.000100	0.00010	0.00010	0.000100	0.00010
Titanium	mg/L	-	-	-	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Uranium	mg/L	0.015	-	-	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010	0.000010
Vanadium	mg/L	-	-	-	0.000053	0.000053	0.000053	0.000053	0.000053	0.000053	0.000053
Zinc	mg/L	0.030	-	-	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030	0.0030
Zirconium	mg/L	-	-	-	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

[1] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[a] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[b] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[c] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[d] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[hardness]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[e] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = $0.2 * e^{\{0.8545[\ln(hardness)]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[f] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(hardness)]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[g] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(hardness)]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[B] = concentration is higher than the BC MOE (2017) guideline.

[C] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.

[S] = concentration is higher than the site-specific guideline guideline.

Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

	Unit	Guidelines			Goose Background Source	Goose Lake					
		CCME Freshwater (Chronic)	Alternative Screening Guideline[1]	Site Specific		Dissolved Metals			Total Metals		
						Absolute Maximum	Long-Term Average	Max at Closure	Absolute Maximum	Long-Term Average	Max at Closure
Conventional Parameters											
Hardness, as $CaCO_3$	mg/L	-	-	-	11	586	47	334	586	47	334
Total alkalinity, as $CaCO_3$	mg/L	-	-	-	2.0	26	9.0	26	26	9.0	26
Total dissolved solids	mg/L	-	-	-	23	459	59	443	459	59	443
Total suspended solids	mg/L	-	-	-	3.0	6.7	4.0	6.0	6.7	4.0	6.0
Total organic carbon	mg/L	-	-	-	4.0	8.9	5.3	8.0	8.9	5.3	8.0
Major Ions											
Chloride	mg/L	120	-	-	1.0	99	5.1	81	99	5.1	81
Cyanide	mg/L	0.0050	-	-	0.00054	0.0012	0.00056	0.00068	0.0012	0.00056	0.00068
Sulphate	mg/L	-	128 - 429[(a)]	-	4.1	134	22	134	134	22	134
Free cyanide	mg/l	-	-	-	0.0010	0.0022	0.0013	0.0020	0.0022	0.0013	0.0020
Cyanide - wad	mg/l	-	-	-	0.0010	0.015	0.0013	0.015	0.015	0.0013	0.015
Nutrients											
Nitrate	mg-N/L	2.9	-	-	0.0065	1.1	0.014	0.93	1.1	0.014	0.93
Nitrite	mg-N/L	0.060	-	-	0.0010	0.058	0.0016	0.055	0.058	0.0016	0.055
Total ammonia	mg-N/L	1.6[(b)]	-	-	0.0050	0.14	0.0050	0.0062	0.14	0.0050	0.0062
Metals											
Aluminum	mg/L	0.0050 - 0.10[(c)]	-	-	0.011	0.086	0.038	0.086	**0.36**[(C)]	**0.22**[(C)]	**0.36**[(C)]
Antimony	mg/L	-	-	-	0.000050	0.0099	0.00023	0.0099	0.0099	0.00023	0.0099
Arsenic	mg/L	0.0050	-	0.010	0.00020	**0.015**[(C, S)]	**0.0058**[(C)]	**0.015**[(C, S)]	**0.016**[(C, S)]	**0.0065**[(C)]	**0.016**[(C, S)]
Barium	mg/L	-	-	-	0.0051	0.087	0.0095	0.045	0.087	0.010	0.046
Beryllium	mg/L	-	-	-	0.00020	0.00044	0.00027	0.00040	0.00045	0.00029	0.00045
Bismuth	mg/L	-	-	-	0.00050	0.0016	0.00068	0.0012	0.0016	0.00068	0.0012
Boron	mg/L	1.5	-	-	0.0050	0.060	0.0084	0.035	0.060	0.0084	0.035
Cadmium	mg/L	0.00011 - 0.077[(d)]	-	-	0.000010	0.000048	0.000020	0.000048	0.000048	0.000020	0.000048
Calcium	mg/L	-	-	-	2.1	211	14	116	211	14	116
Chromium	mg/L	0.0010	-	-	0.00015	0.00047	0.00020	0.00047	**0.0015**[(C)]	0.00091	**0.0015**[(C)]
Cobalt	mg/L	-	-	-	0.00012	0.0077	0.00023	0.0077	0.0077	0.00035	0.0077
Copper	mg/L	0.0020 - 0.0040[(e)]	-	0.0046	0.0014	**0.0047**[(C, S)]	**0.0024**[(C)]	**0.0047**[(C, S)]	**0.0051**[(C, S)]	**0.0027**[(C)]	**0.0051**[(C, S)]
Iron	mg/L	0.30	-	-	0.014	0.17	0.048	0.17	**0.96**[(C)]	**0.59**[(C)]	**0.96**[(C)]
Lead	mg/L	0.0010 - 0.0070 [(f)]	-	-	0.000050	0.00023	0.000068	0.00023	0.00030	0.00012	0.00030
Lithium	mg/L	-	-	-	0.0050	0.099	0.0098	0.048	0.099	0.0098	0.048
Magnesium	mg/L	-	-	-	1.3	16	2.7	12	16	2.8	12
Manganese	mg/L	-	-	-	0.0019	0.043	0.0084	0.037	0.043	0.011	0.040
Mercury	mg/L	0.000026	-	-	0.000010	**0.000028**[(C)]	0.000016	**0.000028**[(C)]	**0.00010**[(C)]	**0.000067**[(C)]	**0.00010**[(C)]
Molybdenum	mg/L	0.073	-	-	0.000050	0.017	0.00039	0.017	0.017	0.00040	0.017
Nickel	mg/L	0.025 - 0.15 [(g)]	-	-	0.0033	0.016	0.0082	0.016	0.016	0.0083	0.016
Phosphorus	mg/L	-	-	-	0.0039	0.031	0.0053	0.031	0.038	0.0099	0.038
Potassium	mg/L	-	-	-	0.34	7.0	0.56	7.0	7.0	0.61	7.0
Selenium	mg/L	0.0010	-	-	0.00010	0.00074	0.00024	0.00074	0.00074	0.00024	0.00074
Silicon	mg/L	-	-	-	0.28	0.63	0.37	0.63	0.63	0.37	0.63
Silver	mg/L	0.00025	-	-	0.000010	0.00014	0.000016	0.00014	0.00014	0.000017	0.00014
Sodium	mg/L	-	-	-	0.66	87	4.0	60	87	4.0	60
Strontium	mg/L	-	-	-	0.0094	4.1	0.16	1.8	4.1	0.16	1.8
Tellurium	mg/L	-	-	-	0.0020	0.0044	0.0027	0.0040	0.0044	0.0027	0.0040
Thallium	mg/L	0.00080	-	-	0.000050	0.00016	0.000068	0.00012	0.00016	0.000069	0.00012
Tin	mg/L	-	-	-	0.00010	0.00032	0.00014	0.00029	0.00032	0.00014	0.00029
Titanium	mg/L	-	-	-	0.010	0.022	0.013	0.020	0.033	0.022	0.033
Uranium	mg/L	0.015	-	-	0.000010	0.000031	0.000014	0.000023	0.000038	0.000023	0.000038
Vanadium	mg/L	-	-	-	0.000053	0.00075	0.000086	0.00075	0.0013	0.00045	0.0013
Zinc	mg/L	0.030	-	-	0.0030	0.011	0.0050	0.0099	0.011	0.0054	0.010
Zirconium	mg/L	-	-	-	0.00040	0.00089	0.00053	0.00080	0.00089	0.00053	0.00080

Notes:

[(1)] = guideline was selected from BC MOE (2017) for the purpose of screening sulphate concentrations.

[(a)] = guideline is dependent on water hardness: very soft (0 - 30 mg/L), 128 mg/L sulphate; soft to moderately soft (31 - 75 mg/L), 218 mg/L sulphate; moderately soft/hard to hard (76 - 180 mg/L), 309 mg/L sulphate; very hard (181 - 250 mg/L), 429 mg/L sulphate. If hardness is greater than 250 mg/L the sulphate guideline needs to be determined based on site water.

[(b)] = guideline is pH and temperature dependent. The guideline that results in the minimum ammonia guideline (1.6353 mg-N/L) is based on the combination of maxmimum field pH (7.48) and maximum water temperature (17.1°C). Guidelines calculated with temperature and pH values falling outside the defined range (i.e., pH 6.0 to 10.0 and temperature 0°C to 30°C) should be used with caution, as the WQG does not necessarily accurately reflect toxic effects at the low and high pH and temperature extremes. The guideline is calculated based on the individual field pH and temperature measurements for each sample.

[(c)] = guideline is pH dependent: 0.0050 mg/L at pH < 6.5 and 0.10 mg/L at pH ≥ 6.5.

[(d)] = guideline is dependent on water hardness: when water hardness is 0 to <5.3 mg/L, 0.00011 mg/L cadmium; at hardness ≥5.3 to ≤360 mg/L , cadmium guideline is calculated using the applicable equation (CWQC short-term benchmark (μg/L) = $10^{\{1.016(\log[\text{hardness}]) - 1.71\}}$); when water hardness if >360 mg/L; 0.0077 mg/L cadmium.

[(e)] = guideline is dependent on water hardness: when water hardness is 0 to <82 mg/L, 0.0020 mg/L copper; at hardness ≥82 to ≤180 mg/L, copper guideline is calculated using the applicable equation (CWQG (μg/L) = 0.2 * $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$); when water hardness if >180 mg/L; 0.0040 mg/L copper.

[(f)] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.0010 mg/L lead; at hardness ≥60 to ≤180 mg/L, lead guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$); when water hardness if >180 mg/L; 0.0070 mg/L lead.

[(g)] = guideline is dependent on water hardness: when water hardness is 0 to <60 mg/L, 0.025 mg/L nickel; at hardness ≥60 to ≤180 mg/L, nickel guideline is calculated using the applicable equation (CWQG (μg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$); when water hardness if >180 mg/L; 0.15 mg/L nickel.

[(B)] = concentration is higher than the BC MOE (2017) guideline.
[(C)] = concentration is higher than the chronic aquatic life CCME guideline or outside the recommended pH, DO or total alkalinity range.
[(S)] = concentration is higher than the site-specific guideline guideline.
Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.
\- = no guideline or no data.

Prepared: TL
Reviewed: KS
Approved: KS

GOLDER

	Unit	MDMER	Goose Background Source	Umwelt Tailings Facility			
				Dissolved Metals		Total Metals	
				Long-Term Average	Max at Closure	Long-Term Average	Max at Closure
Conventional Parameters							
Hardness, as $CaCO_3$	mg/L	-	11	156	213	156	213
Total alkalinity, as $CaCO_3$	mg/L	-	2.0	79	109	79	109
Total dissolved solids	mg/L	-	23	350	540	350	540
Total suspended solids	mg/L	-	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	4.0	4.0	4.0	4.0	4.0
Major Ions							
Chloride	mg/L	-	1.0	1.0	1.0	1.0	1.0
Cyanide	mg/L	0.50	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	4.1	195	329	195	329
Free cyanide	mg/l	-	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	0.0010	0.0010	0.0010	0.0010	0.0010
Nutrients							
Nitrate	mg-N/L	-	0.0065	0.018	0.60	0.018	0.60
Nitrite	mg-N/L	-	0.0010	0.0014	0.030	0.0014	0.030
Total ammonia	mg-N/L	0.50 [(a)]	0.0050	0.0050	0.013	0.0050	0.013
Metals							
Aluminum	mg/L	-	0.011	0.27	0.37	0.63	0.73
Antimony	mg/L	-	0.000050	0.0017	0.0023	0.0017	0.0023
Arsenic	mg/L	0.30	0.00020	0.065	0.094	0.069	0.097
Barium	mg/L	-	0.0051	0.0051	0.0051	0.0052	0.0057
Beryllium	mg/L	-	0.00020	0.00020	0.00020	0.00020	0.00020
Bismuth	mg/L	-	0.00050	0.00050	0.00050	0.00050	0.00050
Boron	mg/L	-	0.0050	0.0050	0.0050	0.0050	0.0050
Cadmium	mg/L	-	0.000010	0.000076	0.00010	0.000077	0.00011
Calcium	mg/L	-	2.1	49	67	49	67
Chromium	mg/L	-	0.00015	0.00015	0.00015	0.0016	0.0016
Cobalt	mg/L	-	0.00012	0.00061	0.00083	0.00086	0.0011
Copper	mg/L	0.30	0.0014	0.0079	0.011	0.0085	0.011
Iron	mg/L	-	0.014	0.31	0.42	1.2	1.4
Lead	mg/L	0.10	0.000050	0.000050	0.000050	0.00012	0.00013
Lithium	mg/L	-	0.0050	0.0050	0.0050	0.0050	0.0050
Magnesium	mg/L	-	1.3	7.8	11	8.0	11
Manganese	mg/L	-	0.0019	0.050	0.069	0.055	0.074
Mercury	mg/L	-	0.000010	0.000037	0.000051	0.00012	0.00013
Molybdenum	mg/L	-	0.000050	0.0034	0.0046	0.0034	0.0046
Nickel	mg/L	0.50	0.0033	0.043	0.060	0.044	0.060
Phosphorus	mg/L	-	0.0039	0.0039	0.0039	0.0094	0.010
Potassium	mg/L	-	0.34	0.34	0.34	0.34	0.36
Selenium	mg/L	-	0.00010	0.0013	0.0019	0.0014	0.0019
Silicon	mg/L	-	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	-	0.000010	0.000031	0.000043	0.000034	0.000045
Sodium	mg/L	-	0.66	0.66	0.66	0.66	0.66
Strontium	mg/L	-	0.0094	0.0094	0.0094	0.0094	0.0094
Tellurium	mg/L	-	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	-	0.000050	0.000050	0.000050	0.000050	0.000050
Tin	mg/L	-	0.00010	0.000100	0.00010	0.000100	0.00010
Titanium	mg/L	-	0.010	0.0100	0.010	0.020	0.022
Uranium	mg/L	-	0.000010	0.000010	0.000010	0.000026	0.000028
Vanadium	mg/L	-	0.000053	0.000053	0.000053	0.00070	0.00071
Zinc	mg/L	0.50	0.0030	0.013	0.017	0.013	0.018
Zirconium	mg/L	-	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

(a) guideline set out for un-ionized ammonia; this guideline was calculated by using the maximum pH (7.48) and maximum temperature (17.1 °C) recorded in Goose Lake from August 2017.

[(M)] = concentration is higher than the proposed amendments to the metal and diamond mining effluent regulations (MDMER, 2018) .
Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

	Unit	MDMER	Goose Background Source	Llama Reservoir			
				Dissolved Metals		Total Metals	
				Long-Term Average	Max at Closure	Long-Term Average	Max at Closure
Conventional Parameters							
Hardness, as $CaCO_3$	mg/L	-	11	249	1,990	249	1,990
Total alkalinity, as $CaCO_3$	mg/L	-	2.0	13	13	13	13
Total dissolved solids	mg/L	-	23	215	1,440	215	1,440
Total suspended solids	mg/L	-	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	4.0	4.0	4.0	4.0	4.0
Major Ions							
Chloride	mg/L	-	1.0	36	315	36	315
Cyanide	mg/L	0.50	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	4.1	33	37	33	37
Free cyanide	mg/l	-	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	0.0010	0.0010	0.0017	0.0010	0.0017
Nutrients							
Nitrate	mg-N/L	-	0.0065	0.045	0.33	0.045	0.33
Nitrite	mg-N/L	-	0.0010	0.0033	0.021	0.0033	0.021
Total ammonia	mg-N/L	0.50 [(a)]	0.0050	0.0050	0.0050	0.0050	0.0050
Metals							
Aluminum	mg/L	-	0.011	0.051	0.050	0.38	0.38
Antimony	mg/L	-	0.000050	0.00039	0.0011	0.00039	0.0011
Arsenic	mg/L	0.30	0.00020	0.010	0.010	0.012	0.012
Barium	mg/L	-	0.0051	0.034	0.27	0.036	0.27
Beryllium	mg/L	-	0.00020	0.00020	0.00021	0.00030	0.00032
Bismuth	mg/L	-	0.00050	0.00066	0.0023	0.00066	0.0023
Boron	mg/L	-	0.0050	0.023	0.18	0.024	0.18
Cadmium	mg/L	-	0.000010	0.000024	0.000055	0.000025	0.000056
Calcium	mg/L	-	2.1	88	720	88	720
Chromium	mg/L	-	0.00015	0.00017	0.00040	0.0015	0.0017
Cobalt	mg/L	-	0.00012	0.00029	0.0011	0.00051	0.0013
Copper	mg/L	0.30	0.0014	0.0024	0.0030	0.0031	0.0036
Iron	mg/L	-	0.014	0.078	0.23	1.1	1.3
Lead	mg/L	0.10	0.000050	0.000067	0.00024	0.00016	0.00033
Lithium	mg/L	-	0.0050	0.038	0.31	0.038	0.31
Magnesium	mg/L	-	1.3	7.1	46	7.3	47
Manganese	mg/L	-	0.0019	0.023	0.13	0.028	0.14
Mercury	mg/L	-	0.000010	0.000014	0.000013	0.00012	0.00012
Molybdenum	mg/L	-	0.000050	0.00087	0.0034	0.00089	0.0034
Nickel	mg/L	0.50	0.0033	0.0094	0.0091	0.0100	0.0097
Phosphorus	mg/L	-	0.0039	0.0047	0.014	0.015	0.025
Potassium	mg/L	-	0.34	1.5	11	1.6	11
Selenium	mg/L	-	0.00010	0.00032	0.00061	0.00033	0.00061
Silicon	mg/L	-	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	-	0.000010	0.000018	0.000058	0.000020	0.000059
Sodium	mg/L	-	0.66	33	297	33	297
Strontium	mg/L	-	0.0094	1.6	14	1.6	14
Tellurium	mg/L	-	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	-	0.000050	0.000066	0.00023	0.000069	0.00024
Tin	mg/L	-	0.00010	0.00013	0.00047	0.00013	0.00047
Titanium	mg/L	-	0.010	0.010	0.013	0.026	0.030
Uranium	mg/L	-	0.000010	0.000013	0.000047	0.000032	0.000066
Vanadium	mg/L	-	0.000053	0.00021	0.0015	0.00087	0.0022
Zinc	mg/L	0.50	0.0030	0.0058	0.017	0.0065	0.018
Zirconium	mg/L	-	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

(a) guideline set out for un-ionized ammonia; this guideline was calculated by using the maximum pH (7.48) and maximum temperature (17.1 °C) recorded in Goose Lake from August 2017.

[(M)] = concentration is higher than the proposed amendments to the metal and diamond mining effluent regulations (MDMER, 2018) .
Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

	Unit	MDMER	Goose Background Source	Goose Tailings Storage Facility			
				Dissolved Metals		Total Metals	
				Long-Term Average	Max at Closure	Long-Term Average	Max at Closure
Conventional Parameters							
Hardness, as $CaCO_3$	mg/L	-	11	27	187	27	187
Total alkalinity, as $CaCO_3$	mg/L	-	2.0	10	49	10	49
Total dissolved solids	mg/L	-	23	50	651	50	651
Total suspended solids	mg/L	-	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	4.0	4.0	4.0	4.0	4.0
Major Ions							
Chloride	mg/L	-	1.0	1.1	114	1.1	114
Cyanide	mg/L	0.50	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	4.1	26	326	26	326
Free cyanide	mg/l	-	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	0.0010	0.0010	0.039	0.0010	0.039
Nutrients							
Nitrate	mg-N/L	-	0.0065	0.0094	2.6	0.0094	2.6
Nitrite	mg-N/L	-	0.0010	0.0011	0.15	0.0011	0.15
Total ammonia	mg-N/L	0.50 [(a)]	0.0050	0.0050	0.0077	0.0050	0.0077
Metals							
Aluminum	mg/L	-	0.011	0.039	0.13	0.40	0.49
Antimony	mg/L	-	0.000050	0.00025	0.029	0.00025	0.029
Arsenic	mg/L	0.30	0.00020	0.0070	0.027	0.0087	0.029
Barium	mg/L	-	0.0051	0.0051	0.0097	0.0066	0.011
Beryllium	mg/L	-	0.00020	0.00020	0.00020	0.00024	0.00025
Bismuth	mg/L	-	0.00050	0.00050	0.00050	0.00050	0.00050
Boron	mg/L	-	0.0050	0.0050	0.016	0.0051	0.016
Cadmium	mg/L	-	0.000010	0.000017	0.000058	0.000018	0.000059
Calcium	mg/L	-	2.1	7.2	58	7.3	58
Chromium	mg/L	-	0.00015	0.00015	0.00054	0.0015	0.0019
Cobalt	mg/L	-	0.00012	0.00019	0.022	0.00043	0.022
Copper	mg/L	0.30	0.0014	0.0021	0.0050	0.0028	0.0057
Iron	mg/L	-	0.014	0.044	0.28	1.1	1.3
Lead	mg/L	0.10	0.000050	0.000050	0.00037	0.00014	0.00046
Lithium	mg/L	-	0.0050	0.0050	0.0050	0.0050	0.0050
Magnesium	mg/L	-	1.3	2.0	9.9	2.2	10
Manganese	mg/L	-	0.0019	0.0069	0.038	0.012	0.043
Mercury	mg/L	-	0.000010	0.000013	0.000026	0.00011	0.00012
Molybdenum	mg/L	-	0.000050	0.00045	0.050	0.00047	0.050
Nickel	mg/L	0.50	0.0033	0.0074	0.020	0.0081	0.021
Phosphorus	mg/L	-	0.0039	0.0039	0.069	0.013	0.078
Potassium	mg/L	-	0.34	0.34	15	0.43	15
Selenium	mg/L	-	0.00010	0.00024	0.0013	0.00024	0.0013
Silicon	mg/L	-	0.28	0.28	0.47	0.28	0.47
Silver	mg/L	-	0.000010	0.000013	0.00036	0.000014	0.00036
Sodium	mg/L	-	0.66	0.70	65	0.70	65
Strontium	mg/L	-	0.0094	0.0095	0.14	0.0096	0.14
Tellurium	mg/L	-	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	-	0.000050	0.000050	0.000050	0.000051	0.000052
Tin	mg/L	-	0.00010	0.00010	0.00023	0.00010	0.00023
Titanium	mg/L	-	0.010	0.0100	0.010	0.026	0.026
Uranium	mg/L	-	0.000010	0.000010	0.000010	0.000028	0.000029
Vanadium	mg/L	-	0.000053	0.000054	0.0014	0.00075	0.0021
Zinc	mg/L	0.50	0.0030	0.0040	0.0065	0.0048	0.0073
Zirconium	mg/L	-	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

(a) guideline set out for un-ionized ammonia; this guideline was calculated by using the maximum pH (7.48) and maximum temperature (17.1 °C) recorded in Goose Lake from August 2017.

[(M)] = concentration is higher than the proposed amendments to the metal and diamond mining effluent regulations (MDMER, 2018) .
Bolded concentrations are higher than water quality guidelines.

Water quality data and guidelines shown in this table were rounded to reflect laboratory or field instrument precision after comparisons to guidelines. Therefore, values slightly above guidelines may be displayed as being equal to the guidelines and identified as exceedances. Concentrations equal to the guideline values were not identified as exceedances.

- = no guideline or no data.

Prepared: TL
Reviewed: KS
Approved: KS

GOLDER

	Unit	MDMER	Goose Background Source	Echo Pit			
				Dissolved Metals		Total Metals	
				Long-Term Average	Max at Closure	Long-Term Average	Max at Closure
Conventional Parameters							
Hardness, as $CaCO_3$	mg/L	-	11	12	13	12	13
Total alkalinity, as $CaCO_3$	mg/L	-	2.0	2.1	2.4	2.1	2.4
Total dissolved solids	mg/L	-	23	13	15	13	15
Total suspended solids	mg/L	-	3.0	3.1	3.2	3.1	3.2
Total organic carbon	mg/L	-	4.0	4.1	4.3	4.1	4.3
Major Ions							
Chloride	mg/L	-	1.0	1.0	1.1	1.0	1.1
Cyanide	mg/L	0.50	0.00054	0.00055	0.00058	0.00055	0.00058
Sulphate	mg/L	-	4.1	4.7	5.5	4.7	5.5
Free cyanide	mg/l	-	0.0010	0.0010	0.0011	0.0010	0.0011
Cyanide - wad	mg/l	-	0.0010	0.0010	0.0011	0.0010	0.0011
Nutrients							
Nitrate	mg-N/L	-	0.0065	0.0066	0.0070	0.0066	0.0070
Nitrite	mg-N/L	-	0.0010	0.0010	0.0011	0.0010	0.0011
Total ammonia	mg-N/L	0.50 [(a)]	0.0050	0.0051	0.0054	0.0051	0.0054
Metals							
Aluminum	mg/L	-	0.011	0.014	0.018	0.32	0.32
Antimony	mg/L	-	0.000050	0.000055	0.000064	0.000055	0.000065
Arsenic	mg/L	0.30	0.00020	0.00052	0.0013	0.0015	0.0023
Barium	mg/L	-	0.0051	0.0052	0.0055	0.0059	0.0063
Beryllium	mg/L	-	0.00020	0.00020	0.00022	0.00022	0.00023
Bismuth	mg/L	-	0.00050	0.00051	0.00054	0.00051	0.00054
Boron	mg/L	-	0.0050	0.0051	0.0054	0.0053	0.0057
Cadmium	mg/L	-	0.000010	0.000011	0.000012	0.000012	0.000013
Calcium	mg/L	-	2.1	2.3	2.6	2.3	2.6
Chromium	mg/L	-	0.00015	0.00015	0.00016	0.0018	0.0018
Cobalt	mg/L	-	0.00012	0.00013	0.00014	0.00042	0.00043
Copper	mg/L	0.30	0.0014	0.0015	0.0017	0.0022	0.0024
Iron	mg/L	-	0.014	0.017	0.022	0.62	0.63
Lead	mg/L	0.10	0.000050	0.000051	0.000054	0.00013	0.00013
Lithium	mg/L	-	0.0050	0.0051	0.0054	0.0051	0.0054
Magnesium	mg/L	-	1.3	1.3	1.5	1.5	1.7
Manganese	mg/L	-	0.0019	0.0024	0.0031	0.0072	0.0079
Mercury	mg/L	-	0.000010	0.000010	0.000011	0.00010	0.00010
Molybdenum	mg/L	-	0.000050	0.000054	0.000064	0.000084	0.000094
Nickel	mg/L	0.50	0.0033	0.0038	0.0045	0.0047	0.0054
Phosphorus	mg/L	-	0.0039	0.0040	0.0042	0.012	0.012
Potassium	mg/L	-	0.34	0.34	0.36	0.38	0.41
Selenium	mg/L	-	0.00010	0.00011	0.00012	0.00011	0.00012
Silicon	mg/L	-	0.28	0.28	0.30	0.28	0.30
Silver	mg/L	-	0.000010	0.000010	0.000011	0.000012	0.000013
Sodium	mg/L	-	0.66	0.68	0.71	0.68	0.72
Strontium	mg/L	-	0.0094	0.0097	0.010	0.0097	0.010
Tellurium	mg/L	-	0.0020	0.0020	0.0022	0.0020	0.0022
Thallium	mg/L	-	0.000050	0.000051	0.000054	0.000052	0.000056
Tin	mg/L	-	0.00010	0.00010	0.00011	0.00010	0.00011
Titanium	mg/L	-	0.010	0.010	0.011	0.019	0.020
Uranium	mg/L	-	0.000010	0.000010	0.000011	0.000028	0.000029
Vanadium	mg/L	-	0.000053	0.000054	0.000057	0.00062	0.00062
Zinc	mg/L	0.50	0.0030	0.0032	0.0035	0.0041	0.0045
Zirconium	mg/L	-	0.00040	0.00041	0.00043	0.00041	0.00043

Notes:

(a) guideline set out for un-ionized ammonia; this guideline was calculated by using the maximum pH (7.48) and maximum temperature (17.1 °C) recorded in Goose Lake from August 2017.

[(M)] = concentration is higher than the proposed amendments to the metal and diamond mining effluent regulations (MDMER, 2018) .
Bolded concentrations are higher than water quality guidelines.

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- = no guideline or no data.

Prepared: TL
Reviewed: KS
Approved: KS

GOLDER

	Unit	MDMER	Goose Background Source	Main Tailings Storage Facility			
				Dissolved Metals		Total Metals	
				Long-Term Average	Max at Closure	Long-Term Average	Max at Closure
Conventional Parameters							
Hardness, as $CaCO_3$	mg/L	-	11	163	163	163	163
Total alkalinity, as $CaCO_3$	mg/L	-	2.0	84	84	84	84
Total dissolved solids	mg/L	-	23	388	389	388	389
Total suspended solids	mg/L	-	3.0	3.0	3.0	3.0	3.0
Total organic carbon	mg/L	-	4.0	4.0	4.0	4.0	4.0
Major Ions							
Chloride	mg/L	-	1.0	1.0	1.0	1.0	1.0
Cyanide	mg/L	0.50	0.00054	0.00054	0.00054	0.00054	0.00054
Sulphate	mg/L	-	4.1	223	223	223	223
Free cyanide	mg/l	-	0.0010	0.0010	0.0010	0.0010	0.0010
Cyanide - wad	mg/l	-	0.0010	0.0010	0.0010	0.0010	0.0010
Nutrients							
Nitrate	mg-N/L	-	0.0065	0.010	0.37	0.010	0.37
Nitrite	mg-N/L	-	0.0010	0.0011	0.019	0.0011	0.019
Total ammonia	mg-N/L	0.50 [(a)]	0.0050	0.0071	0.23	0.0071	0.23
Metals							
Aluminum	mg/L	-	0.011	0.28	0.28	0.64	0.64
Antimony	mg/L	-	0.000050	0.0018	0.0018	0.0018	0.0018
Arsenic	mg/L	0.30	0.00020	0.067	0.067	0.069	0.069
Barium	mg/L	-	0.0051	0.0051	0.0051	0.0051	0.0051
Beryllium	mg/L	-	0.00020	0.00020	0.00020	0.00020	0.00020
Bismuth	mg/L	-	0.00050	0.00050	0.00050	0.00050	0.00050
Boron	mg/L	-	0.0050	0.0050	0.0050	0.0050	0.0050
Cadmium	mg/L	-	0.000010	0.000073	0.000073	0.000074	0.000074
Calcium	mg/L	-	2.1	52	52	52	52
Chromium	mg/L	-	0.00015	0.00015	0.00015	0.0014	0.0014
Cobalt	mg/L	-	0.00012	0.00057	0.00057	0.00082	0.00082
Copper	mg/L	0.30	0.0014	0.0081	0.0081	0.0088	0.0088
Iron	mg/L	-	0.014	0.30	0.30	1.3	1.3
Lead	mg/L	0.10	0.000050	0.000050	0.000050	0.00011	0.00011
Lithium	mg/L	-	0.0050	0.0050	0.0050	0.0050	0.0050
Magnesium	mg/L	-	1.3	8.0	8.0	8.2	8.2
Manganese	mg/L	-	0.0019	0.049	0.049	0.054	0.054
Mercury	mg/L	-	0.000010	0.000038	0.000038	0.00014	0.00014
Molybdenum	mg/L	-	0.000050	0.0036	0.0036	0.0036	0.0036
Nickel	mg/L	0.50	0.0033	0.042	0.042	0.042	0.042
Phosphorus	mg/L	-	0.0039	0.0039	0.0039	0.010	0.010
Potassium	mg/L	-	0.34	0.34	0.34	0.34	0.34
Selenium	mg/L	-	0.00010	0.0014	0.0014	0.0014	0.0014
Silicon	mg/L	-	0.28	0.28	0.28	0.28	0.28
Silver	mg/L	-	0.000010	0.000031	0.000031	0.000033	0.000033
Sodium	mg/L	-	0.66	0.66	0.66	0.66	0.66
Strontium	mg/L	-	0.0094	0.0094	0.0094	0.0094	0.0094
Tellurium	mg/L	-	0.0020	0.0020	0.0020	0.0020	0.0020
Thallium	mg/L	-	0.000050	0.000050	0.000050	0.000050	0.000050
Tin	mg/L	-	0.00010	0.000100	0.00010	0.000100	0.00010
Titanium	mg/L	-	0.010	0.0100	0.010	0.019	0.019
Uranium	mg/L	-	0.000010	0.000010	0.000010	0.000022	0.000022
Vanadium	mg/L	-	0.000053	0.000053	0.000053	0.00072	0.00072
Zinc	mg/L	0.50	0.0030	0.012	0.012	0.013	0.013
Zirconium	mg/L	-	0.00040	0.00040	0.00040	0.00040	0.00040

Notes:

(a) guideline set out for un-ionized ammonia; this guideline was calculated by using the maximum pH (7.48) and maximum temperature (17.1 °C) recorded in Goose Lake from August 2017.

[(M)] = concentration is higher than the proposed amendments to the metal and diamond mining effluent regulations (MDMER, 2018) .
Bolded concentrations are higher than water quality guidelines.

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- = no guideline or no data.

Prepared: TL
Reviewed: KS
Approved: KS

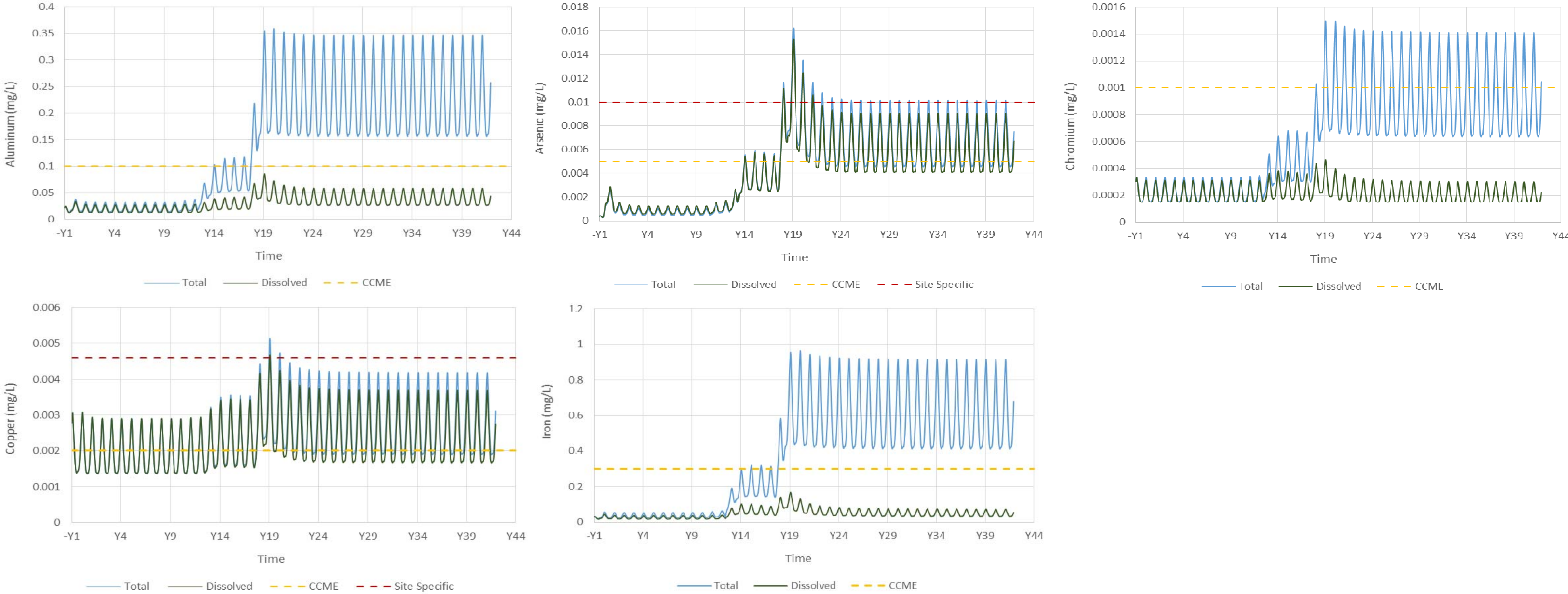


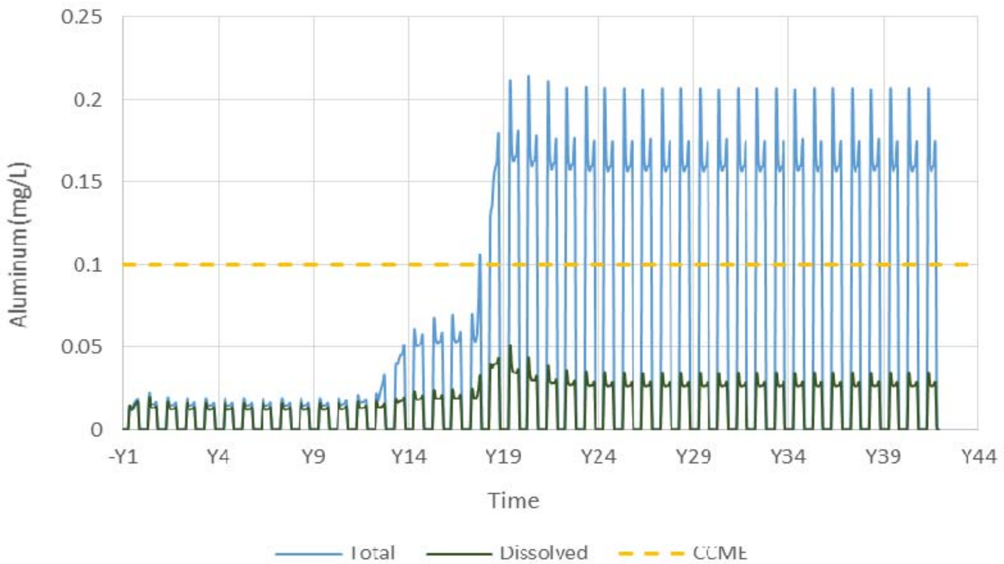
Figure 1

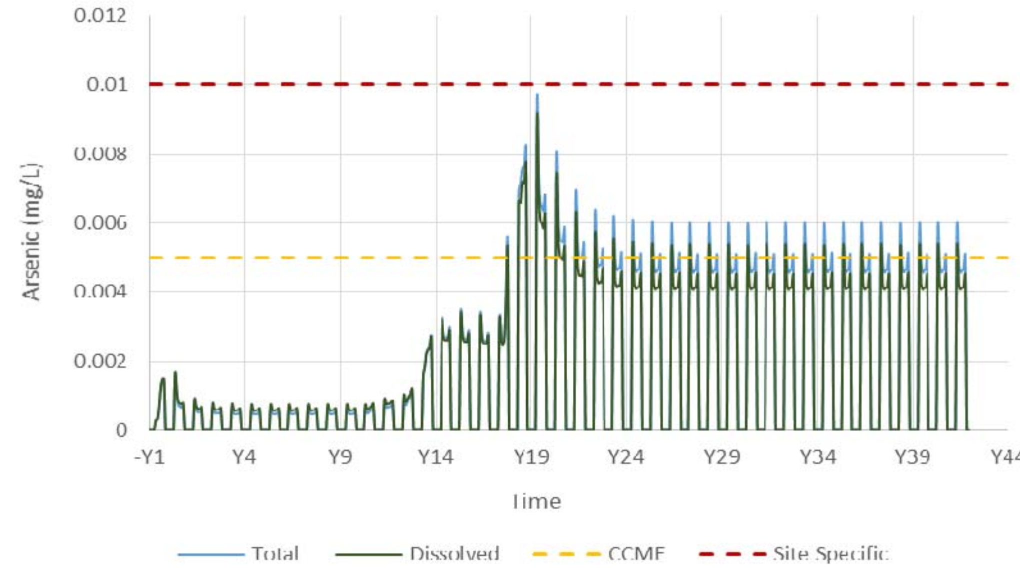
Goose Lake Water Quality Prediction Results

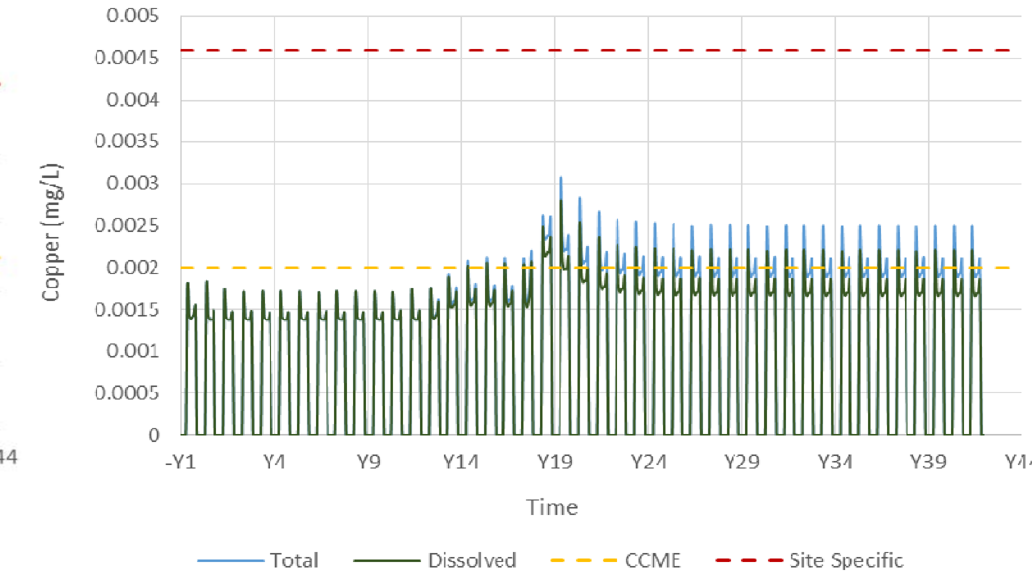
Prepared TL
Design TL
Reviewed TL
Approved SK

GOLDER

Attachment 2
Select Load Balance Model Results







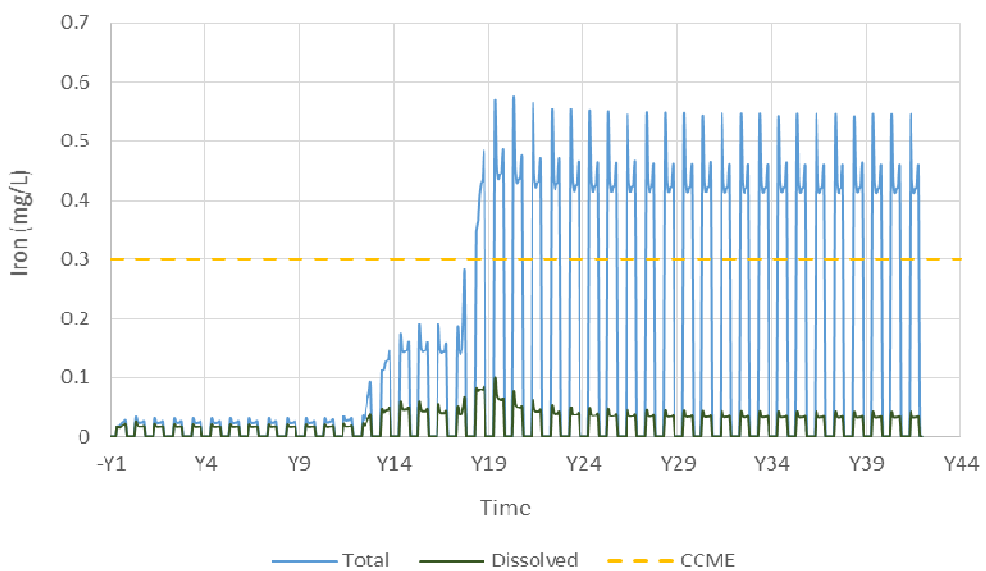


Figure 2

PN03 Water Quality Prediction Results

Prepared SD
Design TL
Reviewed TL
Approved SK

GOLDER

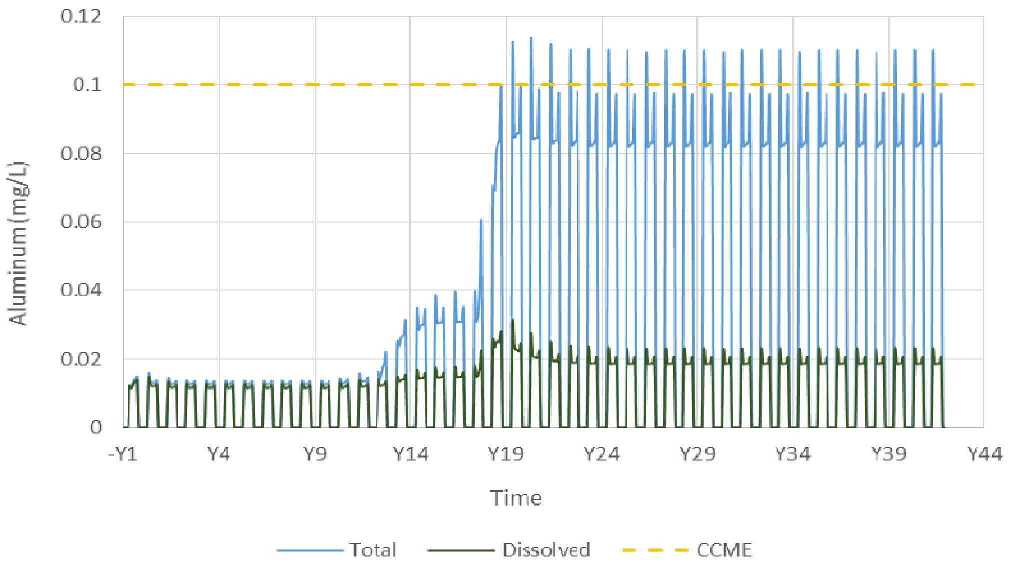


Figure 3

PN02 Water Quality Prediction Results

Prepared SD
Design TL
Reviewed TL
Approved SK

GOLDER

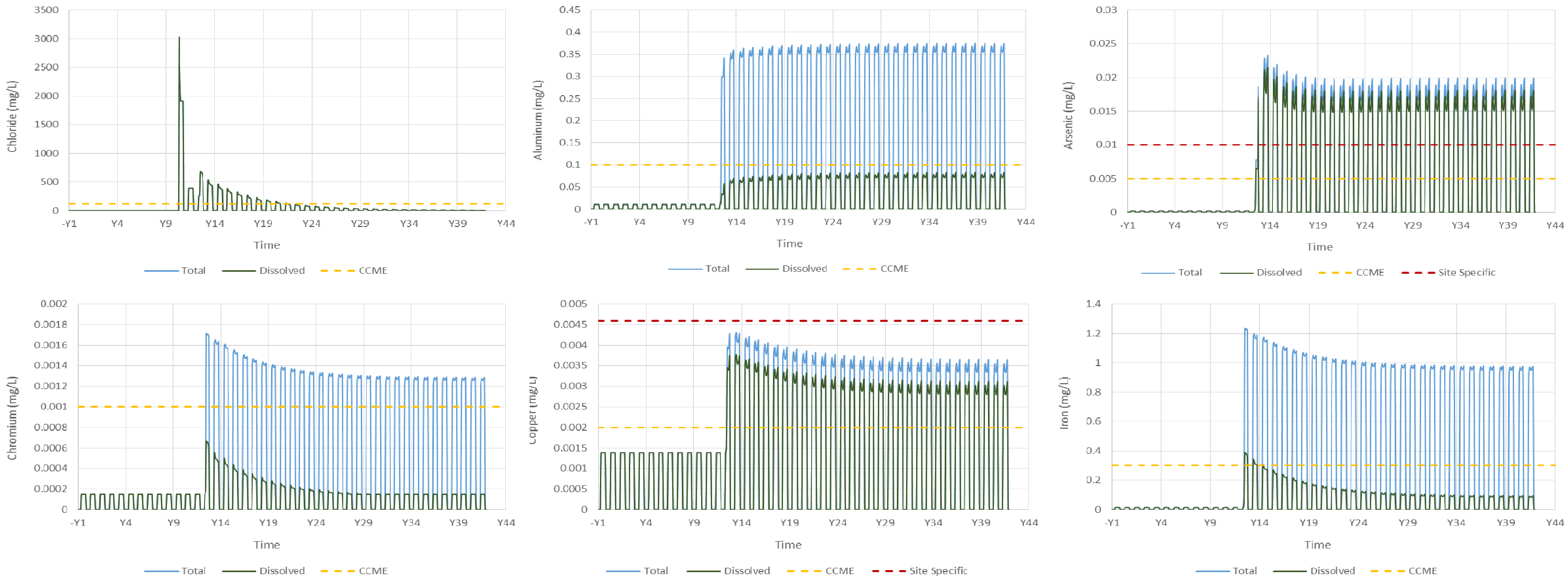


Figure 4

PN10 Water Quality Prediction Results

Prepared SD
Design TL
Reviewed TL
Approved SK

GOLDER

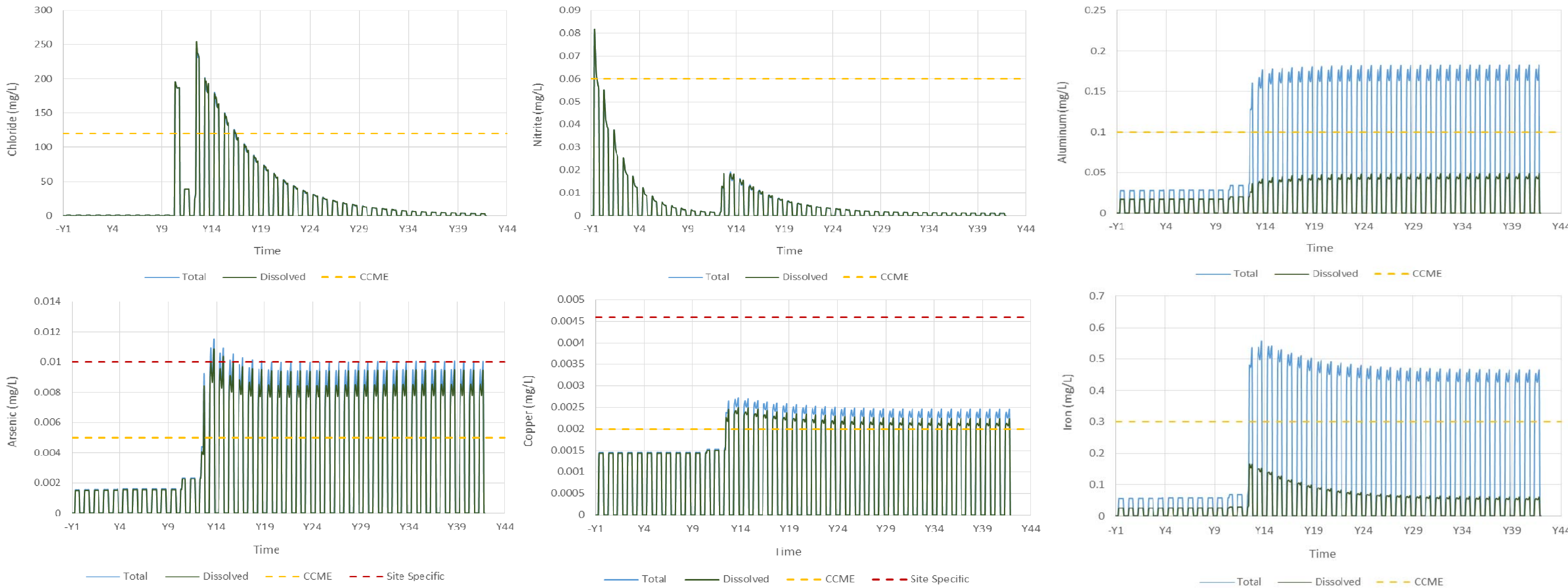


Figure 5

PN04 Water Quality Prediction Results

Prepared SD
Design TL
Reviewed TL
Approved SK

GOLDER

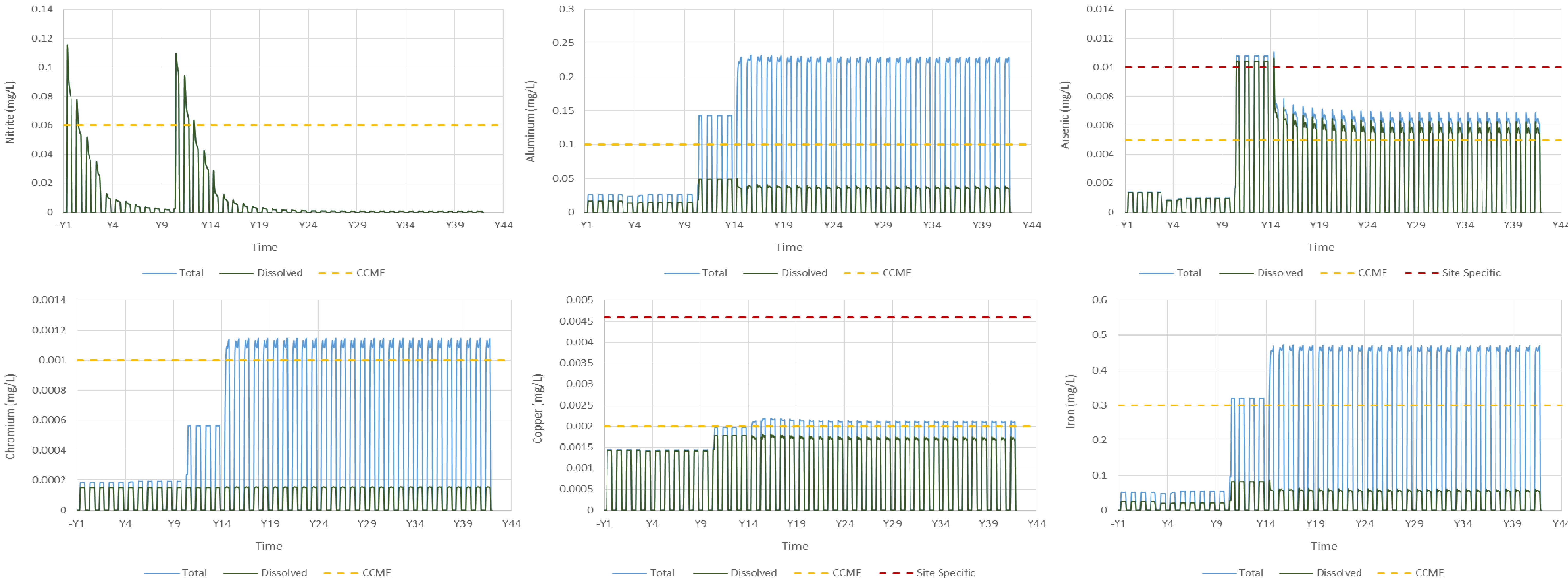


Figure 6

PN09 Water Quality Prediction Results

Prepared SD
Design TL
Reviewed TL
Approved SK

GOLDER

Attachment 2
Select Load Balance Model Results

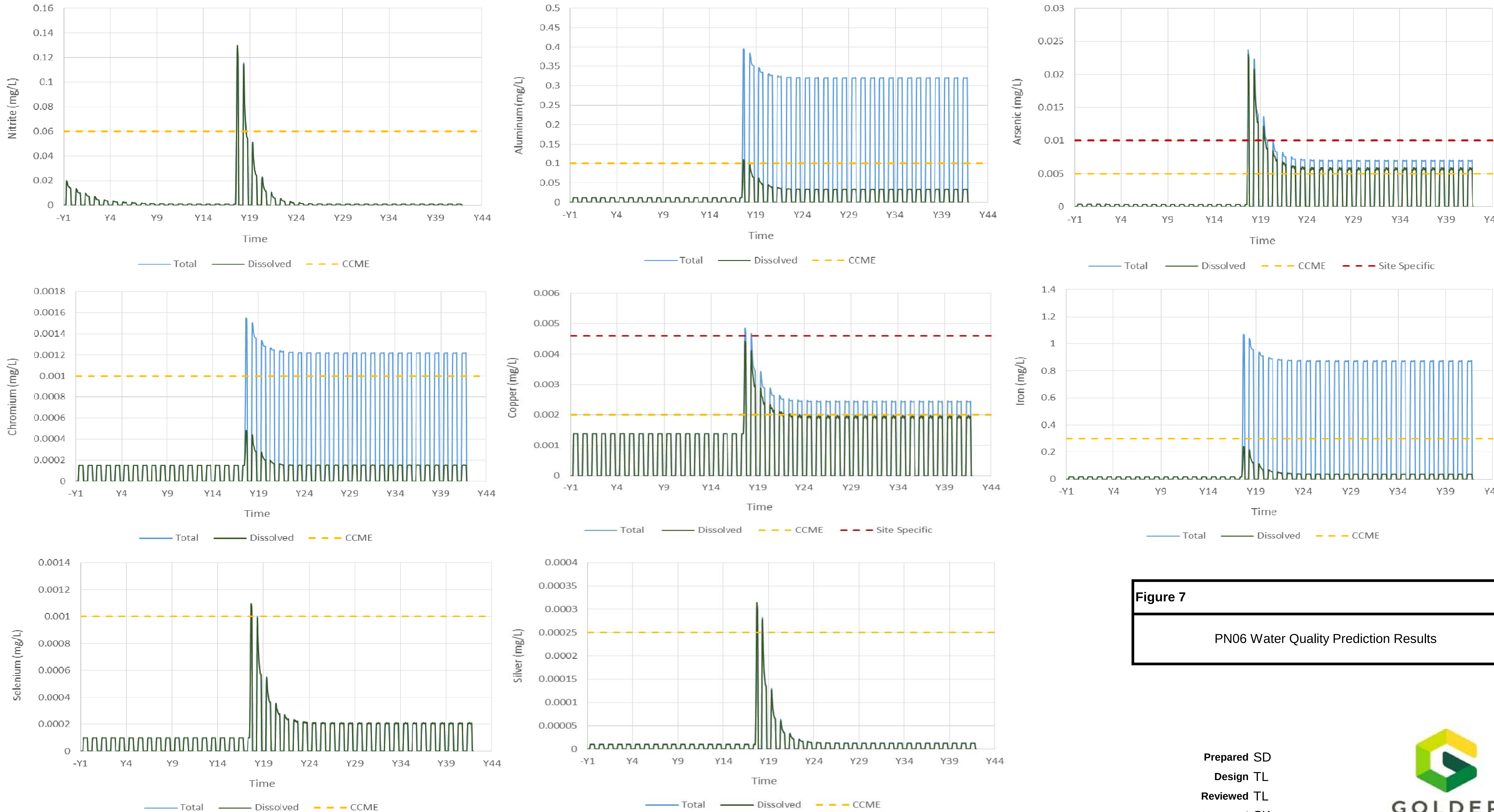


Figure 7

PN06 Water Quality Prediction Results

Prepared SD
Design TL
Reviewed TL
Approved SK

GOLDER

Interested Party: ECCC		**Commitment No.:**	**WTM-COMMITMENT 17 (ECCC-TC-1)**

Post-Technical Meeting Commitment:

Identify best practices for source control of nitrogen through explosives management.

Post-Technical Meeting Response Package:

Sabina has reviewed existing ammonia management best management practices (BMPs) from Management Plans in the Arctic and has summarized in Table 1.

Sabina will implement blasting best management practices to minimize dust production and to minimize the quantity of explosives, which will result in lower concentrations of nitrogenous compounds as residue. Any runoff from the roads is anticipated to be minimal and will be discharged to the terrestrial environment as diffuse sheet flow and will infiltrate into the terrestrial environment prior to reaching the aquatic environment. It should also be noted that the minimum 31 m buffer distance, intended to minimize surface flow impacts on water quality, will be applied to all-weather service roads. This 31 m buffer was identified based on guidance documents and commonly established riparian zone buffer widths used in many regions, including the Arctic.

Reference	**Back River, *Sabina Gold & Silver Corp.*** **Explosives Management Plan (November 2015)** http://www.nirb.ca/application?strP=r (151123-12MN036-Vol 10-Pt 13-Expllosives Management Plan-IA2E.pdf)	**Back River, *Sabina Gold & Silver Corp.*** **Quarry Management Plan (August 2017)** ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2B/2BC%20-%20Construction/2BC-BRP1819/1%20APPLICATION/	**Madrid-Boston Project, *TMAC Resources*** **Hope Bay Project Explosives Management Plan (December 2017)** http://www.nirb.ca/application?strP=r (171221-12MN001-Water Licence –P4-23_Hope Bay Project Explosives Management Plan-IMTE.pdf)	**Meliadine Gold Mine, *Agnico Eagle Mines Limited*** **Explosives Management Plan (March 2018)** ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-MEL1631%20Agnico/3%20TECH/1%20GENERAL%20(B)/2%20ANNUAL%20RPT/2017/180331%202AM-MEL1631%20-%202017%20Annual%20Report%20Final%20Complete%20with%20Appendices-ILAE.pdf (beginning on page 1246)	**Whale Tail Pit / Meadowbank Mine, *Agnico Eagle Mines Limited*** **Ammonia Management Plan (June 2016)** http://www.nirb.ca/application?strP=r (160706-16MN056-App 8-D.1-Addendum Ammonia Mgmt Plan-IA2E.pdf)
Activity					
Transport	• Suppliers will provide AN, mixing equipment; the mine operator shall provide fuel oil (FO), explosives magazines and delivery trucks. • Certified and authorized Sabina employees or contractors will mix ammonium nitrate (AN) with FO at the on-site AN Facility or on a bulk ANFO truck at the blast hole. • All explosives will be transported to site in dedicated containers; secondary containment will be used as required. • Only qualified personnel holding valid blasting certificates shall handle these materials. • Spills will be contained, cleaned up, and placed in suitable containers for use or disposal. All reportable spills will be reported to the spill response coordinator. • Containers and equipment shall be inspected prior to use transporting explosives products on or between Project sites.	• Ammonium nitrate will be delivered by sealift in solid form in tote bags within seacans. They will be protected from the elements to prevent contact with water during transport and storage. • Water from the AN Facility truck wash and collected runoff from the AN Facility area will be transported to a water management pond for treatment or discharge as appropriate, or will be collected and treated in an evaporator.	• All explosives for use in the underground mine will be sea lifted to site with the annual resupply for Doris North. • Mine construction phase explosives will be shipped to site both by sealift and by air transport (under appropriate transport of dangerous goods regulations) and stored in the temporary explosives magazines. • The mixing plant will come to site prebuilt inside a shipping container by sealift.	• All products required for blasting activities will be shipped by vessel from the south to Rankin Inlet, loaded onto barges at the vessel anchoring location, and transported to Itivia. • The handling of explosives on-site will be carried out by the supplier and by qualified Agnico Eagle staff (blasters and helper-blasters) under a permit to conduct such work. • A 3-t capacity explosive delivery truck will be used on-site to transport emulsion (in 1.2 t of capacity totes) from the Emulsion Plant to the underground mining operations. A 10-t capacity explosive truck called MMU will be used to deliver emulsion in the open pit production blastholes.	• Explosive products are packaged in the supplier's containers and packed into sea containers, which limit the possibility of spillage into the environment.

Reference	Back River, *Sabina Gold & Silver Corp.* Explosives Management Plan (November 2015) http://www.nirb.ca/application?strP=r (151123-12MN036-Vol 10-Pt 13-Expllosives Management Plan-IA2E.pdf)	Back River, *Sabina Gold & Silver Corp.* Quarry Management Plan (August 2017) ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2B/2BC%20-%20Construction/2BC-BRP1819/1%20APPLICATION/	Madrid-Boston Project, *TMAC Resources* Hope Bay Project Explosives Management Plan (December 2017) http://www.nirb.ca/application?strP=r (171221-12MN001-Water Licence –P4-23_Hope Bay Project Explosives Management Plan-IMTE.pdf)	Meliadine Gold Mine, *Agnico Eagle Mines Limited* Explosives Management Plan (March 2018) ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-MEL1631%20Agnico/3%20TECH/1%20GENERAL%20(B)/2%20ANNUAL%20RPT/2017/180331%202AM-MEL1631%20-%202017%20Annual%20Report%20Final%20Complete%20with%20Appendices-ILAE.pdf (beginning on page 1246)	Whale Tail Pit / Meadowbank Mine, *Agnico Eagle Mines Limited* Ammonia Management Plan (June 2016) http://www.nirb.ca/application?strP=r (160706-16MN056-App 8-D.1-Addendum Ammonia Mgmt Plan-IA2E.pdf)
Activity					
Storage / Handling	• All explosives will be stored only at safe distances from facilities or personnel. • Explosives will be stored in a designated location within the explosives storage area and away from the explosive caps / detonator storage magazines. • The magazines will be dedicated to storing high energy explosives and blasting caps. • Explosives will be handled and managed only by suitably qualified employees trained in safe handling procedures and applicable legislation and regulations. • Mine personnel involved in explosives spill response will have explosives training. • Only qualified personnel holding valid blasting certificates will handle these materials. • Inventory will be used on a first-in, first-out basis to ensure quality control and prevent degradation due to cold weather storage. • Explosives stored in magazines will be clearly labelled. • Spills shall be contained and placed in suitable containers for use or disposal. All reportable spills will be reported to a spill response coordinator. • Access will be controlled to the AN Facility and explosives storage locations. • Access to the explosives plant will be restricted to authorized personnel and log books shall be kept in each magazine for tracking purposes.	• They will be protected from the elements to prevent contact with water during transport and storage. • Seacans will be placed on a laydown pad. • Spill locations would be generally limited to single storage bags within the AN Facility or seacans in the storage pad areas. These areas will be inspected regularly according to operating procedures. • The explosives storage magazines are located on separate pads. Runoff from these pads will not be collected. • Diversion berms will direct any runoff water to a sump at the AN Facility pad.	• Explosives will be permanently stored in separate Type 4 powder and detonator magazines at the permanent explosives storage facilities. • The AN will be delivered in the form of prills (small pellets or briquettes designed to reduce potential dusting) and be packaged within waterproof plastic tote bags (one tonne tote bag) that are then packed inside steel sea-can containers. • The bags will be handled individually when needed for the preparation of batches of explosive. • At site, explosives will be handled and managed by TMAC personnel and contractors qualified and trained in safe handling procedures and in accordance with applicable legislation and regulations. • The explosives magazines must be a minimum distance from camp. To address this requirement, the permanent explosives magazine pad will have a setback of 760 m from the camp. • In the unlikely event of a larger spill outside the permanent storage facility where the risk of potential transport of spilled AN by precipitation runoff is greater, TMAC will immediately deploy temporary silt curtains in the water path to prevent prills being carried into nearby water courses while the spill is cleaned up. • All explosives manufacturing, storage and product delivery systems will be approved and subject to inspection under Part IV – Explosives at Mines of the Northwest Territories/Nunavut Mines Health and Safety Act and Regulations and under federal regulations (The Canadian Explosives Act) administered by Natural Resources Canada, Explosives Division. • The AN bags will only be removed from the shipping containers when the AN is needed to produce ANFO at the explosives mixing plant. • The magazines and mixing plant will be kept free of empty tote bags and boxes and swept clean on a regular basis. • No explosives will be allowed to be stored in the vehicles when not in use. • The Blasting Supervisor will conduct a weekly inspection and any deficiencies will be immediately remedied.	• After the barges are unloaded, sea cans holding the raw products will be temporarily stored in a fenced laydown area at Itivia before being trucked to the mine site, with the exception of explosives, boosters, and caps, which will be transported directly to the mine site after being unloaded from the barges. • The temporary storage magazines with remain under constant surveillance by Agnico Eagle personnel while in use. • On the mine site, raw materials such as sodium nitrate and ammonium nitrate used in the preparation of emulsion will be contained in 1.2 t tote bags, and stored in sea cans. • Raw materials will also be stored away from any other products as required by explosive regulations. • The explosive caps will be stored in enclosed Cap Magazines (surface and underground). • The boosters, detonating cord, and explosives used for pre-shearing and ANFO will be stored in an enclosed Powder Magazine. • Surface and underground mining activities will require approximately 10 to 20 magazines in total, which will be managed according to the explosive regulations.	• Surface areas are graded to collect water runoff within the storage facilities. • AN based emulsion is used as a blasting agent; this material is designed to repel water thus minimizing the potential for ammonia to impact mine water. • Spillage control protocols, procedures and handling of spilled material, and explosive management for storage and transport, as well as the emergency response plan, have been established. • On a weekly basis, the environment department will conduct inspection in the blasting area to ensure that the Dyno Nobel loading procedures are being implemented (this will minimize blasting residues). • Inspections will be undertaken at explosive product storage facilities (Dyno Nobel) to ensure that explosives products are stored in sealed containers and there is no spillage. If any non-conformities are observed follow up action will be undertaken and corrective measure will be put in place.

Reference	**Back River, *Sabina Gold & Silver Corp.*** **Explosives Management Plan (November 2015)** http://www.nirb.ca/application?strP=r (151123-12MN036-Vol 10-Pt 13-Expllosives Management Plan-IA2E.pdf)	**Back River, *Sabina Gold & Silver Corp.*** **Quarry Management Plan (August 2017)** ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2B/2BC%20-%20Construction/2BC-BRP1819/1%20APPLICATION/	**Madrid-Boston Project, *TMAC Resources*** **Hope Bay Project Explosives Management Plan (December 2017)** http://www.nirb.ca/application?strP=r (171221-12MN001-Water Licence –P4-23_Hope Bay Project Explosives Management Plan-IMTE.pdf)	**Meliadine Gold Mine, *Agnico Eagle Mines Limited*** **Explosives Management Plan (March 2018)** ftp://ftp.nwb-oen.ca/registry/2%20MINING%20MILLING/2A/2AM%20-%20Mining/2AM-MEL1631%20Agnico/3%20TECH/1%20GENERAL%20(B)/2%20ANNUAL%20RPT/2017/180331%202AM-MEL1631%20-%202017%20Annual%20Report%20Final%20Complete%20with%20Appendices-ILAE.pdf (beginning on page 1246)	**Whale Tail Pit / Meadowbank Mine, *Agnico Eagle Mines Limited*** **Ammonia Management Plan (June 2016)** http://www.nirb.ca/application?strP=r (160706-16MN056-App 8-D.1-Addendum Ammonia Mgmt Plan-IA2E.pdf)
Activity					
Blasting	• Only certified and authorized mine employees or contractors will charge the holes, place the detonators and boosters, and tie-in the patterns. • All blasting will follow applicable legislation such as DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (DFO 1998). • The Air Quality Monitoring and Management Plan will be followed to reduce or eliminate impacts on air quality. • Wet blast holes will be lined with plastic liners prior to being loaded with ANFO. Packaged explosives will used as a backup to ANFO for situations when blast holes cannot be lined. • Sleep time in loaded blastholes will be limited to minimize contact between ANFO and water. • Spills shall be contained, cleaned up, and placed in suitable containers for use or disposal. All spills will be reported to a spill response coordinator. • The mine shall record daily use of explosives. Records will be checked and reconciled on a regular basis. • Explosives identified as deteriorated or damaged will be destroyed or disposed of; the supplier shall be consulted on the appropriate handling and disposal. • Contact water will be managed in accordance with the Site Water Monitoring and Management Plan.		• Explosive magazines will be dedicated to storing high energy explosives and blasting caps. Caps and high explosives will be stored in separate magazines as required by the regulations. All of the explosives that are stored in the magazines will be clearly labelled. Inventory will be used on a first-in, first-out basis to ensure quality control and prevent degradation due to cold weather storage	• Blasting will be carried out by certified blasters who will follow blasting regulations and safe practices. • The responsibility for blasting will be split between appropriately trained mine personnel and the explosives supplier. • There is often a relationship between ammonia and nitrate levels in surface water runoff and the quantity of ANFO type explosives that haven't detonated during the blast. Well planned blasts and strict control of spillage are keys to reducing ammonia losses. For safety, environmental, and economic reasons, blast designs will be optimized and will include measures that favor complete detonation of all explosives. • Drill patterns, explosive loads, and initiation methods will be designed and performed by experienced professionals, and will be adaptively managed to make necessary adjustments should any problems be observed. Also, having a single explosives supplier and trained certified blasters loading the holes and performing blasting activities will ensure the consistency and efficiency of the activity. Blasters who are conscientious and aware can prevent most spills by adjusting their loading practices.	• Blasting operations on site include monitoring the quantities of explosives used, and blast design procedures and practices. Combined with water monitoring, the compilation of this data is used to assess blasting performance. The results of this assessment are used to adjust blasting practices as needed to: a) Optimize the use of explosives; and b) Increase the completion and efficiency of explosive detonations. Any modifications to blast design are intended to decrease the amount of ammonia that may become available for mobilization in mine water. • Blast procedures currently in use are designed to minimize sleep time so that standing or flowing water is not in contact with the bulk emulsion for extended periods of time. • Quality control procedures are in place to verify AN content in bulk explosives. Quality control procedures for the emulsion occur at the plant and density tests are done at the blast site (on the trucks). Loading procedures specify that blastholes be loaded with emulsion from the bottom of the blastholes to provide a continuous explosive column.
Disposal	• All explosives will be removed from site or disposed of at Closure. • Explosives will be secured and stored safely or disposed of in case of temporary closure. • All explosives will be disposed of according to the SDS or manufacture. • Spills will be contained, cleaned up, and placed in suitable containers for use or disposal. All spills will be reported to the spill response coordinator.		• TMAC will develop procedures for the destruction of such material [deteriorated or damaged] prior to the start of mining. • Only qualified personnel holding valid blasting certificates will handle these materials. • Typically, such explosives are either burned or detonated under controlled conditions. In either case, only small quantities will be disposed of in a remote location. • The destruction-site will be dependent on the mining stage and will be chosen by the blasting supervisor in consultation with the Mine General Manager. • At the final cessation of mine operations, all unused explosives will be removed from site or safely burned or detonated if small quantities		

The BACK RIVER PROJECT

Technical Meeting Commitment Responses

Nunavut Water Board

Interested Party: NWB	Commitment No.:	WTM-COMMITMENT 5 (NWB-5)

Post-Technical Meeting Commitment:

Identify, in consultation with the NWB, more clearly where the existing Type "B" Licences overlap with the proposed scope of the Type "A".

Post-Technical Meeting Response Package:

GOOSE PROPERTY

Activities and works at the Goose Property already scoped and approved under the existing Goose Exploration Type B Water Licence 2BE-GOO1520 include:

- Goose Exploration Camp and infrastructure operation;
- Drilling activities;
- Ice airstrip construction and operation;
- <u>Land based airstrip</u>;
- Equipment, fuel, and supplies mobilization;
- Winter ice road construction and operation;
  - <u>Goose Exploration Camp to Airstrip Quarry Winter Ice Road</u>;
- <u>Airstrip Quarry operation</u>; and
- Temporary fuel cache storage.

Sabina proposes that those activities underlined are transferred from the Goose Exploration Type B (2BE-GOO1520) to Back River Project Type A (2AM-BRP----). Sabina proposes that the balance of activities remain under the Goose Exploration Type B (2BE-GOO1520).

Development works at the Goose Property already scoped and approved under the existing Development Works Type B Water Licence 2BCB-RP1819 include:

- Winter ice road construction and operation;
  - Goose Exploration Camp to Umwelt Quarry Winter Ice Road;
  - Goose Exploration Camp to Explosives Storage Winter Ice Road;
- Umwelt Quarry operation and expansion of the Airstrip Quarry;
- All-weather service road construction and operation, including associated water crossings;
- Goose Plant Site and Fuel Storage Area Pad initial construction;
- Land based airstrip extension;
- Rascal Stream re-alignment;
- Relocate Explosives Storage Area; and
- Water Intake Installation

Sabina proposes that all these activities are transferred from the Development Works Type B (2BC-BRP1819) to Back River Project Type A (2AM-BRP----).

MARINE LAYDOWN AREA (MLA)
Activities and works at the MLA already scoped and approved under the existing George Exploration Type B Water Licence 2BE-GEO1520 include:

- Temporary Exploration Camp and infrastructure operation;
- Equipment, fuel, and supplies mobilization via cat-train; and
- Temporary fuel cache storage.

Sabina proposes that all of these activities remain under the George Exploration Type B (2BE-GEO1520). Note, the MLA camp (currently permitted under 2BE-GEO1520), is proposed to be addressed within Back River Project Type A (2AM-BRP----).

Development works at the MLA already scoped and approved under the existing Development Works Type B Water Licence 2BC-BRP1819 include:

- Ice airstrip construction and operation;
- Equipment, fuel, and supplies mobilization (air);
- Upgrade Temporary Exploration Camp;
- Operate MLA Quarry;
- All-weather service road, laydown area, and bulk fuel storage area construction and operation;
- Additional equipment, fuel, and supplies mobilization (vessels);
- Install one steel bulk fuel tank; and
- Water intake/discharge installation.

Sabina proposes that all these activities are transferred from the Development Works Type B (2BC-BRP1819) to Back River Project Type A (2AM-BRP----).

EXISTING NWB APPROVED WATER USAGE
A summary of Sabina's water usage under existing NWB Type B Water Licenses is provided in Table 1.

Table 1: Sabina NWB Type B Water Licenses Water Usage

Sabina NWB Type B Water Licenses	Water Use Approved	Activities	Source	Proposed NWB Water Licence
2BC-BRP1819	297 m^3/d	Winter ice road construction and maintenance (winter season), dust suppression and compaction (summer season)	Goose Lake, MLA Pond S1 and S2	Addressed within 2AM-BRP----
2BE-GOO1520	297 m^3/d	Domestic camp use, drill water, miscellaneous industrial use	See Part C, Item 1, of 2BE-GOO1520	Remains in 2BE-GOO1520
2BE-GEO1520	175 m^3/d	Domestic camp use, drill water	See Part C, Item 1, of 2BE-GEO1520	Remains in 2BE-GEO1520

Interested Party: NWB	**Commitment No.:**	**WTM-COMMITMENT 18 (NWB-18)**

Post-Technical Meeting Commitment:

The Applicant suggested that they could submit a Draft Licence Framework document to highlight the Licence approval conditions they believe would align with their commitments and various submissions. Sabina's intends to provide this document to simplify and focus the parties' discussion of the Application. The Board requested that Sabina provide the Draft Licence Framework no later than June 8, 2018 so that all parties could review it and comment as appropriate in their final submissions due on July 9, 2018.

Post-Technical Meeting Response Package:

As request by the Board, Sabina has provided a Draft Water Licence Framework as intended to simplify to dispositions of the Application.

Proposed Back River Project
Type A Water Licence Framework

The following table outlines Sabina's comments on potential water licence conditions to proceed with the activities and infrastructure associated with the Back River Project (Project), should the Nunavut Water Board (NWB or Board) exercise its jurisdiction and authority under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act (NWNSRTA or Act)* to proceed and issue a licence. This framework incorporates conditions included in Type A Water Licences recently issued by the NWB and includes certain Back River specific conditions. This framework also incorporates the Type B Development Water Licence (2BC-BRP1819) where noted.

This table reflects information from the Application as well as the current public record (i.e., commitments from Information Requests and Technical Comment responses). Statements and conditions provided in this table are intended to support the NWB and staff in their development of a water licence for the Project.

Proposed Terms	**Sabina** **Comments and Annotation**
Water Licence Cover Sheet	
Licensee: Sabina Gold & Silver Corp. Mailing Address: #1800 - 555 Burrard Street, Box 220, Vancouver, BC V7X 1M9 Water Management Area: Queen Maud Gulf Watershed - 30 Location: Goose Lake and Marine Laydown Area, Back River Project, Kitikmeot Region, Nunavut Quantity of Water not to Exceed: o XXX cubic meters annually as per Part E Expiry of Licence: 2032	To be updated in revised Draft Framework taking into account final submissions
Part A: Scope, Definitions and Enforcement	
1. Scope	
a. This License authorizes the Licensee to use Waters and deposit of Waste in support of a Mining Undertaking classified as per Schedule 1 of the Regulations, at the Back River Project as outlined in the Type "A" Water Licence Application (the Application) submitted to the Nunavut Water Board (NWB) on October 5, 2017 and as reviewed throughout the regulatory process.	
The Licensee may conduct, mining, milling and associated activities at the Back River Project (Project) in the Kitikmeot Region of Nunavut, located at the following general geographical coordinates: [refer to Sabina Comments and Annotation]	**Table 2.1-1. Project Extents** Project Extents / Latitude / Longitude NW / 66°42' N / 107°50' W NE / 66°42' N / 106°11' W SE / 65°29' N / 106°12' W SW / 65°29' N / 107°50' W
The activities and facilities included under the scope of this Licence for construction, operations, closure and reclamation of the Project, are as follows:	
o Construction and Operation of mill for gold recovery; o Construction, Operation and maintenance of Plant Site and Fuel Storage Area Pad, Laydown Areas and fuel storage areas o Construction and Operation of Fuel Storage Facilities, fuel storage areas, dispensing storage facilities and associated secondary containment areas or berms for the bulk fuel storage facilities and day tanks; o Construction and Operation of a TSF, associated pipelines and pumping systems for water management; o Construction and Operation of all-weather airstrips (including extension); o Construct and Operation of ice airstrips o Construction and Operation of the MLA. o Construct all-weather service roads and water crossings o Realign Rascal Stream and/or install fish bearing culverts at airstrip extension	

Proposed Terms	**Sabina** **Comments and Annotation**
Access and Infrastructure o Construction and Operation of all-weather roads (i.e., service roads, haul roads); o Develop and operate Quarries; o Construction and maintenance of Project infrastructure; and o Construction and Operation of WIRs and Bathurst Inlet Port Road (BIPR) WIR connector. o Goose Exploration Camp to Umwelt Quarry/Plant Site/Airstrip Quarry o Goose Exploration Camp (or other ice road) to the Explosives Storage o Mobilize fuel, equipment, and supplies	
Water Use and Management: o Construction, Operation and Maintenance of Water Supply Facilities for all purposes; o Construction, Operation and Maintenance of water management infrastructure, including; o Watercourse crossings including pipelines, channel, and bank alterations, culverts, spurs, and erosion control; o Flood control, diversions, alteration of flow, or storage by means of dykes or dams; o Runoff management from the Ore Stockpile, WRSAs, laydown areas, and other mine infrastructure; and o Water treatment facilities.	
Waste Disposal and Management: o Construction, Operation and Maintenance of Waste Disposal Facilities o Construction, Operation and Maintenance of Landfarms for the deposition and treatment of hydrocarbon contaminated material; o Construction, Operation and Maintenance Landfills for deposition of solid waste; o Construction, Operation and Maintenance of Waste rock disposal areas; o Construction, Operation of Tailings Storage Facility and/or Facility(s); o Management of effluent discharges.	
Material Management: o The transportation, use, management, disposal, and treatment of petroleum, oils, and lubricants; o Storage and management of hazardous materials; o Containment areas for temporary storage of hazardous/nonhazardous waste (waste transfer areas) and new product storage for drums and totes; o Waste sorting facilities and temporary storage facilities for hazardous wastes; and o Operation and handing of explosives storage and explosives manufacturing facilities.	
Monitoring o Implementation of regular inspection and maintenance of all earthworks and water management and waste disposal infrastructure; and o Implementation of Environmental Management and Protection Plan.	
Closure o Implementation of remediation and reclamation including progressive reclamation.	
1 (b) This Licence is issued subject to conditions contained herein with respect to the use of Waters and the deposit of Waste of any type in any Waters or in any place under any conditions where such Waste or any other Waste that results from the deposits of such Waste may enter any Waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the Act, or other statutes imposing more stringent conditions relating to the quantity, type or manner under which any such Waste may be so deposited, this Licence shall be deemed to be subject to such requirements.	NWB Standard Terms and Conditions

Proposed Terms	**Sabina** **Comments and Annotation**
1(c) Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with all applicable legislation, guidelines and directives.	
2. Definitions The Licensee shall refer to Schedule A for definitions of terms used in this Licence.	See "Schedule A" below for revisions
3. Enforcement	
(a) Failure to comply with this Licence will be a violation of the Act, subjecting the Licensee to the enforcement measures and the penalties provided for in the Act.	NWB Standard Terms and Conditions
(b) All inspection and enforcement services regarding this Licence will be provided by Inspectors appointed under the Act.	NWB Standard Terms and Conditions
(c) For the purpose of enforcing this Licence and with respect to the use of Water and deposit of Waste by the Licensee, Inspectors appointed under the Act, hold all powers, privileges and protections that are conferred upon them by the Act or by other applicable laws.	NWB Standard Terms and Conditions
Part B: General Conditions	
1. This licence incorporates the scope of the Existing Type "B" Water Licence No. 8BC-BRP1819 and where applicable Type B Water Licence No. 2BE-GOO1520 and No. 2BE-GEO1520 in accordance with Part A, Item 1(a). To the extent that any required reports, studies or plans having not yet been received, accepted or approved by the Board, the requirements associated with such documents are now brought forward under this Licence.	NWB Standard Terms and Conditions
2. The amount of Water use fees shall be determined and payment of those fees shall be made in accordance with section 12 of the Regulations.	NWB Standard Terms and Conditions
3. The Licensee shall file an Annual Report with the Board no later than March 31th in the year following the calendar year being reported. The Annual Report shall be developed in accordance with Schedule B.	NWB Standard Terms and Conditions
4. Any communication with respect to this Licence shall be made in writing to the attention of: Manager of Licensing, Nunavut Water Board P. O. Box 119 Gjoa Haven, NU X0B 1J0 Telephone: (867) 360-6338 Fax: (867) 360-6369 Email: licensing@nwb-oen.ca	NWB Standard Terms and Conditions
5. Any notice made to an Inspector shall be made in writing to the attention of: Water Resources Officer Nunavut District, Nunavut Region P.O. Box 100 Iqaluit, NU X0A 0H0 Telephone: (867) 975-4295 Fax: (867) 979-6445	NWB Standard Terms and Conditions
6. The Licensee shall submit one (1) electronic copy of all reports, studies, and plans to the Board unless otherwise requested by the Board. Unless otherwise directed by the Board, reports or studies submitted to the Board by the Licensee shall include an executive summary in English, Inuinnaqtun, and Inuktitut.	NWB Standard Terms and Conditions
7. This Licence is assignable as provided in Section 44 of the Act.	NWB Standard Terms and Conditions
8. The Licensee shall ensure that any document(s) or correspondence submitted by the Licensee to the Board is received and acknowledged by the Manager of Licensing.	NWB Standard Terms and Conditions
9. The Licensee shall post signs in the appropriate areas to inform the public of the location of the Water Supply Facilities and the Waste Disposal Facilities. All signs must be in English, Inuinnaqtun and Inuktitut and shall be located and	NWB Standard Terms and Conditions

Proposed Terms	**Sabina** **Comments and Annotation**
10. The Licensee shall, for all Plans submitted under this Licence, include a proposed timetable for implementation. Plans submitted cannot be undertaken without subsequent written Board approval and direction. The Board may alter or modify a Plan if necessary to achieve the legislative objectives and will notify the Licensee in writing of acceptance, rejection or alteration of the Plan.	NWB Standard Terms and Conditions
11. Unless otherwise directed by the Board in writing, if a Plan is not acceptable to the Board, the Licensee shall provide a revised version to the Board for review within thirty (30) days of notification by the Board.	NWB Standard Terms and Conditions
12. The Licensee shall, for all Plans submitted under this Licence, implement the Plan as approved by the Board. Any changes to the plans deemed significant shall be considered as an amendment to the plan(s) or as a modification and must be submitted to the Board for approval in writing. The Board has approved the following plans for implementation under the relevant section of this Licence.	
a. Road Management Plan (October 2017) (SD-02) b. Borrow Pits and Quarry Management Plan (October 2017) (SD-03) c. Water Management Plan (October 2017) (SD-05) d. Ore Storage Management Plan (October 2017) (SD-07) e. Mine Waste Rock Management Plan (October 2017) (SD-08) f. Tailings Management Plan (October 2017) (SD-09) g. Landfill and Waste Management Plan (October 2017) (SD-10) h. Incineration Management Plan (October 2017) (SD-11) i. Landfarm Management Plan (October 2017) (SD-12) j. Hazardous Materials Management Plan (October 2017) (SD-13) k. Risk Management and Emergency Response Plan (October 2017) (SD-15) l. Fuel Management Plan (October 2017) (SD-16) m. Spill Contingency Plan (October 2017) (SD-17) n. Environmental Management and Protection Plan (October 2017) (SD-20) o. Aquatic Effects Management Plan (October 2017) (SD-21) p. Quality Assurance / Quality Control Plan (October 2017) (SD-24) q. Interim Closure and Reclamation Plan (including Interim Closure Cost Estimate) (October 2017) (SD-26)	Sabina requests that all of these plans be approved with the issuance of the Type A Water Licence.
13. The Licensee shall update and revise for submission to the Board for review and/or approval as required under the relevant section of this Licence, the following plans and documents. The updates are to take into account commitments made with respect to submissions received during the regulatory review of the Application. a. Water Management Plan (October 2017) (SD-05)	
14. Every Plan to be carried out pursuant to the terms and conditions of this Licence shall become a part of this Licence, and any additional terms and conditions imposed upon approval of a Plan by the Board become part of this Licence. All terms and conditions of the Licence should be contemplated in the development of a Plan where appropriate.	NWB Standard Terms and Conditions
15. The Licensee shall review the Plans or Manuals referred to in this Licence as required by changes in operation and/or technology and modify the Plans or Manuals accordingly. Revisions to the Plans or Manuals are to be submitted in the form of an Addendum to be included with the Annual Report required by Part B, Item 2, complete with a revisions list detailing where significant content changes are made.	NWB Standard Terms and Conditions
16. The expiry or cancellation of this Licence does not relieve the Licensee from any obligation imposed by the Licence, or any other regulatory requirement.	NWB Standard Terms and Conditions

Proposed Terms	**Sabina Comments and Annotation**
17. The Schedules attached to this Licence provide details regarding the requirements associated with specific items in the main body of the Licence and are included in the Schedule to provide greater clarity and as an aid to interpretation for the Licensee. If the Board subsequently determines that an item in any of the Schedules requires revision in order to better reflect the intent and objectives of the Licence, the Board may at its discretion, and upon consulting and providing written notice to the Licensee and interested parties, revise the Schedule accordingly. Unless the Board directs otherwise, such revision may not necessarily be considered as an "Amendment" to the Licence.	NWB Standard Terms and Conditions
18. Unless otherwise stated, references in the Licence to any specific legislation, policy, guideline or other regulatory requirement are deemed to refer to the regulatory requirement as may be amended or as may be expressly replaced by successor legislation, policy, guidelines or other regulatory requirements after the Licence is approved by the Minister.	NWB Standard Terms and Conditions
Part C: Conditions Applying to Security	
1. The Licensee shall: a. within thirty (30) days following the approval of this Licence by the Minister: i. furnish and maintain security with the Minister in the amount of XXX million XXX thousand dollars ($XXX); and ii. file evidence, in writing, that is acceptable to the Board, and with notice to the Minister and the Kitikmeot Inuit Association, verifying that the Licensee has furnished and maintained reclamation security in an amount of no less than XXX million XXX hundred XXX thousand XXX hundred and XXX dollars ($XXX) with the Kitikmeot Inuit Association for the purposes of reclamation consistent with the purposes set out in s. 76(2)(b) of the Act and as applicable to reclamation of the Mining Undertaking described in the Licence. b. sixty days prior to Construction i. furnish and maintain security with the Minister in the amount of XXX million XXX thousand dollars ($XXX); and ii. file evidence, in writing, that is acceptable to the Board, and with notice to the Minister and the Kitikmeot Inuit Association, verifying that the Licensee has furnished and maintained reclamation security in an amount of no less than XXX million XXX hundred XXX thousand XXX hundred and XXX dollars ($XXX) with the Kitikmeot Inuit Association for the purposes of reclamation consistent with the purposes set out in s. 76(2)(b) of the Act and as applicable to reclamation of the Mining Undertaking described in the Licence.	Sabina is in current discussions with INAC and the KIA respecting security matters in order to build further consensus and will provide an update to this section incorporating specific values at the Public Hearing. The terms and conditions set out at this Part C generally mirror those found in 2AM-DOH1323. Parties also in discussion related to phased approach to security increases regarding increased activities on site overtime and further update will be provided in revised Draft Framework prior to the final hearing.
2. The Licensee must ensure that the security furnished and maintained under Part C, Items 1(a) and (b), is no less than XXX million XXX hundred and XXX thousand XXX hundred and XXX dollars ($XXX) and that the security is in the form, of the nature, subject to applicable terms and conditions, in accordance with the Regulations, or that is otherwise satisfactory to the Minister.	
3. If the Licensee fails to provide evidence of the security required under Part C, Item 1(b), or if, during the term of the Licence, the Licensee fails to maintain the security required under Part C, Item 1(b), the Licensee shall, within thirty (30) days of the Licensee's failure, furnish and maintain such additional security with the Minister as is required to ensure that the total reclamation security held under Part C, Items 1(a) and (b) is no less than the amount prescribed under Part C, Item 2.	
4. The Licensee is required to provide the Board and the Minister with at least sixty (60) days written notice prior to any material change affecting the reclamation security arrangements between the Licensee and the Kitikmeot Inuit Association, including, but not limited to changes to the form of security, quantum of security or terms associated with holding, accessing or releasing the security. Notwithstanding this requirement, should the Licensee or the Kitikmeot Inuit Association become aware of, or cause any change to, the amount or terms of security referred to in Part C, Item 1(b), the Licensee or the Kitikmeot Inuit Association will promptly notify the Board.	

Proposed Terms	Sabina Comments and Annotation
5. The Licensee shall submit to the Board for approval at least twelve (12) months prior to Closure, an updated estimate of the total mine closure restoration liability using the current version of RECLAIM, its equivalent or other similar method approved by the Board in writing, in accordance with principles of the INAC "Mine Site Reclamation Policy for Nunavut" (2002). Upon the Project entering into or being maintained in Care and Maintenance, an updated estimate of total mine closure restoration liability shall be submitted, as above, within twelve (12) months of entering Care and Maintenance and every three (3) years thereafter.	
6. The Licensee shall furnish and maintain such further or other amounts of security as may be required by the Board, based on the updated estimate of current mine reclamation liability under PART C, Item 5.	
7. The Licensee, the Minister, or the Kitikmeot Inuit Association may apply to amend the amount of security required to be held under the Licence. Any submission requesting a review of the security provisions of the Licence shall include supporting evidence to justify the amendment and will be processed by the Board as an amendment to the terms and conditions of the Licence.	
8. Upon the Board receiving a request under PART C, Item 7 to amend security, or upon receiving an updated reclamation cost estimate as required under PART C, Item 5, the Board, may on its own initiative, or upon application by the Licensee, the Minister and/or the Kitikmeot Inuit Association, conduct a periodic review of the outstanding reclamation liability associated with the Undertaking and may, as the Board considers appropriate, amend the amount of security required to be held under PART C, Items 1 and 2.	
9. If the Board determines it to be necessary, or upon the request of Licensee, the Minister and/or the Kitikmeot Inuit Association, the Board may issue further directions under this Part with respect to the process for amending the amount of security to be furnished and maintained under the Licence.	
10. The security referred to in PART C, Item 1 shall be maintained until such time as it is fully or in part refunded by the Minister pursuant to Section 76(5) of the Act. This clause shall survive the expiry of this Licence and remains in force until amended by the Board under this Part or until full and final reclamation has been completed to the satisfaction of the Minister.	
Part D: Conditions Applying to Construction and Operations	
1. The Licensee shall use fill material for construction from an approved source that shall be free of contaminants, unless otherwise approved by the Board.	
2. The Licensee shall implement preventive and mitigation measures to prevent any chemicals, fuel or Wastes associated with the undertaking from entering any Water body.	NWB Standard Term and Condition
3.The Licensee shall locate equipment storage areas on gravel, sand or other durable land, a distance of at least thirty-one (31) metres above the ordinary High Water Mark of any Water body in order to minimize impacts on surface drainage and water quality unless otherwise approved by the Board with appropriate mitigation measures implemented by the Licensee.	
4. The Licensee shall implement sediment and erosion control measures where necessary, during all phases of the Project to prevent entry of sediment into Water.	NWB Standard Term and Condition
5. The Licensee shall undertake appropriate corrective measures to mitigate impacts on surface drainage resulting from the Licensee's operations.	NWB Standard Term and Condition
6. The Licensee shall limit any in-stream activity to the low Water period and this activity is prohibited during fish migration unless otherwise approved by the Board or Fisheries and Oceans Canada.	NWB Standard Term and Condition
7. The Licensee shall conduct construction monitoring during periods where construction activities are undertaken.	NWB Standard Term and Condition

Proposed Terms	Sabina Comments and Annotation
8. The Licensee shall, during periods of Construction activities, submit an annual Construction Summary Report no later than March 31 in the year following the calendar year being reported. The report shall be developed in accordance with Schedule D, Item 1 and submitted with the Annual Report in accordance with Part B, Item 3.	Sabina recommends streamlining of the construction monitoring report to be included in the Annual report.
9. The Licensee shall identify and tag any potentially acid generating rock identified through the Borrow Pits and Quarry Management Plan for removal and disposal into the WRSAs, backfill in the undergrounds or Tailings Facility and/or Tailings Facilities or as otherwise approved by the Board.	
10. The Licensee shall monitor the underground backfill and mine Waste placement underground during Operations to confirm that the proposed closure and reclamation targets of returning waste rock into the underground are achieved.	
11. The Licensee shall construct and operate the Fuel Storage and Containment Facility(s) to meet, at a minimum, all applicable legislation and industry standards that include the following: a. Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products, 2003; CCME, PN 1326; and b. National Fire Code, 2010.	NWB Standard Term and Condition
12. The Licensee shall, for the purposes of bridge construction, ensure that all activities remain outside of the natural channel width by the placement of abutments, footings or armouring above the ordinary High Water Mark so that there is no restriction to the natural channel processes.	NWB Standard Term and Condition
13. The Licensee shall submit to the Board for approval, at least thirty (30) prior to Construction, final design and Construction drawings accompanied, with a detailed report, both stamped and signed by the appropriately qualified Engineer, where appropriate, for the following: a. Water Works, including: Water Intake and water control structures (dikes, berms, jetties, channels) and water crossings (culverts); b. Waste Disposal Facilities, including: Tailing Storage Facility, Water Treatment Plant, Sewage Treatment Plant, Discharge Diffuser(s), Waste Rock Storage Facilities, Ore Stockpiles, Landfarm, and Landfill, and c. Bulk Fuel Storage Facilities.	
14. The Licensee shall conduct all activities, including the construction and maintenance of the all-weather roads, in such a way as to minimize impacts on surface drainage and shall immediately undertake any corrective measures in the event the Licensee’s activities cause significant pooling of Water or any impacts on surface drainage.	NWB Standard Term and Condition
15. With respect to access road, pad construction or other earthworks where direct or indirect flow into a Water body is possible, the deposition of debris or sediment into or onto any Water body is prohibited. These materials shall be disposed at a distance of at least thirty-one (31) metres from the ordinary High Water Mark in such a fashion that they do not enter the Water, unless otherwise approved by the Board with appropriate mitigation measures implemented by the Licensee.	NWB Standard Term and Condition
16. The Licensee shall monitor all activities for signs of erosion and shall implement and maintain sediment and erosion control measures prior to the undertaking to prevent entry of sediment into any Water body.	NWB Standard Term and Condition
17. The Licensee shall conduct visual inspections for all construction activity during spring freshet and during and after remarkable rainfall events with sampling of runoff/seepage where turbidity is evident.	NWB Standard Term and Condition

Proposed Terms	Sabina Comments and Annotation
18 All surface runoff and/or discharge from drainage management systems, during the construction/operation of any facilities and infrastructure associated with this project, including laydown areas, where flow may directly or indirectly enter a Water body, shall not exceed the following Effluent quality limits:	NWB Standard Term and Condition

Parameter	Maximum Average Concentration	Maximum Concentration of Any Grab Sample
Total Suspended Solids (mg/L)	50.0	100.0
Oil and Grease	No Visible Sheen	No Visible Sheen
pH	Between 6.0 and 9.5	Between 6.0 and 9.5

Proposed Terms	Sabina Comments and Annotation
19. The Licensee shall operate the Sewage Treatment Plant in accordance with conditions provided in PART G, Item 3 with Effluent compliance at monitoring station BRP-17 during discharge to the tundra.	
20. The Licensee shall implement quarry seepage and runoff management in accordance with the approved Water Management Plan.	This proposed wording reflects Sabina commitments made in response to WT-KIA-NWB-11.
21. The Licensee shall provide a summary and analysis in the Annual Report submitted in the year following data collection, that presents the data collected analysis from the Quarry Rock Seepage Monitoring and Management Program conducted under PART D, Item 20.	NWB Standard Term and Condition
22. The Licensee shall use fill material for construction only from approved sources that has been demonstrated by appropriate geochemical analyses to not produce Acid Rock Drainage and to be Non-Metal Leaching, and free of contaminants, unless otherwise approved by the Board.	
23. The Licensee shall construct and maintain all containment and runoff control structures to prevent non-permitted releases of Wastes to the terrestrial environment or groundwater systems.	NWB Standard Term and Condition
24. The Licensee shall submit to the Board for review, with the Construction Summary Report referred to under PART D, Item 8, and following completion of each facility designed to contain, withhold, divert or retain Waters or Wastes, a Construction Summary Report prepared by a qualified Engineer(s) that shall include as-built drawings, documentation of field decisions that deviate from original plans and any data used to support these decisions.	NWB Standard Term and Condition
25. The Licensee shall, during the construction of all engineered structures designed to contain, withhold, divert or retain Waters or Wastes, provide the required supervision and field checks by an appropriately qualified and experienced Engineer in such a manner that the project specification can be enforced and, where required, the quality control measures can be followed. The Licensee shall maintain all construction records of all engineered structures, as above, to be made available at the request of the Board and/or an Inspector.	NWB Standard Term and Condition
26.The Licensee shall direct contact water at the Goose Property to the Pollution Control Ponds for collection and transfer to the Tailings Facility(s) and/or Tailings Storage Facility and/or Underground, unless otherwise approved by the Board.	
27. The Licensee shall consider the principles of Adaptive Management in Construction and Operations.	NWB Standard Term and Condition

Proposed Terms	**Sabina** **Comments and Annotation**
Part E: Conditions Applying to the Use of Water	
1. The Licensee shall obtain fresh Water as follows or as otherwise approved by the Board: a. For domestic and industrial use, for the Goose Property for all phases of the project, from Goose Lake at Monitoring station BRP-24, Big Lake at Monitoring Station BRP-12; de-watering phase at Monitoring station BRP-XX and BRP-XX; b. For domestic and industrial use, for the Marine Laydown Area for all phases of the project from MLA Pond S1, Pond S2, Lake 3, and Lake 4 at Monitoring station BRP-XX, BRP-XX, BRP-XX, BRP-XX; c. For Winter Ice Road construction, maintenance, and operation the use of water from all source locations proximal to the road routing shall be undertaken in accordance with Part F, Item 3 (New); d. The use of Waters from Big Lake, for all purposes, shall not exceed a total of 77,068 cubic metres per year from the Licence approval date; e. The use of Waters from Goose Lake, for all purposes, shall not exceed a total of 474,825 cubic metres per year from the Licence approval date; f. The use of Waters from Llama Lake and Umwelt Lake, for de-watering purpose, shall not exceed a total of 1.4 million cubic metres per year from the Licence approval date; g. The use of Waters from MLA Pond S1, Pond S2, Lake 3, and Lake 4, for all purposes, shall not exceed a total of 108,405 cubic metres per year from the Licence approval date h. Additional Water for domestic and industrial use at the Marine Laydown Area may be sourced from the marine environment.	Sabina will confirm final water volumes in revised draft framework prior to final hearing.
2. The Licensee shall maximize to the greatest practical extent, the use of reclaim Water from the Tailings Storage Facility(s) for use in the mill.	
3. The Licensee shall not use streams as a Water source unless authorized and approved by the Board	NWB Standard Term and Condition
4. The Licensee shall maintain the Water Intakes to the satisfaction of the Inspector.	
5. The Licensee shall equip all Water intake hoses with a screen of an appropriate mesh size to ensure that fish are not entrained and shall withdraw Water at a rate such that fish do not become impinged on the screen.	NWB Standard Term and Condition
6. The Licensee shall not remove any material from below the ordinary High Water Mark of any Water body unless authorized by an Inspector or the Board.	NWB Standard Term and Condition
7. The Licensee shall provide the controls necessary to prevent erosion to the banks of any body of Water. Sediment and erosion control measures shall be implemented prior to and maintained during the operation to prevent entry of sediment into Water.	NWB Standard Term and Condition
Part F: Conditions Applying to Water Management	
1. The Board has approved, the Water Management Plan dated October 2017. The Licensee shall submit to the Board for review within sixty (60) days of approval of this Licence, a revised Water Management Plan. The revised Plan shall include the following: a. updated Saline Water Management plan appendix; and b. further detail respecting potential management and treatment options related to water quality in the effluent discharged from flooded pits and the downstream receiving environment.	a. Reflects commitment No. 6 from the NWB PHC/TM Decision b. Reflects commitment No. 3 from the NWB PHC/TM Decision
2. The Licensee shall carry out regular inspections of all Water management structures during periods of flow and the records be kept for review upon request of an Inspector. More frequent inspections may be required at the request of an Inspector. This information may be included in the Annual report required by Part B, Item 3.	NWB Standard Term and Condition

Proposed Terms	**Sabina** **Comments and Annotation**
3. (New) The Licensee shall submit to the Board sixty (60) days prior to annual Winter Ice Road construction an updated Technical Memorandum titled "Winter Ice Road Withdrawal Evaluation (February 2018) for approval of the Board. The memorandum will confirm bathymetry, depth, potential locations of possible water withdrawal, proposed volumes to be extracted and anticipated water level decreases. The memorandum may be submitted as an addendum appendix to the approved Water Management Plan.	The proposed wording reflects DFO TC 3.3 [In final draft, write out text]
4. (New) The Licensee shall submit to the Board sixty (60) days prior to initiation of dewatering a Dewatering Plan for review of the Board. The Plan may be submitted as an addendum appendix to the approved Water Management Plan.	The proposed wording reflects DFO TC 3.5 [In final draft, write out text]
5. (New) The Licensee shall submit to the Board for review with the Annual Report in accordance with Part B, Item 3, an updated Water and Load Balance Model as an appendix to the approved Water Management Plan. The updates are to take into account the following: a. updated 2017-2018 baseline data collection that takes into account seasonal variation; and b. updated hydrodynamic model	The proposed wording reflects Commitment No. 7 and 9 from the NWB PHC/TM Decision .
6. (New) The Water and Load Balance Model shall be reviewed periodically, to reflect key changes in operations and submit results for review with the Annual Report in accordance with Part B, Item 3 as appendix to the approved Water Management Plan.	
Part G: Conditions Applying to Waste Disposal and Management	
1. The Licensee shall provide at least three (3) days notice to the Inspector prior to any planned discharges from any Facilities. The notice shall include the estimated volume proposed for discharge and location.	
2. The Licensee shall perform all land applied discharges in a manner that prevents erosion at the point of discharge and downstream.	NWB Standard Term and Condition.
4. The Licensee shall implement the approved Landfill and Waste Management Plan.	
5. The Licensee shall not open burn plastics, wood treated with preservatives, electric wire, Styrofoam, asbestos or painted wood in order to prevent the deposition of Waste materials (e.g. products of incomplete combustion, leachate from contaminated ash residual, etc.) from impacting any surrounding Waters, unless otherwise approved by the Board.	NWB Standard Term and Condition
6. The Licensee shall implement the approved Incineration Management Plan.	
7. The Licensee is authorized to dispose of and contain all non-hazardous solid Wastes at the Landfill(s), or as otherwise approved by the Board.	
8. The Licensee shall implement the approved Hazardous Materials Management Plan.	
9. The Licensee shall implement the approved Borrow Pits and Quarry Management Plan.	
10. The Licensee shall backhaul and dispose of all hazardous Wastes, through the course of the operation at a licensed Waste disposal site in accordance with the Hazardous Waste Management Plan.	
11. The Licensee shall maintain records of all Waste backhauled and records of confirmation of proper disposal of backhauled Waste. These records shall be made available to an Inspector upon request.	NWB Standard Term and Condition
12. The Licensee shall implement the approved Landfarm Management Plan.	
13. The Licensee shall implement the approved Mine Waste Rock Management Plan and approved Ore Storage Management Plan.	
14. The Licensee shall submit to the Board for approval in writing, at least sixty (60) days prior to planned implementation, any changes that are contemplated to the geochemical confirmatory sampling and testing program or the criteria for using non- mineralized Waste Rock for construction as outlined in the approved Plans, approved as per PART G, Item 13, including a description of and justification for the change.	

<table>
<tr><th>Proposed Terms</th><th>Sabina
Comments and Annotation</th></tr>
<tr><td>15. The Licensee shall store all potentially acid generating rock temporarily at the underground laydown pads prior to ultimate disposal underground as mine backfill, or in the WRSAs or as otherwise approved by the Board.</td><td></td></tr>
<tr><td>16. All Waste Rock brought to the surface from underground shall be managed in accordance with the approved Plan(s) submitted under PART G, Item 13 as otherwise approved by the Board.</td><td></td></tr>
<tr><td>17. The Licensee shall operate and maintain all Waste management facilities to the satisfaction of the Inspector.</td><td>NWB Standard Term and Condition</td></tr>
<tr><td>18. All Water from the Pollution Control Ponds, and Sumps shall be directed to the Tailings Facility(s) or Tailings Storage Area, unless otherwise authorized by the Board.</td><td></td></tr>
<tr><td>19. The Licensee shall operate and maintain the Sumps associated with the site, in accordance with the following:
a. Water discharged from the Landfill Sump at monitoring station BRP-09, and BRP-29 shall not exceed the following Effluent quality limits: [See Sabina Comments]</td><td>Table 7.4-1. Proposed Landfill Seepage Monitoring Water Quality Criteria
<table>
<tr><th>Parameters</th><th>Maximum Average Concentration (mg/L)</th></tr>
<tr><td>pH</td><td>6.0 - 9.5</td></tr>
<tr><td>As</td><td>0.5</td></tr>
<tr><td>Cu</td><td>0.3</td></tr>
<tr><td>Pb</td><td>0.2</td></tr>
<tr><td>Ni</td><td>0.5</td></tr>
<tr><td>Zn</td><td>0.5</td></tr>
<tr><td>Total Suspended Solids</td><td>15</td></tr>
<tr><td>Oil and Grease</td><td>No visible sheen</td></tr>
</table></td></tr>
<tr><td>b. Water from the Landfill Sump that is acceptable for discharge under PART G, Item 23(a), may be discharged to the tundra or as designated by an Inspector;
c. Water discharged from the Landfarm Sump at monitoring station BRP-44, and BRP-51 shall not exceed the following Effluent quality limits: [See Sabina Comments]</td><td>Table 7.5-1. Proposed Landfarm Pooling Water Quality Discharge Criteria
<table>
<tr><th>Parameter</th><th>Maximum Average Concentration(mg/L)</th></tr>
<tr><td>pH</td><td>6.0 - 9.0</td></tr>
<tr><td>Total Suspended Solids</td><td>15</td></tr>
<tr><td>Oil and Grease</td><td>15 and no visible sheen</td></tr>
<tr><td>Benzene</td><td>0.370</td></tr>
<tr><td>Ethylbenzene</td><td>0.090</td></tr>
<tr><td>Toluene</td><td>0.002</td></tr>
<tr><td>Xylene</td><td>0.300</td></tr>
</table>
Sources: Nunavut Water Board Water Licence No: 2AM-MRY1325 (2013); Back River technical comment DEIS-ECCC-TC-30</td></tr>
<tr><td>d. Water from the Landfarm Sump that is acceptable for discharge under PART G, Item 23(c) may be discharged to the tundra or as designated by an Inspector;
e. Water discharged from the Bulk Fuel Storage Facility secondary containment Sumps at monitoring stations BRP-15, BRP-43, and BRP-49 shall not exceed the following Effluent quality limits: [See Sabina Comments]</td><td>Takes into account Development Licence Part D, Item 3
<table>
<tr><th>Parameter</th><th>Maximum Average Concentration</th><th>Maximum Concentration of any Grab Sample</th></tr>
<tr><td>Benzene (µg/L)</td><td>370</td><td>370</td></tr>
<tr><td>Ethylbenzene (µg/L)</td><td>90</td><td>90</td></tr>
<tr><td>Toluene (µg/L)</td><td>2</td><td>2</td></tr>
<tr><td>Lead (mg/L)</td><td>0.1</td><td>0.1</td></tr>
<tr><td>Oil and Grease (mg/L)</td><td>5 and no visible sheen</td><td>5 and no visible sheen</td></tr>
<tr><td>Total Suspended Solids (mg/L)</td><td>15</td><td>30</td></tr>
<tr><td>pH</td><td>Between 6.0 and 9.5</td><td>Between 6.0 and 9.5</td></tr>
</table></td></tr>
</table>

Proposed Terms	**Sabina Comments and Annotation**
f. Water from the Fuel Storage and Containment Facility Sumps that is acceptable for discharge under PART G, Item 19 (e) may be discharged to the tundra or as designated by an Inspector; and g. Sump Water from the Landfill, Landfarm and Fuel Storage and Containment Facility that does not meet the criteria in PART G, Items 19 (a),(c) and (e) respectively shall be directed to Tailings Facility(s) and/or Tailings Storage Facility.	
19. The Licensee shall implement the approved Tailings Management Plan	
20. (NEW) The discharge of effluent from the TSF and/or Tailings Facility(s) at Umwelt or Goose Main during Operations is acceptable for discharge if Effluent criteria is met .	
21. (NEW) The Licensee is authorized to operate a Desalination plant.	
Part H: Conditions Applying to Modifications	
1. The Licensee may, without written consent from the Board, carry out Modifications to the Water Supply Facilities and Waste Disposal Facilities provided that such Modifications are consistent with the terms of this Licence and the following requirements are met: a. The Licensee has notified the Board of such proposed Modifications at least sixty (60) days prior to beginning the Modifications; b. Such Modifications do not place the Licensee in contravention of the Licence or the Act; c. Such Modifications are consistent with the applicable terms and conditions of the NIRB Project Certificate; d. The Board has not, within sixty (60) days following notification of the proposed Modifications, informed the Licensee that review of the proposal will require more than sixty (60) days; and e. The Board has not rejected the proposed Modifications.	NWB Standard Term and Condition
2. Modifications for which any of the conditions referred to in Part G, Item 1 have not been met can be carried out only with approval from the Board.	NWB Standard Term and Condition
3. Applications for modifications shall contain: a. A description of the facilities and/or works to be constructed; b. The proposed location of the structure(s); c. Identification of any potential impacts to the receiving environment; d. A description of any monitoring required, including sampling locations, parameters measured, and frequencies of sampling; e. A proposed schedule for construction; f. Drawings of Engineered Structures stamped by a Professional Engineer, where applicable; and g. Proposed sediment and erosion control measures.	NWB Standard Term and Condition. Certain facilities would not make sense to have "stamped drawings"
4. The Licensee shall provide to the Board, within ninety (90) days of completion of the Modification, as-built plans and drawings of the Modifications referred to in this Part. These plans and drawings shall be stamped by an Engineer, where applicable.	NWB Standard Term and Condition
Part I: Conditions Applying to Contingency Planning	
1. The Licensee shall implement the Emergency Response Program including: Risk Management and Emergency Response Plan; Fuel Management Plan; and Spill Contingency Plan, as approved by the Board. The Licensee shall comply with the Plan(s) and any changes deemed significant shall require the submission and subsequent approval of the Board.	
2. The Licensee shall prevent any chemicals, petroleum products or unauthorized Wastes associated with the Project from entering Water.	NWB Standard Term and Condition
3. The Licensee shall provide secondary containment for fuel and chemical storage as required by applicable standards and acceptable industry practice.	NWB Standard Term and Condition

Proposed Terms	Sabina Comments and Annotation
4. The Licensee shall perform regular inspections in accordance with the approved Environmental Management and Protection Plan and Fuel Management Plan, of petroleum products storage and containment facilities, fuel tanks and connectors, for leaks and settlement and shall keep a written log of inspections to be made available to an Inspector upon request. More frequent inspections may be requested by an Inspector.	NWB Standard Term and Condition
5. The Licensee shall, report any unauthorized deposits or foreseeable unauthorized deposits of waste and/or discharges of Effluent in accordance of the Regulations.	NWB Standard Term and Condition
6. If the Licensee provides notification of Care and Maintenance under Part L, Item 2, the Licensee shall submit to the Board an Addendum to the Emergency Response Plan and the Spill Contingency Plan, detailing the changes in operations, personnel, responsibilities, availability of equipment and access to the site for assistance.	NWB Standard Term and Condition
Part J: Conditions Applying to General and Aquatic Effects Monitoring	
1. The Licensee shall install and maintain flow meters or other such devices, or implement suitable methods required for the measuring of Water use and Effluent discharge volumes, where such discharges are made to land or inland Waters, to be operated and maintained to the satisfaction of an Inspector.	NWB Standard Term and Condition
2. The Licensee shall undertake the Water Monitoring Program detailed in the tables of Schedule J or as may be directed by the Board after consulting with the Licensee and other interested parties.	NWB Standard Term and Condition
3. Water quality monitoring shall be carried out in accordance with the Quality Assurance/Quality Control Plan.	NWB Standard Term and Condition
4. The Licensee, in consultation with an Inspector, shall establish the locations and GPS coordinates for all monitoring stations referred to in Schedule J.	NWB Standard Term and Condition
5. The Licensee shall install and maintain, to the satisfaction of an Inspector, signs that identify monitoring stations. The signs shall be posted in English, Inuktitut, and Inuinnaqtun.	NWB Standard Term and Condition
6. Additional monitoring may be directed by the Board.	NWB Standard Term and Condition
7. All analyses shall be conducted as described in the most recent edition of "Standard Methods for the Examination of Water and Wastewater" or by other such methods approved by an Analyst.	NWB Standard Term and Condition
8. All compliance analyses shall be performed in an accredited laboratory.	
9. The Licensee shall measure and record all flow and volume measurements on a monthly basis, during Operations and during any use of Waters (unless otherwise stated): a. The volume of freshwater obtained from Big Lake; b. The volume of freshwater obtained from Goose Lake; c. The volume of freshwater obtained from proximal lakes for Winter Ice Road; d. The volume of freshwater obtained from Ponds (S1 and S2) and Lakes (3 and 4) at the Marine Laydown Area; e. The volume of reclaim water obtained from Tailings Storage Facility and Tailings Facility(s) for process water at the process plant; f. Tonnes of Waste Rock stored in the Waste Rock Storage Area(s) and at other locations approved by the Board during Construction, Operations and Closure; g. The volume of sewage sludge removed from the Sewage Treatment Plant and the locations or method of sewage sludge disposal during Construction, Operation and Closure; h. Report the data in accordance to Schedule B.	
10. The Licensee shall measure and record in tonnes including the location of disposal (temporary and permanent) for the following: a. The daily dry tonnes of tailings placed in the Tailings Storage Facility and Tailings Facility(s); and b. The monthly quantity of ore processed.	

Proposed Terms	Sabina Comments and Annotation
11. The Licensee shall undertake the Infill Geotechnical Characterization Program detailed in Schedule G or as may be directed by the Board after consulting with the Licensee and other interested parties	Reflects commitment made by Sabina in response to KIA-NWB-04

12. The Licensee shall undertake a geotechnical inspection annually between July and September, by a Geotechnical Engineer. The inspection shall be conducted in accordance with the Canadian Dam Safety Guidelines where applicable and take into account all major earthworks at the Goose Property, Marine Laydown Area and Winter Ice Road, where applicable, including:
a. Tailings Storage Facility and associated Ponds and Dams/Dykes;
b. Geotechnical instrumentation and associated monitoring data;
c. A description of geophysical and permafrost conditions at the project site;
d. Tailings Facility(s);
e. Open Pit Walls;
f. All weather access roads and culvert crossings;
g. Landfill(s);
h. Landfarm(s);
i. Fuel Storage Facilities;
j. Quarries and borrow pits;
k. Pollution Control Ponds (event ponds);
l. Sumps;
m. Underground mine openings;
n. Groundwater conditions underground;
o. Geotechnical Instrumentation;
p. Perimeter berms and collection Ponds;
q. Steam Diversions; and
r. Winter Ice Road routing.	

13. The Licensee shall submit to the Board for review, within ninety (90) days of completion of the geotechnical inspection in accordance with Part J, Item 12, the Geotechnical Engineer's inspection report. The report shall include a cover letter from the Licensee outlining an implementation plan addressing each of the Geotechnical Engineer's recommendations.	

14. The Licensee shall visually monitor and record observations in accordance with the approved Environmental Management and Protection Plan, to be made available to an Inspector upon request, during periods of discharge onto the tundra from:
a. Landfill Sump(s);
b. Landfarm Sump(s);
c. Bulk Fuel Storage Facilities Sump(s);
d. Sewage Treatment Plant Sump; and
e. Any other treated effluent water discharge Sump(s).	

15. The Licensee shall, within thirty (30) days following the month being reported, submit to the Board a monthly monitoring report in an electronic. The Report shall include the following: a. All data and information required by this Part and generated by the Monitoring Program in the Tables of Schedule J; b. An assessment of data to identify areas of non-compliance with regulated discharge parameters referred to in this Licence; and c. Reports should document conditions during spring freshet, major rain events, and periods of sustained precipitation should be monitored. Documented information can include flow measurements, photographs and notes.	

Proposed Terms	Sabina Comments and Annotation
Part K: Conditions Applying to General and Aquatic Effects Monitoring Plans	
1. The Licensee shall annually review the approved QA/QC Plan and modify the Plan as necessary.	
2. The Licensee shall submit to the Board for review sixty (60) days prior to triggering Aquatic Effects Monitoring requirements, an updated Aquatic Effects Management Plan. The updates are to take into account commitments made with respect to submissions received during the regulatory review of the Application.	
Part L: Conditions Applying to Abandonment, Reclamation and Closure	
1. The Licensee shall notify the Board in writing, at least sixty (60) days prior to any intent to achieve Recognized Closed Mine status.	NWB Standard Term and Condition
2. The Licensee shall notify the Board, a soon as practically possible, of any intent to enter into a Care and Maintenance Phase.	
3. The Licensee shall, upon providing notice to the Board as per PART L, Item 2, review all operational plans and submit revised Plans to reflect the Care and Maintenance status, to the Board for approval in writing, within three (3) months of providing notice.	
4. The Licensee shall provide to the Board in writing, at least thirty (30) days advanced notification of the initial start of Operations or change of Project Phase. Notification may be provided separately or in accordance with the monthly monitoring report as per PART J, Item 15.	
5. The Licensee shall implement the approved Interim Closure and Reclamation Plan and the addendum submitted in June 2018.	
6. The Licensee shall submit to the Board for approval at least twelve (12) months prior to the expected end of planned mining, a Final Closure and Reclamation Plan. The Final Closure and Reclamation Plan shall incorporate revisions, which reflect the pending closed status of the mine, and include: a. Soil Quality Remediation Objectives reflecting the applicable CCME Guidelines and the Government of Nunavut Environmental Guideline for Site Remediation; b. Environmental Site Assessment plans in accordance with the applicable Canadian Standards Association (CSA) criteria; and c. An evaluation of the human health and ecological risks associated with the Closure options proposed.	NWB Standard Term and Condition
7. The Licensee shall, should the Project remain, or be in Care and Maintenance, submit an updated estimate of total mine closure restoration liability, within twelve (12) months of entering Care and Maintenance and every three (3) years thereafter.	NWB Standard Term and Condition
8. The Licensee shall include, with the Plan submitted under PART L, Items 6, and 7, an updated estimate of the total mine closure restoration liability using the current version of RECLAIM, its equivalent or other similar method approved by the Board, in accordance with principles of the INAC "Mine Site Reclamation Policy for Nunavut" (2000).	NWB Standard Term and Condition
9. The Licensee shall, if not approved by the Board, revise the Plan(s) referred to in this Part and resubmit to the Board for approval within thirty (30) days of receiving notification of the Board's decision.	NWB Standard Term and Condition
10. The Licensee shall submit to the Board for approval, at least twelve (12) months prior to the start of Closure works, engineering drawings and specifications of the Tailings Storage Facility final cover system design.	NWB Standard Term and Condition
11. The Licensee shall complete all reclamation work in accordance with the Plan(s) referred to in this Part, as and when approved by the Board.	NWB Standard Term and Condition
12. The Licensee shall carry out progressive reclamation of any components of the project no longer required for the Licensee's operations.	NWB Standard Term and Condition
13. All roads and airstrips, if any, shall be re-graded to match natural contour to reduce erosion.	NWB Standard Term and Condition
14. The Licensee shall remove any culverts and restore the drainage to match the natural channel. Measures shall be implemented to minimize erosion and sedimentation.	NWB Standard Term and Condition

Proposed Terms	**Sabina** **Comments and Annotation**
15. In order to promote growth of vegetation and the needed microclimate for seed deposition, all disturbed surfaces shall be prepared by ripping, grading, or scarifying the surface to conform to the natural topography.	NWB Standard Term and Condition
16. Areas that have been contaminated by hydrocarbons from normal fuel transfer procedures shall be reclaimed to meet objectives as outlined in the Government of Nunavut's Environmental Guideline for Site Remediation, (2010 version or current version in place at the time of Reclamation).	NWB Standard Term and Condition
17. To the extent practical, the Licensee shall contour and stabilize all disturbed areas to a pre-disturbed state upon completion of work.	NWB Standard Term and Condition
SCHEDULE A: Definitions	
o Abandonment o Act o Acid Rock Drainage (ARD) o Adaptive Management o Analyst o Annually o Care and Maintenance o Commercial Operation o Deposit o Discharge o Domestic Waste o Engineer o Engineering Geologist o Engineered Structure o Freeboard o Frozen Core o Geotechnical Engineer o Grab Sample o Greywater o Ground Ice o Ground Water	NWB Standard Definitions

Proposed Terms	Sabina Comments and Annotation
o Inspector o Interim Closure and Reclamation Plan o Maximum Average Concentration o Metal Leaching o Mine Water o Monthly o Operator o Ore Stockpile o Progressive Reclamation o Quarterly o Sewage o Surface Drainage o Talik o Traditional Knowledge o Use o Waste o Waste Rock o Wastewater o Weekly	NWB Standard Definitions
o Acutely Lethal Effluent o Addendum o Amendment o Aquatic Effects Monitoring (AEMP) o Board o Canadian Council of Ministers of the Environment (CCME) o Chief Administrative Officer o Chief Executive Officer o Contact Water o Closure o Dam Safety Guidelines o Deleterious Substances o Domestic Waste o Effluent o Environmental Assessment o Final Discharge Point o Hazardous Waste o ICP Metal Scan	NWB Standard Definitions recently updated in 2AM-WTP1826

Proposed Terms	**Sabina** **Comments and Annotation**
o Maximum Monthly Mean o Minister o Modification o Monitoring Program o Non Contact Water o Nunavut Agreement o Operational Phase o Quality Assurance/Quality Control (QA/QC) o Reclamation o Recognized Closed Mine o Regulations o Seepage o Water	NWB Standard Definitions recently updated in 2AM-WTP1826
To be revised to reflect Back River Project specific requirements: o Airstrip o Bulk Fuel Storage Facility(s) o Construction o Desalination Plant o Dissolved Metals o Fresh Water Intake o Goose Property o Goose Property o Goose Main Tailings Facility o Incinerator o Landfarm o Landfill o Licence o Licensee o Marine Laydown Area o Metal Mining Effluent Regulations o Nutrients o Open Pits o Project	Project specific requirement definitions will be compiled for the revised Draft Water Licence Framework for submission prior to the Final Public Hearing.

Proposed Terms	**Sabina Comments and Annotation**
o Pollution Control Pond o Receiving Environment o Saline Water o Saline Water Pond o Sewage Treatment Plant o Tailings Storage Facility o TSF Containment Dam o TSF WRSA Pond o Total Metals o Underground Operations o Umwelt Tailings Facility o Waste Disposal Facilities o Waste Rock Storage Areas o Wastewater Treatment Plant o Water Management Ponds o Water Supply Facilities o Water Treatment Plant o Water Licence Application	Project specific requirement definitions will be compiled for the revised Draft Water Licence Framework for submission prior to the Final Public Hearing.
o Quarry or Quarries o Secondary Containment o Sump or Sumps o Winter Ice Road	To be taken from 2BC-BRP1819 To be taken from Development Licence
SCHEDULE B: General Conditions	Sabina notes NWB has recently streamlined "schedule" requirements under the WTP Licence as such Sabina as use the WTP licence foundation for recommended changes for the Draft Framework. To be taken where noted from 2AM-WTP1826:
The Annual Report referred to in Part B, Item 3, shall include:	
CONSTRUCTION 1. For the dikes, dams and structures constructed to withhold water or waste: a. An overview of methods and frequency used to monitor deformations, Seepage and geothermal responses; b. A comparison of measured versus predicted performance; c. A discussion of any unanticipated observations including changes in risk and mitigation measures implemented to reduce risk; d. As-built drawings of all mitigation works undertaken; e. Any changes in the design and/or as-built condition and respective consequences of any changes to safety, water balance and water quality; f. Data collected from instrumentation used to monitor earthworks and an interpretation of that data; g. A summary of maintenance work undertaken as a result of settlement or deformation of dikes and dams; and h. The monthly and annual quantities of Seepage from dikes and dams in cubic metres.	NWB Standard Term and Condition
WATER 2. Monthly and annual volume of fresh Water obtained from all sources 3. Summary of Winter Ice Road and Dewatering plans implemented in accordance with Part F, Item XX and Item XX, respectively. 4. Summary update of the Water and Load Balance results, if any	

Proposed Terms	**Sabina** **Comments and Annotation**
WASTE 5. Geochemical monitoring results including: a. Operational acid/base accounting and paste pH test work used for Waste Rock designation (PAG and NPAG rock); b. As-built volumes of Waste Rock used in construction and sent to the Waste Rock Storage Areas with estimated balance of acid generation to acid neutralization capacity in a given sample as well as metal toxicity; c. All monitoring data with respect to geochemical analyses on site and related to roads, and quarries; d. Leaching observations and tests on pit slope and dike exposure; and e. Any geochemical outcomes or observations that could imply or lead to environmental impact. 6. Volumes of Waste Rock used in construction and placed in the Waste Rock Storage Areas. 7. Volumes of ore stockpiled stored at site. 8. Summary of quantities and analysis of Seepage and runoff monitoring from the Tailing Storage Facility, Waste Rock Storage Area(s), Landfill(s), and associated dikes/berms. 9. A summary report of all general waste disposal activities including monthly and annual quantities in cubic metres of waste generated and location of disposal.	
SPILLS 10. A list and description of all unauthorized discharges including volumes, spill report line identification number and summaries of follow-up action taken.	NWB Standard Term and Condition:
MODIFICATIONS 11. A summary of Modifications and/or major maintenance work carried out on all Water and Waste-related structures and facilities.	NWB Standard Term and Condition:
MONITORING 12. The results and interpretation of the Monitoring Program in accordance with Part J and Schedule J. 13. The results of monitoring related to the Aquatic Effects Monitoring Program (AEMP) in accordance with Part K, Item 4.	
CLOSURE 14. A summary of any progressive Closure and Reclamation work undertaken, including photographic records of site conditions before and after completion of operations, and an outline of any work anticipated for the next year, including any changes to implementation and scheduling. 15. A summary of on-going field trials to determine effective capping thickness for the Waste Rock Storage Areas for the purpose of long term environmental protection. 16. An updated estimate of the current restoration liability based on Project development monitoring, results of restoration/revegetation research and any changes or modifications to the Appurtenant Undertaking.	NWB Standard Term and Condition:
PLANS/REPORTS/STUDIES 17. A summary of any studies requested by the Board that relate to Water use, Waste disposal or Reclamation, and a brief description of any future studies planned. 18. Where applicable, revisions as Addenda, with an indication of where changes have been made, for Plans, Reports, and Manuals. 19. An executive summary in English, Inuktitut and of all plans, reports, or studies conducted under this Licence.	NWB Standard Term and Condition:
GENERAL 20. A summary of actions taken to address concerns or deficiencies listed in the inspection reports and/or compliance reports filed by an Inspector.	

Proposed Terms	Sabina Comments and Annotation
OTHER 21. A summary of public consultation and participation with local organizations and the residents of the nearby communities, including a schedule of upcoming community events and information sessions. 22. Any other details on Water use or Waste Disposal requested by the Board by November 1st of the year being reported.	
SCHEDULE D: Conditions Applying to Construction	
1. The Construction Monitoring Report referred to in Part D, Item 8 shall include: a. All final design and Construction drawings; b. A summary of Construction activities including photographic records before, during and after Construction; c. As built; d. Documentation and detailed explanation of field decisions reflecting any deviations from original Construction drawings and plans, and how such deviations may affect performance of engineered structures; e. Discussion of mitigation measures implemented during Construction and effectiveness of measures taken; f. Monitoring undertaken in compliance with Part D and/or Part J of the Licence; g. Blast vibration monitoring for quarrying activities carried out in close proximity to fish bearing waters; h. Monitoring for sediment release from Construction areas; and i. Monitoring and reporting on use of Water to manage dust emissions from crushing and Construction activity.	
SCHEDULE G: Conditions Applying to Waste Management and Waste Management Plans	
	Assumed all plans approved by the NWB (section may be revised pending final submission from Parties)
SCHEDULE J: Conditions Applying to General and Aquatic Effects Monitoring	Sabina notes NWB has recently streamlined "schedule" requirements under the WTP Licence as such Sabina as use the WTP licence foundation for recommended changes for the Draft Framework. To be taken where noted from 2AM-WTP1826:
TABLES - Table 1 Monitoring Groups	
	Attach tables from Appendix B of Water Management Plan for Type A Water Licence;
	Tables to be updated to reflect agreed upon commitments during the regulatory review process.
TABLES - Table 2 Monitoring Requirements	
	Attach tables from Appendix B of Water Management Plan for Type A Water Licence;
	Tables for Type A Licence to be updated to include BRP-S-01 to TBD; and BRP - 49 (To be taken from Development Licence Part J, Item 3)

Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code[5]	Frequency
BRP-G-01 to BRP-G-TBD	Regulated Monitoring[1]	General Site Runoff including Quarries - both Goose and MLA	Applies anywhere on the site; monitoring for erosion and sedimentation	Construction	C	Weekly if flow enters a waterbody
BRP-01	Regulated Monitoring[2]	Discharge to Goose Lake (after treatment)	Test of dewatering discharge (i.e., effluent), at final point of control. If water does not meet TSS discharge criteria, water will be treated prior to release[2].	Construction	A, B, G	Weekly during dewatering
					D	Four times during dewatering, at the same time as the weekly samples
					H	Once per month during dewatering, at the same time as groups D and F
					I	One time during dewatering, at the same time as groups D and F
BRP-02	General Monitoring	Llama Lake Dewatering (prior to treatment) if required	If treatment is required, this station will test pretreated water. When paired with results from BRP-01 this will be used to evaluate treatment efficiency.	Construction	C (TSS only)	Weekly if treatment is required; no sample if treatment is not required
BRP-03	Verification Monitoring	Llama Pit	Pit water quality prior to transfer to a tailings facility	Operations (Stage 1) to Operations (Stage 2)	A, G	See note [6]
BRP-04	General Monitoring	Llama Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post-closure	A, D	Twice per year
BRP-05	Verification Monitoring	Llama WRSA Pond	Test quality of drainage water from Llama WRSA	Operations (Stage 1) to Closure	A, G	See note [6]

(continued)

Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area (continued)

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code[5]	Frequency
BRP-06	General Monitoring	Umwelt Lake Dewatering (prior to treatment) if required	If treatment is required, this station will test pretreated water. When paired with results from BRP-01 this will be used to evaluate treatment efficiency.	Construction	C (TSS only)	Weekly if treatment is required; no sample if treatment is not required
BRP-07	Verification Monitoring	Umwelt Pit	Pit water quality prior to transfer to a tailings facility; Umwelt underground water directed to Saline Pond and not Umwelt Pit	Construction to Operations (Stage 2)	A, G	See note [6]
BRP-08	General Monitoring	Umwelt Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post-closure	A, D	Twice per year
BRP-09	Verification Monitoring	Umwelt WRSA Pond	Test quality of drainage water from Umwelt WRSA. A landfill is located in this WRSA. Appropriate landfill parameters will be tested for; see the LWMP (SD-10) for details.	Construction to Closure (early)	A, G	See note [6]
BRP-10	Verification Monitoring	Primary Water Pond	Test quality of water in pond for industrial water use	Construction to Closure (early)	A, D	See note [6]
BRP-11	Verification Monitoring	Saline Water Pond	Test quality of water in pond; Formerly Umwelt Lake; different than station 3; monitoring at 14 does not overlap with monitoring at 3	Construction (late) to Closure (early)	A, D	See note [6]
BRP-12	General Monitoring	Big Lake Intake;	Source intake water quality for potable and industrial use	Construction to Closure	A, D	Four times per year
					B	Weekly
BRP-13	Verification Monitoring	Ore Stockpile Pond	Test quality of drainage water from Ore stockpile	Construction to Closure (early)	A, D	See note [6]
BRP-14	Verification Monitoring	ANFO Plant	Test quality of runoff water in the ANFO plant containment area	Construction to closure	A, E	See note [6]

(continued)

Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area (continued)

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code[5]	Frequency
BRP-15	Regulated Monitoring[3]	Goose Fuel Tank Farm	Test quality of runoff water in the Fuel Tank Farm containment area	Construction to closure	A, E	Prior to discharge or transfer of water
BRP-16	Regulated Monitoring[3]	Goose Hazardous Waste Mgmt Area	Test quality of runoff water in the Hazardous Waste Management containment area	Construction to closure	A, E	Prior to discharge or transfer of water
BRP-17	Regulated Monitoring[4]	Treated sewage discharge to land	Test quality of sewage effluent discharge water quality	Construction to closure	A, E	Prior to discharge or transfer of water
BRP-18	General Monitoring	Llama Watershed Outflow (PN04 from water and load balance)	Test quality of non-contact water runoff from the "Llama" watershed	Construction to closure	A, D	Once during freshet
BRP-19	General Monitoring	Echo Outflow (PN09 from water and load balance)	Test quality of non-contact water runoff from the "Echo" watershed	Operations (Stage 1) to Closure	A, D	Once during freshet
BRP-20	Verification Monitoring	Echo Pit	Pit water quality prior to transfer to a tailings facility; Echo underground water is always directed to the TSF	Operations (Stage 2)	A, G	See note [6]
BRP-21	General Monitoring	Echo Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post-closure	A, D	Twice per year
BRP-22	Verification Monitoring	Echo WRSA Pond	Test quality of drainage water from Echo WRSF	Operations (Stage 2) to Closure (early)	A, G	See note [6]
BRP-23	General Monitoring	Gander Pond Outflow (PN07 from water and load balance)	Test quality of non-contact water runoff from the "Gander" watershed	Operations (Stage 1) to Closure	A, D	Once during freshet
BRP-24	General Monitoring	Goose Lake Intake	Source intake water quality; for operational use (mill water make up)	Operations (Stage 2) to Closure (early)	B	Weekly
BRP-25	Verification Monitoring	Goose Pit	Pit water quality prior to transfer to a tailings facility; underground (saline) water directed to Saline Water Pond	Operations (Stage 1) to Operations (Stage 2)	A, G	See note [6]

(continued)

Table B-01. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Goose Property Area (completed)

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code[5]	Frequency
BRP-26	General Monitoring	Goose Pit Lake	During pit flooding and before overflow to the downstream environment	Closure to Post-closure	A, D	Twice per year
BRP-27	Verification Monitoring	Goose Main TF Intake; collected at "inlet" to treatment facility	Pretreatment quality	Operations (Stage 3) to Closure	A, G	See note [6]
BRP-28	Verification Monitoring	Goose Main TF Discharge into Goose Main TF (after treatment); collected at "outlet" of treatment facility; no discharge to the receiving environment	Post-treatment quality to confirm treatment efficiency	Operations (Stage 3) to Closure	A, G	See note [6]
BRP-29	Verification Monitoring	TSF WRSA Pond	Test quality of drainage water from TSF; A landfill is located in this WRSA. Appropriate landfill parameters will be tested for; see the LWMP (SD-10) for details.	Operations (Stage 1) to Closure	A, G	See note [6]
BRP-30	General Monitoring	Goose Southeast Inflow (PN06 from water and load balance)	Test quality of non-contact water runoff from the "TSF" watershed	Operations (Stage 1) to Closure	A, D	Once during freshet
BRP-51	Regulated Monitoring[3]	Goose Landfarm	Test quality of runoff water in the Landfarm containment area	Construction to Closure	E	Prior to discharge or transfer of water

Notes BRP = Back River Project; MLA = Marine Laydown Area
1) See Table 7.5-2 (Dewatering Discharge Criteria) in the Water Management Plan
2) See Table 7.5-1 (Site Runoff Discharge Criteria) in the Water Management Plan
3) See Table 7-5.3 (Discharge to Land Criteria) in the Water Management Plan
4) See Table 7.5-4 (Treated Sewage Effluent Criteria) in the Water Management Plan
5) See Table B-03 for parameters in each monitoring group
6) Monitoring parameters and frequency at the discretion of Sabina as results from the verification stations are used for operational and management purposes

Table B-02. Proposed Water Quality Monitoring for the Project during Construction, Operations, and Closure in Marine Laydown Area

Monitoring Location Number	Monitoring Type	Description	Purpose	Mine Phase	Parameter Group Code[4]	Frequency
BRP-G-01 to BRP-G-TBD	Regulated Monitoring[1]	General Site Runoff including Quarries - both Goose and MLA	Applies anywhere on the site; monitoring for erosion and sedimentation	Construction	C	Weekly if flow enters a waterbody
BRP-40	General Monitoring	Bathurst Inlet Intake (pre-treatment)	Source intake water quality for potable and industrial use	Construction to Closure	A, D	See note [5]
					B	See note [5]
BRP-41	General Monitoring[1]	Bathurst Inlet Discharge (post treatment)	Test quality at final point of control	Construction to Closure	A, J	See note [5]
BRP-42	Regulated Monitoring[2]	MLA Treated Effluent Discharge Location to land (greywater)	Confirm quality of greywater before release	Construction to Closure	A, F	Prior to discharge or transfer of water
BRP-43	Regulated Monitoring[3]	MLA Fuel Tank Farm	Test quality of runoff water in the Fuel Tank Farm containment area	Construction to closure	A, E	Prior to discharge or transfer of water
BRP-44	Regulated Monitoring[3]	MLA Landfarm	Test quality of runoff water in the Landfarm containment area	Construction to closure	A, E	Prior to discharge or transfer of water
BRP-45	Regulated Monitoring[3]	MLA Hazardous Waste Mgmt Area	Test quality of runoff water in the Hazardous Waste Management containment area	Construction to closure	A, E	Prior to discharge or transfer of water

Notes BRP = Back River Project; MLA = Marine Laydown Area
1)Marine Discharge Criteria not required for the Water Licence
2) See Table 7.5-4 (Treated Sewage Effluent Criteria) in the Water Management Plan
3) See Table 7.5-3 (Discharge to Land Criteria) in the Water Management Plan
4) See Table B-03 for parameters in each monitoring group
5) Monitoring parameters and frequency at the discretion of Sabina as results from the verification stations are used for operational and management purposes

Table B-03. List of Constituents in Each Parameter Group

Parameter Group	Parameter Group Code	Specific parameters
Field Chemistry	A	pH, specific conductivity, and temperature.
Flow	B	Flow datalogger, calculated volume
General Surface runoff	C	Total Suspended Solids (TSS), Oil and Grease, pH
General Chemistry	D	Conventional: turbidity, hardness, alkalinity, calcium, chloride, fluoride, magnesium, potassium, sodium, sulphate, total dissolved solids, TSS, total cyanide, free cyanide, and weak acid dissociable (WAD) cyanide. Nutrients: ammonia, nitrate, nitrite, total phosphorus (TP), and dissolved organic carbon. Total and dissolved metals: aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, uranium, and zinc Other: radium-226, *Escherichia coli,* and Total coliforms, when required
Secondary Containment	E	TSS, pH, ammonia, total arsenic, total copper, total lead, total nickel, total zinc, benzene, toluene, ethylbenzene, xylene, Oil and Grease
Sewage	F	Biochemical Oxygen Demand (5-day), TSS, Fecal coliform, ammonia, phosphorus, Oil and Grease, pH, Acute toxicity (Rainbow Trout and Daphnia magna)
MMER deleterious substances	G	TSS, total cyanide, total arsenic, total copper, total lead, total nickel, total zinc, and radium-226
MMER toxicity	H	Acute toxicity (Rainbow Trout and Daphnia magna)
MMER sublethal toxicity	I	Sublethal toxicity (Fathead Minnow or Rainbow Trout, Ceriodaphnia dubia, Lemna minor, Pseudokirchneriella subcapitata)
Discharge to Marine	J	Salinity, total metals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, uranium, and zinc), oil and grease

Note: Detection limits may vary for site monitoring and for downstream receiving environment monitoring

REFERENCES

1985. *Fisheries Act*. R.S.C. 1985, c. F-14.

1988. *Environmental Protection Act*. RSNWT (Nu) 1988, c E-7.

1993. *Nunavut Agreement Act*. S.C. 1993, c. 29.

CCME (Canadian Council of Ministers of the Environment). 1999 (with updates to 2017). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life – Summary Table. Available at: http://st-ts.ccme.ca/.