# BACK RIVER PROJECT
# Water Management Plan

April 2022

# BACK RIVER PROJECT

# WATER MANAGEMENT PLAN

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# Revision Log

| Version | Date | Section | Page | Revision |
|---|---|---|---|---|
| 0 | November 2015 | All | All | Supporting Document for Final Environmental Impact Statement; submitted to Nunavut Impact Review Board (NIRB). |
| 1 | October 2017 | All | All | Supporting Document for Type A Water Licence Application; submitted to Nunavut Water Board (NWB). |
| 2 | June 2020 | All | All | Updated to reflect the 2020 Modification Package changes, and as a Supporting Document; submitted to the Nunavut Planning Commission (NPC) and NIRB. |
| 3 | October 2020 | All | All | Submitted as a Supporting Document for the Type A Water Licence Amendment Application to the NWB. |
| 4 | April 2022 | All | All | Supporting Document for Type A Water Licence Amendment Application; submitted to Nunavut Water Board (NWB) |

# Acronyms

| | |
|---|---|
| AEMP | Aquatic Effects Management Plan |
| AN | ammonium nitrate |
| ANFO | ammonium nitrate fuel oil |
| ARD | acid rock drainage |
| CCME | Canadian Council of Ministers of the Environment |
| DFO | Department of Fisheries and Oceans Canada |
| ECCC | Environment and Climate Change Canada |
| FEIS | Final Environmental Impact Statement |
| GCL | geosynthetic clay liner |
| LOM | life of mine |
| masl | metres above sea level |
| ML | metal leaching |
| MLA | Marine Laydown Area |
| MDMER | Metal and Diamond Mining Effluent Regulations |
| WRMP | Waste Rock Management Plan |
| $NH_3$ | ammonia |
| NIRB | Nunavut Impact Review Board |
| NPAG | non-potentially acid generating |
| NWB | Nunavut Water Board |
| PAG | potentially acid generating |
| Project | Back River Project |
| Sabina | Sabina Gold & Silver Corp. |
| SOP | standard operating procedure |
| STP | Sewage Treatment Plant |
| SSWQO | Site-Specific Water Quality Objectives |
| SWMP | Saline Water Management Plan |
| SWP | Saline Water Pond |
| tpd | tonnes per day |
| TF | Tailings Facility |
| TSS | Total Suspended Solids |
| WIR | Winter Ice Road |

| | |
|---|---|
| WL | Type A Water Licence (2AM-BRP1831 Amendment No.1) |
| WMP or Plan | Water Management Plan |
| WRSA | Waste Rock Storage Area |
| WTP | Water Treatment Plant |

# 1. Introduction

The Back River Project (Project) is a gold project owned by Sabina Gold & Silver Corp. (Sabina) within the West Kitikmeot region of southwestern Nunavut. It is situated approximately 400 kilometres (km) southwest of Cambridge Bay, 95 km southeast of the southern end of Bathurst Inlet, and 520 km northeast of Yellowknife, Northwest Territories. The Project is located predominantly within the Queen Maud Gulf Watershed (Nunavut Water Regulations, Schedule 4) (Figure A-01).

The Project is comprised of two main areas with an interconnecting Winter Ice Road (WIR) (Figure A-01): Goose Property (Figure A-02), and the Marine Laydown Area (MLA) (Figure A-03) situated along the western shore of southern Bathurst Inlet. The majority of annual resupply will be completed using the MLA, and an approximately 160 km long WIR will connect the MLA to the Goose Property.

Version 3 of the WMP was a subset of the previously approved permitted Project that did not include Llama Underground, Goose Main Underground, Echo Open Pit, and Echo Underground (PC No. 007 and Type A Water Licence (WL; 2AM-BRP1831 Amendment No.1).

The refined mine plan outlined in this WMP (Version 4) reintegrates Llama Underground, Goose Main Underground, Echo Open Pit, and Echo Underground into the mine plan and omits the Tailing Storage Facility (TSF), the Umwelt Waste Rock Storage Area(WRSA) Containment Dam, and Umwelt WRSA Diversion Berm. Sabina highlights that, with the continued advancement in detailed engineering and market considerations, the previously approved deposits and infrastructure may be reintegrated into the mine plan at a later date. Sabina will update the WMP as outlined in Part B, Item 17 of the Type A Water Licence, 2AM-BRP1831 Amendment No.1.

This plan is a living document to be updated upon changes in related regulatory requirements, engineering design, management reviews, incident investigations, changes to facility operation or maintenance, and environmental monitoring results, best practice updates or other Project-specific protocols once Construction starts through to Project closure activities. Any updates will be filed with the Annual Report submitted under the Type A Water Licence (2AM-BRP1831 Amendment No.1 Part B, Item 2, and Schedule B).

# 2. Scope and Objectives

The WMP is the key document that forms part of Sabina's overall Water Management Program for the Project. The Plan has been written to meet requirements of the Type A Water Licence (2AM-BRP1831 Amendment No.1).

This plan is divided into the following components:

- Applicable Legislation and Guidelines (Section 3);
- Roles and Responsibilities (Section 4);
- Planning and Implementation (Section 5);
- Water Modelling and Design Criteria (Section 6);
- Water Management (Section 7);
- Water Management Phases (Section 8);
- Environmental Protection Measures (Section 9);
- Monitoring Program (Section 10);
- Environmental Reporting (Section 11); and
- Adaptive Management (Section 12).

This plan describes the procedures necessary to manage the quality and quantity of water interacting with Project components throughout the Construction, Operations, Closure, and Post-Closure phases of the mine. It includes management practices that reduce the potential for adverse impacts to receiving waters, to aquatic ecosystems, and to fish and fish habitat. The Plan includes:

- A brief summary of the physical setting at the mine site;
- A description of mine development;
- A summary of water treatment and water supply locations and requirements throughout the life of mine (LOM), including sewage disposal facilities;
- Water quantity thresholds and water quality objectives and discharge criteria;
- A summary of water management infrastructure design;
- A description of the water management at the mine site during Construction, Operations, and Closure;
- A summary of the Water and Load Balance model;
- A summary of environmental protection measures;
- A description of the mine site water quality monitoring program; and
- An overview of mitigation and adaptive management.

The Plan is structured to help ensure that: the Project is built as proposed; predicted adverse environmental effects are promptly mitigated; the applied mitigation measures are successful; and relevant laws and regulations are met. It outlines procedures for the reassessment, improvement, or reorientation of the Plan if determined at any point in the Project's development that it no longer meets the initial purpose or objective.

Results of monitoring identified in this plan will be publicly reported and may feed into other ongoing regional initiatives or programs with relevant government organizations, or regional authorities.

## 2.1 RELATED PLANS OR STUDIES

The WMP should be read in conjunction with the following key plans, which have been approved for implementation by the Nunavut Water Board (NWB) in accordance with the Type A Water Licence, 2AM-BRP1831 Amendment No.1 Part B, Item 13 and 14:

- Road Management Plan;
- Borrow Pit and Quarry Management Plan;
- Ore Storage Management Plan;
- Waste Rock Management Plan;
- Tailings Management Plan;
- Landfill and Waste Management Plan;
- Landfarm Management Plan;
- Environmental Management and Protection Plan;
- Aquatic Effects Management Plan;
- Fish Offsetting Plan;
- Quality Assurance/Quality Control Plan; and
- Interim Closure and Reclamation Plan.

The following reports and studies have also informed the development of the WMP:

- Geochemical Characterization Report (Sabina 2017, Appendix E-3);
- Tailings Management System Design Report (Sabina 2017, Appendix F-4);
- Hydrogeological Characterization and Modelling (Sabina 2017, Appendix F-5);
- Geotechnical Design Parameters Report (Sabina 2017, Appendix F-2);
- Hydrology Report (Sabina 2015, Appendix V2-7B); and
- Hydrology Update Memo (SRK 2021).

# 3. Applicable Legislation and Guidelines

Specific legislation, regulations, and guidelines related to water management in Canada, and specifically within Nunavut, are summarized in Table 3-1.

Sabina will also be bound by the terms and conditions of its land use permits issued by the Kitikmeot Inuit Association for Inuit Owned Land, and its Type A Water Licence, 2AM-BRP1831 Amendment No.1, issued by the NWB.

**Table 3-1. Applicable Legislation to Water Management in Nunavut**

| Acts | Regulations | Guidelines |
|---|---|---|
| **Federal** | | |
| *Canadian Environmental Protection Act* (CEPA; 1999) | | |
| *Nunavut Waters and Nunavut Surface Rights Tribunal Act (2002)* | Nunavut Water Regulations (2013) | |
| *Territorial Lands Act* (1985) | Territorial Land Use Regulations (CRC, c.1524)<br>Northwest Territories and Nunavut Mining Regulations (CRC, c.1516) | Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure (BGC 2003) |
| *Fisheries Act* (1985) | Metal and Diamond Mining Effluent Regulations (SOR/2002-220) | Fisheries and Fish Habitat Protection Policy Statement (Department of Fisheries and Oceans Canada (DFO) 2019a)<br>Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act* (DFO 2019b)<br>DFO Measures to Protect Fish and Fish Habitat (DFO 2019c), including those for the Timing Window to Conduct Projects In or Around Water, Sediment Control, and other applicable measures (DFO Standards and Codes of Practice (DFO 2020), including those for End-of-Pipe Fish Protection Screens for Small Water Intakes in Freshwater (also see DFO 1995), Culvert Maintenance, Temporary Stream Crossings, and other applicable standards<br>Fisheries Productivity Investment Policy: A Proponent Guide to Offsetting (2013)<br>Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut (DFO 2010)<br>Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995)<br>Method for Determining Available Winter Water Volumes for Small-Scale Projects (April 27, 2020, MVLWB) |

| Acts | Regulations | Guidelines |
|---|---|---|
| **Territorial – Nunavut** | | |
| Nunavut *Environmental Protection Act* (1988) | Spill Contingency Planning and Reporting Regulations (NWT Reg (Nu) 068-93) | Government of Nunavut (GN) Environmental Guidelines where applicable (various):https://www.gov.nu.ca/environment/information/documents/195%2C184 |
| *Public Health Act (2016); Amended 2018* | Public Water Supply Regulations (RRNWT. 1999, c.P-23)<br>Public Sewerage Systems Regulations (RRNWT. 1999, c.P-22) | |
| *Mine Health and Safety Act* (SNWT (Nu) 1994, c.25) | Mine Health and Safety Regulations (NWT Reg (Nu) 125-95) | |

# 4. Roles and Responsibilities

The General Manager is ultimately responsible for the success of the Plan and approves all relevant policies and documents, auditing, action planning, and the verification process.

The Environmental Superintendent and his/her direct reports are responsible for the implementation of this plan including:

- Overall management of the Plan;
- Monitoring;
- Operational aspects;
- Internal reporting;
- External reporting; and
- Ensuring compliance and adaptive management.

# 5. Planning and Implementation

Water is an essential component of any mine. Understanding the existing physical setting and the overall mine development plan are essential components for development of an effective WMP for the Project.

## 5.1 PHYSICAL SETTING

### 5.1.1 Topography

The topography of the region is dominated by undulating landscapes of low relief that present in a sequence of smooth, non-linear rises and hollows, and elongated rises and valleys that repeat in a wave-like pattern. Slopes are generally uniform and range between 0 and 5%. Terrain elevation ranges between 300 and 700 metres above sea level (masl) in the region.

Uplands are typically covered by veneers of morainal materials deposited on Precambrian, sedimentary, metamorphic, or intrusive rocks. The thickness of overburden, defined as unconsolidated organic or mineral material, is generally small; it is greatest in areas of plains or gentle slopes where it can range from 1 to 37 m (average of 10.8 m). A number of distinct landforms also exist throughout the region including small and medium sized kettle lakes, eskers, moraines, and boulder fields.

### 5.1.2 Seismicity

The Back River Property is located in an area of low seismic risk. The peak ground acceleration for the area was estimated using seismic hazard calculator from the National Building Code of Canada’s website (NRCC 2014a). The peak ground acceleration value of 0.036 (corresponding to the 1:2,475 year event) was accounted for in the design.

### 5.1.3 Permafrost and Groundwater

The Back River Property is in the continuous permafrost region of the Canadian Arctic. While permafrost may extend more than 400 metres below the ground surface (mbgs), it is expected that the underground development will extend below the regional permafrost into unfrozen rock and soil. In addition, Llama Open Pit and Llama Underground will occur underneath a lakes associated with open talik. Of the proposed developments, groundwater inflow during Operations is expected at Llama Open Pit, and the Llama, Umwelt, Goose Main, and Echo undergrounds. The other developments (Umwelt, Echo, and Goose Main open pits) are expected to be fully within permafrost and not intersect unfrozen groundwater. Groundwater may flow through the active layer (the top 1 to 3 m of overburden) during unfrozen months; however, the volume of flow is likely insignificant in comparison to surface water runoff.

As part of the Project, a groundwater model was completed to predict potential groundwater inflows during mining at the Goose Property; this model was employed in both the Final Environmental Impact Statement (FEIS) (Sabina 2015) and the Type A Water Licence Application (Sabina 2017). The groundwater model was recently updated to predict revised groundwater inflows for the new mine plan (Appendix D). A summary of the estimated annual groundwater inflows is summarized in in Table 5.1-1 for the developments extending into unfrozen rock.

**Table 5.1-1. Goose Property Groundwater Inflows**

| Mine Year | Predicted Groundwater Inflow ($m^3$/day) | | | | |
|---|---|---|---|---|---|
| | Umwelt Underground | Llama Open Pit | Llama Underground | Echo Underground | Goose Main Underground |
| Y1 | 75 | 190 | 0 | 0 | 0 |
| Y2 | <50 | 130 | 120 | 0 | 0 |
| Y3 | <50 | 100 | 350 | 0 | 0 |
| Y4 | <50 | 90 | 410 | 0 | 0 |
| Y5 | <50 | 80 | 350 | 0 | 0 |
| Y6 | 0 | 80 | 330 | 0 | 0 |
| Y7 | 0 | 80 | 310 | 0 | 10 |
| Y8 | 0 | 80 | 300 | 0 | 80 |
| Y9 | 0 | 80 | 290 | 0 | 70 |
| Y10 | 0 | 80 | 280 | 0 | 70 |
| Y11 | 0 | 70 | 280 | 0 | 70 |
| Y12 | 0 | 70 | 270 | 0 | 70 |
| Y13 | 0 | 70 | 270 | 0 | 60 |
| Y14 | 0 | 70 | 260 | <50 | 60 |
| Y15 | 0 | 70 | 260 | <50 | 60 |

*Source: Appendix D*

Groundwater inflows predicted by the model considered the uncertainty in the assumed hydraulic properties for the bedrock based on the field investigation program results. To be conservative on water management planning, the values presented in the Table 5.1-1 represent the higher flow values of the two simulations completed (Scenario 2; Appendix D).

Sabina recognizes that there is a chance that flow in the mines may be dominated by specific fractures or features that are intercepted. This uncertainty exists for all mining projects and is never completely alleviated until structural geology and hydrogeology data is regularly collected from mining operations. The influx of water into a mine is a normal and well understood phenomenon and is regularly managed by standard operating procedures (SOPs) in operating mines.

Sabina is aware of the uncertainty related to fault zones and will safely and appropriately manage groundwater inflows. Actions may include use of surface and underground exploration information to identify enhanced permeability that may be intercepted, advancing cover and probe drilling (i.e., exploration drainage holes), and interpretation of groundwater pressure and inflow data when high permeability formations are encountered.

### 5.1.4 Climate and Hydrometric Characteristics

Ongoing baseline meteorological and hydrometric programs have been initiated for the Back River Property since 2004. Detailed climate and hydrometric characteristics are presented in the Hydrology Report and the Meteorological Baseline Report (Sabina 2015, Appendix V2-7B and V4-3A; updated by SRK 2021).

The meteorological analysis for the Project relied on regional characterization using precipitation data from Environment and Climate Change Canada (ECCC), as Project-specific meteorological data did not present winter precipitation measurements. The analysis estimated an undercatch-adjusted mean annual precipitation (MAP) of 427 mm and a 24-hour PMP of 285 mm (SRK 2021).

Available site data was correlated to the corresponding monthly temperature data at the Lupin Meteorological Services of Canada station using a linear regression analysis. The resulting synthetic temperature record has an average annual temperature of -10°C. The minimum and maximum average monthly temperatures of -29°C and 13°C occur in January and July, respectively. Channel freeze-up generally occurs in late October or early November, and ice break-up generally occurs in May or early June (Sabina 2015, Appendix V4-3A).

Regional wind speed data are not available near the Project area, so mean monthly values were derived from the measured Goose Property record. The mean annual wind speed on site is approximately 4.4 m/s, with the wind direction exhibiting strong seasonality. The maximum recorded wind gust during the monitoring period was measured at 30.7 m/s or 111 km/h (Sabina 2015, Appendix V4-3A).

The annual long-term lake evaporation (including sublimation) in the region is about 324 mm (Sabina 2015G); the strongest control on evaporation is net radiation. Annual actual evapotranspiration from the tundra is estimated to be approximately 199 mm.

Hydrometric data are currently being collected at 25 stations in the immediate Project area. Of these stations, the Propeller Lake inflow (i.e., PL-H2) and outflow (i.e., PL-H1) stations were deemed to be the most complete and representative for the Property. The 2011 monitoring year had the longest continuous record, including spring freshet and late summer flows, and was therefore used in the development of long-term synthetic flow series for the Project area (SRK 2021).

A regional analysis was conducted using 11 hydrometric stations from the Water Survey of Canada to determine regional hydrologic trends. The Baillie River near the Mouth Water Survey of Canada station (10RA002) was found to be the most comparable regional station to the 2011 local hydrometric station records (i.e., PL-H1 and PL-H2). The 25 years of flow data from Baillie River were corrected to the site, generating a continuous flow record for the Project. The resultant long-term mean annual runoff for the Project area is 149 mm (SRK 2021).

Table 5.1-2 presents the runoff and total precipitation distributions, evaporation, and air temperature characteristics of the Back River Property. Table 5.1-3 presents the estimated average and extreme values of annual precipitation and runoff for various return periods at the mine site based on frequency analyses.

**Table 5.1-2. Summary of Mean Hydrologic Inputs**

| Month | Runoff Distribution (%) [a] | Precipitation Distribution (%) [a] | Evaporation [b] | | Air Temperature (°C) [b] |
|---|---|---|---|---|---|
| | | | Distribution (%) | Mean (mm) | |
| January | 0.0 | 4.7 | 0.0 | 0 | -29.1 |
| February | 0.0 | 4.2 | 0.0 | 0 | -28.7 |
| March | 0.0 | 5.9 | 0.0 | 0.1 | -26.1 |
| April | 0.0 | 6.2 | 1.8 | 5.9 | -16.4 |
| May | 4.0 | 6.4 | 8.0 | 25.8 | -5.3 |
| June | 50.5 | 9.8 | 29.8 | 96.4 | 6.1 |
| July | 19.0 | 12.5 | 33.0 | 106.7 | 12.5 |
| August | 8.7 | 18.2 | 20.3 | 65.8 | 10.0 |
| September | 11.9 | 11.4 | 6.9 | 22.4 | 2.6 |
| October | 5.5 | 9.7 | 0.1 | 0.4 | -6.7 |

**Table 5.1-2. Summary of Mean Hydrologic Inputs**

| Month | Runoff Distribution (%) [(a)] | Precipitation Distribution (%) [(a)] | Evaporation [(b)] Distribution (%) | Evaporation [(b)] Mean (mm) | Air Temperature (°C) [(b)] |
|---|---|---|---|---|---|
| November | 0.4 | 6.3 | 0.0 | 0 | -19.9 |
| December | 0.0 | 4.8 | 0.0 | 0 | -25.7 |
| Annual | 100.0 | 100.0 | 100.0 | 324 | -10.5 |

*(a) Source: SRK 2021; (b) Source: Sabina 2015, Appendix V4-3A*

**Table 5.1-3. Summary of Frequency Analysis for Annual Runoff and Precipitation**

| Hydrological Condition | Return Period | Annual Runoff (mm) [(a)] | Annual Precipitation (mm)[(a) (b)] |
|---|---|---|---|
| Wet | 200 | 269 | 653 |
| | 100 | 258 | 628 |
| | 50 | 245 | 601 |
| | 20 | 227 | 561 |
| | 10 | 210 | 527 |
| | 5 | 190 | 486 |
| Average | - | 149 | 427 |
| Dry | 5 | 112 | 341 |
| | 10 | 92 | 306 |
| | 20 | 75 | 278 |
| | 50 | 56 | 247 |
| | 100 | 44 | 227 |
| | 200 | 32 | 209 |

*(a) SRK 2021; (b) An undercatch factor of 1.61 was applied to account for undercatch errors and precipitation measurements*

#### *5.1.4.1 Climate Change*

Climate change projections over the Project life were developed in SRK 2021. While most surface water management infrastructure will have a short lifespan and be breached as soon as their effective use has been fulfilled, Waste Rock Storage Areas and pits will remain in perpetuity.

The long-term mean air temperature, precipitation, and windspeed are expected to change over the lifespan of the Project. The change relative to the baseline scenario is summarized in Table 5.1-4.

**Table 5.1-4. Climate Change Projections**

| Period | Change with Respect to Baseline [(a)] | | |
|---|---|---|---|
| | Mean Annual Air Temperature | Total Annual Precipitation | Wind Speed |
| 2020s (2011 – 2040) | +0°C | +6% | +2% |
| 2050s (2041 – 2070) | +1°C | +11% | +3% |
| 2080s (2071 – 2100) | +2°C | +16% | +5% |

*(a) Source: SRK 2021*

#### *5.1.4.2 Hydrology*

#### *5.1.4.3 Waterbody Description*

The Property is predominantly located within the Queen Maud Gulf Watershed with a small portion in the Back River Watershed (Nunavut Water Regulations, Schedule 4); these watersheds are shown in Figure A-01. The Project is composed of two main areas, the Goose Property area and the MLA. The majority of proposed infrastructure at the Goose Property area is within the Queen Maud Gulf Watershed, which flows northwest and enters the ocean on the west side of Bathurst Inlet. The Back River Watershed is located south of the Goose Property and flows east eventually entering the Arctic Ocean south of Gjoa Haven. The MLA is a narrow strip of land that drains directly to the west side Bathurst Inlet. A list of all waterbodies within the Potential Development Area can be found in Final Environmental Impact Statement (FEIS) Volume 6, Chapter 3 (Sabina 2015).

The Goose Property is divided by several smaller drainage areas each contributing to the larger, previously described watersheds. These drainage areas are shown on Figure A-04. This figure also indicates flow direction and the lakes in which bathymetry has been completed.

#### *5.1.4.4 Hydrological Processes*

The Project lies within the continuous permafrost zone of the continental Canadian Arctic. The physiography of the region is dominated by vegetated tundra hillslopes with lakes and scattered wetlands. The presence of permafrost is hydrologically influential, as it has very low hydraulic conductivity, and thus acts as a barrier to deep groundwater recharge. This physical restriction tends to increase surface water runoff and decrease infiltration.

Compared to unfrozen regions, permafrost watersheds tend to have higher peak flows and lower baseflows (Kane 1997). Streamflow in the continuous permafrost zone is governed by the Arctic nival regime, where runoff is dominated by high, snowmelt-driven flows in spring (i.e., freshet). Following freshet, streamflow declines throughout the summer and early fall, with the exception of rare and episodic rainfall-generated runoff (Church 1974).

Channel freeze-up typically occurs between late October and early November. In smaller drainage basins, stream channels typically freeze to their bottom, with zero flow occurring in winter. In very large catchments and larger lake outlets, depth, flow energy, and water turbulence may be sufficient to maintain streamflow and prevent downstream reaches from freezing completely.

Ice begins to form in October and is generally present on lakes until July. Ice depths are typically 1.5 to 2 m and reach their maximum depth in February (Fish Offsetting Plan; Sabina 2019a). Shallow water bodies, including most streams in the Project area, generally freeze to bottom over winter.

The maximum daily snowmelt rate was determined to be 28 mm/day (Sabina 2015, Appendix V2-7B). Snowmelt occurs in the month of May and June. The open water season typically starts in July and ends in September; however, there are variations in the length of the open water season year to year (Rescan 2014).

Return period unit peak flows were calculated using the index flood method, and a precipitation-based hydrology model with Soil Conservation Service unit hydrographs and curve numbers. Curve numbers were calibrated for each return period using two smaller regional gauging stations from the Ekati Diamond Mine (Sabina 2015, Appendix V2-7B).

## 5.2 MINE DEVELOPMENT PLAN

The total mine life of the Project from Construction to the end of Closure is estimated to be approximately 25 years. The mine life was divided into four phases as detailed in Table 5.2-1.

**Table 5.2-1. Mine Phase**

| Phase | Description | Start | End | Comment |
|---|---|---|---|---|
| 1 | Construction | Y-3, Q1 | Y-1, Q4 | *Site construction completed; mining begins* |
| 2 | Operations– Echo Tailings Facility (TF) | Y1, Q1 | Y3, Q2 | *Milling begins; mining continues; tailings deposition in Echo TF* |
| | Operations – Umwelt TF | Y3, Q3 | Y6, Q3 | *Milling and mining continues; tailings deposition in* Umwelt *TF* |
| | Operations - Llama TF | Y6, Q4 | Y15, Q4 | *Milling continues; tailings deposition in Llama TF* |
| 3 | Closure | Y16, Q1 | Y22, Q4 | *Removal of site infrastructure; pit flooding; continued water treatment* |
| 4 | Post-Closure | Y23, Q1 | + | *Site closed; performance monitoring* |

The Construction Phase will occur over approximately three years, and involve lake dewatering, pit excavation, and the construction of water management structures as well as pads and roads. Major mine development infrastructure will be constructed at both the Goose Property and the MLA. The design of water management conveyance structures is described in detail in Section 6. For detailed activity descriptions of Water Management refer to Section 8.

The major infrastructure at the Goose Property will include the following:

- Goose Plant Site (Goose Camp Accommodations and Process Plant);
- Ore Stockpile;
- Open pits and underground mine workings (Echo, Umwelt, Llama, and Goose Main open pits and undergrounds);
- Tailings management facilities (i.e., Echo Open Pit as Echo Tailings Facility [TF], Umwelt Open Pit as Umwelt TF, and Llama Open Pit as Llama TF);
- Waste Rock Storage Areas (WRSAs) (Umwelt WRSA, Llama WRSA, and Echo / Goose Main WRSA);
- Goose Property All-weather Airstrip;
- Saline Water Pond (SWP) (Umwelt Lake, once dewatered);
- Primary contact water storage pond (Primary Pond);
- Goose Main Reservoir (Goose Main Pit as meromictic lake);
- Event ponds (i.e., Llama WRSA Pond, Echo/Goose Main WRSA Pond, Plant Site Pond, Ore Stockpile Pond); and
- Haul and service roads.

The infrastructure at the MLA will include the following:

- Industrial area including camp and storage areas;
- Hazardous waste management area and landfarm;
- Desalination plant and associated water management infrastructure;
- Construction laydown area; and
- Fuel storage and offloading pad.

Four deposits; namely Echo, Umwelt, Llama, and Goose Main, will be mined by both open pit and underground methods. The mining schedule for each deposit is described in Table 5.2-2, with some preproduction activities (e.g., open pit pre-stripping, underground ramp pre-development) occurring before these dates. A total of 18.7 Mt of ore is planned to be mined, at a milling rate of 3,000 tonnes per day (tpd) in Year 1, increasing to 4,000 tpd by the end of Year 2, and ramping down in the last three years of operations. Open pit mining will begin two years prior to Process Plant commissioning to generate a stockpile to feed the Process Plant. The Process Plant will then operate for the 15 years of Operations.

**Table 5.2-2. Summary of Mine Schedule**

| Mine Operation | Start | End |
|---|---|---|
| **Open Pit Development** | | |
| Echo Open Pit | Y-2, Q1 | Y-1, Q4 |
| Umwelt Open Pit | Y-2, Q2 | Y1, Q4 |
| Llama Open Pit | Y1, Q2 | Y5, Q2 |
| Goose Main Open Pit | Y3, Q3 | Y12, Q3 |
| **Underground Development** | | |
| Umwelt Underground Mine | Y1, Q4 | Y15, Q4 |
| Llama Underground Mine | Y1, Q4 | Y6, Q1 |
| Goose Main Underground Mine | Y7, Q3 | Y13, Q2 |
| Echo Underground Mine | Y13, Q4 | Y15, Q4 |

The Closure Phase will occur over approximately seven years. The majority of the mine workings and water management structures will be decommissioned throughout Closure. The Project will subsequently enter Post-Closure, which will consist of monitoring and adaptive management.

The development sequence for mining and water management activities is summarized in Table 5.2-3 and is shown in Figures A-06 through A-11. For detailed activity descriptions of Water Management refer to Section 8.

Table **5.2-3**. **Mine Development Sequence**

| Mine Year | Mine Development Sequence and Key Activities |
|---|---|
| -3 | **Phase 1 – Construction**<br>• Construction activities begin, including construction of the Goose Plant Site, Camp area, and all-weather roads/crossings and pads.<br>• Water intake infrastructure is constructed at Goose Lake and Big Lake to meet the freshwater demands for domestic, construction, operation, and associated uses, including mining and milling activities.<br>• Primary Pond and Echo WRSA Pond construction begins.<br>• Plant Site Pond and Ore Stockpile Pond construction begins at the Goose Plant Site.<br>• Pre-stripping activities at Echo Open Pit and Umwelt Open Pit begins.<br>• Refer to Figure A-06 and Section 8.1 for additional clarification. |
| -2 | **Phase 1 – Construction**<br>• Water discharge infrastructure is constructed at Llama and Umwelt lakes to prepare for fish-out activities and dewatering activities.<br>• Construction of the Goose Plant Site, and all-weather roads/crossings and pads continues.<br>• Plant Site Pond and Ore Stockpile Pond are constructed at the Goose Plant Site.<br>• Primary Pond and Echo WRSA Pond are constructed.<br>• Open pit mining begins in Echo Open Pit and Umwelt Open Pit.<br>• Waste rock deposition in the Echo WRSA and Umwelt WRSA begins.<br>• Ore is stockpiled at the Plant Site.<br>• Contact water in Echo Open Pit and Ore Stockpile Pond are pumped to the Primary Pond via Echo WRSA Pond.<br>• Contact water in Umwelt Open Pit is pumped to the Primary Pond.<br>• Contact water from the Plant Site is collected in the Plant Site Pond, then released to the tundra.<br>• Refer to Figure A-06 and Section 8.1 for additional clarification. |
| -1 | **Phase 1 – Construction**<br>• Llama Lake is dewatered to Goose Lake via Umwelt Lake; assumes 50% of water requires treatment for TSS.<br>• Umwelt Lake is fully dewatered to Goose Lake to allow for construction of the Saline Water Pond (SWP); assumes 50% of water requires treatment for total suspended solids (TSS).<br>• The SWP is constructed.<br>• Umwelt Underground decline begins.<br>• Contact water in Echo Open Pit and Ore Stockpile Pond are pumped to the Primary Pond via Echo WRSA Pond.<br>• Contact water in Umwelt Open Pit is pumped to the Primary Pond.<br>• Contact water from the Plant Site is collected in the Plant Site Pond, then released to the tundra.<br>• Echo Open Pit mining is complete.<br>• Deposition of waste rock in the Echo WRSA is complete.<br>• Refer to Figure A-06 and Section 8.1 for additional clarification. |
| 1 | **Phase 2: Operations - Echo TF**<br>• Milling operation begins; withdrawal from the Ore Stockpile begins.<br>• Tailings deposition begins in the Echo TF; contact water from the Ore Stockpile Pond and Echo WRSA Pond are pumped to Echo TF.<br>• Pre-development activities and mining of Llama Open Pit and Underground begins.<br>• Umwelt Underground ore production begins.<br>• The Llama WRSA containment dam and diversion berms are built (i.e., Llama Berm Break Line East and West), which create the Llama WRSA Pond.<br>• Waste rock deposition in the Llama WRSA begins.<br>• Umwelt and Llama Underground, and Llama Open Pit groundwater inflows are pumped to the SWP, which continues throughout Operations.<br>• Contact water from Llama WRSA Pond and Umwelt Open Pit are pumped to Primary Pond.<br>• Reclaimed water is pumped from the Primary Pond or Echo TF.<br>• Umwelt Open Pit mining is complete.<br>• Deposition of waste rock in the Umwelt WRSA is complete.<br>• Refer to Figure A-07 and Section 8.2 for additional clarification. |
| 2 | **Phase 2: Operations - Echo TF**<br>• Mining continues in Llama Open Pit, Umwelt Underground, and Llama Underground.<br>• A non-contact water diversion berm (i.e., Goose Main Pit Diversion Berm) is constructed south of Goose Main Open Pit to divert water away from the pit and into Goose Lake.<br>• Refer to Figure A-07 and Section 8.2 for additional clarification. |

Table **5.2-3**. **Mine Development Sequence**

| Mine Year | Mine Development Sequence and Key Activities |
|---|---|
| 3 | **Phase 2: Operations - Echo TF**<br>• Mining continues in Llama Open Pit, Umwelt Underground, and Llama Underground.<br>• Goose Main Open Pit development continues.<br>• Refer to Figure A-07 and Section 8.2 for additional clarification.<br>**Phase 2: Operations - Umwelt TF Begins**<br>• Goose Main Open Pit mining begins.<br>• Tailings deposition transitions from Echo TF to Umwelt TF.<br>• Contact water is pumped to the Umwelt TF, with exception to the Llama WRSA Pond and runoff from the Umwelt WRSA, which are conveyed to the Primary Pond.<br>• Saline water collected in the SWP is sent to a reverse osmosis unit for treatment, with brine effluent deposited back in the SWP and treated water pumped to Umwelt TF.<br>• Reclaimed water is pumped from the Umwelt TF or Primary Pond.<br>• Refer to Figure A-08 and Section 8.2 for additional clarification. |
| 4 | **Phase 2: Operations - Umwelt TF**<br>• No change from previous year.<br>• Refer to Figure A-08 and Section 8.2 for additional clarification. |
| 5 | **Phase 2: Operations – Umwelt TF**<br>• Llama Pit mining complete.<br>• Deposition of waste rock in the Llama WRSA is complete.<br>• Refer to Figure A-08 and Section 8.2 for additional clarification. |
| 6 | **Phase 2: Operations – Umwelt TF**<br>• Goose Main Underground decline begins.<br>• Llama Underground mining is complete.<br>• Refer to Figure A-08 and Section 8.2 for additional clarification.<br>**Phase 2: Operation – Llama TF**<br>• Tailings deposition transitions from Umwelt TF to Llama TF.<br>• Brine effluent from the reverse osmosis unit is deposited in Llama TF.<br>• Refer to Figure A-09 and Section 8.2 for additional clarification. |
| 7 | **Phase 2: Operations – Llama TF**<br>• Goose Main Underground mining begins.<br>• Refer to Figure A-09 and Section 8.2 for additional clarification. |
| 8-12 | **Phase 2: Operations – Llama TF**<br>• No change from previous year.<br>Refer to Figure A-09 and Section 8.2 for additional clarification. |
| 13 | **Phase 2: Operations – Llama TF**<br>• Goose Main Pit mining complete.<br>• Deposition of waste rock in the Goose Main WRSA is complete.<br>• Echo Underground decline begins.<br>• Umwelt and Llama TFs are dewatered to Goose Main Open Pit (then called Goose Main Reservoir) to support closure filling and final saline water storage.<br>• The reverse osmosis unit is decommissioned.<br>• Year-round recirculation treatment of Umwelt and Llama TF water begins.<br>• Refer to Figure A-09 and Section 8.2 for additional clarification. |
| 14-15 | **Phase 2: Operations – Llama TF**<br>• Goose Main Underground mining is complete.<br>• Umwelt and Echo Underground, groundwater inflows are pumped to the Goose Main Reservoir for permeant storage.<br>• Ore production ramps down and is completed.<br>• Refer to Figure A-09 and Section 8.2 for additional clarification. |

Table **5.2-3**. **Mine Development Sequence**

| Mine Year | Mine Development Sequence and Key Activities |
|---|---|
| 16 – 22 | **Phase 3: Closure**<br>• Year-round recirculation treatment of Umwelt and Llama TF water continues.<br>• Umwelt and Echo Underground mining complete.<br>• Decommissioning of remaining infrastructure.<br>• Goose Main Reservoir and Umwelt TF are actively filled with freshwater from Goose Lake or Big Lake; Llama Open Pit passively fills.<br>• Open pits/TFs equipped with spillways (where required) and allowed to overtop and discharge to the environment once monitoring confirms discharge limits have been achieved.<br>• Monitoring to ensure compliance with regulatory requirements.<br>• Refer to Figure A-10 and Section 8.3 for additional information related to closure. |
| 23+ | **Phase 4: Post-Closure**<br>• Final decommissioning, including Water Treatment Plan (WTP).<br>• Monitoring to ensure compliance with regulatory requirements.<br>• Refer to Figure A-11 and Section 8.4 for additional information related to Post-closure.<br>• Refer to the Interim Closure and Reclamation Plan (2AM-BRP1831 Amendment No.1 Part J, Part 1) for additional information. |

### 5.2.1 Mine Waste Management Summary

This subsection provides a summary of the mine waste management plans. Detailed plans regarding the management of tailings, overburden, and waste rock are presented in the Tailings Management Plan (TMP; 2AM-BRP1831 Part F, Item 1) and the Waste Rock Management Plan (WRMP; 2AM-BRP1831 Amendment No.1 Part F, Item 1).

Table 5.2-4 presents a summary of the estimated tonnages of waste materials that will be produced by the Project. The table also indicates the quantities of waste materials that will be deposited in each waste storage facility, or if the material will be used for another purpose. There are three WRSAs: Umwelt WRSA, Llama WRSA, and Echo WRSA / Goose Main WRSA (Echo WRSA until mining of Goose Main Pit begins, the Goose Main WRSA).

**Table 5.2-4. Mine Waste Summary**

| Waste Type | Estimated Quantities (Mt) | | Source Area and Destination |
|---|---|---|---|
| Overburden | 5.8 | 0.56 | Removed from the Echo Open Pit and stored in Echo WRSA. |
| | | 0.69 | Removed from the Umwelt Open Pit and stored in Umwelt WRSA. |
| | | 1.2 | Removed from the Llama Open Pit and stored in the Llama WRSA. |
| | | 3.3 | Removed from the Goose Main Open Pit and stored in the Goose Main WRSA. |
| Waste Rock | 99.9 | 8.2 | Removed from the Echo Open Pit and stored in Echo WRSA. |
| | | 15.0 | Removed from the Umwelt Open Pit and stored in Umwelt WRSA. |
| | | 31.0 | Removed from the Llama Open Pit and stored in the Llama WRSA. |
| | | 45.7 | Removed from the Goose Main Open Pit and stored in the Goose Main WRSA. |
| Tailings | 18.7 | 2.67 | Stored in the Echo TF. |
| | | 6.27 | Stored in the Umwelt TF |
| | | 9.77 | Stored in the Llama TF. |

Should Sabina identify additional opportunities for the use of other open pits as TFs or WRSAs, or the expansion of current waste management facilities, Sabina intends to provide the NWB, as per 2AM-BRP1831 Amendment No.1 Part B, Item 16, with the following:

- waste disposal quantities;
- volumes;
- disposal timing;
- maximum pit capacity;
- effects to pit closure; and
- appropriate mitigation and monitoring plans.

### 5.2.2 Overburden Management

Overburden will be removed from the surface footprint of the four open pits (quantities as shown in Table 5.2-4). A majority of the overburden materials will be co-disposed with waste rock in the WRSAs. Depending on the physical characteristics of the overburden material, a portion may be used for the construction of site infrastructure, kept for future revegetation studies/efforts, or used for WRSA cover material. Refer to the WRMP (2AM-BRP1831 Amendment No.1 Part F, Item 1) for more details on overburden.

### 5.2.3 Waste Rock Management

A summary of the location and surface areas of each WRSA is included in Table 5.2-5. Details regarding approximate final waste rock material quantities and source locations are shown in Table 5.2-4. Refer to the WRMP (2AM-BRP1831 Amendment No.1 Part F, Item 1) for more details on waste rock.

**Table 5.2-5. Waste Rock Storage Area Summary Information**

| Facility | Approximate Location | Surface Area (ha) |
|---|---|---|
| Llama WRSA | 200 m southeast of the Llama Open Pit | 14.7 |
| Umwelt WRSA | 200 m east of the Umwelt Open Pit | 19.6 |
| Echo WRSA | 200 m southeast of the Echo Open Pit | 37.8 |
| Goose Main WRSA | Previously Echo WRSA, covering Echo Open Pit | 68.9 |

### 5.2.4 Tailings Management

Approximately 18.7 Mt of tailings will be produced over the 15-year LOM. All tailings will be deposited as slurry. Initially, tailings will be deposited in the Echo TF, then transition to Umwelt Open Pit and Llama Open Pit once mining operations have ceased in each location (called Umwelt TF and Llama TF, respectively). The Operations Phase is described in three stages according to the tailings storage and water management plans, as follows:

- Echo Tailings Facility (Echo TF) – For the first two years of Operations (Years 1 to 2), the mined-out Echo Open Pit will be used for tailings deposition;
- Umwelt Tailings Facility (Umwelt TF) – From Years 2 to 6, the mined-out Umwelt Open Pit will be used for tailings deposition;

- o Llama Tailings Facility (Llama TF) – From Year 7 onward, tailings will be disposed of in the mined-out Llama Open Pit.

The Echo TF will be covered with waste rock and overburden material once tailings deposition is complete. Water covers with a minimum water depth of 5 m will be used for closure of the Umwelt TF and Llama TF.

Refer to the Tailings Management Plan (2AM-BRP1831 Amendment No.1 Part F, Item 1) for further tailings management details.

### 5.2.5 Ore Management

There will be one main Ore Stockpile at the Goose Property located southeast of the Process Plant, and temporary stockpiles at the underground laydowns areas (Figure A-02). The Ore Stockpile will contain three sub-stockpiles: low-grade, mid-grade, and high-grade ore. Ore will be processed during the Operations Phase only, and runoff from the Ore Stockpile will be collected in the Ore Stockpile Pond and managed as site contact water. Refer to the Ore Storage Management Plan (2AM-BRP1831 Amendment No.1 Part F, Item 1) for more details.

# 6. Water Modelling and Design Criteria

The focus of water management is to control the inventory of mine water stored on site, and to enhance the separation of saline, contact, and non-contact water. Water management at the Property entails multiple, codependent components which include storage facilities and conveyance facilities. Water is stored using ponds (short-term storage) and reservoirs (long-term storage). Ponds are structures with a finite operational life and will be fully decommissioned at Closure. The ponds on site are a combination of event ponds and short term (few years) non-event water ponds. Event ponds are sized with retention capacity for specific design storms and are normally empty or will hold only a nominal amount of water. The non-event ponds on site consist of the SWP for saline water, and the Primary Pond for contact water; these ponds have defined storage capacity. The SWP will remain operational as a storage facility until the transfer of saline water to Goose Main Reservoir (via Llama Reservoir) is completed. The Primary Pond will remain in use to assist with the Process Plant start up as a water source, and to capture contact water until the Llama and Umwelt Open Pit mining is complete, at which point the Primary Pond can be breached, and pre-mining flows will be re-established.

Long-term (i.e., permanent) water storage facilities are denoted as reservoirs, and include the three pit lakes (Llama, Umwelt, and Goose Main). Note the pits are also called tailings facilities as Llama TF and Umwelt TF will permanently hold tailings as well as act as long-term water storage.

Sumps in each of the open pits will be used to collect water during active mining, which may later be conveyed to an alternative reservoir via pipeline in accordance with the WMP.

Diversions are engineered structures that maintain separation between contact and non-contact water. These structures are constructed for the Operations Phase of the Project and are completely decommissioned during Closure.

## 6.1 WATER AND LOAD BALANCE

The Water and Load Balance model (the model) was used as a tool to analyze water management options and confirm that the selected water management strategy allows meeting the water management objectives during the life of the Project. For additional information refer to the Water and Load Balance Report (Appendix D). Where necessary, treatment and discharge of mine water were assessed to manage excess site-wide contact water and meet water quality guidelines downstream of the discharge points from the Goose Property.

The Water and Load Balance model for the Project was developed using the GoldSim© software package (version 12.1.5) (GoldSim Technology Group 2020). The model was run on a daily time step and runs from Year -3 to Year 64. This run length was chosen as it allows the model to run until steady-state conditions are reached in pits and downstream receptors.

The Water and Load Balance Report (Appendix D) includes a detailed description of the model assumptions, framework, inputs and results, and an overview of the model limitations and sensitivity analysis. The report also provides details on the main mine components relevant to the water quality predictions, including the mine plan, open pits, underground facilities, WRSAs, Ore Stockpile, and water reservoirs. Flowsheets for each phase of the Project, including Construction, Operations, and Closure, are presented in Appendix D. The flowsheets depict the water management strategy that was implemented for the Project, cumulative volumes, and change in storage over the period of a specified Project phase.

The Water and Load Balance Model shall be reviewed periodically, to reflect changes in operations and/or technology and submit results for review with the Annual Report in accordance with the Type A Water Licence (2AM-BRP1831 Amendment No.1, Part E, Item 16 and Part B, Item 2) as appendix to the approved Water Management Plan (WMP).

## 6.2 HYDROTECHNICAL DESIGN CRITERIA

The hydrotechnical design criteria for the Project include a combination of best management practices (BMPs) and specified criteria based on engineering and operational judgement and/or constructability considerations. Four classes of design criteria were considered: Table 6.2-1 presents the hydrologic design criteria used to formulate peak flows; Table 6.2-2 presents the design criteria used for sizing of pond infrastructure; Table 6.2-3 presents containment dam and diversion berm design criteria, and Table 6.2-4 presents culvert design criteria.

**Table 6.2-1. Hydrologic Design Criteria for Formulating Peak Flows**

| Item | Value | Unit | Source |
|---|---|---|---|
| SCS Curve Number (Waste Rock) | 84 | - | George (2008) |
| SCS Curve Number (Natural Ground) | 72-89 | - | Sabina (2015), Appendix V2-7B |
| SCS Curve Number (Pit Walls) | 92 | - | George (2008) |
| Critical Snowmelt Month | June | - | Sabina (2015), Appendix V2-7B |
| June Average Snowmelt Rate | 28 | mm/day | Sabina (2015), Appendix V2-7B |
| Rainfall Distribution | Type I | - | USDA (1986) |
| Minimum Time of Concentration | 10 | minutes | Engineering Judgement |

*SCS = Soil Conservation Service (current Natural Resources Conservation Service)*

**Table 6.2-2. Pond (Event and Saline Water) Design Criteria**

<table>
<tr><th colspan="2">Item</th><th>Value</th><th>Unit</th><th>Source/Comments</th></tr>
<tr><td rowspan="4">Event Ponds</td><td>Event Return Period</td><td>10-100</td><td>Years</td><td>BMP. See Table 6.4-1</td></tr>
<tr><td>Minimum Dewatering Requirement</td><td>2</td><td>days</td><td>Operational consideration</td></tr>
<tr><td>Storage Requirement</td><td>24-hour total rainfall volume + snowmelt</td><td>m³</td><td>BMP</td></tr>
<tr><td>Minimum Freeboard</td><td>0.5</td><td>m</td><td>Engineering Judgement</td></tr>
<tr><td rowspan="2">SWP</td><td>Storage Volume</td><td>1.1</td><td>Mm³</td><td>95th percentile volume from SRK/Golder Water Balance (Sabina 2015, Appendix V2-7B; and Appendix D)</td></tr>
<tr><td>Minimum Freeboard</td><td>1.0 – 1.3</td><td>m</td><td>SWP Freeboard Memo (Sabina 2017, Appendix A of Appendix F-1)</td></tr>
</table>

**Table 6.2-3. Containment Dams (Event and Saline Water Ponds) and Diversion Berm Design Criteria**

| | Item | Value | Unit | Source/Comments |
|---|---|---|---|---|
| Diversion Berm Design | Event Return Period | 10-100 | Yrs | BMP |
| | Conveyance Capacity | 24-hour total rainfall volume + Snowmelt | m³/s | BMP |
| | Manning's Roughness | 0.035 | - | For minor natural steam with stones and weeds (Chow 1994) |
| | Minimum Slope | 0.005 | m/m | BMP |
| | Upstream Side Slopes | 2:1 | (H:V) | Constructability consideration |
| | Downstream Side Slopes | 1.5:1 | (H:V) | Engineering judgement |
| | Berm Top Width - minimum | 4 | m | Constructability consideration |
| | Minimum Berm Height | 2 | m | Constructability consideration and for foundation permafrost preservation. |
| | Minimum Berm Freeboard | 0.5 | m | Engineering judgement and to allow for adequate time for maintenance if / as required |
| Event Pond Containment Dam Design | Minimum Dam Height | 2 | m | Constructability consideration |
| | Bedding Material Thickness around Geosynthetic Clay Liner (GCL) | 0.5 | m | Engineering judgement |
| | Liner Tie-Back Length (without liner anchor trench) | 3 | m | Engineering judgement |
| | Liner Tie-Back Length (with anchor trench) | 1 | m | Engineering judgement and based on pull out calculations. |
| | Upstream Side Slope (Ponded Water Level >4m) - minimum | 3:1 | (H:V) | Constructability consideration |
| | Upstream Side Slope (Ponded Water Level <4m) | 2:1 | (H:V) | Constructability consideration |
| | Downstream Side Slopes | 2:1 | (H:V) | Stability and permafrost requirement |
| SWP Containment Dam Design | Bedding Material Thickness around GCL | 0.5 | m | Engineering judgement |
| | Dam Top Width | 8 | m | Constructability consideration |
| | Minimum Dam Height | 2 | m | Constructability consideration |
| | Upstream Side Slope | 3:1 | (H:V) | Constructability consideration |
| | Downstream Side Slope - minimum | 2:1 | (H:V) | Engineering Judgement |
| | Liner Tie-Back Length (without liner anchor trench) | 3 | m | Engineering judgement |
| | Liner Tie-Back Length (with anchor trench) | 1 | m | Engineering judgement and based on pull out calculations. |
| | Key Trench Tie-in Depth - minimum | 2.2 | m | May be adjusted / deepened to 3m in areas where massive ice encountered in the foundation (Sabina 2017, Appendix C of Appendix F-1). |

**Table 6.2-4. Culvert Design Criteria**

| Item | Value | Unit | Source |
|---|---|---|---|
| Event Return Period | 50 to 100 * | Years | BMP; SRK (2014) |
| Conveyance Capacity | 24-hour total rainfall volume | $m^3/s$ | BMP; SRK (2014) |
| Maximum Velocity during Average June flow for Fish Passage | 1.5 | m/s | SRK (2014) |
| Manning's Roughness for culverts with cobble stone base | 0.040 | - | Chow (1994) |
| Manning's Roughness for culverts without cobble stone base | 0.024 | - | Chow (1994) |

** Event return period for culverts will be based on a location specific risk assessment. Wherever practical, a 100-year design event will be adopted (and will be required for high risk culvert locations) and a minimum 50-year design event will be use for all culverts.*

## 6.3 HYDROLOGIC MODEL

Hydrologic modelling was completed to appropriately design and size the water management infrastructure including ponds and pumps, and to verify that the diversion structures were sufficiently sized to management the specified design storm events.

### 6.3.1 Catchment Delineation

The Goose Property was delineated into catchments associated with each pit (or TF), WRSA, event pond, and diversion. Areas were also incorporated into the Water and Load Balance model to allow developing predictive flow and water quality estimates.

Catchments were delineated in AutoCAD (AutoDesk) and Global Mapper™ (Blue Marble Geographics) using available LiDAR topography. Once delineated, the catchment characteristics, including average slope, total area, and head differential, were calculated in Global Mapper. Catchments are presented in Figure A-05, and in Table 6.3-2.

### 6.3.2 Approach

Instantaneous peak flows and volumes for design storm events were generated in HEC-HMS software (US Army Corps of Engineers) using the design criteria summarized in Table 6.2-1 along with catchment areas presented in Table 6.3-2. Peak flows derived for a rain-on-snow event were used to size the water management infrastructure, and required storage volumes were determined based on the total snowmelt and rainfall accumulation over a 24-hour period. Resultant rainfall depths are summarized in Table 6.3-1.

#### 6.3.2.1 Return Period Selection

The return period was selected for each structure based on the qualitative level of risk associated with overtopping or breaching of the structure, whether it was an event pond, open pit, or diversion. Three levels of risk were selected for the Project, with an associated return period (Table 6.3-1). The risk was determined using engineering judgement, taking into consideration the human health and safety, environmental, reputational, and economic consequences of the specified failure events.

**Table 6.3-1. Return Period Selection Criteria**

| Level of Risk | Type of Facility | Return Period | 24-hour total rainfall volume + snowmelt [1](mm) |
|---|---|---|---|
| Low | Non-contact water diversions<br>Pit sumps | 10 | 44.4 |
| Medium | Contact water diversions<br>Contact water event ponds with additional water infrastructure downstream<br>Culverts on all-weather road away from primary infrastructure or not connected to other water management infrastructure systems | 50 | 64.2 |
| High | Contact water event ponds without downstream water infrastructure<br>Culverts connected to water management infrastructure or near ponds, diversions or puts. | 100 | 73.4 |

*1) From SRK Hydrology Report (Sabina (2015), Appendix V2-7B) and increased based on the regional climate change work.*

Infrastructure which has the potential to overtop/breach and discharge to the downstream environment was assigned a "High Risk". At the Goose Property, this includes the Llama WRSA Pond, Ore Stockpile Pond, SWP, and Echo/Goose Main WRSA Pond. The Goose Property infrastructure and corresponding risk level are listed in Table 6.3-2, as well as their associated catchment areas. The culverts are assigned a risk rating (typically at medium risk and above) based on their connection to other water management elements.

For any structure that is classified as a 'dam' then the Canadian Dam Association (CDA 2013, 2014) standards must be applied and therefore override the return period selection criteria outlined in Table 6.3-1. Structures that classify as a dam includes the Llama WRSA Containment Dam (East and West), Ore Stockpile Containment Dam, SWP Containment Dam, the Primary Pond Containment Dam, and Echo/Goose Main Containment Dam.

**Table 6.3-2. Level Of Risk For Each Item of Goose Infrastructure and Contributing Catchment Areas**

| Infrastructure | Catchment ID | Catchment Area (km²) | Level of Risk | Type of Water | Pumped Inflow | Pumped Outflows | Embankment | Downstream Water Infrastructure |
|---|---|---|---|---|---|---|---|---|
| Umwelt Pit Sump | UP<br>UP1<br>UCP2<br>UWD1 | 0.10<br>0.15<br>0.05<br>0.20 | Low | Contact Water | None | Primary Pond | No | N/A |
| Primary Pond Containment Dam (Primary Pond) | PRMYPND<br>UWD2<br>LWD1<br>UCP1 | 0.23<br>0.14<br>0.25<br>0.12 | Medium | Contact Water | Echo WRSA Pond and Llama WRSA Pond | Process Plant | Yes | SWP and Umwelt Open Pit |
| Llama Diversion Berms | LD1<br>LD2<br>LL | 0.17<br>0.62<br>0.36 | Low | Non-Contact Water | None | None | Yes | Llama Lake Reservoir/Llama Open Pit |
| Llama WRSA Containment Dam West and West (Llama WRSA Pond) | LCP<br>LWD2<br>LD1 | 0.18<br>0.15<br>0.17 | High | Contact Water | None | Primary Pond | Yes | Llama Lake Reservoir/Llama Open Pit |
| Llama Pit Sump | LP<br>LP1<br>LD2 | 0.07<br>0.17<br>0.62 | Low | Saline Water | None | Saline Water Pond | No | SWP |
| Ore Stockpile Pond Containment Dam (Ore Stockpile Pond) | OP<br>OD | 0.01<br>0.09 | High | Contact Water | None | Echo TF or Umwelt TF | Yes | None |
| SWP Containment Dam (SWP) | SWP<br>SWP1 | 0.83<br>0.29 | High | Saline Water | Llama Open Pit and Underground | Water Treatment | Yes | None |

**Table 6.3-2. Level Of Risk For Each Item of Goose Infrastructure and Contributing Catchment Areas**

| Infrastructure | Catchment ID | Catchment Area ($km^2$) | Level of Risk | Type of Water | Pumped Inflow | Pumped Outflows | Embankment | Downstream Water Infrastructure |
|---|---|---|---|---|---|---|---|---|
| Echo Pit Sump | EP<br>ECWR1 | 0.07<br>0.38 | Medium | Contact Water | None | Echo WRSA Pond | None | Echo WRSA Pond |
| Echo Containment Dam<br>(Echo WRSA Pond) | ECPND<br>ECP1 | 0.24<br>0.08 | High | Contact Water | Echo Open Pit | Primary Pond | None | None |
| Goose Main Containment Dam<br>(Goose Main WRSA Pond) | ECPND<br>ECP1<br>ECWR1 | 0.24<br>0.08<br>0.38 | High | Contact Water | None | Umwelt TF | None | None |
| Echo Diversion Berm | ECUS | 0.71 | Medium | Non-Contact Water | None | None | None | Echo Open Pit and Echo/Goose Main WRSA Pond |
| Goose Main Pit Sump | GP<br>GP1 | 0.06<br>0.78 | Low | Contact Water | None | Umwelt TF | None | None |
| Goose Main Diversion Berm | GOOSE2<br>GOOSE3 | 0.45<br>2.80 | Low | Non-contact Water | None | None | None | Goose Main Open Pit |

#### 6.3.2.2 Interpretation of Results

The resultant peak instantaneous flows and 24-hour storage volumes were used to size water management infrastructure. Peak flows were used to size culverts and diversion structures, and total storm volumes were used to size water management event ponds and pumping rates.

Since all diversions are constructed as berms as opposed to excavating into existing ground, the minimum berm height defines the conveyance configuration. In all cases, the 2 m minimum berm height (Table 6.2-3) was greater than the design flow depth and freeboard, and therefore governed the design requirements.

## 6.4 POND AND PUMP SIZING

Table 6.4-1 summarizes the pond capacities and associated pumping rate requirements for the Goose Property. The location of each of the ponds is illustrated on Figure A-02. A summary of the pond capacity and pumping rate are shown in Table 6.4-1. Sabina is committed to providing detailed design details 60 days prior to construction.

**Table 6.4-1. Goose Property Pond Capacity and Pumping Rate Summary**

| Description | Design Return Period | Required Capacity ($m^3$) | Available Capacity ($m^3$)[1] | % Full | Dewatering Duration (days) | Pumping Rate ($m^3$/s) |
|---|---|---|---|---|---|---|
| Umwelt Open Pit Sump | 10 | 18,000 | N/A | N/A | 2 | 0.10 |
| Primary Pond | 50 | 109,500 | 316,650 | 35% | 23 | 0.06 |
| Llama WRSA Pond | 100 | 20,000 | 26,000 | 77% | 2 | 0.11 |
| Llama Open Pit Sump | 10 | 12,000 | N/A | N/A | 2 | 0.07 |
| Ore Stockpile Pond[2] | 100 | 25,000 | 40,000 | 63% | 2 | 0.15 |
| SWP[3] | N/A | 1,473,000 | 1,790,000 | 91% | N/A | 0.15 |
| Echo Pit Sump | 50 | 5,000 | N/A | N/A | 2 | 0.03 |
| Echo / Goose Main WRSA Pond | 100 | 48,000 | 65,100 | 74% | 10 | 0.06 |
| Goose Main Open Pit Sump | 10 | 20,000 | N/A | N/A | 2 | 0.11 |

1) *Pit sump actual capacities are defined by the open pit design, and as a result are always larger than the required capacity.*
2) *Required capacity estimated based on SRK 2021 runoff estimates, to be confirmed in detailed design.*
3) *Pond size and dewatering rate from SWP are based on water balance results. Pond size is based on the 95$^{th}$ percentile maximum ponded water volume and dewatering is assumed to occur over two open water seasons. (SRK 2020.)*

The approved event ponds were sized for the 24-hour storm design criteria (Table 6.3-1) and conservatively assume dewatering pumps are not operating over the storm duration. The pumping rate for each pond was set to allow dewatering the pond in 2 days (Table 6.2-2) to allow for quick re-establishment of storage capacity after large storm event. The dewatering duration was increased beyond the 2 days only for the ponds that have an available capacity significantly larger than the minimum required capacity. This additional available capacity will allow for managing storm events that may occur during the longer dewatering period. From a practical operational perspective, the maximum design pumping rate was set at 0.15 $m^3$/s.

As described in the design criteria outlined in Table 6.2-2, all collection ponds will be sized with sufficient freeboard contingency to provide both operational flexibility and accommodate large flows. Further refinements to the design will be completed during detailed engineering and will be captured in an updated version of this plan prior to construction.

## 6.5 CULVERT SIZING

There are five proposed culvert crossing locations at the Goose Property: one crossing through the airstrip and four crossings through the all-weather roads. Two types of culverts are considered for the all-weather roads and airstrip:

- Non fish-bearing crossings; and
- Fish-bearing crossings.

The non-fish-bearing crossings will consist of corrugated steel pipe and are currently designed with a diameter of either 1.2 m or 2.5 m, depending on the associated design flow. The fish-bearing crossings will be sized to keep maximum water velocities below 1.5 m/s for the average June flow such that they do not present a velocity barrier to migrating Arctic Grayling. In addition, all culverts, will meet the 0.3 m criteria for maximum water depth above the top of culvert. The fish-bearing culverts will be embedded at depth and a thin layer of streambed material will be placed to promote fish passage and habitat suitability. The design characteristics for the culverts are presented in Table 6.5-1; Figure A-02 shows the culvert locations in plan view, and typical crossing sections are shown in Figure A-12. Sabina will provide the detailed engineering drawings and report 60 days in advance of construction, pursuant to the requirements of the Type A Water Licence (2AM-BRP1831 Amendment No.1). Sabina notes that fish bearing crossings are subject to appropriate Department of Fisheries and Oceans Canada (DFO) processes.

**Table 6.5-1. Goose Property Culvert Characteristics – Design Storm**

| | Culvert Description | Goose Culvert | Gander Pond Culvert | Goose Airstrip Culvert | Echo Culvert | Goose Neck Culvert |
|---|---|---|---|---|---|---|
| | **Culvert ID** | C1 | C2 | C3 | C4 | C5 |
| Characteristics | Slope (%) | 1.0 | 3.6 | 1.0 | 1.5 | 3.5 |
| | Diameter (m) | 2.5 | 2.5 | 2.5 | 1.2 | 2.5 |
| | Culvert Shape | Circ. | Circ. | Circ. | Circ. | Circ. |
| | Number of Barrels | 2 | 2 | 2 | 1 | 1 |
| | Culvert Material | CSP | CSP | CSP | CSP | CSP |
| | Embedment Depth (m) | 0 | 0.4 | 0 | 0 | 0 |
| 100 Year Event | Total Discharge ($m^3/s$) | 19.27 | 9.64 | 18.82 | 1.99 | 10.47 |
| | Culvert Inlet Elevation | 100 | 100 | 100 | 100 | 100 |
| | Headwater Elevation (m) | 102.27 | 101.89 | 102.23 | 101.46 | 102.39 |
| | Water Depth above | 0 | 0 | 0 | 0.26 | 0 |
| | Invert Control Depth (m) | 2.27 | 1.49 | 2.23 | 1.32 | 2.39 |
| | Outlet Control Depth (m) | 1.31 | 0 | 0.23 | 1.46 | 1.01 |
| | Normal Depth (m) | 1.18 | 0.98 | 1.17 | 1.20 | 1.06 |
| | Critical Depth (m) | 1.41 | 1.21 | 1.4 | 0.77 | 1.10 |
| | Outlet Depth (m) | 1.20 | 0.99 | 1.18 | 0.77 | 1.47 |
| | Tail Water Depth (m) | 0.82 | 0.54 | 0.83 | 0.06 | 0.12 |
| | Outlet Velocity (m/s) | 4.14 | 4.21 | 4.12 | 2.58 | 5.03 |
| | Tail Water Velocity | 2.34 | 1/.8 | 2.27 | 0.64 | 0.49 |

*Note – the final design criteria for the culverts will be determined at the detailed design stage based on the level of associated risk. Drawings with additional design details and layouts will be submitted for regulatory approval before construction, as per the Type A Water Licence (2AM-BRP1831 Amendment No.1).*

Refer to Section 9.4 for additional information on environmental protection measures related to culvert installations and stream crossing or diversions.

## 6.6 DIVERSION BERMS AND CONTAINMENT DAMS

Two types of berms will be constructed to support water management across the Project area:

- Unlined non-contact water diversion berms;
- Lined contact water containment dams and berms; and

All diversion berms will be constructed directly onto the tundra surface with non-potentially acid Generating (NPAG) run of mine or run of quarry material that contains sufficient fines to contain and convey water. All containment dams and berms will also be constructed with run of mine or run of quarry material; in addition, all lined structures will contain a geosynthetic clay liner (GCL) that will be tied into the active permafrost layer if the operational head is less than 4 m, and into permafrost if the operational head is greater than 4 m. Additional design criteria are summarized in Table 6.2-3. Table 6.6-1 summarizes the containment and diversion structures, in terms of their purpose and whether or not they require a liner. All diversion and containment structures will consider the design criteria presented in Table 6.2-3. Typical design drawings for the diversion and containment structures are presented in Figures A-13 to A-22. Further refinements to the designs will be completed during detailed engineering and will be captured in an updated version of this plan prior to construction.

**Table 6.6-1. Diversion and Containment Structure Summary**

| Structure | Lining Details | Notes |
|---|---|---|
| Llama Pit Diversion Berms | Unlined | Divert (or partially diverts) upstream non-contact runoff. Minimize non-contact water volumes entering Llama Open Pit and assists with general water management at the pit. |
| Llama WRSA Containment Dams (West/East) | Lined | Contains runoff from Llama WRSA into Llama WRSA Pond. |
| Primary Pond Containment Dam | Lined | Contains contact water in the Primary Pond to the east, alignment along haul road. Will be designed to Canadian Dam Association (CDA 2013, 2014) standards. |
| SWP Containment Dam | Lined | South section of dam containing saline water, around former Umwelt Lake footprint / outlet of former Umwelt Lake. Will be designed to Canadian Dam Association (CDA 2013, 2014) standards. |
| SWP Diversion Berms | Unlined | Diverts upstream non-contact runoff from the SWP. |
| Ore Stockpile Pond Containment Dam | Lined | Contains contact water from the Ore Stockpile. Will be designed to Canadian Dam Association (CDA 2013, 2014) standards. |
| Echo Diversion Berm | Unlined | Diverts (or partially diverts) non-contact runoff away from the Echo/Goose Main WRSA. |
| Echo/Goose Main Containment Dam | Lined | Contains runoff from Echo/Goose Main WRSA into Echo/Goose Main WRSA Pond. Will be designed to Canadian Dam Association (CDA 2013, 2014) standards. |
| Goose Main Diversion Berm | Unlined | Diverts non-contact runoff around Goose Main Pit. |
| Rascal Berm | Unlined | Redirects flow in the Rascal Lake catchment away from the Goose Main Pit and into Gander Pond catchment. |

As described in the Geotechnical Design Parameters Report (Sabina 2017, Appendix F-2), permafrost soils are sensitive to damage if they are altered in any way. Therefore, excavation into permafrost soils will be avoided as much as practical. The diversions and containment structure designs are presented in the WMP Figures (Figure A-02). If diversion structures result in water flowing and/or ponding over previously dry areas, it is possible that permafrost degradation may result due to the additional heat source imparted from the water. If the underlying soils are ice rich, the subsequent differential settlement resulting from ice melting may be notable. This may result in increased localized ponding that might affect the natural drainage. These potential occurrences will be monitored, and if degradation is observed, then clean overburden soil or NPAG material will be imported to manage and stabilize the settlement.

# 7. Water Management

Many water management considerations and design criteria apply throughout the LOM. Sections 5 and 6 outline those considerations; this section provides details on the specific plans that occur during different phases of the mine life.

## 7.1 WATER CLASSIFICATION

Site water at Goose Property is categorized into three types:

- Contact water: surface water that is impacted by/contacts mine workings (runoff over waste rock, ore stockpiles, open pits, tailings, etc.);
- Non-contact water: surface water that is not impacted by/does not contact mine workings; and
- Saline water: groundwater that flows into open pit and underground workings.

Each type of water is managed separately throughout each Project phase, to the extent practicable. Contact water is contained within event ponds and tailings management facilities and is conveyed on site via diversions and pumped pipelines. Non-contact water is diverted off site through berms, and culverts.

Saline water is pumped out of the underground workings, as well as Llama Open Pit, and temporarily stored in the SWP (previously Umwelt Lake), or Llama TF (when available). The final repository for saline water generated on the Property will be Goose Main Pit (then called Goose Main Reservoir) once mining is complete. Sabina commits to continue looking for alternative strategies/locations for temporary storage of saline water, before pumping it to the Goose Main Reservoir.

The MLA does not require any pond or diversion infrastructure for water management purposes and remains in the same condition for both the Construction and Operations phase. A desalination plant will produce domestic and industrial water, and greywater will be discharged to the tundra.

## 7.2 WATER MANAGEMENT OBJECTIVES

The key water management objectives for the Project include:

- Minimizing the impact of mining activities on the aquatic environment surrounding the mining area to the greatest reasonable extent;
- Using BMPs, recognizing the unique constraints of each project element;
- Providing a reliable freshwater supply to the Process Plant;
- Managing contact, non-contact, and saline water separately in order to minimize freshwater withdrawal from Goose Lake and Big Lake;
- Facilitating mining operations by managing inflows that occur as a result of groundwater or direct precipitation; and
- Collecting and treating contact water as required to meet Site-Specific Water Quality Objectives (SSWQOs) in the receiving environment.

## 7.3 WATER SUPPLY

Water intake structures will be constructed in Goose Lake and Big Lake to supply domestic, industrial, and process make-up water. The selected locations for these intakes are deep and close to shore. The structures will consist of PVC pipe installed on a rockfill base within the lake to keep the pipe above the lake bottom and the intakes will be screened. The proposed freshwater intake structure locations are presented in Figure A-02, and a typical intake design is shown on Figure A-23. Rock armouring will protect the pipeline from ice scour. Water intakes will be equipped with screens to prevent the entrainment or impingement of fish in accordance with current DFO requirements.

High-density polyethylene pipelines will convey freshwater from the intakes at Goose and Big lakes to dedicated pumphouses for the Process Plant, Goose Camp, and other operational uses. A potable treatment plant will be constructed at the end of the domestic supply pipeline.

The water intake structures are temporary as they will only be used throughout the LOM. Both intake structures at Goose and Big lakes will be constructed in Year -3.

Construction of these intakes will involve in-water works. To limit disruption to aquatic resources, the following practices will be implemented:

- Only NPAG armour rock that is free of sediment will be placed in the water during construction to minimize acid generation and turbidity;
- Work will be isolated using silt curtains;
- Work will be carried out during calm water periods to minimize any turbidity effects due to the re-suspension of sediment; and
- Total suspended solids and turbidity levels will be monitored throughout construction and work will be delayed if TSS levels and turbidity become too high.

In-water blasting is not planned for the construction of the water intakes.

At Closure, all pumphouses will be drained, decommissioned, and landfilled. All pipelines will be cut at the shoreline, decommissioned, and landfilled. The pipelines extending into the water, along with the surrounding rock armour and rock bases, will be left in place and capped at the substrate so not as to disturb the in-water environment. Additional design details will be provided in future updates to this plan. For additional information, refer to the Fish Offsetting Plan (Sabina 2019a) Section 4.0 and 5.2.1.1.

The intake locations and consumption rates during the various Project phases are summarized in Table 7.3-1.

**Table 7.3-1. Water Supply Locations and Volumes**

| Water Source | Total Water Use as per Modification Package Type A Water Licence Amendment [$m^3$/yr] |
|---|---|
| Total Water Use: Goose Lake | 608,700 |
| Total Water Use: Big Lake | 273,750 |
| Total Water Use: MLA | 110,000 |
| Total Water Use: Dewatering | 1,400,000 |
| Total Water Use: Winter Ice Road | 2,025 $m^3$/km |

During the life of the Project, water consumption requirements from Goose Lake include 1,500 $m^3$/day of freshwater year-round and an additional 400 $m^3$/day during the open water season for a total of 1,900 $m^3$/day (Table 7.3-1). For Big Lake, water consumption requirements include 750 $m^3$/day of freshwater year-round for the life of the Project. Water from both of these sources will be utilized for domestic, construction, operation, and associated uses, including mining and milling (2AM-BRP1831 Amendment No.1, Part E Item 3). No water use is required for hydrostatic testing of Goose Property and MLA fuel tanks at the respective fuel storage areas. Tanks will be commissioned using non-destructive examination techniques (e.g., tank x-ray, vacuum testing of tank floors, and air testing of fittings); this testing will be completed in accordance with API650 (API 2013).

Llama Lake will be dewatered to Goose Lake in the open water season of Year -1 in advance of open pit mining. Llama Lake has a natural capacity of 0.95 M-$m^3$. It is assumed that 50% of the current lake volume can be discharged directly to Umwelt Lake and ultimately into Goose Lake without treatment. The remaining 50% is anticipated to have TSS concentrations in excess of allowable discharge limits. A modular Water Treatment Plant (WTP) for suspended solids removal will be operational in Year -1 to treat this portion of lake volume (Table 7.4-1). Effluent from the treatment plant will be discharged into Umwelt Lake where it will continue to flow into Goose Lake.

Umwelt Lake, which has a natural capacity of 0.24 M-$m^3$, will also be dewatered to Goose Lake in Year -1. Similar to Llama Lake, only 50% of the total lake volume is estimated to be acceptable for direct discharge into Goose Lake. The remaining 50% is anticipated to have TSS concentrations in excess of allowable discharge limits. A modular WTP for suspended solids removal will be operational in Year -1 to treat this portion of lake volume (Table 7.4-1). Effluent from the treatment plant will be discharged into Goose Lake.

Depending on process water start up requirements (Table 7.3-2), water from Llama and Umwelt lakes may be stored and directed to the Process Plant for use during Operations.

**Table 7.3-2. Milling Rates and Parameters**

| Parameter | Value |
|---|---|
| Average Production Rate | 3,000 – 4,000 tpd |
| Specific Gravity of Tailings | 3.06 tonne/$m^3$ |
| Tailings Dry Density | 1.20 tonne/$m^3$ |
| Void Ratio[1] | 1.55 |
| Slurry Percent Solids | 65% |
| Ore Moisture Content | 3% |

*1) The void rate was calculated based on material properties.*

Based on the milling parameters (Table 7.3-2), the tailings slurry will result in 1,620 $m^3$/day and 2,150 $m^3$/day of water and 2,500 $m^3$/day and 3,330 $m^3$/day of solids for a 3,000 tpd and 4,000 tpd production rate, respectively. The volume of water entrained in the tailings voids is a function of the void ratio and tailings dry density, which is approximately 1,520 $m^3$/day and 2,030 $m^3$/day for a 3,000 tpd and 4,000 tpd production rate, respectively.

Supernatant water included in the tailings slurry will be directed towards the active tailings management facility and eventually used as reclaim at a rate of 1296 $m^3$/day for a 3,000 tpd production rate and 720 $m^3$/day for a 4,000 tpd production rate. Freshwater required for milling production will vary from 230 $m^3$/d for the 3,000 tpd production rate and 350 $m^3$/d for 4,000 tpd production rate.

All water will be withdrawn, distributed, and directed via pumped pipelines.

## 7.4 WATER TREATMENT

Water treatment is required throughout the mine life for various water uses and constituent reductions. The following sections describe the various types of water treatment.

### 7.4.1 Marine Laydown Area Desalination Plant

Freshwater requirements at the MLA are met using a desalination plant, drawing ocean water from Bathurst Inlet. The plant will operate using reverse osmosis or similar process and will discharge brine to Bathurst Inlet as a product of the desalination process.

Discharge of brine water from the desalination plant will meet the Canadian Council of Ministers of the Environment (CCME) salinity guideline for the protection of marine life and will not cause the salinity of the receiving environment to fluctuate by more than 10% of the natural expected salinity (CCME 2015). The desalination plant is designed with a maximum intake flow rate of 33 $m^3$/h and a maximum discharge rate of 30 $m^3$/h; therefore, only a small portion of intake water will be desalinated. Assuming the freshwater plant product has a salinity of zero, the discharge from the plant is predicted to be no more than 10% more saline, and therefore within the CCME salinity guideline at the point of ocean discharge. The discharged effluent is expected to mix in the receiving environment and is not expected to be detectable beyond the outfall. The locations of the water intake and effluent discharge are identified in Figure A-02. Consumption rates at the MLA during the various Project phases are summarized in Table 7.3-1.

### 7.4.2 Goose Property Water Treatment Plant

A WTP will be required at Goose Property during the Construction Phase during the initial dewatering of Llama Lake and Umwelt Lake. Year-round recirculation treatment of the Umwelt and Llama TF will also be required during the Operations and Closure Phase, until discharge criteria has been met. In addition, a WTP will be required between Year 3 and Year 13 of Operations to treat saline water collected in the SWP. If possible, the same WTP will be used during each phase of the Project, and upgraded as required; otherwise, additional WTPs will be installed at the Project to meet water treatment requirements.

During the Construction Phase (Year -1), it is assumed that 50% of the water within Llama and Umwelt Lakes will required to be treated for TSS before discharging to the Goose Lake. If TSS is higher than expected, a greater percentage of water will be treated. Any treatment sludge generated will be disposed of in Umwelt WRSA.

Treatment is inactive during Operations until mining of the Umwelt Open Pit is complete in Year 3, at this time saline water from the SWP is treated with a reverse osmosis unit, with brine effluent deposited back in the SWP and treated effluent pumped to the Umwelt TF. This treatment continues until milling productions start ramping down in Year 13.

In Year 13, recirculation treatment of tailing water contained in the Umwelt and Llama TF begins, and saline water collected on site is transferred to Goose Main Reservoir for permanent saline water storage. The primary constituents to be removed in treatment from the tailings facilities are metals, phosphorus, nitrogen species, and suspended solids. Tailings water treatment will continue into Closure until discharge limits have been achieved. The treatment is proposed to be year-round at a flow rate of approximately 5,000 $m^3$/day to achieve Metal and Diamond Mining Effluent Regulations (MDMER) limits at PN04 when pit flooding occurs. Treated effluent will be recirculated back into Umwelt and Llama TF to aid in pit flooding. In the years when no treatment occurs, all mine effluent will be stored in the active tailings management facility and used as reclaim water for the Process Plant.

During the Closure Phase, overflow water from the Llama and Umwelt Reservoirs will be treated before arrival at PN04 to achieve MDMER limits at this location. This overflow is seasonal and will see greatest flow rates (approx. 27,000 $m^3$/day) during freshet. The primary constituents to be removed in treatment include metals, phosphorus, and nitrogen species.

The WTPs will be modular, can be relocated, and combined as necessary to achieve the appropriate water treatment at different phases of the Project. Table 7.4-1 summarizes the water treatment activities at Goose Property throughout the LOM.

**Table 7.4-1. Water Treatment Goose Property**

| Source | Discharge Location | Period Start | Period End | Flow Rate ($m^3$/d) | Parameter | Comment | Approximate Treated Volume ($m^3$) |
|---|---|---|---|---|---|---|---|
| Llama Lake | Goose Lake (via Umwelt Lake) | Yr-1, Q3 | Yr-1, Q3 | 13,000 | TSS | 50% lake volume, open water season | 480,000 |
| Umwelt Lake | Goose Lake | Yr-1, Q3 | Yr-1, Q3 | 13,000 | TSS | 50% lake volume, open water season | 120,000 |

**Table 7.4-1. Water Treatment Goose Property**

| Source | Discharge Location | Period Start | Period End | Flow Rate ($m^3/d$) | Parameter | Comment | Approximate Treated Volume ($m^3$) |
|---|---|---|---|---|---|---|---|
| SWP | Umwelt TF | Yr3, Q3 | Yr12, Q3 | Variable (0 - 800) | Total Dissolved Solids | Brine effluent to SWP, treated effluent pumped to Umwelt TF | 950,000 |
| Umwelt and Llama TF | Umwelt and/or Llama TF | Yr13, Q2 | Yr22, Q4 | 5,000 | Ammonia, Arsenic, and TSS | Recirculation of treated water back into Umwelt and Llama TF, year-round | 20,030,000 |
| Umwelt and Llama Reservoir | Umwelt and/or Llama Reservoir | Yr13, Q3 | Yr22, Q4 | Variable (0 – 27,000) | Metals, phosphorus, nitrogen species | Recirculation of treated water back into Umwelt and Llama Reservoir, year-round | 1,620,000 |

*Note: Flow rates for water treatment plant to be further refined at detailed design stage.*

### 7.4.3 Sewage Treatment and Disposal

#### *7.4.3.1 Goose Property Sewage Treatment and Disposal*

Sewage at the Goose Property will be treated using a package Sewage Treatment Plant (STP), such as a Membrane Bioreactor or similar. The STP will be located in the Goose Plant Site area (Figure A-02), and during the Construction Phase and Closure Phase (i.e., when all tailings management facilities are not available), treated sewage effluent will be discharged to the tundra west of the Goose Plant Site (Figure A-24). It will be land discharged to maximize attenuation distance prior to entering an outflow watercourse from Fox Lake and ultimately entering Goose Lake. Off-specification treated sewage during upset conditions will be discharged to the closest collection pond. Any discharges of sewage effluent from the collection pond will need to meet the applicable discharge criteria. In-pond treatment by coagulation can be applied if required as a contingency. Refer to the Landfill and Waste Management Plan (2AM-BRP1831 Amendment No.1 Part F, Item 1) for details on STP treated effluent volumes.

In Operations, effluent will be discharged to the active tailings management facility. During Post-Closure, the Goose Camp will convert to Pacto or incinerating toilets and effluent discharge will not be necessary. If STP effluent meets discharge requirements during Operations, Sabina may choose to discharge on land consistent with Construction Phase STP effluent management. See the Landfill and Waste Management Plan (2AM-BRP1831 Amendment No.1 Part F, Item 1) for information on sludge disposal.

#### *7.4.3.2 Marine Laydown Area Sewage Management*

There will be no direct discharge of treated sewage effluent or camp greywater to the marine environment. The MLA camp will employ Pacto or incinerating toilets for all Project phases to avoid the need for a STP.

Greywater from domestic use is pumped through a grease trap prior to discharge to the tundra. It is discharged through a designated pipeline to a relatively flat, non-channelized area on the tundra north of the Laydown Area (Figure A-03) and will ultimately flow into Bathurst Inlet. Water management at the MLA consists of the following:

- o Greywater will be discharged in an area of low slope to minimize velocities, encourage sheet flow, and minimize channelization.
- o The discharge will be directed towards gravel beds or rock to reduce water velocities as appropriate.
- o To maximize attenuation, the expected flow path to the nearest receiving environment (Bathurst Inlet) will be greater than 700 m. This is due to the gently sloping topography extending to the west and north of the discharge location.

Greywater will meet the ocean disposal criteria identified in the Licence.

### 7.4.4 Potable Water Treatment

Public water supply of potable water is regulated under the *Public Health Act* and Public Water Supply Regulations administer by the Government of Nunavut. Sabina may use chlorination, ozone treatment and/or UV to ensure potability of water. Regular test work of water quality will be conducted to ensure potable water meets Canadian drinking water standards. Sabina will meet all regulatory requirements around the management of potable water.

## 7.5 EFFLUENT CRITERIA

Effluent criteria applicable to the Project are outlined in the Type A Water Licence (2AM-BRP1831 Amendment No.1) and the MDMER. These regulatory instruments outline the locations, parameters, timing and frequencies at which various effluent discharges must be sampled and reported. This sampling includes sampling of runoff, seepage, dewatering, discharges to land, greywater and treated sewage effluent, as well as all other discharges to the receiving environment. The MDMER requirements become applicable upon triggering of the MDMER.

At least one hundred and twenty (120) days prior to the discharges of Effluent from Monitoring program stations BRP-58a to BRP-58xx(TBD) directed to Goose Lake, Sabina will file an Effluent Discharge Plan in accordance with the Type A Water licence (2AM-BRP1831 Amendment 1 Part G, Item 16).

## 7.6 WINTER ICE ROAD

Overland winter access to the Project is possible between December through May each season. Annually, in early December, preparation for the WIR linking the MLA to the Goose Property will be undertaken. Once the WIR is ready for traffic, the equipment, materials, fuel, and supplies staged at the MLA will be transported by trucks over the WIR to the Goose Property. It is expected that the transfers will occur annually between January and April.

### 7.6.1 Winter Ice Road Construction and Use

Winter Ice Road construction will adhere to the following guidelines based on DFO Operational Statements:

- o Use existing trails or WIRs wherever possible as access routes to limit unnecessary clearing of additional vegetation and prevent soil compaction;

- Construct approaches and crossings perpendicular to the watercourse wherever possible;
- Construct ice bridge and snow fill approaches using clean, compacted snow and ice to a sufficient depth to protect the banks of the lake, river, or stream;
- Install sediment and erosion control measures before starting work to prevent the entry of sediment into the watercourse. Inspect the installed control measures regularly during the course of construction and decommissioning activities and make all necessary repairs if damage occurs;
- Operate machinery on land or on ice, and in a manner that minimizes disturbance to the banks of the lake, river, or stream;
- Ensure that the intakes are sized and adequately screened to prevent debris blockage and fish mortality;
- Crossings do not impede water flow at any time of the year;
- When the crossing season is over and where it is safe to do so, create a v-notch in the centre of the ice bridge to allow it to melt from the centre, and to also prevent blocking fish passage, channel erosion and flooding. Compacted snow should be removed from snow fills prior to the spring freshet;
- Stabilize any waste materials removed from the work site to prevent them from entering the lake, river, or stream. This could include covering spoil piles with biodegradable mats or tarps; and
- The site should be stabilized using effective sediment and erosion control measures. In areas with permafrost, care should be exercised to ensure these measures do not cause thawing or frost heave.

Water withdrawal for the construction of WIRs will also adhere to the following DFO guidelines taken from the *Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut* (DFO 2010):

- In one ice-covered season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume;
- In cases where there are multiple users withdrawing water from a single waterbody, the total combined withdrawal volume is not to exceed 10% of the available water volume; and
- Only waterbodies with a minimum unfrozen water thickness of 1.5 m under ice should be considered for water withdrawal.

Water for the WIR will be drawn from various sources along the WIR alignment. The supply locations and consumption rates will be provided at least 60 days prior to water withdrawal. Consistent with the Project terms and conditions Nunavut Impact Review Board (NIRB; 2017), Sabina will provide bathymetry, depth, and location of proposed water withdrawal sites, volumes to be extracted, anticipated water level decreases, and fish habitat features within each waterbody proposed to be used for winter water withdrawal in support of the annual construction of the WIRs. If additional waterbodies are required, Sabina will provide all required information on the additional proposed lakes prior to the use of the waterbodies.

In addition, Sabina will implement all applicable DFO BMPs to avoid and mitigate serious harm to fish as a result of the construction, operation, and decommissioning of WIRs, and from under ice water withdrawals. This includes adequately screening the water intakes pipes to prevent impingement and entrainment of fish.

# 8. Water Management Phases

Water management throughout the mine life is described in a series of phases:

- Phase 1: Construction (Year -3 to Year -1)
- Phase 2: Operations (Year 1 to Year 15)
- Phase 3: Closure (Year 16 to Year 22)
- Phase 4: Post-Closure (Year 23 +)

These phases are illustrated in Figures A-06 through A-11, as well as the flow diagrams attached to Appendix D. The Operations Phase (Phase 2) is subdivided into three stages; each stage represents the duration of tailings deposition in a single tailings management facility (TF). The three stages are:

- Echo Open Pit (Echo TF) (Year 1, Q1 to Year 3, Q2)
- Umwelt Open Pit (Umwelt TF) (Year 3, Q3 to Year6, Q3)
- Llama Open Pit (Llama TF) (Year 6, Q4 to Year 15, Q4)

The following subsections describe the water management details of each phase.

## 8.1 PHASE 1: CONSTRUCTION

A summary of the key water management activities during Phase 1 are included in Table 8.1-1. Further details on the water management infrastructure and activities are included in the subsections that follow and depicted in Figure A-06, as well as the flow diagrams attached to Appendix D.

**Table 8.1-1. Summary of Water Management Activities during Phase 1**

| Mine Year | Water Management Activities |
|---|---|
| -3 | • Water intake infrastructure is constructed at Goose Lake and Big Lake to meet the freshwater demands for domestic, construction, operation, and associated uses, including mining and milling activities.<br>• The Plant Site Pond and Ore Stockpile Pond are constructed at the Goose Plant Site.<br>• One culvert crossing in the Goose Airstrip is constructed.<br>• Construction of the Primary Pond and Echo WRSA Pond begins. |
| -2 | • Water discharge infrastructure is constructed at Llama and Umwelt lakes to prepare for fish-out and dewatering activities.<br>• Echo Open Pit mining begins.<br>• Contact water in Echo Open Pit and Ore Stockpile Pond are pumped to the Primary Pond via Echo WRSA Pond.<br>• Umwelt Open Pit mining begins, and inflows are pumped to the Primary Pond.<br>• Contact water from the Plant Site is collected in the Plant Site Pond, then released to the Tundra.<br>• Four culvert crossing locations in the all-weather roads are constructed.<br>• Construction of permanent fish barriers at migratory pathways into channels prior to ice melt. |

**Table 8.1-1. Summary of Water Management Activities during Phase 1**

| Mine Year | Water Management Activities |
|---|---|
| -1 | • Llama Lake is dewatered fully during the open water season, with approximately 50% of the volume dewatered directly to Umwelt Lake, ultimately flowing to Goose Lake. The remaining 50% volume is expected to have high TSS and will be treated prior to discharge into Umwelt Lake.<br>• Umwelt Lake is dewatered fully during the open water season, with approximately 50% of the volume dewatered to Goose Lake. The remaining 50% volume is expected to have high TSS and will be treated prior to discharge into Goose Lake.<br>• Pumping of site contact water to the Primary Pond continues, with exception to the Plant Site Pond which is released to the Tundra.<br>• Construction of the SWP begins<br>• Echo Open Pit mining is complete.<br>• Deposition of waste rock in the Echo WRSA is complete. |

### 8.1.1 Lake Dewatering

Llama Lake, which has a natural capacity of 0.96 M-m$^3$, will be dewatered to Goose Lake in the open water season of Year -1 in advance of open pit mining. It is assumed that 50% of the lake water volume will be suitable for direct discharge to Goose Lake via Umwelt Lake. The remaining 50% is assumed to have TSS concentrations in excess of the discharge limit and will be treated in a modular WTP. Effluent will be discharged to Umwelt Lake and ultimately flow into Goose Lake. Dewatering will be undertaken in accordance with the Type A Water Licence (2AM-BRP1831 Amendment 1 Part E, Item 4 & 14).

Umwelt Lake, which has a natural capacity of 0.24 M-m$^3$, will be dewatered in Year -1. Similar to Llama Lake, it is assumed that only 50% of the lake water volume will be suitable for direct discharge. The remaining 50% is assumed to have TSS concentrations in excess of the discharge limit and will be treated in a modular WTP. Effluent will be discharged to Goose Lake; this will allow for the Saline Water Pond to be constructed around the existing extents of Umwelt Lake.

In advance of dewatering, a fish-out program will be completed. For additional information related to conservation and mitigation measures to be implemented, refer to Section 9.3.

### 8.1.2 Water Treatment

A WTP will be operational in the open water season at the Goose Property in the Construction Phase to dewater Llama Lake, in advance of open pit mining, and to dewater Umwelt lake, in advance of the Saline Water Pond construction. The purpose of water treatment in Construction is the removal of TSS.

It is assumed that 50% of the water in both Umwelt and Llama lakes can be dewatered directly to Goose Lake using the natural channels, while the other 50% of the water in both lakes will require treatment for TSS prior to discharge to Goose Lake. If TSS is higher than expected, a greater percentage of water will be treated. Any treatment sludge generated will be disposed of in Umwelt WRSA.

Once Llama Lake dewatering is complete, lake bottom sediments within the Llama Open Pit boundaries will be excavated and placed in the Umwelt WRSA footprint.

### 8.1.3 Open Pits

The development of Echo and Umwelt Open Pit will commence during the Construction Phase. Water will be collected in the Echo and Umwelt Open Pit using sumps, and pumped to the Primary Pond to be stored until ready for reclaim use in the Process Plant.

### 8.1.4 Waste Rock Storage Areas

Runoff from the Echo and Umwelt WRSA will be conveyed to the Primary Pond. The Umwelt WRSA footprint has taken the natural topography and catchments into consideration to best use the topography to direct surface water towards the Primary Pond minimizing the amount of contact water that needs to be managed. The Echo WRSA runoff will be collected in the Echo WRSA Pond and pumped to the Primary Pond.

### 8.1.5 Ore Stockpile

The Ore Stockpile will be used for ore deposition starting in Year -2 from mining of Echo and Umwelt Open Pits, this will occur prior to the Process Plant becoming operational. Runoff from the Ore Stockpile will be directed towards the Ore Stockpile Pond,  and pumped to the Primary Pond via the Echo WRSA Pond .

### 8.1.6 Saline Water Pond

Umwelt Lake will be fully dewatered to construct the Saline Water Pond (SWP). The SWP Containment Dam and SWP Diversion Berms will be constructed in Year -1. As the lake will be fully dewatered, there will be capacity available for saline water storage. Refer to Section 5.1.3 for more information on potential saline water inflows during mining at the Property.

To manage saline groundwater and minimize potential associated impacts, a Saline Water Management Plan (SWMP) is provided in Appendix C of the WMP.

### 8.1.7 Stream Diversions

The majority of the Project infrastructure has been located to avoid fish-bearing water and, wherever possible, to avoid encroaching on freshwater fish habitat. Additional mitigation to avoid adverse effects on fish is required for streams that may experience reduced discharge resulting in the potential for increased fish and egg stranding. In these cases, all potential fish use (migration, spawning, rearing, and egg incubation) will be prevented by creating permanent fish barriers at migratory pathways into channels prior to ice melt. These barriers will be constructed at the following locations:

- Umwelt Lake Outflow: at the limit of the southern flowing downstream end where the stream connects to eastern flows toward Goose Lake;
- Goose Lake Inflow East: at the downstream limit where the stream enters Goose Lake; and
- Rascal Stream East: upstream of the airstrip culverts.

Blocking fish access to these locations will involve creating a permanent impassable fall or cascade barrier to prevent fish access to upstream water management areas.

The Goose Airstrip is extended in Year -3, crossing the Rascal Stream East. A culvert crossing denoted as the Goose Airstrip Culvert, or C3 in Figure A-02, will facilitate drainage through the Goose Airstrip to Goose Lake via the Goose Main Diversion Berm. Three additional culvert crossings along the haul road are constructed in Year -2, including the Goose Neck Culvert (C5) south of Llama Pit, the Echo Culvert (C4), and the Gander Pond Culvert (C2), northwest of the Goose Airstrip. Further culvert details can be found in Section 6.5.

#### 8.1.8 Roads

All-weather roads at the Property include haul roads, which will connect the ore bodies to the WRSAs and the Plant Site; and service roads, which connect other on-site infrastructure. Where possible, the roadways servicing the mining areas will be constructed so that drainage will be directed towards the proposed contact water management infrastructure. Five culvert crossings will be installed within the Property, four of which cross all-weather roads; culvert details are included in Section 6.5.

#### 8.1.9 Marine Laydown Area

Water management strategies at the MLA will remain the same during the Construction Phase (Year -3 to Year -1) and the Operations Phase (Year 1 to Year 15) (Figure A-03). The MLA will not require ponds or other diversion infrastructure for water management purposes and will discharge towards Bathurst Inlet along the same flow paths as the predevelopment topography.

MLA infrastructure will be designed such that footprints are minimized to limit changes to local drainage patterns. Roads and pads, which will be constructed using geochemically suitable material, will be designed to have runoff as dispersed sheet flow to minimize channelized flow.

Non-contact water will be diverted around MLA infrastructure as much as practicable and directed to natural downstream drainage networks to maintain local drainage patterns. Clean water and snow will be managed to restrict contribution to potentially poor-quality water and will be diverted to maintain natural drainage networks as much as possible.

### 8.2 PHASE TWO: OPERATIONS

A summary of the key water management activities during Operations (Phase 2) are included in Table 8.2-1 to Table 8.2-3. The tables break Phase 2 into its three stages, based on the active tailings management facility at the time. Further details of the water management infrastructure and activities are included in the subsections that follow and are depicted in Figure A-07 to A-19, as well as the flow diagrams attached to Appendix D.

**Table 8.2-1. Summary of Water Management Activities during Phase 2 – Echo TF (Year 1 to 3-Q2)**

| Mine Year | Water Management Activities |
|---|---|
| 1 | • Milling operations begin and tailings are deposited in the Echo TF.<br>• Contact water from the Ore Stockpile Pond and Echo WRSA Pond are pumped to Echo TF.<br>• The Llama WRSA Containment Dams (East and West) are built, which create the Llama WRSA Pond.<br>• Mining of Llama Open Pit begins. Waste rock is placed in the Llama WRSA; contact water runoff from the Llama WRSA is collected in the Llama WRSA Pond and pumped to the Primary Pond, as required.<br>• Umwelt Open Pit mining and deposition of waste rock in the Umwelt WRSA is complete.<br>• Underground production starts at the Umwelt and Llama undergrounds.<br>• Saline groundwater inflows encountered at Llama Open Pit are pumped to the Saline Water Pond, along with saline groundwater inflows from the Umwelt and Llama Underground.<br>• The Primary Pond collects contact water across the Property, including flows collected in the Llama WRSA Pond, runoff from the Umwelt WRSA, and pumped inflows Umwelt Open Pit. The collected contact water is used as reclaim in the Process Plant.<br>• Runoff from the Plant Site is collected in the Plant Site Pond which is released to the tundra. |
| 2 | • A non-contact water diversion berm, the Goose Main Diversion Berm, is constructed south of Goose Main Open Pit to divert water away from the facility and into Goose Lake.<br>• Mining continues in Llama Open Pit, Umwelt Underground, and Llama Underground.<br>• The contact water collected in the Primary Pond or Echo TF is used as reclaim in the Process Plant. |
| 3 (ends Q2) | • Mining continues in Llama Open Pit, Umwelt Underground, and Llama Underground.<br>• Pre-development activities of the Goose Main Open Pit continues.<br>• The contact water collected in the Primary Pond or Echo TF is used as reclaim in the Process Plant.<br>• Umwelt Open Pit starts to fill with site contact water within its catchment and stored to be used as reclaim in the Process Plant. |

**Table 8.2-2. Summary of Water Management Activities during Phase 2 – Umwelt TF (Year3-Q3 to Year 6-Q3)**

| Mine Year | Mine Development Sequence and Key Activities |
|---|---|
| 3 (starts Q3) | • Mining continues in Llama Open Pit, Umwelt Underground, and Llama Underground. Goose Main Open Pit mining begins.<br>• Tailings deposition transitions from Echo TF to Umwelt TF.<br>• Contact water from the Echo WRSA Pond and Ore Stockpile Pond are pumped to the Umwelt TF.<br>• Saline groundwater encountered is pumped to the SWP, and treated by reverse osmosis, sending brine effluent back to the SWP and treated effluent to Umwelt TF.<br>• The contact water collected in the Primary Pond or Umwelt TF is used as reclaim in the Process Plant. |
| 4 | • Water management strategies beginning Year 3, Q3 continue. |
| 5 | • Llama Pit mining and deposition of waste rock in the Llama WRSA is complete, and the open pit starts to fill with site contact water.<br>• Other water management strategies from Year 4 continue. |
| 6 (ends Q3) | • Goose Main Underground decline begins and Llama Underground mining complete.<br>• Water management strategies from Year 5 continue. |

**Table 8.2-3. Summary of Water Management Activities during Phase 2 – Llama TF (Year 6 to 15)**

| Mine Year | Mine Development Sequence and Key Activities |
|---|---|
| 6 (starts Q4) | • Mining continues in Goose Main Open Pit, Goose Main Underground, and Umwelt Underground.<br>• Tailings deposition transitions from Umwelt TF to Llama TF.<br>• Saline groundwater is stored in the SWP and treated by the reverse osmosis unit. Brine effluent from the reverse osmosis unit will be deposited back in the SWP for temporary saline water (brine) storage, until the Goose Main Open Pit becomes available to receive saline water for permanent storage.<br>• If insufficient capacity is available in the SWP, saline water can be stored in the Llama TF or Umwelt Underground.<br>• The contact water collected in the Primary Pond or Umwelt TF is used as reclaim in the Process Plant. |
| 7 | • Goose Main Underground mining begins and saline groundwater encountered is pumped to SWP.<br>• Water management strategies from Year 6, Q4 continue. |
| 8 - 12 | • Water management strategies from Year 6, Q4 continue. |
| 13 | • Goose Main Pit Mining is complete, and water from the Umwelt and Llama TF are transferred to Goose Main Open Pit (then called Goose Main Reservoir) to support closure filling and final repository of saline water.<br>• Saline groundwater encountered is pumped to the Goose Main Reservoir, including that collected in the SWP.<br>• Recirculation treatment of the Umwelt and Llama TF begins.<br>• Echo Underground mining begins. |
| 14 -15 | • Water management strategies from Year 13 continue. |

### 8.2.1 Open Pits and other Contact Water

During Operations, precipitation will accumulate in open pits, which will be collected using sumps, and event ponds. Sumps will pump water across the site, eventually discharging to the active tailings facility or the Primary Pond to be used as reclaim water in the Process Plant. Llama Open Pit is the exception, which is expected to have saline water inflows from the associated Llama Lake through talik; this saline groundwater and meteoric inflows will be pumped to the SWP.

After mining of open pits are complete, the open pits will be used for tailings, and contact water storage. For the first two years of Operations (i.e., Years 1 to 2), the mined-out Echo Open Pit will be used for tailings deposition. From Years 2 to 6, tailings deposition transitions from Echo TF to Umwelt TF as the Echo TF has reached its capacity and mining of Umwelt Open Pit will be complete. The Echo TF will then be covered with waste rock as part of the Goose Main WRSA. From Year 7 onward, tailings will be disposed in the mined-out Llama Open Pit.

In Year 13, contact water generated at the Property (including saline water) will be pumped to Goose Main Reservoir for permanent storage and to support closure filling, and recirculation treatment of contact water contained in the Umwelt and Llama TF begins.

### 8.2.2 Water Treatment

Treatment is inactive during Operations until mining of the Umwelt Open Pit is complete (Year 3), at which point saline water from the SWP is treated with a reverse osmosis unit, with treated effluent pumped to the Umwelt TF and brine effluent deposited back in the SWP. Starting in Year 13,the Umwelt and Llama TF water is recirculated though treatment year-round to reduce metals, phosphorus, nitrogen species, and suspended solids loading in the facilities. The duration of water treatment, based on an treatment rate of approximately 5,000 $m^3$/day.

### 8.2.3 Underground Facilities

Average groundwater inflows into the underground workings during the Operations Phase have been estimated for Umwelt, Llama, Echo, and Goose Main Underground, as well as, Llama Open Pit (See Section 5.1.3, Table 5.1-1). Saline groundwater inflows encounter over the LOM will be pumped to the Saline Water Pond, or Goose Main Reservoir (starting Year 13) when available to create a meromictic lake.

### 8.2.4 Waste Rock Storage Areas

During the Operations Phase, water accumulating from the WRSAs at the Property will be monitored and pumped to Primary Pond or active tailings facility (as described in Section 8.2.1), ultimately providing water for reclaim at the Process Plant. Shallow groundwater around the WRSAs prior to freeze back will ultimately report to the event ponds (sometimes via sumps) which are situated at the local topographic low points. The containment dams around each pond will be lined with geosynthetic materials (liners) which will be keyed into bedrock where possible. If bedrock is not practical, the liners will be keyed into the permafrost foundation.

### 8.2.5 Ore Stockpile

During Operations, runoff water from the Ore Stockpile will be collected in the Ore Stockpile Pond, which will be pumped to the active tailings management facility.

### 8.2.6 Tailings Management Facilities

The tailings management strategy is based on the principle of maximizing the use of open pits for tailings storage. To that end, tailings will be stored in the mined-out Echo, Umwelt, and Llama Open Pit as soon as the pits are available for tailings deposition (Table 8.2-4). Echo TF will be filled with tailings to approximately 5 m from the top of the pit during Year 3 of mining and covered with waste rock as part of the Goose Main WRSA starting in Year 4. Umwelt and Llama TF will be dewatered to Goose Main Reservoir in Year 13 for permanent saline water storage and to support pit filling. In Year 13, the tailings facilities will be allowed to fill with site contact water both passively and actively. Tailings disposal will continue in Llama TF, and recirculation treatment will begin for the Umwelt and Llama TF for the remaining duration of Operations (i.e., end of Year 15) and into closure.

**Table 8.2-4. Back River Property Tailings Management System Storage Requirements**

| Location | Period (Quarter and Year) | Tailings (M-m3) |
|---|---|---|
| Echo TF | Y1, Q1to Y3, Q2 | 2.22 |
| Umwelt TF | Y3, Q3 to Y6, Q3 | 5.23 |
| Llama TF | Y6, Q4to Y15, Q4 | 8.14 |
| Total Project | Y1, Q1 to Y15, Q4 | 15.6 |

### 8.2.7 Saline Water Pond

Saline water from the Umwelt, Llama, and Goose Main Undergrounds as well as the Llama Open Pit will be collected and pumped to the SWP. Once the Umwelt TF is active in Year 3, saline water from the SWP will be treated by a reverse osmosis unit, with brine effluent deposited back into the SWP and treated effluent to the Umwelt TF. Once Goose Main Open Pit mining is complete, saline water at the Project will be transferred to the Goose Main Open Pit (then called Goose Main Reservoir) for permanent storage. In the event of insufficient storage within the SWP before the Goose Main Reservoir is available, saline water can be transferred to the Llama TF once active in Year 6, or Umwelt Underground around Year 10 and Year 12, when the void spaces within the underground will be available.

### 8.2.8 Explosives Manufacture and Storage

Pre-packaged explosives delivered by air or WIR will be used early in construction until an ammonium nitrate (AN) facility is constructed at the Goose Property. Ammonium nitrate for ammonium nitrate fuel oil (ANFO) production will be delivered to the mine site in shipping containers. The storage of pre-packaged explosives and AN is expected to represent a low potential to impact water resources.

An explosives truck wash facility will be constructed and operated at the AN Facility. Wash water from this facility may be high in ammonia, suspended solids, and/or metals. This wash water will be treated at the AN Facility in an evaporator. Alternatively, the truck wash water will be transported to a water management pond for treatment or discharge as appropriate.

### 8.2.9 Marine Laydown Area

Water management strategies at the MLA will remain the same during the Construction Phase (Year -3 to Year -1) and the Operations Phase (Year 1 to Year 15) (Figure A-03). Refer to Section 8.1.10 for further details.

## 8.3 PHASE THREE: CLOSURE

Operations end and Closure begins in Year 16, for a total duration of 7 years (i.e., ends Year 22). Water management during the Closure Phase relates to ongoing camp operation, passive and active filling of open pits, runoff control from WRSAs, and recirculation treatment within the Umwelt and Llama TF. These activities will continue to be implemented until the contact water in the flooded open pits and runoff from the WRSAs meets site-specific discharge limits and receiving water quality objectives. At that point, passive discharge to the environment will be possible. Water management infrastructure and activities are depicted in Figure A-10, as well as the flow diagrams attached to Appendix D.

Further details regarding the Closure and reclamation activities outlined in 8.3.1 to 8.3.9 are presented in the Interim Closure and Reclamation Plan (2AM-BRP1831 Amendment No.1 Part J, Part 1).

### 8.3.1 Culvert Closure

Culverts will be removed from all-weather roads and the natural drainage restored. Roads will otherwise remain intact to ensure preservation of permafrost and facilitate long-term site access for monitoring and inspection.

### 8.3.2 Berm Closure

During the Closure period, the diversion and containment structures will be breached to restore natural drainage and allow runoff to naturally support filling of the open pits. A general water management infrastructure breaching schedule for the diversion and containment structures at the Goose Property can be seen in Figure A-10 to A-11 and described in Table 8.3-1.

Berm closure is not expected to significantly impact the water quality of site runoff water. All runoff is expected to meet the site runoff quality standards as indicated in the Licence. Water quality monitoring will occur at strategic locations throughout Closure to identify whether water quality criteria are being met.

Breached diversion structures will remain in place during and beyond the Post-Closure Phase. Collection ponds will have been breached, liners removed and landfilled, and the breaches re-contoured and armoured (if necessary) to allow for passive runoff.

**Table 8.3-1. Diversion and Containment Berm Breach Schedule**

| Mine Year | Water Management Structure | Closure Timeline | Closure Strategy |
|---|---|---|---|
| 16-22 | SWP Containment Dam and Berms | Operations | Decommissioned after dewatering of SWP to Goose Main Reservoir is complete. |
| | Primary Pond Containment Dam | Closure | All Primary Pond flows conveyed to the restored Umwelt Lake (formerly SWP). Umwelt WRSA capped and freeze back promoted. |
| | Ore Stockpile Pond Containment Dam | Closure | Ore Stockpile Pond is dewatered after removal of the Ore Stockpile. Runoff from the area will report to Goose Lake. |
| | Llama WRSA Containment Dams and Llama Pit Diversion Berms | Closure | Drains Llama WRSA Pond into Llama TF when open pit mining is complete, and Closure begins. Allow Llama TF to flood. Llama WRSA capped and freeze back promoted. |
| | Echo/Goose Main WRSA Containment Dam and Echo Diversion Berm | Closure | Echo/Goose Main WRSA Pond is dewatered upon completion of mining operations. Runoff from the area will report to Goose Lake. Echo/Goose Main WRSA capped and freeze back promoted. |
| | Goose Main Diversion Berm and Rascal Berm | Closure | Breached upon completion of Operations, allowing Goose Main Reservoir to flood. |

### 8.3.3 Open Pit Closure

The open pits, with exception to Echo Open Pit which is covered with waste rock, will be filled by breaching of various water management structures as well as active filling with freshwater from Goose Lake (if required), thereby allowing both contact and non-contact water to fill the pits. Pit water will be monitored to ensure it meets applicable discharge criteria and then be allowed to overtop into nearby watercourses. The Water and Load Balance Report presented in Appendix D provides a summary of the average monthly water quality concentrations at the time of flooding and the average open water long-term steady state conditions at the downstream prediction nodes of the flooded open pits. These predictions are compared to MDMER discharge limits. With the support of recirculation treatment within the Umwelt and Llama TF, all parameters in each pit lake facility are expected to meet MDMER limits at the time of flooding and long-term steady state conditions are expected to meet CCME guidelines or SSWQOs as appropriate. Water treatment will continue into the Closure Phase until water quality guidelines are met.

Llama Open Pit (or Llama Reservoir), which was already partially flooded by the operation of Llama TF, will be further flooded as all Llama diversion berms will be breached. Runoff from the Llama WRSA will also be routed to Llama TF. The Llama TF will overtop under average hydrologic conditions within the Closure Phase and discharge into Goose Lake via Umwelt Lake (formerly the SWP). Recirculation treatment in Llama TF will continue year-round until water quality objectives are met.

Umwelt Open Pit (or Umwelt Reservoir), which was already partially flooded by the operation of Umwelt TF, will be allowed to continue to fill with catchment water, as well as active filling with freshwater from Goose Lake as required. Umwelt Reservoir will be breached at the north end and will overtop within the Closure Phase under average hydrologic conditions.

Goose Main Open Pit (or Goose Main Reservoir), which was already partially flooded with supernatant water and saline water collected at the Property during Operations, will be allowed to fill with catchment water after berms are breached. Goose Main Reservoir will be breached at the east side and overtop into Goose Lake once water quality objectives have been met, which is expected to occur within the Closure Phase with the support of active filling with freshwater from Goose Lake under average hydrologic conditions. The freshwater cap above the saline water will promote formation of a meromictic lake.

Pit lake water quality monitoring will be conducted to ensure water meets discharge criteria prior to pit overtopping and passive discharge. In the unlikely event that the water in any of the pit lakes is not suitable for discharge, the pit lake water will be batch-treated to address remaining water quality impairments. Sabina intends to implement five years of post-closure water quality monitoring for each open pit to ensure that water quality objectives are met. If closure objectives have not been met in this five-year monitoring period, Sabina will extend monitoring beyond the stated 5-year Post-Closure monitoring period. Additional details of the above proposed monitoring are included in the ICRP (2AM-BRP1831 Amendment No.1 Part J, Part 1).

As described in Section 8.2.6, Echo Open Pit will be filled with tailings during and covered with waste rock as part of the Goose Main WRSA.

### 8.3.4 Underground Facility Closure

Saline groundwater encountered during Operations will be permanently stored in the Goose Main Reservoir. Vent raises and the underground portal will be capped with concrete and waste rock, respectively. Echo underground mine will be flooded with natural runoff.

### 8.3.5 Waste Rock Storage Area Closure

During Operations, potentially acid generating (PAG) material in WRSAs will be progressively covered with NPAG material starting in the first year of development for each facility. Progressive reclamation will consist of a 5-m cap of NPAG waste rock to promote the aggradation of permafrost into the WRSAs so that the PAG rock remains frozen. Final sloping and minor NPAG covering activities will occur during the Closure Phase. Permafrost aggradation into the WRSAs will be monitored during placement and once the WRSAs are closed.

Once the WRSA runoff consistently meets the site-specific contact water discharge criteria following completion of WRSA operations, the WRSA ponds and diversion structures will be breached and removed, and the final post-closure discharge will be established. Five years of post-closure water quality monitoring from the WRSAs will take place to confirm water quality objectives are being met.

### 8.3.6 Ore Stockpile Facility Closure

Milling of all remaining stockpiled material will be completed in Year 15. The Ore Stockpile Pond Containment Dam will be breached and runoff from the area will be restored to its natural drainage, directed towards Goose Lake. Five years of post-closure water quality monitoring will be conducted in the area to confirm runoff meets water quality objectives.

### 8.3.7 Tailings Management Facility Closure

No tailings deposition or milling will occur during the Closure period. The final Closure measures for each tailings facility (i.e., Echo TF, Umwelt TF, and Llama TF) are described in Section 8.3.3, Open Pit Closure.

### 8.3.8 Saline Water Pond Closure

The Saline Water Pond is dewatered to Goose Main Reservoir in Year 13 when Goose Main Open Pit mining is complete. Once dewatered, the top one to two-meter layer of sediments around the original footprint of Umwelt Lake is planned to be excavated and placed into Llama TF. The excavation and storage of this sediment has been included into the Water and Load Balance model. The remaining chloride in the porewater of the sediments underlying the original footprint Umwelt Lake is assumed to diffuse upwards into Umwelt Lake within the first year of it being re-established.

The proposed depth of sediment excavation was determined by a chloride diffusion model that calculated the concentration of chloride in the porewater of the sediment underlying the Saline Water Pond over time, based on the predicted chloride concentration in the Saline Water Pond water itself (Sabina 2015, Appendix V2-7H). Should the chloride concentration at the 2-m depth be higher than the long-term CCME guideline, more sediment around the original footprint of Umwelt Lake will be excavated and placed in the Llama TF.

Following excavation of the lake-bed sediment, the Saline Water Pond Containment Dam and Diversion Berms will be breached allowing Umwelt Lake to re-establish. No further water management activities at the Saline Water Pond will take place during Closure. Water quality monitoring will happen during the closure and five-year post-closure periods to confirm water quality objectives are being met.

### 8.3.9 Water Treatment Closure

Once water treatment is completed at the Project, the WTPs and all associated pipelines will be dismantled, cleaned, and disposed of in the landfill. All water treatment plants will be decommissioned once runoff water quality at designated control points has met the required closure criteria (i.e., Water Licence and MDMER discharge limits).

Year-round recirculation water treatment in Umwelt and Llama TF for metals, phosphorus, nitrogen species and suspended solids will occur starting Year 13 and into Closure until water quality objectives are met. Should additional treatment be required to meet water quality objectives, Sabina would continue the water treatment into the Closure Phase during the open water season in Umwelt and/or Llama TF. Once objectives have been confirmed by water quality sampling, all pumping and piping infrastructure, as well as the WTP itself, will be dismantled and landfilled. Any sludge produced from water treatment during the Closure period will also be landfilled.

### 8.3.10 Marine Laydown Area Closure

Water management strategies at the MLA will remain consistent during the Closure Phase (Year 16 to Year 22).

The MLA will require minimal closure with the respect to water management as the site does not require ponds or other diversion infrastructure for water management purposes. Decommissioned roads and pads, which will be constructed using geochemically suitable material, will be designed to have runoff as dispersed sheet flow to minimize channelized flow.

Refer to the Interim Closure and Reclamation Plan (2AM-BRP1831 Amendment No.1 Part J, Part 1) for discussion on other closure aspects of the MLA.

## 8.4 PHASE FOUR: POST-CLOSURE

Water management activities during the Post-Closure Phase at the Goose Property are presented in the flow diagrams in Appendix D and are depicted in Figure A-11. All water management structures are decommissioned during Closure (Phase 3). The Goose Airstrip Culvert crossing will be removed, and the Goose Airstrip will be decommissioned.

Water management strategies at the MLA will remain consistent during the Post-Closure Phase (Year 23 +).

## 8.5 WATER MANAGEMENT – CARE AND MAINTENANCE

Temporary closure (also termed Care and Maintenance) is defined as the cessation of mining and processing operations for a finite period of time with the intention of resuming operations upon resolution of the cause of cessation (MVLWB/AANDC 2013). Care and Maintenance activities will depend on the phase at which cessation of operations takes place. For more details, refer to the Interim Closure and Reclamation Plan (2AM-BRP1831 Amendment No.1 Part J, Part 1).

Monitoring will take place and continue as outlined in Section 10 at whatever phase cessation occurs. Key surface water infrastructure will be maintained through Care and Maintenance to ensure proper operation. Depending on the stage at which temporary closure occurs, the water level in the active tailings management facility at the time may need to be monitored as there will be a net buildup of water due to precipitation inflows and no water reclaim for processing. Should temporary closure occur for an extended period of time (i.e., two or more years), it may be necessary to begin pumping from the active tailings management facility and treating the excess water for discharge.

# 9. Environmental Protection Measures

## 9.1 GENERAL OBJECTIVES

The purpose of environmental protection measures for site water management is to eliminate or reduce Project effects on water quality.

The main objectives of Sabina's water management strategies are to:

- Minimize the amount of water that contacts mine ore and wastes, which ultimately reduces the volume of water requiring management;
- Appropriately manage all contact water and discharges to protect local aquatic resources; and
- Implement water conservation and recycling to maximize water reuse and minimize the use of natural waters.

Protection measures may include the planning and design of engineered structures, the application of control technologies, the implementation of BMPs, and specific requirements from regulatory authorizations. Monitoring of the protection measures and adaptive management are also an integral part of effective environmental protection measures.

Pending further direction from the NWB, Sabina is committed to maintain a Water Management Plan designed to the above main objectives. The plan includes monitoring that demonstrates that contact water (runoff and shallow groundwater) from the ore storage and WRSAs is adequately captured and managed consistent with the WRMP (2AM-BRP1831 Amendment No.1 Part F, Item 1).

## 9.2 WATER USAGE

The following protection measures will be applied to water usage:

- Freshwater intake and discharge pipelines will be designed to limit erosion and sedimentation, protect against freezing, and accommodate peak flows;
- Controlled construction of the engineered intake and discharge pipelines will ensure minimal changes in turbidity and resuspension of sediment;
- All material used in construction will be clean, free of sediment, and geochemically stable; and
- All intake and discharge pipelines will be screened in accordance with the *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995). The water withdrawal rate will be controlled such that fish do not become impinged on screens.

Water will be recycled to the maximum extent possible. The most significant water recycling activities will be within the tailings management facilities. The Echo TF, Umwelt TF, and Llama TF will store both tailings solids and supernatant water. The supernatant water will include contact water from the open pits and WRSAs. Water will be recycled and form the main source of water for the Process Plant.

## 9.3 CONSERVATION MEASURES

Long-term water usage has been closely evaluated; the focus has been on identifying maximum water use, while protecting fish and fish habitat. Short-term use will be required for various Project activities (i.e., WIR construction, dust suppression, etc.). Potential short-term water sources will be evaluated in advance to determine if they will be adequate for the activity in accordance with the DFO (2010) winter water withdrawal guidelines, including:

- Total water withdrawal from a single waterbody will not exceed 10% of the available water volume; and
- Only waterbodies with a minimum unfrozen water thickness of 1.5 m under ice will be considered for water withdrawal.

Sabina is committed to minimize and mitigate impacts to fisheries. For fish bearing crossings, Sabina will implement all applicable DFO BMPs to avoid and mitigate serious harm to fish as the result of water crossing construction, operation, and decommissioning for all fish-bearing water crossings. These measures will include, but are not limited to, appropriate design of water crossings to facilitate fish passage at both high and low flows; timing windows that incorporate spawning, incubation, and hatch times for all species using watercourses; sediment and erosion control; protection of riparian vegetation; and other forms of bank stabilization.

Sabina will ensure that all project infrastructure in watercourses are designed and constructed in such a manner that they do not unduly prevent and limit the movement of water in fish bearing streams and rivers, unless otherwise authorized by DFO. In addition, unless otherwise directed by DFO, Sabina's monitoring program for culverts on fish bearing watercourses during Construction, Operations, and Closure phases will include measures to ensure that barriers to fish passage do not form over time as a result of crossing damage due to ice blockage, flooding, or movement of debris; all of which may occur at freshet. Detailed design drawings and an updated monitoring program for culverts on fish bearing watercourses will be produced prior to construction.

Sabina anticipates, and has confirmed with the DFO, that an update is necessary to the existing DFO Letter of Advice (18-HCAA-00971) to reflect planned in-water works related to the MLA Shoreline Pad Extension. Sabina will also prepare an application addressed to TC to ensure any in-water works will not substantially interfere with navigation, as is required under the Navigation Protection Act (Sabina 2020). A full as-built will also be completed once the Shoreline Pad Extension has been constructed.

Sabina will continue to engage DFO, the Kitikmeot Inuit Association, and other interested parties during the regulatory phase on the design, construction, and operation of adequate fish passage to permit migration of Arctic Grayling from Goose Lake to natural spawning and rearing habitat located in upper Rascal Stream East, south of the planned airstrip. Any additional information required to ensure the design of the fish passage will be completed prior to significant construction activities at the Goose Property. Specifically, Sabina will provide annual monitoring updates regarding the Rascal Stream Fish Passage that enables parties to determine its effectiveness.

Inline with dewatering, a fish-out program will be completed. The fish-out program will follow the DFO's *General Fish-Out Protocol for Lakes and Impoundments in the Northwest Territories and Nunavut* (Tyson et al. 2011). Lake dewatering will commence once the catch-per-unit-effort (CPUE)/recapture phase of the fish-out program has been completed (typically between August and September).

The fish-out program will aim to be completed outside of periods where there is high migratory bird use of the lake (i.e., nesting, brood rearing, and migration periods) to avoid the incidental take of migratory birds through entanglement in gill nets. Mitigation measures for minimizing mortalities of diving birds may include increasing the visibility of gill nets, use of visual or auditory deterrents to prevent birds from landing on the lake during active gill-netting, monitoring migratory bird usage of the lake, determining high use feeding areas prior to setting gill nets and avoiding these areas, and reporting of by-catch to adjust mitigation measures.

## 9.4 GENERAL SITE RUNOFF

Collected water or runoff that meets the criteria applicable water licence criteria will be discharged to land, and where possible at a minimum setback of 31 m from a waterbody. To protect the freshwater environment during construction and decommissioning activities, the Project will minimize runoff and the transport of material into freshwater by the following planning and design measures:

- WRSAs will be confined to the local watersheds where the deposits are located to limit potential effects on water quality in local drainage areas;
- Infrastructure will be located, whenever feasible, on competent bedrock or appropriate base material that will limit permeability and the transport of potentially lower quality water into the active layer and ultimately to the freshwater environment;

Footprint areas of Project components will be minimized to the extent practicable, such as locating infrastructure nearer to the central location of Project sites around the deposits; and

- The landscape will be reclaimed as soon as feasible to minimize erosion potential.

At select water crossings, pumping or siphoning may be employed to facilitate the transfer of water from one side of the structure to the other side. Pumping can also serve as a temporary solution during freshet or prior to a culvert installation.

### 9.4.1 Sediment and Erosion Control Measures

Surface water will be managed within the Project footprint such that sediment-laden runoff is minimized, intercepted, and/or treated prior to entering downstream receiving waters or mine process facilities. Effective sediment control depends on the isolation of easily-erodible, disturbed ground surfaces.

Measures will be implemented to reduce the quantity of runoff where the mobilization of sediments cannot be eliminated. Sediment-laden water will be captured and routed to sediment basins.

Sediment and erosion management and control during initial and ongoing construction may involve establishing contact water collection ditches/berms, constructing sediment ponds, limiting land disturbance to a practical minimum, reducing water velocities across the ground through surface texturing and re-contouring, and progressively rehabilitating and stabilizing disturbed land surfaces to minimize erosion.

Exposed landscape surfaces will be protected by the installation of covering material such as riprap, aggregate, or rolled erosion control products. Runoff flow may be controlled by a combination of measures, including:

- Texturing/grading of slopes to slow runoff and reduce effective slope length;
- Synthetic permeable barriers and/or fibre rolls to reduce runoff velocities and retain sediments; and
- Check dams, gabions, and energy dissipation structures to reduce flow velocities in channels.

Sediment levels in runoff will be minimized by intercepting sediment before it reaches the freshwater environment. In addition to measures aimed at controlling runoff flow, the quantity of transported material in runoff may be controlled by measures including:

- Preserving riparian zones which trap sediment and reduce flow velocities;
- Installing synthetic permeable barriers, fibre rolls, and/or silt fences as required;
- Installing check dams, gabions, and sediment basins to reduce flow velocities and encourage sediment deposition;
- Maintaining and repairing any machinery prior to use that has the potential to result in a fluid release or leak; and
- Locating fuel transfer and maintenance activities greater than 31 m from a watercourse or waterbody, except for approved activities near water.

Sabina will implement the following mitigation and management measures for erosion and sediment controls, as well as the following bank stabilization measures:

<u>Mitigation by Erosion and Sediment Control</u>

- The area of landscape disturbance will be minimized, and restoration will occur as soon as possible to minimize erosion potential.
- Silt fences will be used in areas of cuts and excavations, downslope from exposed or erodible areas to prevent sedimentation of waterbodies.
- Effective erosion and sediment control measures will be installed before starting work to prevent sediment from entering the waterbody.
- Site isolation measures (e.g., silt boom or silt curtain) will be used to contain suspended sediment where in-water work is required.
- Regular inspection and maintenance of erosion and sediment control measures and structures will be conducted during the course of construction.

<u>Mitigation by Shoreline/bank re-vegetation and stabilization</u>

- Clearing of riparian vegetation will be kept to a minimum to avoid disturbance to the riparian vegetation and prevent soil compaction.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, appropriately-sized, clean rock will be installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Exposed landscape surfaces will be protected, where possible, by the installation of covering material like riprap, aggregate, or rolled erosion control products.
- Decommissioning of the roads will involve restoring natural drainages and stabilizing any slopes where there is potential for erosion; stabilization measures may require pulling back of side-cast fills on locally steep slopes or buttressing and/or re-contouring of steepened slopes using non-potentially acid generating material.

A total suspended solids (TSS)-turbidity relationship will be developed, where needed, either from historical site data (if sufficient TSS-turbidity data are available to create a statistically supported relationship), experimentally, or during activities (in which case, the use of Turbidity in place of TSS would only be possible once a relationship had been established; until that time compliance would only be verifiable through TSS concentrations). Which methodology to be used will depend on the site, the amount of historical data available, and the planned work. In all situations, regression analysis will be used to identify site-specific statically significant relationships (equations) relating turbidity to TSS in a manner to allow the derivation of TSS from in-field measurements of turbidity. TSS will be monitored during in-water construction against criteria presented in Section 7.5. Should monitoring indicate that TSS has surpassed 80% of these criteria additional mitigation measures will be implemented (such as a temporary reduction in, or cessation of, activity or use of additional mitigation).

### 9.4.2 Saline Water Management

The SWMP is included an Appendix C to the WMP, and provides details related to the management of saline groundwater in compliance with the Type A Water Licence 2AM-BRP1831 Amendment No.1.

The SWMP provides a description of the saline water management, outlines the procedures required to manage the quantity and quality of saline groundwater interacting with Project components throughout the mine life, and characterization of saline water inflows into the underground mine workings. The SWMP also includes monitoring of thermal conditions, monitoring of saline water at the Goose Property, mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the open pits and the underground mine, and potential water treatment and disposal methods.

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, the SWP. The saline water collected in the SWP is treated with a reverse osmosis unit and then used for reclaim in the Process Plant. Once milling production starts ramping down in Year 13, saline water encountered will be transferred to Goose Reservoir for permanent storage. In the event of insufficient storage in the SWP before Year 13, saline water can be transferred to the Llama TF once active in Year 6, or Umwelt Underground around Year 10 and Year 12, when the void space within the Underground will be available. Additional details can be found in Appendix C.

### 9.4.3 Mine Water Runoff Management

Environmental protection measures will be implemented to manage mine water runoff, including:

- Collection of all mine water runoff through use of diversions, collection ditches/berms and pipelines;
- Recycling of mine contact water to the extent possible at the Goose Property;
- Treatment of mine contact water prior to discharge to the environment during Construction, Operations, and Closure;
- Land discharge of mine contact water where possible, rather than direct discharge to surface waters; and
- Passive discharge of mine contact water during the Post-Closure Phase, provided discharge criteria are met.

At the Goose Property, these measures will be achieved by collecting all mine contact water from open pits, ore stockpiles, and WRSAs. Water collected will be recycled for use in the milling process. At Closure, pits lakes will be equipped with spillways (where required) and allowed to overtop and discharge to the environment once monitoring confirms discharge limits have been achieved . In the unlikely event that mine water runoff from pit lakes and WRSAs do not meet discharge criteria, water treatment will be provided by directing runoff from these areas to a central location and treating from there.

Diversion structures will be required around Llama, Goose Main and Echo open pits, and the SWP to divert non-contact water away from mining areas. This strategy will reduce the total amount of contact water generated by the Project. Mine water runoff management has been optimized based on the plans as outlined in Section 6 of the original application (Sabina 2017). The management strategies will continue to evolve and will be finalized during detailed design.

## 9.5 ACID ROCK DRAINAGE/ METAL LEACHING

This plan and the WRMP (2AM-BRP1831 Amendment No.1 Part F, Item 1) will be periodically updated as new geochemical information becomes available. The management and mitigation measures will include protocols for identification of appropriate quarry and borrow pit material for construction to minimize potential effects related acidic or metal leaching (ML) rock drainage.

<u>Goose Property Waste Rock</u>

Goose Property mine workings and waste rock represent a moderate acid rock drainage (ARD)/ML potential. Low to moderate bulk Neutralizing Potential (NP) contents could result in acidic drainage after a lag time of 14 to 20 years. Interaction with the deposit material and air/water could result in runoff/drainage exhibiting concentrations of arsenic and copper greater than MDMER limits. This plan has been designed to minimize exposure time of the mine workings and waste rock to air/water and, wherever possible, to ensure the exposure time is less than the expected lag time.

## 9.6 BORROW PIT AND QUARRY DEVELOPMENT

Plans to develop aggregate sources, as well as the identified environmental protection measures and monitoring plans, are described in the Borrow Pits and Quarry Management Plan (2AM-BRP1831 Amendment No.1 Part D, Item 1). The following summarizes the environmental protection measures identified to minimize impacts to water during borrow area and quarry planning and development:

- Maintain a setback distance of 31 m from creeks and streams;
- Preserve vegetative buffers to limit impacts on water quality;
- Use berms and ditches to direct runoff away from the excavation;
- Slope rock quarry floors so that water is diverted to a sump within the quarry or adjacent to the quarry boundaries where it can be monitored prior to release;
- Sample accumulated water within water collection areas for TSS, oil and grease, and ammonia-nitrogen;
- Apply sediment and erosion control measures such as those described in Section 9.4.1;
- Use dust skirts on conveyors and apply dust suppression measures as identified in the Air Quality Monitoring and Management Plan (Sabina 2019b);
- Monitor for ground ice during excavation of borrow areas;
- Monitor and address any subsequent settlement to maintain positive drainage and avoid the ponding of water (which can further exacerbate thawing of ground ice); and
- Routinely inspect the effectiveness of water management structures.

Sabina will maintain an appropriate setback distance between Project quarries and fish-bearing or permanent waterbodies, or implement appropriate mitigation measures, as required to prevent acidic or metal leaching rock drainage into such waterbodies.

These environmental protection measures are described further in the Borrow Pits and Quarry Management Plan (2AM-BRP1831 Amendment No.1 Part D, Item 1). Individual quarry development plans and SOPs will be prepared by the contractor before extraction activities commence.

## 9.7 DUST MANAGEMENT

Dust from ore stockpiles and WRSAs is not expected to be substantial; however, dust will be monitored and managed to the extent reasonable. Crushing and screening operations will be conducted with equipment designed to mitigate dust dispersion. In the unlikely event that an unacceptable amount of dust is generated from end-dumping or front-loading during stockpiling and transferring operations, additional dust mitigation measures will be applied as identified in the WRMP (2AM-BRP1831 Amendment No.1 Part F, Item 1). A nominal amount of water has been requested for dust suppression if needed (Table 7.3-1).

## 9.8 AMMONIA MANAGEMENT PLAN

Ammonium nitrate will be used in large quantities by the Project. ANFO is the main explosive mixture to be used for mining at the Project. 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. The seacans will be placed on a laydown pad at the Goose AN Facility. Diversion berms will direct any runoff water to a sump at the AN Facility pad. Collected runoff from the AN Facility area will be treated as contact water as described in Section 8.2.8. Water from the AN Facility truck wash will be transported to a water management pond for treatment or discharge as appropriate, or will be collected and treated in an evaporator.

Ammonia concentration predictions for all sources were incorporated in the Water and Load Balance model; these sources include blasting residues associated with rock, Process Plant/tailings contributions, and camp wastewater. Ammonia, nitrate, and nitrite concentrations as a result of blast residue were derived from methods described by Ferguson and Leask (1998). These methods calculate the annual release of total AN as nitrogen based on the powder factor, fraction of ammonium nitrate in ANFO, the fraction of nitrogen content in AN, and the residual nitrogen remaining. Additional details on the assumptions are presented in the Water and Load Balance Report (Appendix D).

With adherence to BMPs for AN storage and handling there is minimal risk of AN spillage; however, ammonium nitrate and/or ANFO may be spilled during handling or during use in the open pit or underground. 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. Spill prevention and response actions will include the following:

- establish and use SOPs for handling and working around storage areas;
- ensure proper containers are used for the storage and transport of explosives and AN;
- restrict access to authorized and trained personnel;
- conduct regular inspections of storage areas, containers, and transport vehicles with frequency driven by activity levels;
- clean up dry AN according to established SOPs, to minimize likelihood of nitrates entering watercourses;

- manage and limit contact with snow and water, with particular anticipation of spring thaw/freshet period; and
- properly dispose of spill material and any impacted rock pad material, which could include placing within a blast pattern prior to initiation.

More detailed spill response procedures for AN and explosives will be provided with the explosive's supplier Emergency Response Assistance Plan. An Emergency Response Assistance Plan will be prepared by the explosive's supplier for the transportation of explosives to all storage sites for the Project as required by the Transportation of Dangerous Goods regulations. For detailed information related to spill response for potential explosives refer to the Spill Contingency Plan (2AM-BRP1831 Amendment No.1 Part H, Item 1).

For specific water quality monitoring related to ammonia management refer to Section 10.

# 10. Monitoring Program

The three levels of monitoring proposed for mine development are:

- o Environmental Monitoring (locations shown in Figure A-25 and A-26); which further refines three forms of general monitoring into:
  - regulated discharge monitoring (i.e., set by legislation or authorization requiring specific discharge/effluent criteria to be met for compliance);
  - verification monitoring (i.e., internal operation management monitoring); and
  - general monitoring (i.e., NWB general monitoring requirements set in Type A Water Licence [2AM-BRP1831 Amendment No.1]);
- o Performance Measurement Monitoring; which tracks performance of mitigation measures implemented, identifies environmental changes in the receiving environment, and validates environmental effects predictions; and
- o Design Support Monitoring; which is site-specific field monitoring required to support detailed engineering designs and confirm modelling assumptions.

All three types of monitoring will be used at the Project. The sum of all three types of monitoring will provide sufficiently robust data to support decisions in water management.

The proposed general water monitoring program station locations provided in the Type A Water Licence (2AM-BRP1831 Amendment No.1, Schedule I). Additional information supporting the general water monitoring plan can be found in the General and Aquatic Effects Monitoring Program documents accepted by the NWB under Part B, Item 14, which includes the Environmental Management and Protection Plan, Aquatic Effects Management Plan and the Quality Assurance/Quality Control Plan.

The Aquatic Effects Management Plan is a comprehensive monitoring program that considers Project related effects on the aquatic environment and is harmonized in consideration of MDMER requirements. Where appropriate all monitoring will be undertaken using established methods and defined Quality Assurance/Quality Control Plan and in accordance with the Type A Water Licence 2AM-BRP1831 Amendment No.1 requirements of Part I.

Sabina will also have in place an internal inspection plan to monitor activities and mine components that could adversely affect the use of water or the deposit of waste into water. Sabina’s internal due diligence plan for inspections is provided in the Environmental Management and Protection Plan (2AM-BRP1831 Amendment No.1 Part I, Item 1), and be completed for each mine component or activity, including all earthworks or facilities constructed for the use, storage, treatment, and/or disposal of water and/or waste into water.

Further, Sabina’s proposed monitoring program for culverts on fish bearing watercourses during the Operations and Closure phases will include measures to ensure that barriers to fish passage do not form over time as a result of crossing damage due to ice blockage, flooding, or movement of debris.

In addition, Sabina has completed the commitment to collect additional baseline water quality data to characterize the lakes and streams within the freshwater aquatic environment prior to Construction, and Sabina has used this data to update the Water and Load Balance model to account for potential seasonal variation (2AM-BRP1831 Amendment No.1, Part E Item 15).

Results collected under the general monitoring program outlined in the Licence will be included in the monthly and annual reports required by the Licence. Results will be compared to applicable Water Licence criteria. MDMER-related results will be reported as required under the MDMER.

# 11. Environmental Reporting

Internal reporting structures will provide the framework so monitoring results can be reviewed, instances of non-compliance with this plan can be identified, and subsequent corrective action can be undertaken in a timely manner. Items of non-compliance with applicable permits, licenses, and authorizations will be reported to the respective agency as outlined in those authorizations.

External reporting of Sabina's monitoring results and performance against this management plan will be in accordance with the following permits, licenses, approvals, and authorizations (Table 11-1).

**Table 11-1. Reporting Requirements**

| Regulatory Instrument | Responsible Agency | Information to be Reported | Frequency | Compliance Inspections |
|---|---|---|---|---|
| Project Certificate | NIRB | Terms and conditions relevant to water management | Annually | A NIRB Monitoring Officer will inspect the site against the Project Certificate annually |
| Type A Water Licence | NWB | Water licence reporting requirements, including those identified in this plan | Monthly (General Monitoring requirements); Summary results in Annual Report | A waters inspector will inspect the site |
| Authorization for HADD of fish habitat under the Fisheries Act | DFO | Specified in the authorization – focused on protection of fish habitat | Annually | A fisheries officer may inspect the site periodically to determine compliance |
| MDMER | ECCC | Effluent quality and toxicology; sediment, benthics, fish population data | Monthly reporting of effluent quality and receiving water quality; annual reporting | |
| AEMP | NWB | To be determined – possibly inclusive of water and sediment quality and freshwater biota | As prescribed in the AEMP; Summary results in Annual Report | The AEMP will be submitted to the NWB and reviewed by other relevant agencies including DFO and ECCC |

# 12. Adaptive Management

The mine design, including the water management design, 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 was limited, conservative assumptions were consistently applied. Notwithstanding, a key element of monitoring as outlined in Section 10 is to verify that mitigation measures in relation to water management activities are being implemented and are achieving their intended outcomes. Adaptive management will be employed where mitigation is not achieving the intended result. Alternative mitigation measures may be identified at a later time and will be reflected in updates to this plan and related management plans.

Possible water management scenarios and the potential contingency strategies are outlined Table 12-1.

**Table 12-1. Water Management Contingency Strategies**

| Possible Scenario | Contingency Strategy |
|---|---|
| While dewatering Llama and Umwelt lakes to Goose Lake, the concentration of TSS may be higher than the expected 50% volume requiring treatment before discharge. | Treat a greater percentage of the water from Llama and Umwelt lakes. Additional contingencies described below. |
| Seepage from any of the contact berms or other dams on site occurs. | Repairs to the berms/dams may be required. Alternatively, seepage collection berms may need to be constructed and return pumps may be required. |
| Saline inflows into the mine workings are greater than expected. | Additional storage locations will need to be identified, blending of saline water with other contact water may be investigated, or treatment to desalinate the water may be required. See SWMP Section 7 for additional details. |
| Waste rock leaches a greater concentration of metals or other constituents than expected. | Additional settlement time or water treatment may be required. |
| The results of Water quality monitoring (WMP, Appendix B) or the Aquatic Effects Monitoring Program (AEMP) shows non-compliance. | Identify the issue (i.e. contact water not collected by contact berms, seepage through contact berms, ineffective treatment, etc.) and develop a strategy to improve treatment or reduce the release of mine water. |

Checking and corrective action will occur during dewatering through the evaluation of continuous flow data and daily TSS and turbidity data. Results of the monitoring program will be reviewed by the Environmental Team, and water quantity and quality trends will be updated on a time scale relevant to the dewatering activity. If the dewatering activity will take two weeks or less, then data will be updated daily. If dewatering will take longer, then a more appropriate time scale may be used (e.g., every 3 days or weekly). This program will allow early detection of changes in water quality and implementation of corrective actions, if required. If trigger levels or thresholds are approached or exceeded, dewatering activities will be suspended.

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# Appendix A. Figures

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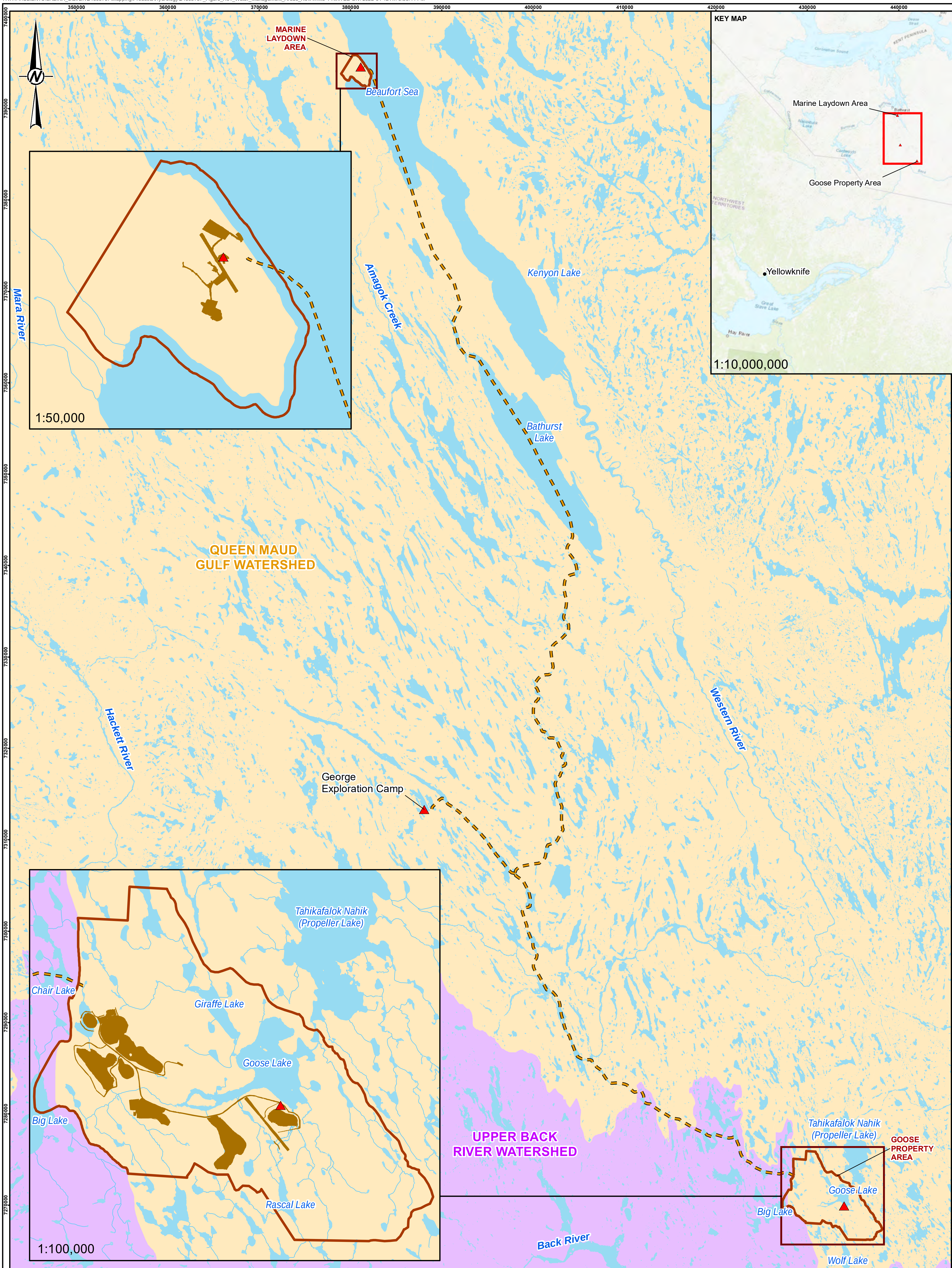


**LEGEND**

- EXISTING EXPLORATION CAMP
- WINTER ICE ROAD
- WATERCOURSE
- POTENTIAL DEVELOPMENT AREA
- MINE FOOTPRINT
- WATERBODY

**WATERSHEDS**

- QUEEN MAUD GULF
- UPPER BACK RIVER

DRAFT

0 10 20

1:400,000 KILOMETRES

REFERENCE(S)
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PROJECTION: UTM ZONE 13 DATUM: NAD 83

CLIENT
Sabina

PROJECT
SABINA BACK RIVER PROJECT

TITLE
**NUNAVUT WATER MANAGEMENT AREAS OF THE BACK RIVER PROJECT**

CONSULTANT
GOLDER MEMBER OF WSP

| | |
|---|---|
| YYYY-MM-DD | 2022-04-12 |
| DESIGNED | AR |
| PREPARED | NB |
| REVIEWED | - |
| APPROVED | - |

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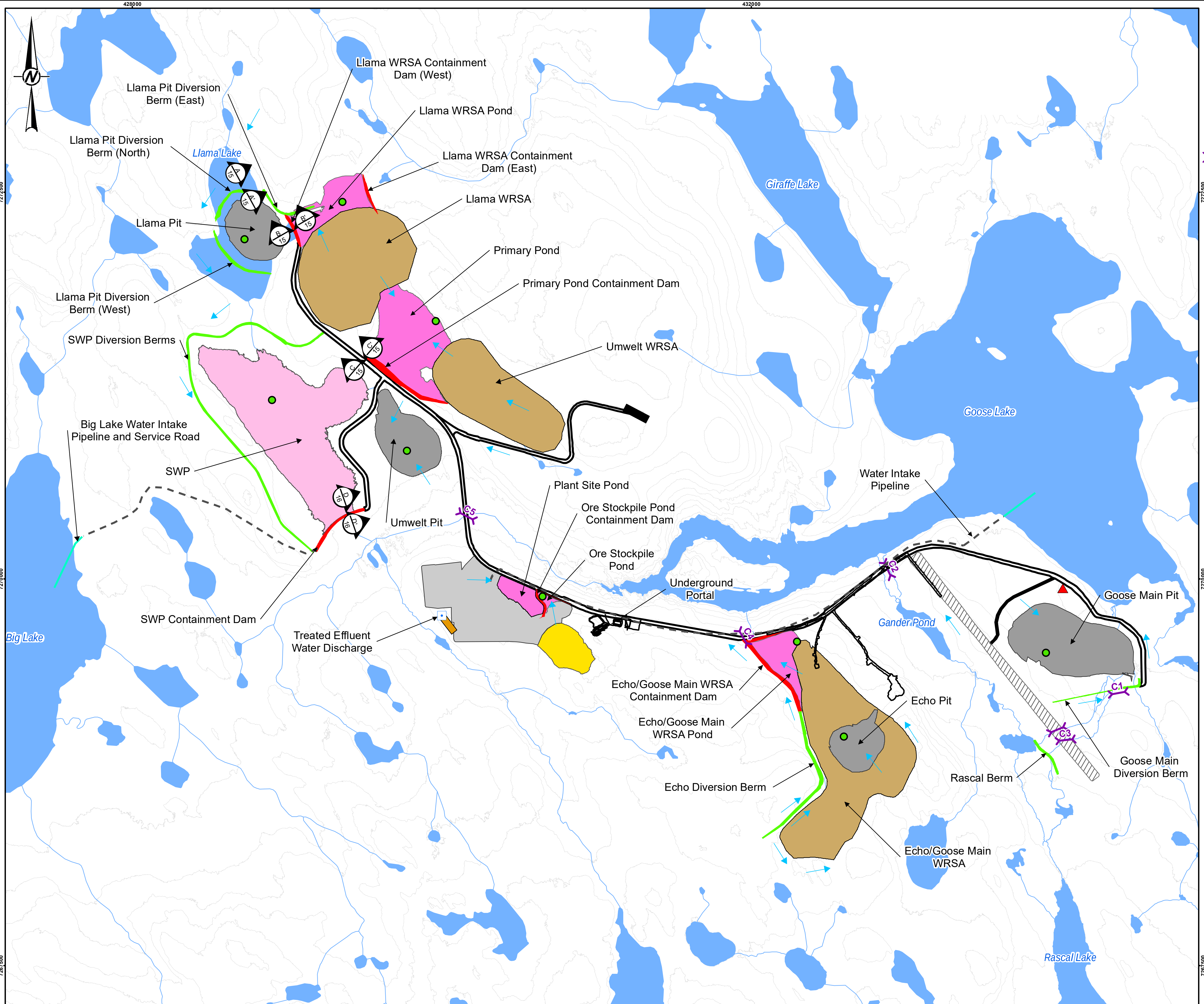


**LEGEND**

- CROSS SECTION
- EXISTING EXPLORATION CAMP
- FLOW DIRECTION
- TREATED EFFLUENT WATER DISCHARGE
- PUMP
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE
- AIRSTRIP
- CONTACT WATER POND
- GOOSE PLANT SITE
- HAUL ROAD
- OTHER INFRASTRUCTURE
- ORE STOCKPILE
- OPEN PIT
- NON-CONTACT WATER CONTAINMEMNT BERM (UNLINED)
- CONTACT WATER CONTAINMENT DAM (LINED)
- SALINE WATER POND (SWP)
- WASTE ROCK STORAGE AREA (WRSA)
- LANDFARM
- WATERBODY

**DRAFT**

0 750 1,500
1:25,000 METRES

**REFERENCE(S)**
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PROJECTION: UTM ZONE 13N DATUM: NAD 83

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|---|---|
| YYYY-MM-DD | 2022-04-25 |
| DESIGNED | AR |
| PREPARED | SG/NB |
| REVIEWED | - |
| APPROVED | - |

CLIENT
Sabina

CONSULTANT
GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**GOOSE PROPERTY AREA – POTENTIAL DEVELOPMENT AREA AND LAYOUT**

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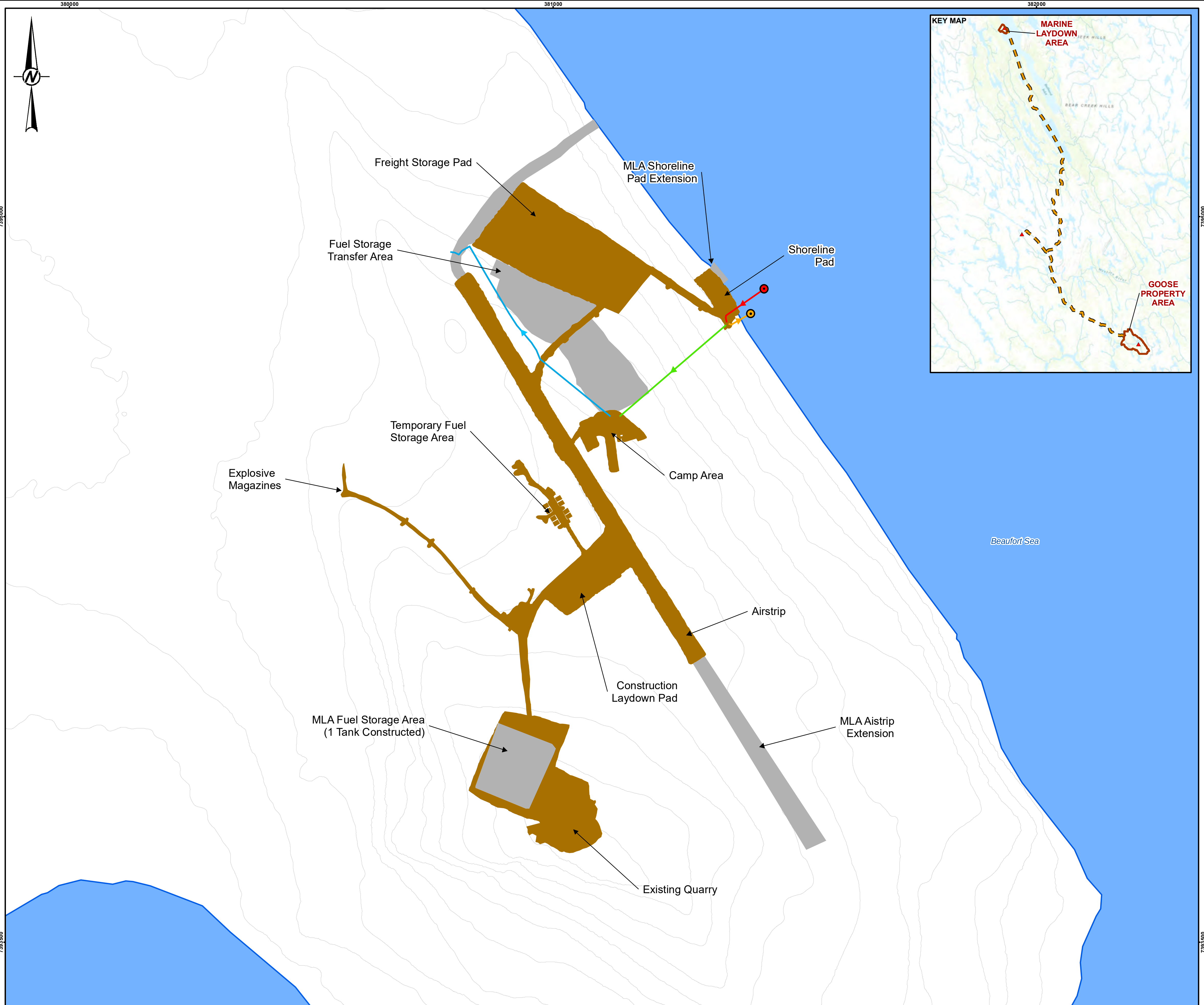


LEGEND

- DESALINATION DISCHARGE (INTERMITTENT)
- DESALINATION INTAKE (INTERMITTENT)
- CONTOUR (5 M)
- DESALINATION WATER PIPELINE
- GREY WATER PIPELINE
- SALINE WATER DISCHARGE
- SALINE WATER INTAKE
- MLA PERMITTED FOOTPRINT
- MLA EXISTING INFRASTRUCTURE
- WATERBODY

DRAFT

0 200 400

1:8,000 METRES

REFERENCE(S)

FOOTPRINT OBTAINED FROM CLIENTAND MODIFIED BY GOLDER.. HYDROGRAPHY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED, MODIFIED BY GOLDER.
PROJECTION: UTM ZONE 13N DATUM: NAD 83

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| YYYY-MM-DD | 2022-04-19 |
| DESIGNED | AR |
| PREPARED | NB |
| REVIEWED | - |
| APPROVED | - |

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Sabina

CONSULTANT
GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**MARINE LAYDON AREA – POTENTIAL DEVELOPMENT AREA AND LAYOUT**

| PROJECT NO. | FIGURE | REV. |
|---|---|---|
| 21505757 | A-03 | A |

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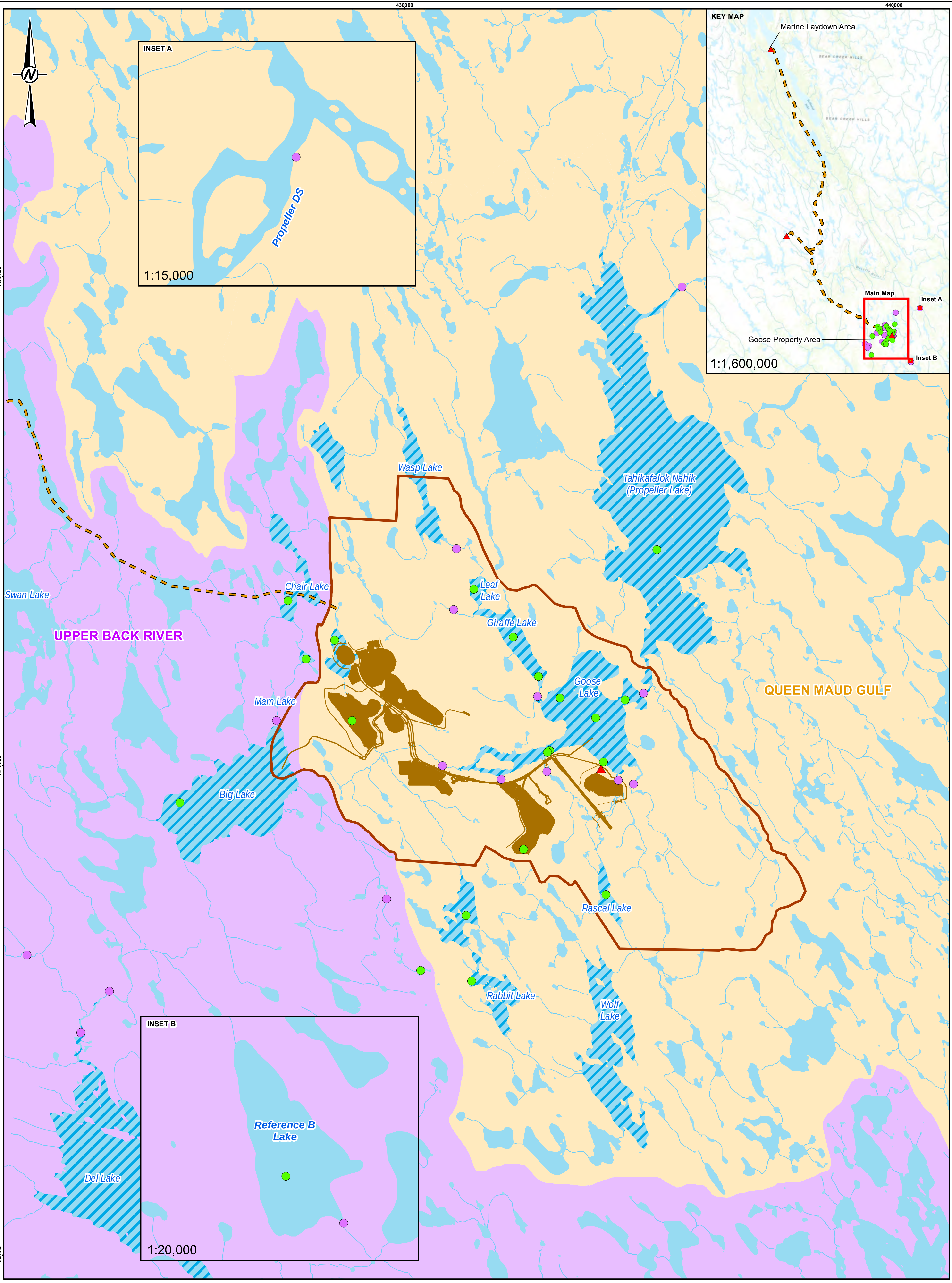


LEGEND

- EXISTING EXPLORATION CAMP
- LAKE LIMNOLOGY
- STREAM TEMPERATURE
- WINTER ICE ROAD
- WATERCOURSE
- POTENTIAL DEVELOPMENT AREA
- FOOTPRINT INFRASTRUCTURE
- LAKE WITH BATHYMETRY
- WATERBODY

WATERSHEDS

- QUEEN MAUD GULF
- UPPER BACK RIVER

DRAFT

0 2 4

1:75,000 KILOMETRES

REFERENCE(S)
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PROJECTION: UTM ZONE 13 DATUM: NAD 83

CLIENT
Sabina

PROJECT
SABINA BACK RIVER PROJECT

TITLE
**LIMNOLOGY AND BATHYMETRY SAMPLING CONDUCTED IN THE GOOSE PROPERTY AREA**

CONSULTANT
GOLDER MEMBER OF WSP

| | |
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| YYYY-MM-DD | 2022-04-19 |
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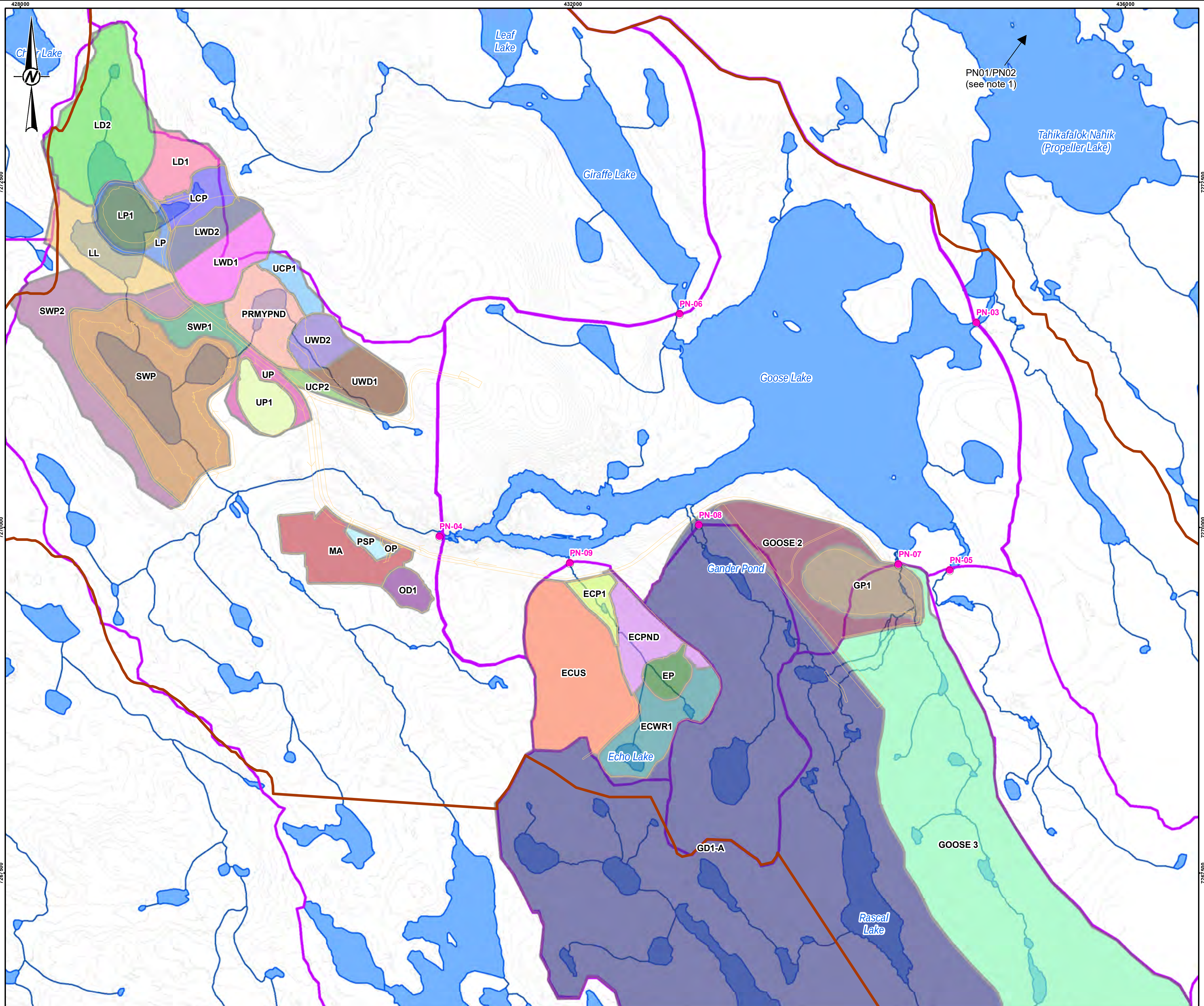


**LEGEND**

- PREDICTION NODES
- CONTOUR (2 m)
- WATERCOURSE
- SITE INFRASTRUCTURE
- POTENTIAL DEVELOPMENT AREA
- PREDICTED NODE CATCHMENT
- WATERBODY

**CATCHMENT**

- ECP1 - Echo/Goose Main WRSA Pond
- ECPND - Upstream of Echo WRSA Pond
- ECUS - Echo Diversion Berm
- ECWR1 - Echo/Goose Main WRSA
- EP - Echo Pit
- GD1-A - Upstream of Goose Main Pit (Diverted)
- GOOSE 2 - Upstream of Goose Main Pit (Partially Diverted)
- GOOSE 3 - Upstream of Goose Main Pit (Diverted)
- GP1 - Goose Main Pit Ultimate Surface Area
- LCP - Llama WRSA Pond
- LD1 - East Llama Lake Diverted
- LD2 - West Llama Lake Diverted
- LL - Llama Lake around Llama Pit Diverted
- LP - Llama Pit
- LP1 - Llama Pit Ultimate Surface Area
- LWD1 - South Llama WRSA
- LWD2 - North Llama WRSA
- MA - Goose Main Plant Site
- OD1 - Ore Stockpile
- OP - Ore Stockpile Pond
- PRMYPND - Primary Pond Surface Area
- PSP - Plant Site Pond Surface Area
- SWP - Saline Water Pond
- SWP1 - Upstream of SWP
- SWP2 - Upstream of SWP Diverted
- UCP1 - Upstream of Primary Pond
- UCP2 - Upstream of Primary Pond
- UP - Umwelt Pit
- UP1 - Umwelt Pit Ultimate Surface Area
- UWD1 - South Umwelt WRSA
- UWD2 - North Umwelt WRSA

**DRAFT**

0 750 1,500

1:28,000 METRES

**NOTE(S)**

1. PN02 IS LOCATED AT PROPELLER LAKE OUTLET AND PN01 IS DOWNSTREAM OF PROPELLER LAKE OUTLET.

**REFERENCE(S)**

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CONSULTANT
GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**GOOSE PROPERTY CATCHMENTS**

| PROJECT NO. | FIGURE | REV. |
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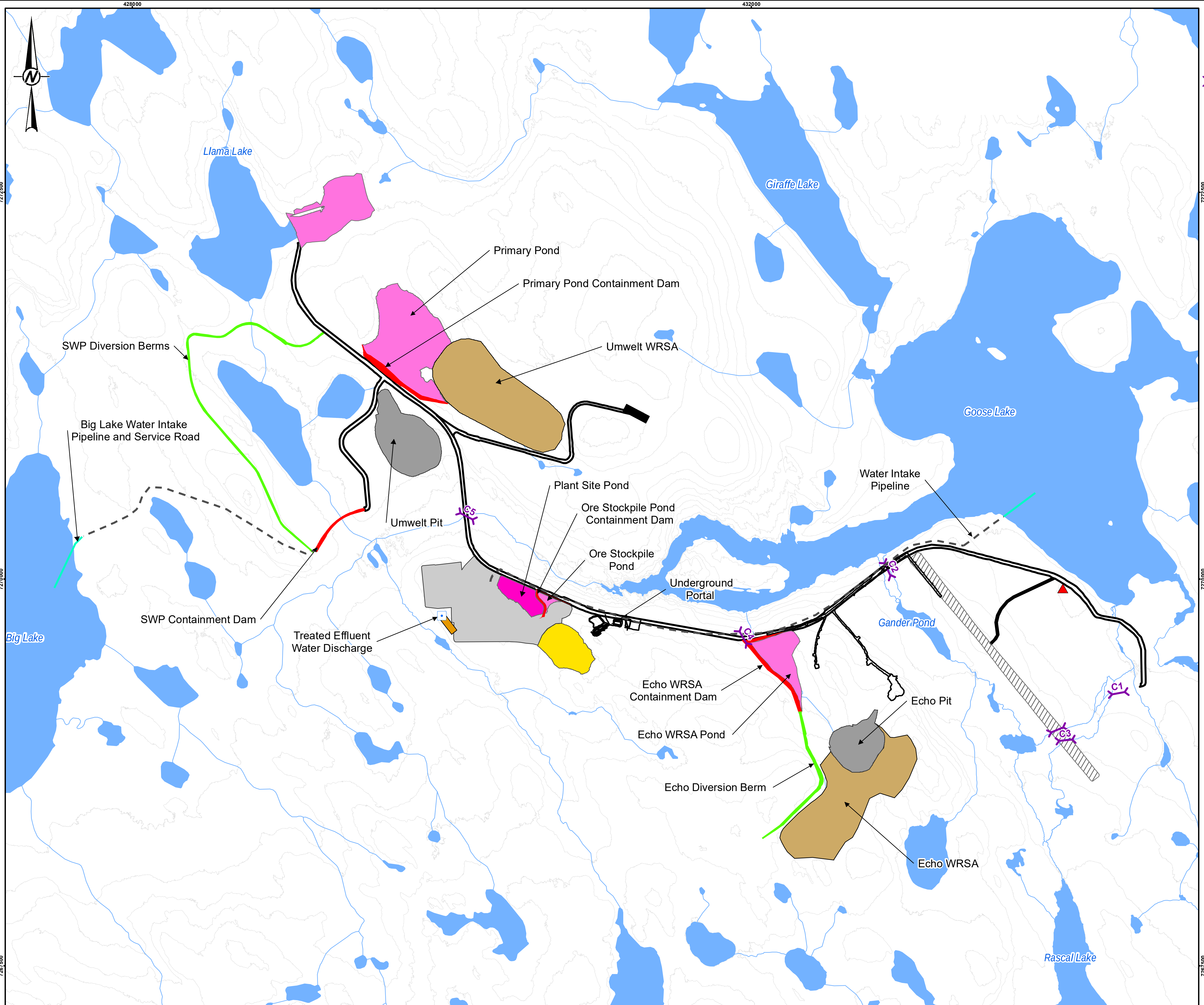


**LEGEND**

- EXISTING EXPLORATION CAMP
- TREATED EFFLUENT WATER DISCHARGE
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE
- AIRSTRIP
- CONTACT WATER POND
- GOOSE PLANT SITE
- HAUL ROAD
- OTHER INFRASTRUCTURE
- ORE STOCKPILE
- OPEN PIT
- NON-CONTACT WATER CONTAINMEMNT BERM (UNLINED)
- CONTACT WATER CONTAINMENT DAM (LINED)
- WASTE ROCK STORAGE AREA (WRSA)
- LANDFARM
- WATERBODY

**DRAFT**

0 750 1,500

1:25,000 METRES

**REFERENCE(S)**

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CONSULTANT: GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**PHASE 1: CONSTRUCTION (YEAR -3 TO YEAR -1)**

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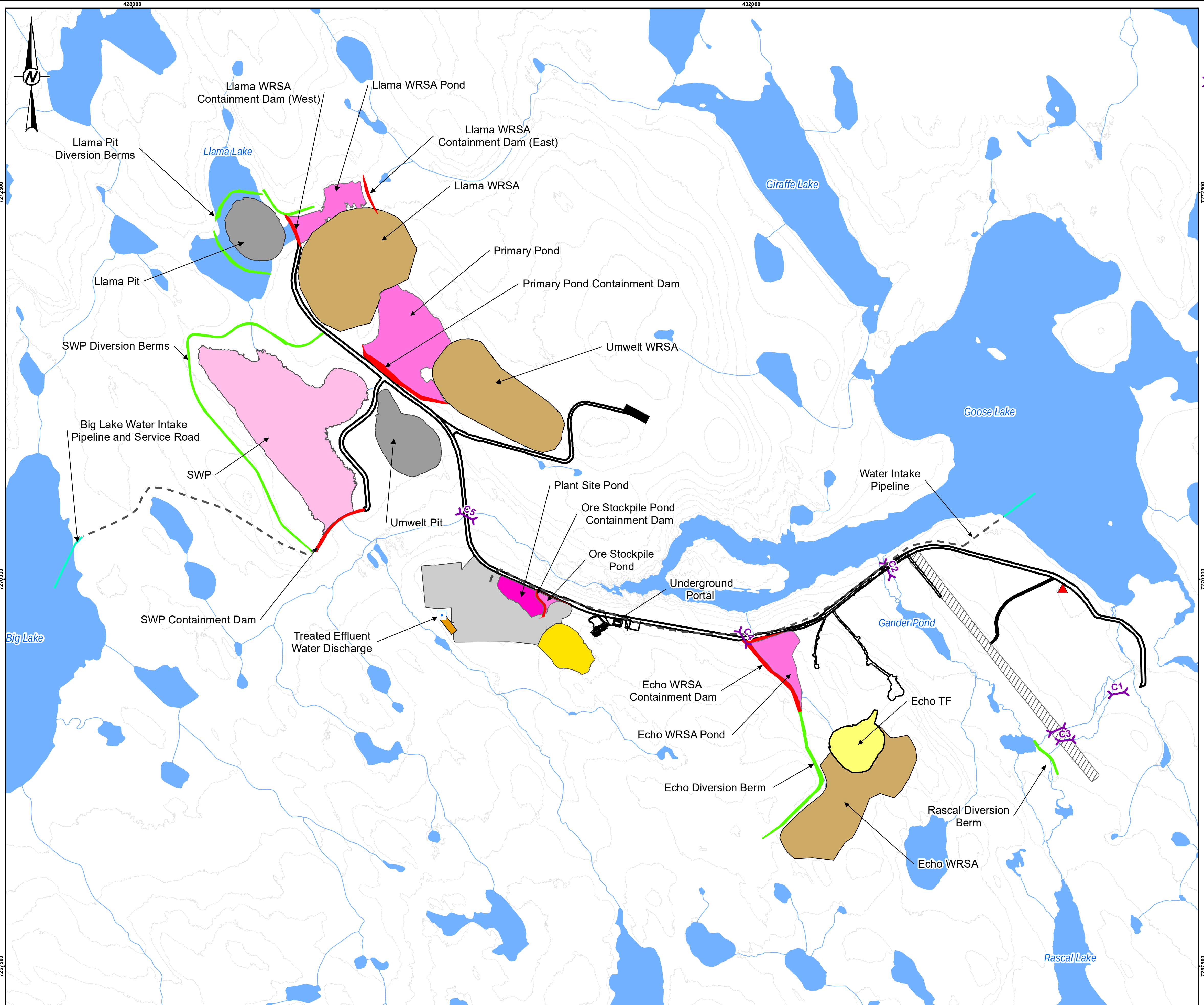


**LEGEND**

- EXISTING EXPLORATION CAMP
- TREATED EFFLUENT WATER DISCHARGE
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE
- ACTIVE TAILINGS FACILITY (TF)
- AIRSTRIP
- CONTACT WATER POND
- GOOSE PLANT SITE
- HAUL ROAD
- OTHER INFRASTRUCTURE
- ORE STOCKPILE
- OPEN PIT
- NON-CONTACT WATER CONTAINMEMNT BERM (UNLINED)
- CONTACT WATER CONTAINMENT DAM (LINED)
- SALINE WATER POND (SWP)
- WASTE ROCK STORAGE AREA (WRSA)
- LANDFARM
- WATERBODY

**DRAFT**

0 750 1,500
1:25,000 METRES

REFERENCE(S)
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PROJECTION: UTM ZONE 13N DATUM: NAD 83

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| APPROVED | - |

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CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**PHASE 2: OPERATIONS - ECHO TF (YEAR 1, Q1 TO YEAR 3, Q2)**

| PROJECT NO. | FIGURE | REV. |
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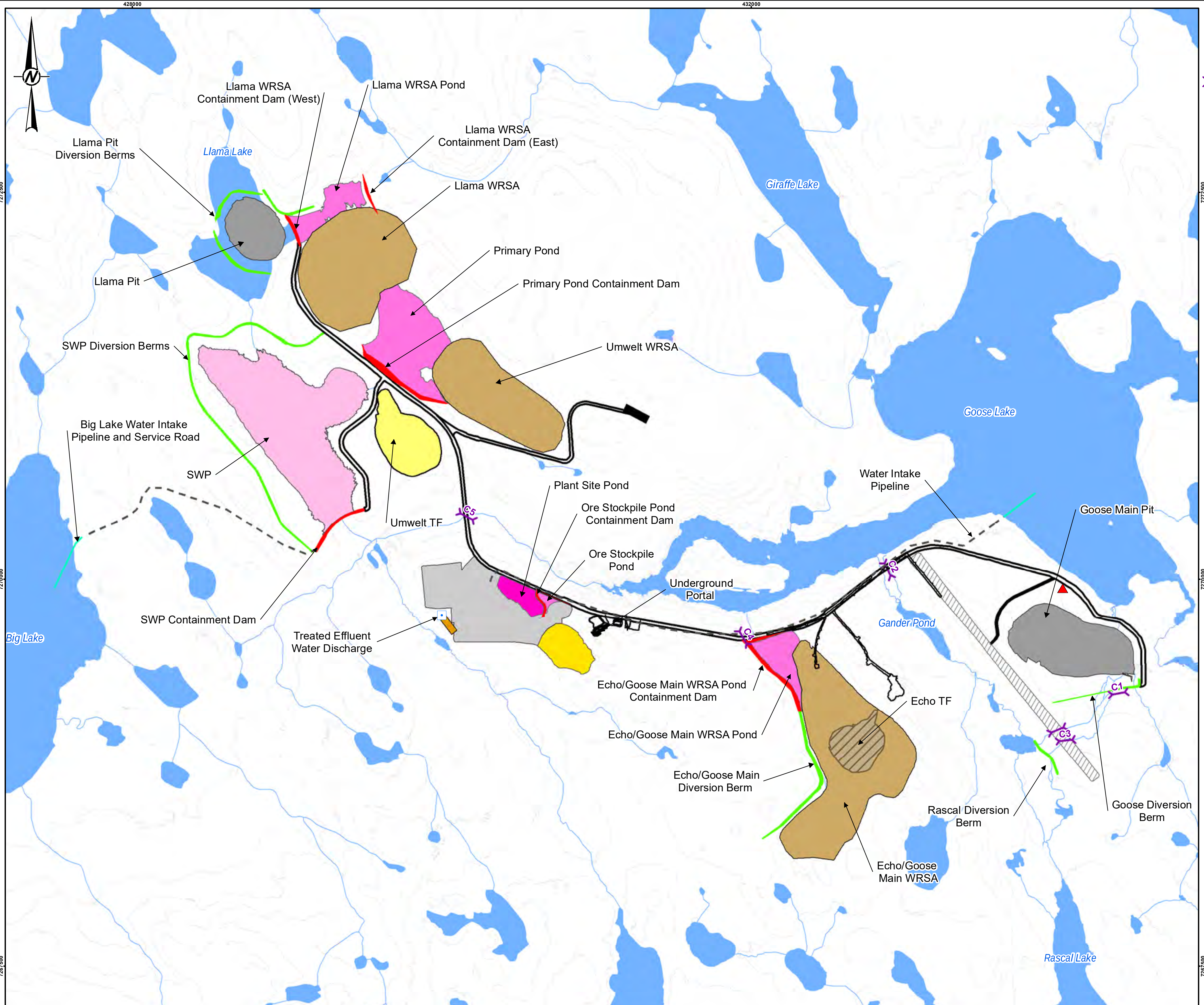


**LEGEND**

- EXISTING EXPLORATION CAMP
- TREATED EFFLUENT WATER DISCHARGE
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE

**Feature**

- ACTIVE TAILINGS FACILITY (TF)
- INACTIVE TAILINGS FACILITY (TF)
- AIRSTRIP
- CONTACT WATER POND
- GOOSE PLANT SITE
- HAUL ROAD
- OTHER INFRASTRUCTURE
- ORE STOCKPILE
- OPEN PIT
- NON-CONTACT WATER CONTAINMEMNT BERM (UNLINED)
- CONTACT WATER CONTAINMENT DAM (LINED)
- SALINE WATER POND (SWP)
- WASTE ROCK STORAGE AREA (WRSA)
- LANDFARM
- WATERBODY

**DRAFT**

0 750 1,500
1:25,000 METRES

REFERENCE(S)
FOOTPRINT DERIVED BY GOLDER FROM FILES OBTAINED FROM SABINA AUG. 2021, OCT. 2021 AND FEB. 2022. HYDROGRAPHY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA MODIFIED BY GOLDER. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 13N DATUM: NAD 83

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| PREPARED | SG/NB |
| REVIEWED | - |
| APPROVED | - |

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Sabina

CONSULTANT
GOLDER
MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**PHASE 2: OPERATIONS - UMWELT TF (YEAR3, Q3 TO YEAR6, Q3)**

| PROJECT NO. | FIGURE | REV. |
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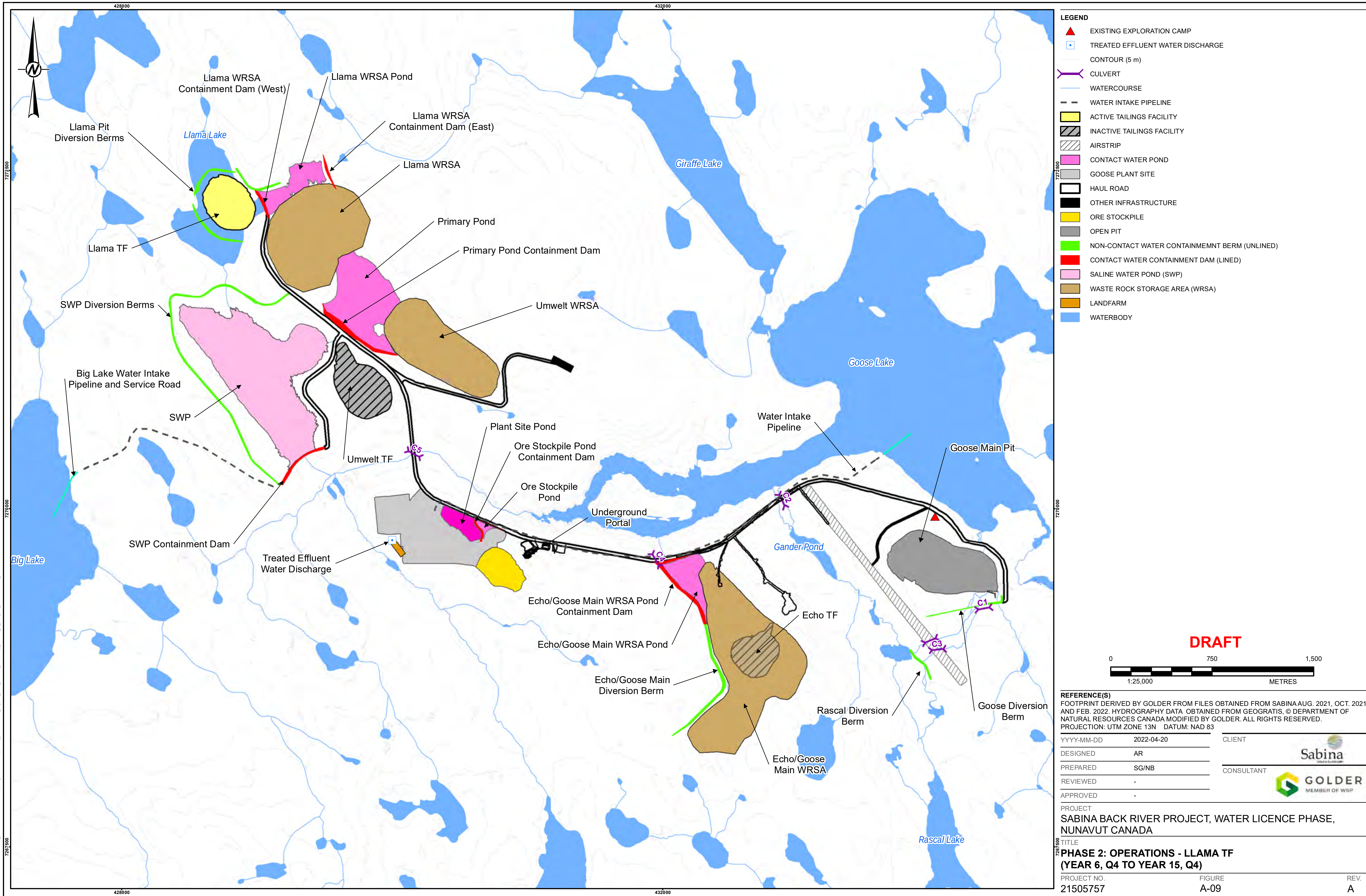


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| PREPARED | SG/NB |
| REVIEWED | - |
| APPROVED | - |

CLIENT: Sabina

CONSULTANT: GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**PHASE 2: OPERATIONS - LLAMA TF (YEAR 6, Q4 TO YEAR 15, Q4)**

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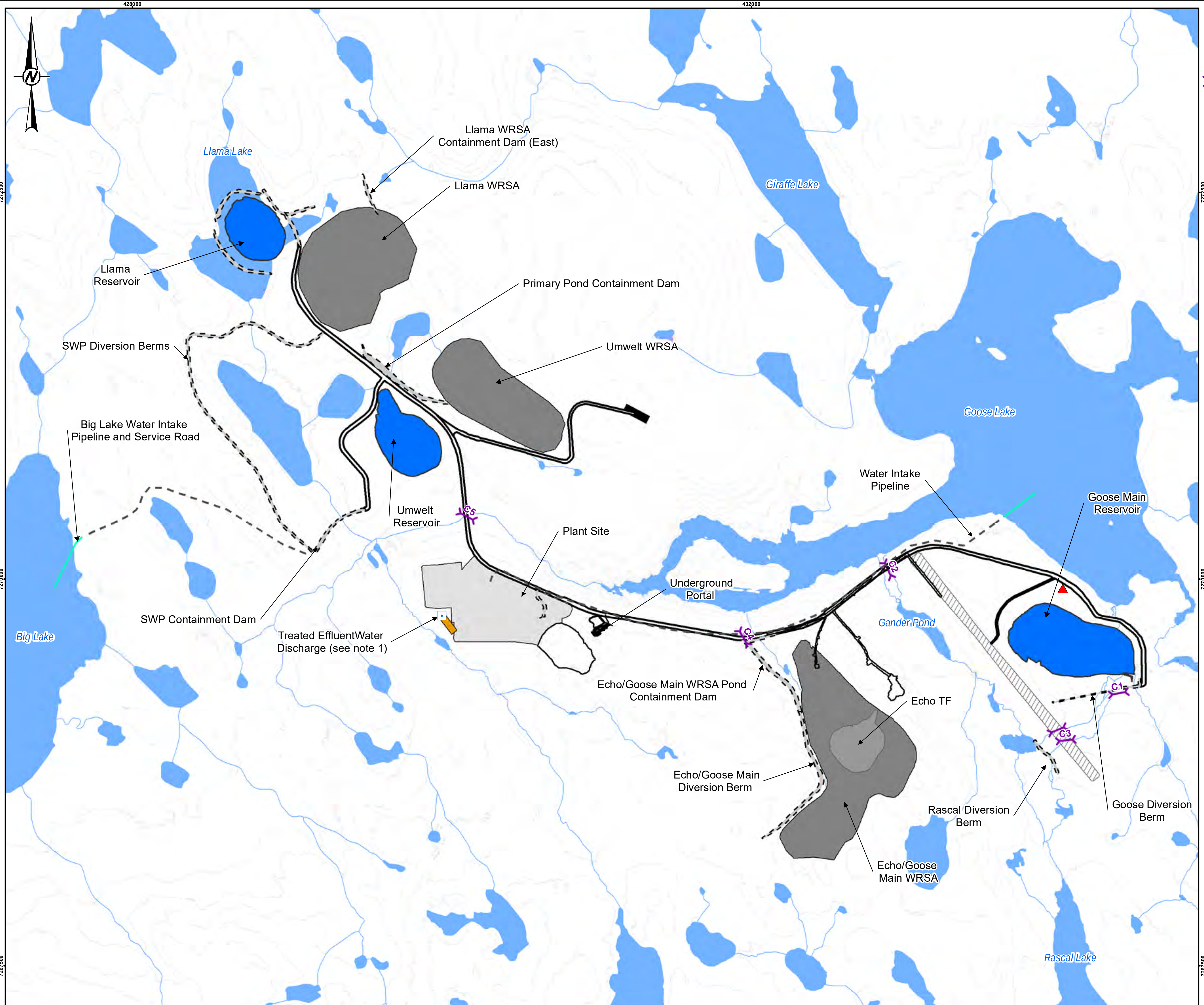


**LEGEND**

- EXISTING EXPLORATION CAMP
- TREATED EFFLUENT WATER DISCHARGE
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE
- INACTIVE TAILINGS FACILITY (COVERED WITH WASTE ROCK)
- AIRSTRIP
- BREACHED DIVERSION BERM/CONTAINMENT DAMS
- DECOMISIONED PAD
- HAUL ROAD
- INACTIVE WRSA
- ORE STOCKPILE BASE PAD SITE
- OTHER INFRASTRUCTURE
- PIT LAKES (CLOSED)
- LANDFARM
- WATERBODY

**DRAFT**

0 750 1,500

1:25,000 METRES

**REFERENCE(S)**

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PROJECTION: UTM ZONE 13N DATUM: NAD 83

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CLIENT: Sabina

CONSULTANT: GOLDER MEMBER OF WSP

PROJECT

SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE

**PHASE 3: CLOSURE (YEAR 16 TO YEAR 22)**

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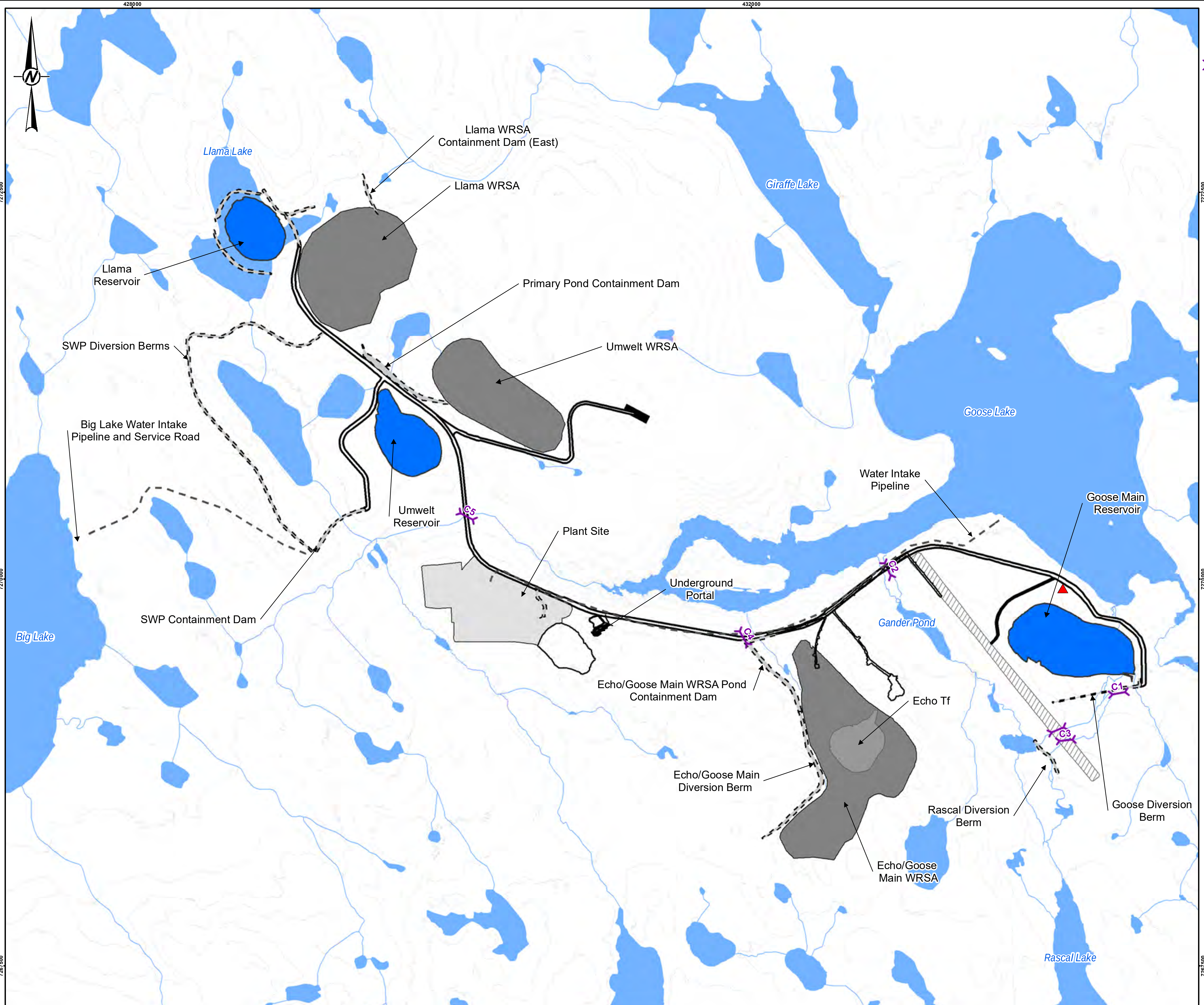


**LEGEND**

- EXISTING EXPLORATION CAMP
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE
- INACTIVE TAILINGS FACILITY (COVERED WITH WASTE ROCK)
- AIRSTRIP
- BREACHED DIVERSION BERM/CONTAINMENT DAMS)
- DECOMISIONED PAD
- HAUL ROAD
- INACTIVE WRSA
- ORE STOCKPILE BASE PAD SITE
- OTHER INFRASTRUCTURE
- PIT LAKES (CLOSED)
- WATERBODY

**DRAFT**

0 750 1,500

1:25,000 METRES

REFERENCE(S)
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PROJECTION: UTM ZONE 13N DATUM: NAD 83

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| APPROVED | - |

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Sabina

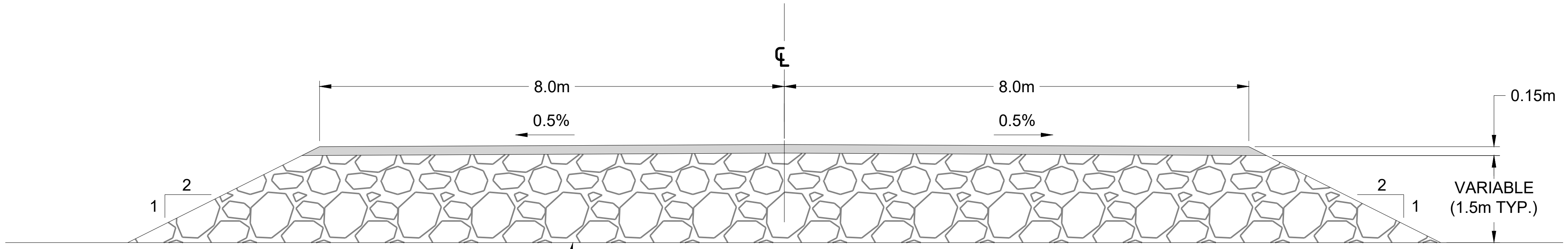
CONSULTANT
GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**PHASE 4: POST-CLOSURE (YEAR 23+)**

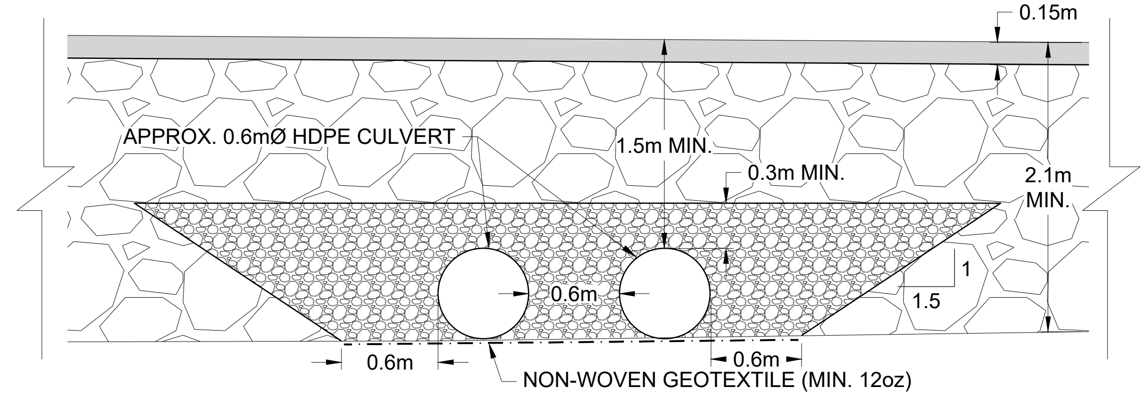
| PROJECT NO. | FIGURE | REV. |
|---|---|---|
| 21505757 | A-11 | A |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



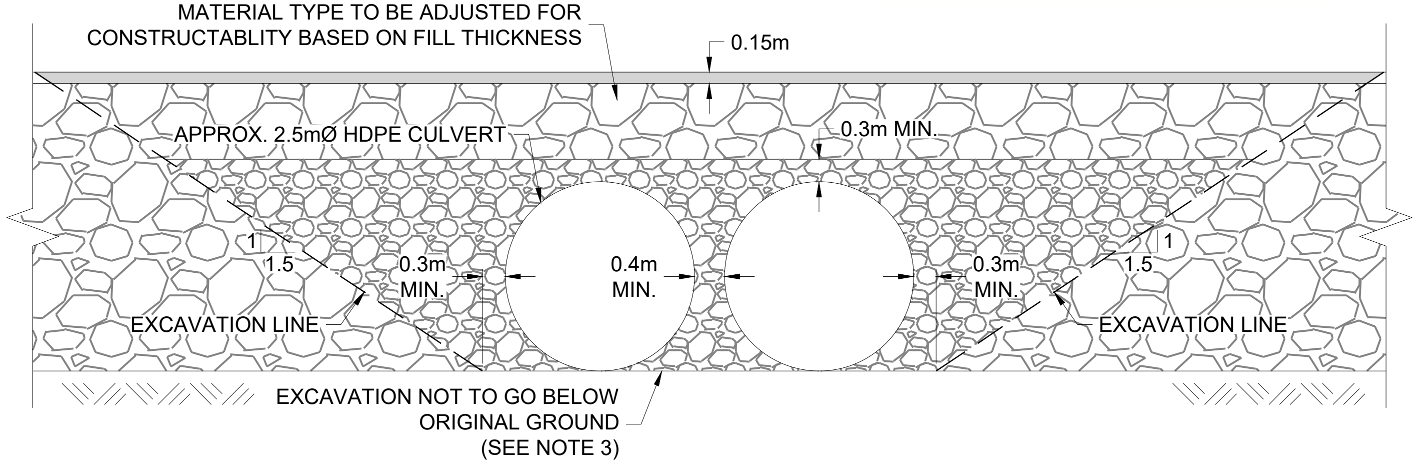

**TYPICAL ROAD SECTION**

0 2.5 5
1:100 METRES



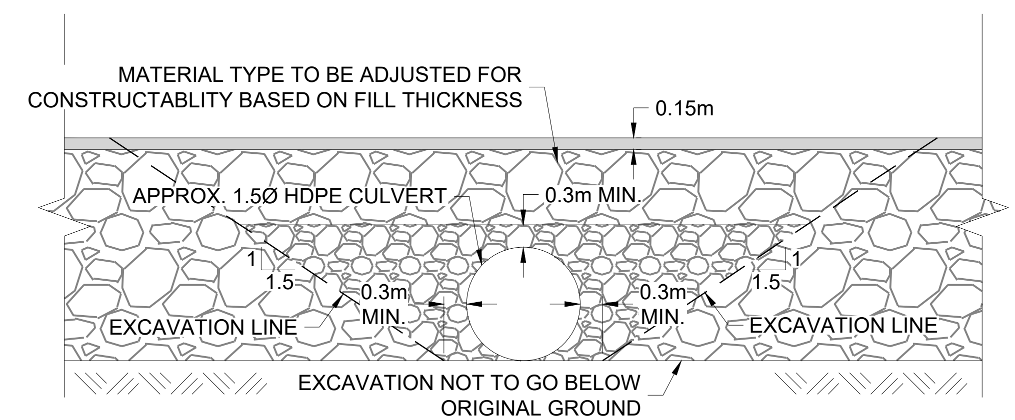

**TYPICAL CROSS SECTION OF SMALL DIAMETER DOUBLE HDPE CULVERT CROSSING**

0 1 2
1:50 METRES




**TYPICAL CROSS SECTION OF LARGE DIAMETER DOUBLE CULVERT CROSSING**

0 2.5 5
1:100 METRES




**TYPICAL CROSS SECTION OF SINGLE CULVERT CROSSING**

0 2.5 5
1:100 METRES

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING.
   CAD FILE: 1CS020.018 - TYPICAL SECTIONS.DWG; TITLE: TYPICAL ROAD AND CROSSING SECTIONS; DRAWING NO. A-17; DATED: 2020/06/05.

**LEGEND**

- NON-WOVEN GEOTEXTILE
- RUN OF MINE MATERIAL
- ENGINEERED FILL / CRUSH MATERIAL
- SURFACING MATERIAL

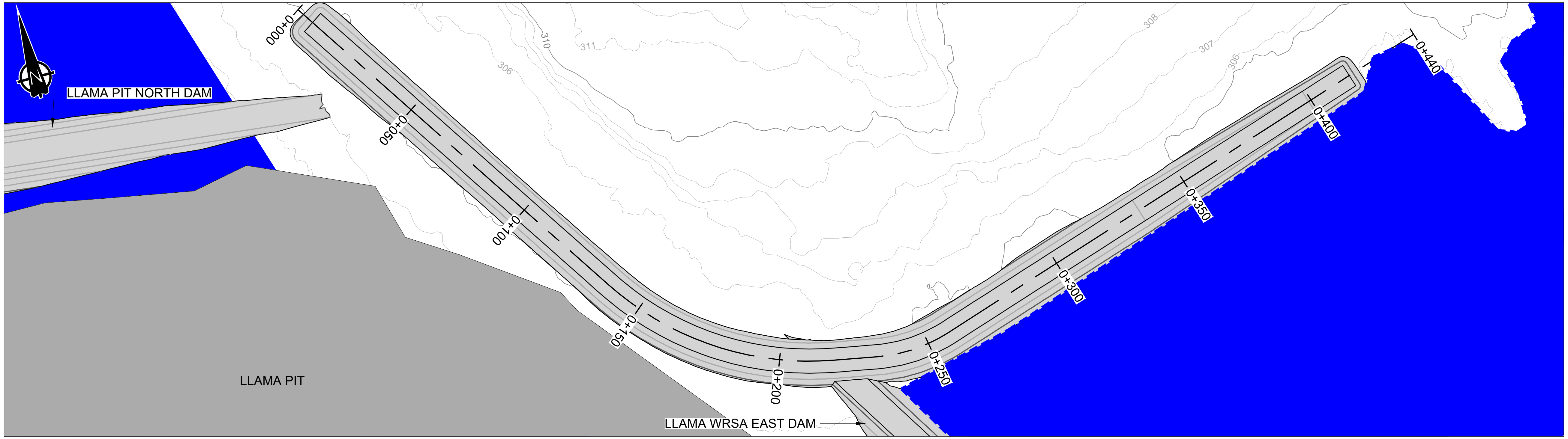
**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. INSTALLATION OF CULVERTS TO FOLLOW THE MANUFACTURERS ASSEMBLY AND INSTALLATION GUIDE.
3. TOTAL DEPTH OF COVER ABOVE CULVERT, INCLUDING BEDDING MATERIAL, SURFACING MATERIAL, AND ROQ MATERIAL, WILL BE 1.5M MINIMUM.
4. FOR SAFETY BARRIER SIZING, HEIGHT TO BE A MINIMUM ¾ THE DIAMETER OF THE LARGEST VEHICLE TIRE.
5. IF NATURAL GROUND IS LESS THAT 1% GRADE, FILL MATERIAL (SURFACING MATERIAL) TO BE PLACED BELOW CULVERT TO ESTABLISH MINIMUM 1% GRADE.
6. NON-WOVEN GEOTEXTILE IS SUGGESTED TO BE PLACED BELOW ALL CULVERT PIPES TO HELP LOW RATES OF PERMAFROST DEGRADATION FROM SURFACE WATER FLOW, AND TO HELP REDUCE DIFFERENTIAL SETTLEMENT.
7. ULTIMATE CREST WIDTH OF ROADS WILL BE SET BASED ON THE DESIGN VEHICLES. THE MINIMUM ROAD CREST WIDTH OF SINGLE LAND TRAFFIC SHALL BE TWICE THE WIDTH OF THE LARGEST DESIGN VEHICLE AS PER WSCC (2015). DUAL LANE TRAFFIC REQUIRES ROAD WIDTH THREE TIMES THE LARGEST DESIGN VEHICLE.
8. CULVERTS ON SITE MAY BE HDPE (HIGH-DENSITY POLYETHYLENE) OR CSP (CORRUGATED STEEL PIPE). FINAL MATERIALS TO BE DETERMINED DURING DETAILED DESIGN.

NOT FOR CONSTRUCTION

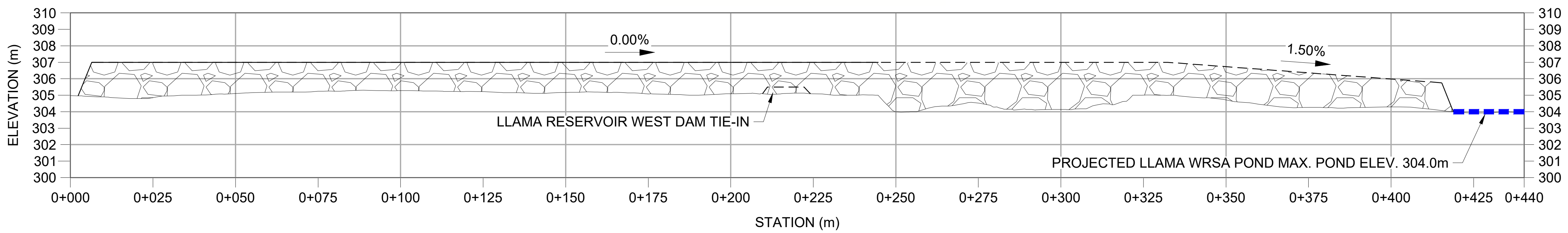
**DRAFT**

| | | | |
|---|---|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. | PROJECT | SABINA BACK RIVER PROJECT |
| CONSULTANT | GOLDER MEMBER OF WSP | TITLE | TYPICAL ROAD AND CROSSING SECTIONS |
| YYYY-MM-DD | 2022-04-21 | PROJECT NO. | 21505757 |
| DESIGNED | JKB | PHASE/TASK | 11000/40 |
| PREPARED | J. FUNKE | REV. | A |
| REVIEWED | - | FIGURE | A-12 |
| APPROVED | - | | |




## LLAMA PIT DIVERSION BERM

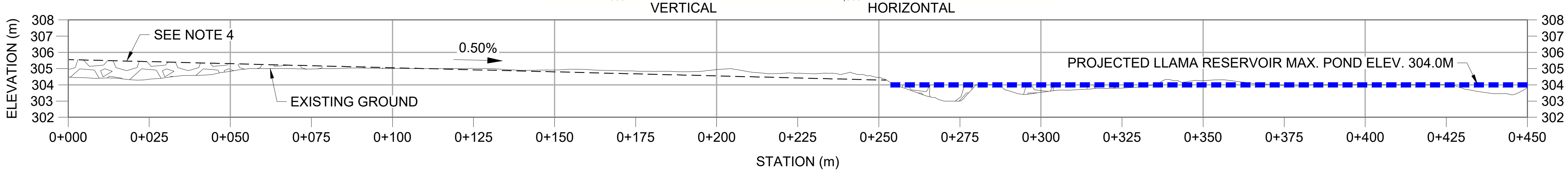
0 25 50
1:1,500 METRES




## LLAMA PIT DIVERSION BERM CENTERLINE PROFILE

0 5 10
1:300 METRES
VERTICAL

0 25 50
1:1,500 METRES
HORIZONTAL




## LLAMA PIT DIVERSION BERM UPSTREAM TOE PROFILE

0 5 10
1:300 METRES
VERTICAL

0 25 50
1:1,500 METRES
HORIZONTAL

NOT FOR CONSTRUCTION

**DRAFT**

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.018 - LLAMA RESERVOIR.DWG; TITLE: LLAMA RESERVOIR DIVERSION BERM PLAN AND PROFILE; DRAWING NO. A-22; DATED: 2020/06/05.

**LEGEND**

- FULL SUPPLY LEVEL (ELEV. 304.0M)
- DESIGN INFRASTRUCTURE
- ROCKFILL
- MAXIMUM WATER LEVEL (304.0m)

**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOURS SHOWN AT 1.0 m INTERVALS.
3. WATER DIVERSION / CONVEYANCE WILL BE AT THE UPSTREAM / UPSLOPE TOE. CONTOURS WILL BE REQUIRED TO BE CONFIRMED TO ENSURE THAT MINIMUM 0.5% GRADE ESTABLISHED / MAINTAINED.
4. ADDITIONAL FILL MATERIAL OR ALIGNMENT ADJUSTMENT EXPECTED TO BE REQUIRED TO ENSURE THAT WATER WILL NOT POND AGAINST BERM. FINAL ALIGNMENT OPTIMIZATIONS TO BE BASED ON FIELD GROUND SURVEY.
5. REQUIRED KEY TRENCH DEPTH AND DAM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
6. COORDINATE SYSTEM: NAD83 UTM ZONE 13.

CLIENT
SABINA GOLD & SILVER CORP.

CONSULTANT
GOLDER
MEMBER OF WSP

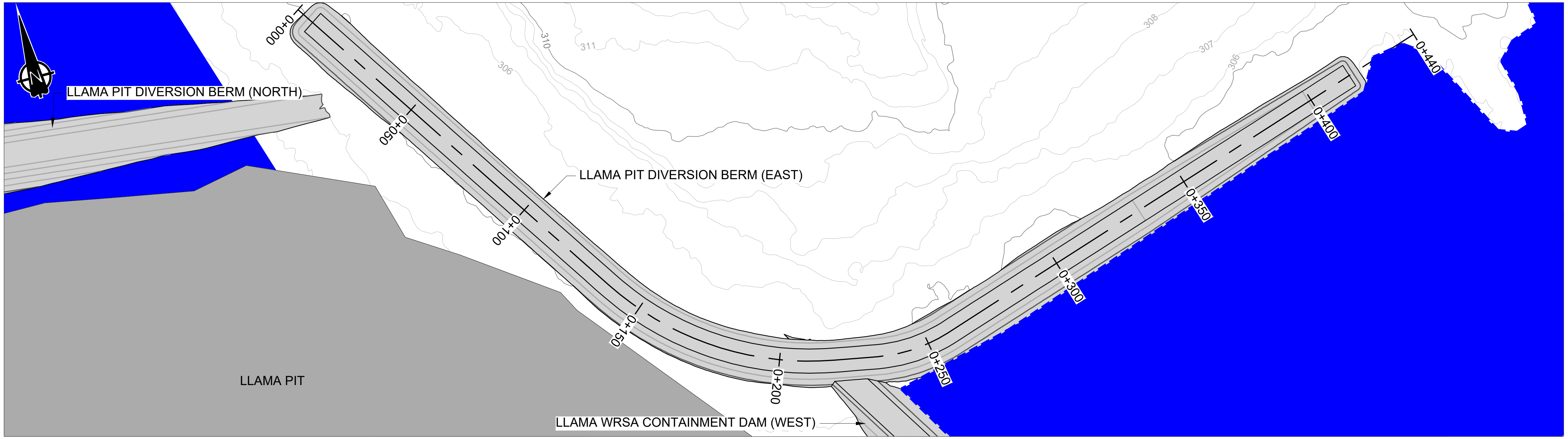
| | |
|---|---|
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |

PROJECT
SABINA BACK RIVER PROJECT

TITLE
**LLAMA PIT DIVERSION BERM PLAN AND PROFILE**

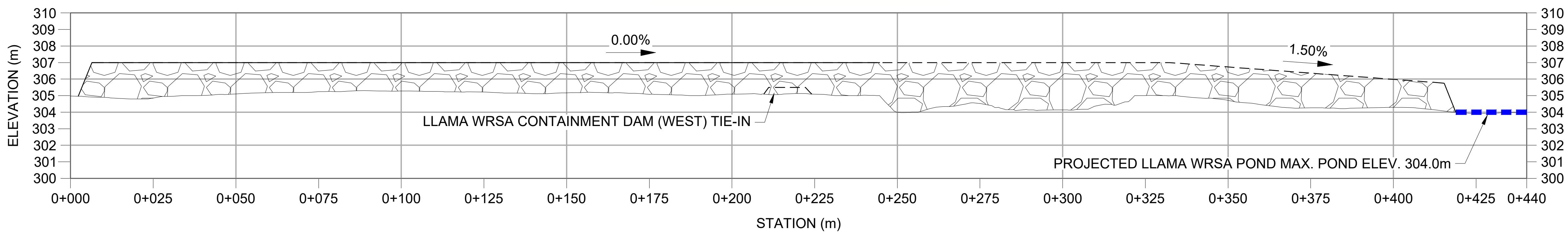
| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 21505757 | 11000/40 | A | A-13 |

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B




## LLAMA PIT DIVERSION BERM

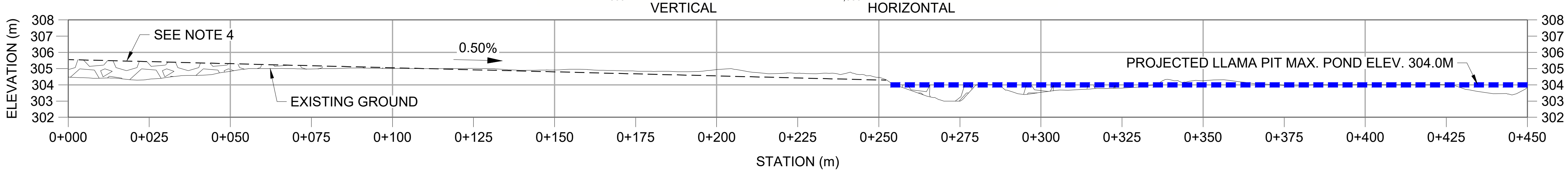
0 25 50
1:1,500 METRES




## LLAMA PIT DIVERSION BERM (EAST) CENTERLINE PROFILE

0 5 10
1:300 METRES
VERTICAL

0 25 50
1:1,500 METRES
HORIZONTAL




## LLAMA PIT DIVERSION BERM (EAST) UPSTREAM TOE PROFILE

0 5 10
1:300 METRES
VERTICAL

0 25 50
1:1,500 METRES
HORIZONTAL

NOT FOR CONSTRUCTION

**DRAFT**

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.018 - LLAMA RESERVOIR.DWG; TITLE: LLAMA RESERVOIR DIVERSION BERM PLAN AND PROFILE; DRAWING NO. A-22; DATED: 2020/06/05.

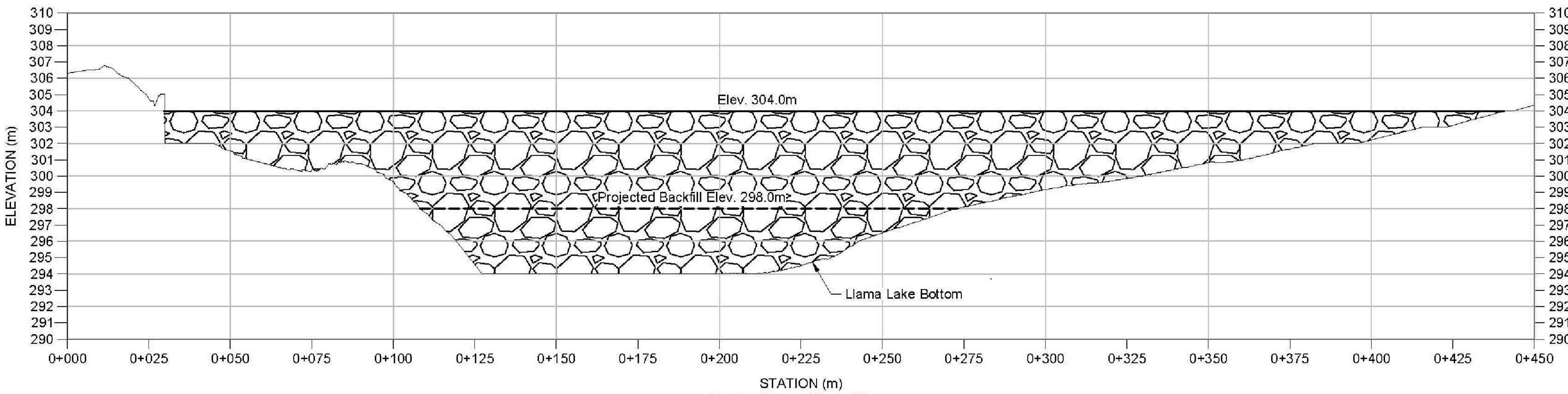
**LEGEND**

- FULL SUPPLY LEVEL (ELEV. 304.0M)
- DESIGN INFRASTRUCTURE
- ROCKFILL
- MAXIMUM WATER LEVEL (304.0m)

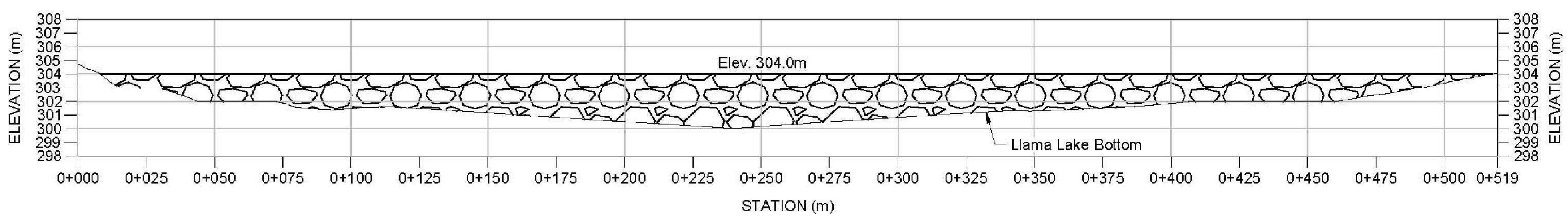
**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOURS SHOWN AT 1.0 m INTERVALS.
3. WATER DIVERSION / CONVEYANCE WILL BE AT THE UPSTREAM / UPSLOPE TOE. CONTOURS WILL BE REQUIRED TO BE CONFIRMED TO ENSURE THAT MINIMUM 0.5% GRADE ESTABLISHED / MAINTAINED.
4. ADDITIONAL FILL MATERIAL OR ALIGNMENT ADJUSTMENT EXPECTED TO BE REQUIRED TO ENSURE THAT WATER WILL NOT POND AGAINST BERM. FINAL ALIGNMENT OPTIMIZATIONS TO BE BASED ON FIELD GROUND SURVEY.
5. REQUIRED KEY TRENCH DEPTH AND DAM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
6. COORDINATE SYSTEM: NAD83 UTM ZONE 13.

| | |
|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. |
| CONSULTANT | GOLDER MEMBER OF WSP |
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |
| PROJECT | SABINA BACK RIVER PROJECT |
| TITLE | LLAMA PIT DIVERSION BERM (EAST) PLAN AND PROFILE |
| PROJECT NO. | 21505757 |
| PHASE/TASK | 11000/40 |
| REV. | A |
| FIGURE | A-14 |




LLAMA PIT DIVERSION BERM (NORTH) PROFILE VIEW




LLAMA PIT DIVERSION BERM (WEST) PROFILE VIEW

## LEGEND

Rockfill

## NOTES

1. All units are in meters unless otherwise specified.
2. Required key trench depth and dam and berm cross sections designs to be confirmed at detailed design stage.
3. Any backfill at or around the mined out Llama Pit to have a minimum 5.0m water cover.

NOT FOR CONSTRUCTION

**DRAFT**


**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING.
TITLE: LLAMA PIT NORTH BERM AND WEST BERM PROFILES; DRAWING NO. A-24; DATED: 2020/06/05.


CLIENT
SABINA GOLD & SILVER CORP.

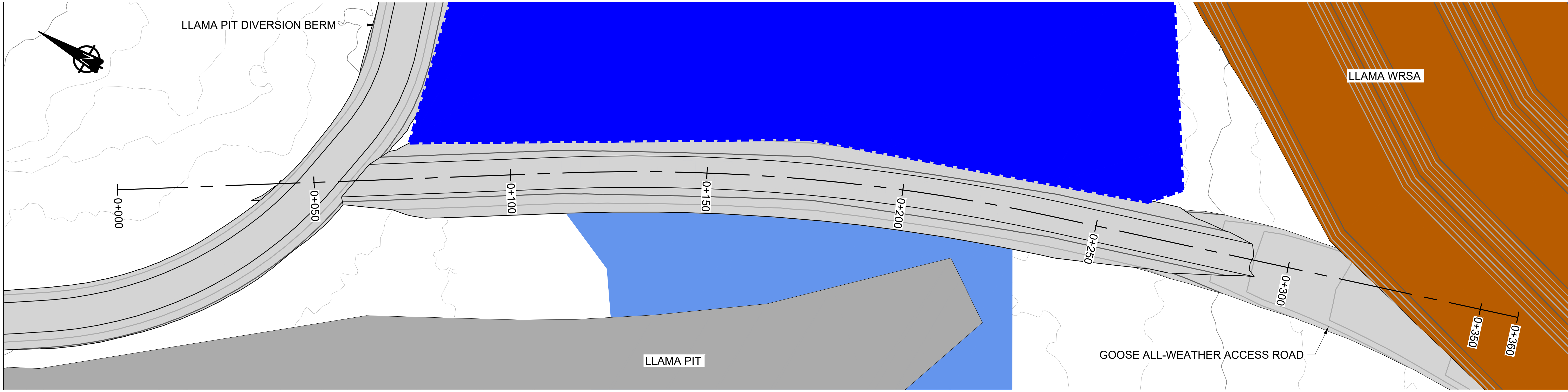
PROJECT
2021 WATER MANAGEMENT PLAN

CONSULTANT
GOLDER MEMBER OF WSP

| | |
|---|---|
| YYYY-MM-DD | 2022-04-18 |
| DESIGNED | SRK |
| PREPARED | J. KOWNACKI |
| REVIEWED | - |
| APPROVED | - |

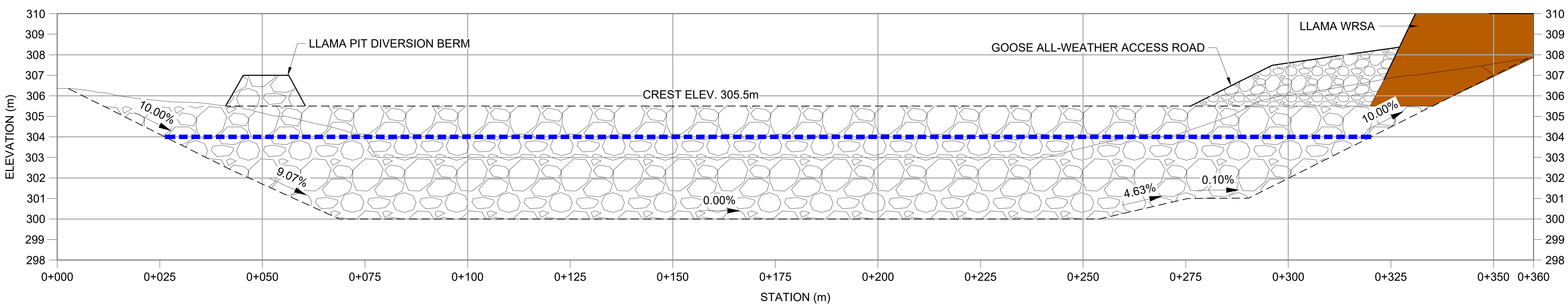
TITLE
**LLAMA PIT DIVERSION BERM (NORTH AND WEST) PROFILES**

| PROJECT NO. | PHASE/TASK/DOC | REV. | FIGURE |
|---|---|---|---|
| 21505757 | 11000/40 | A | A-15 |




**LLAMA WRSA CONTAINMENT DAM (WEST)**

0 25 50
1:1,000 METRES




**LLAMA WRSA CONTAINMENT DAM (WEST) PROFILE**

0 5 10
1:200 VERTICAL METRES

0 25 50
1:1,000 HORIZONTAL METRES

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

- FULL SUPPLY LEVEL (ELEV. 304.0M)
- DESIGN INFRASTRUCTURE
- WASTE ROCK STORAGE AREA
- ROCKFILL
- MAXIMUM WATER LEVEL (304.0M)

**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOURS SHOWN AT 1.0 m INTERVALS.
3. REQUIRED KEY TRENCH DEPTH AND DM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
4. COORDINATE SYSTEM: NAD83 UTM ZONE 13.

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.18 - LLAMA RESERVOIR.DWG; TITLE: LLAMA PIT EAST DAM PLAN AND PROFILE; DRAWING NO. A-14; DATED: 2020/06/05.

CLIENT
SABINA GOLD & SILVER CORP.

CONSULTANT
GOLDER MEMBER OF WSP

| | |
|---|---|
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |

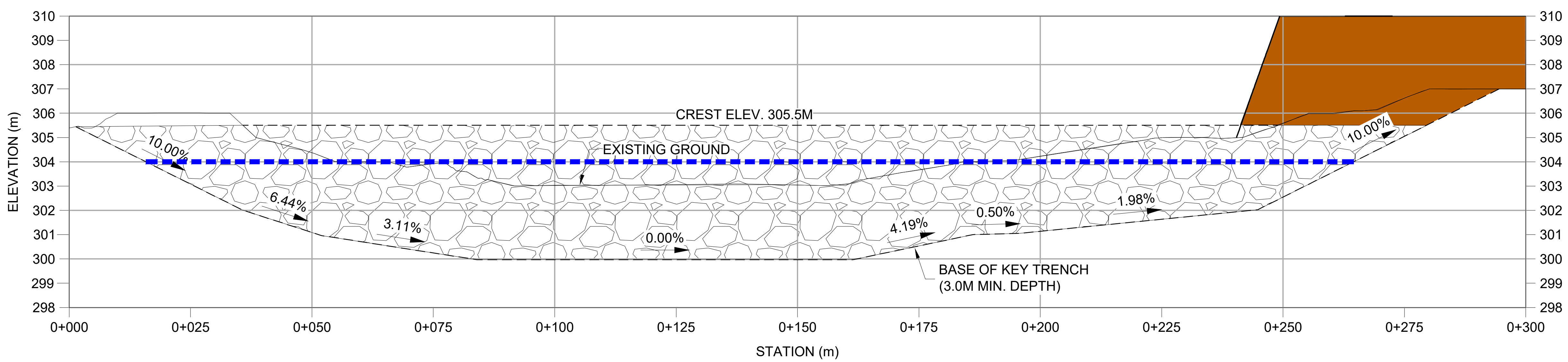
PROJECT
SABINA BACK RIVER PROJECT

TITLE
**LLAMA WRSA CONTAINMENT DAM (WEST) PLAN AND PROFILE**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 21505757 | 11000/40 | A | A-16 |


**LLAMA WRSA CONTAINMENT DAM (EAST)**

1:1,000 METRES




**LLAMA WRSA CONTAINMENT DAM (EAST) PROFILE**

1:200 METRES VERTICAL

1:1,000 METRES HORIZONTAL

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

- FULL SUPPLY LEVEL (ELEV. 304.0M)
- DESIGN INFRASTRUCTURE
- WASTE ROCK STORAGE AREA
- ROCKFILL
- MAXIMUM WATER LEVEL (304.0M)

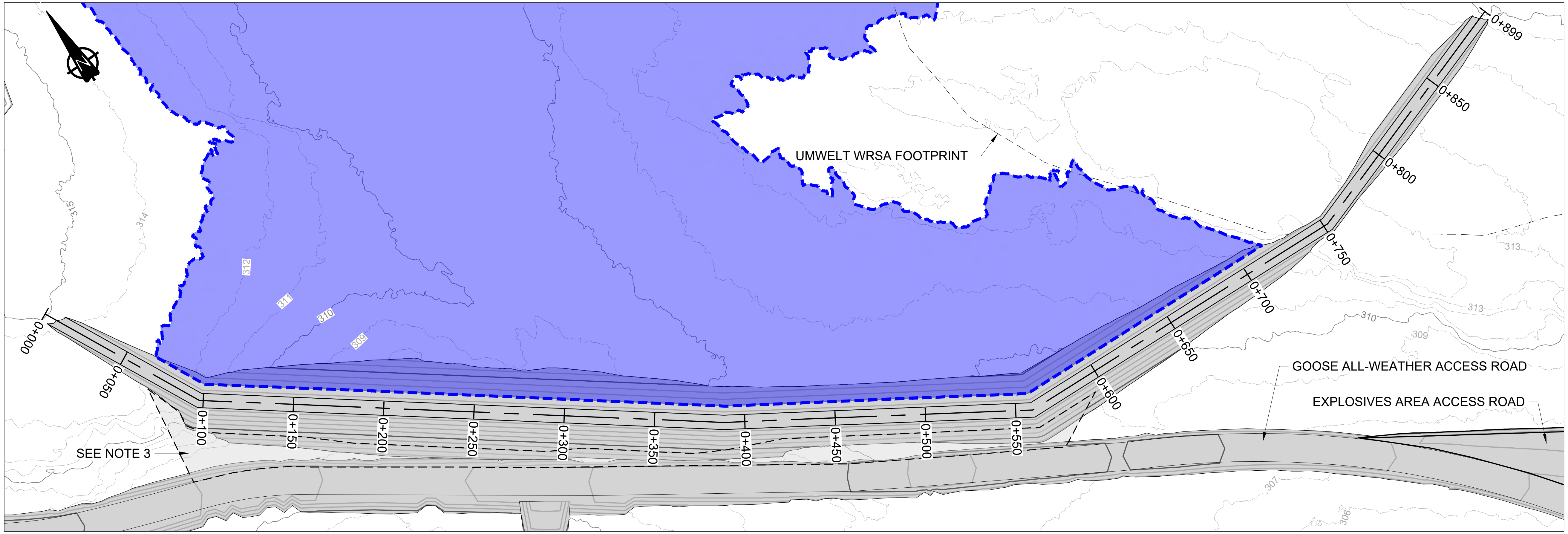
**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOURS SHOWN AT 1.0 m INTERVALS.
3. REQUIRED KEY TRENCH DEPTH AND DM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
4. COORDINATE SYSTEM: NAD83 UTM ZONE 13.

**REFERENCES**

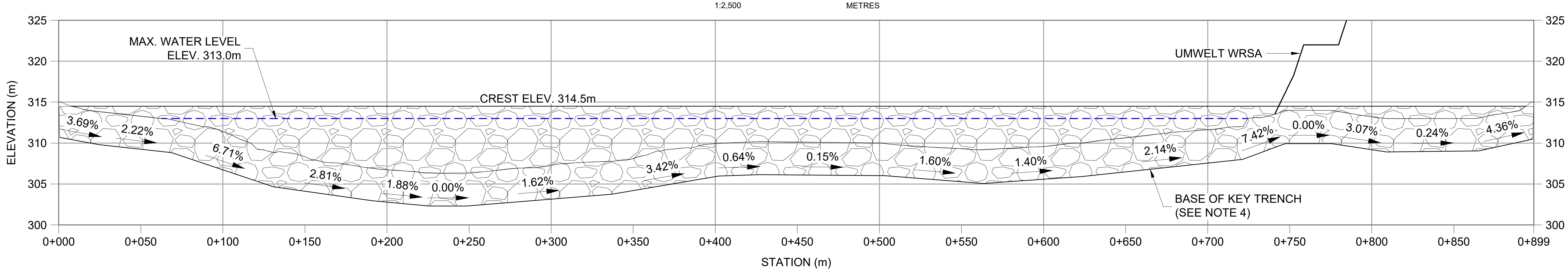
1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.18 - LLAMA RESERVOIR.DWG; TITLE: LLAMA RESERVOIR WRSA CONTAINMENT DAM PLAN AND PROFILE; DRAWING NO. A-13; DATED: 2020/06/05.

| | |
|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. |
| CONSULTANT | GOLDER MEMBER OF WSP |
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |
| PROJECT | SABINA BACK RIVER PROJECT |
| TITLE | LLAMA WRSA CONTAINMENT DAM (EAST) PLAN AND PROFILE |
| PROJECT NO. | 21505757 |
| PHASE/TASK | 11000/40 |
| REV. | A |
| FIGURE | A-17 |




**PRIMARY POND CONTAINMENT DAM**

0 50 100
1:2,500 METRES




**PRIMARY POND CONTAINMENT DAM PROFILE**

0 10 20
1:500 METRES
VERTICAL

0 50 100
1:2,500 METRES
HORIZONTAL

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

- DESIGN INFRASTRUCTURE
- ROCKFILL
- MAXIMUM WATER LEVEL (313.0m)

**REFERENCES**

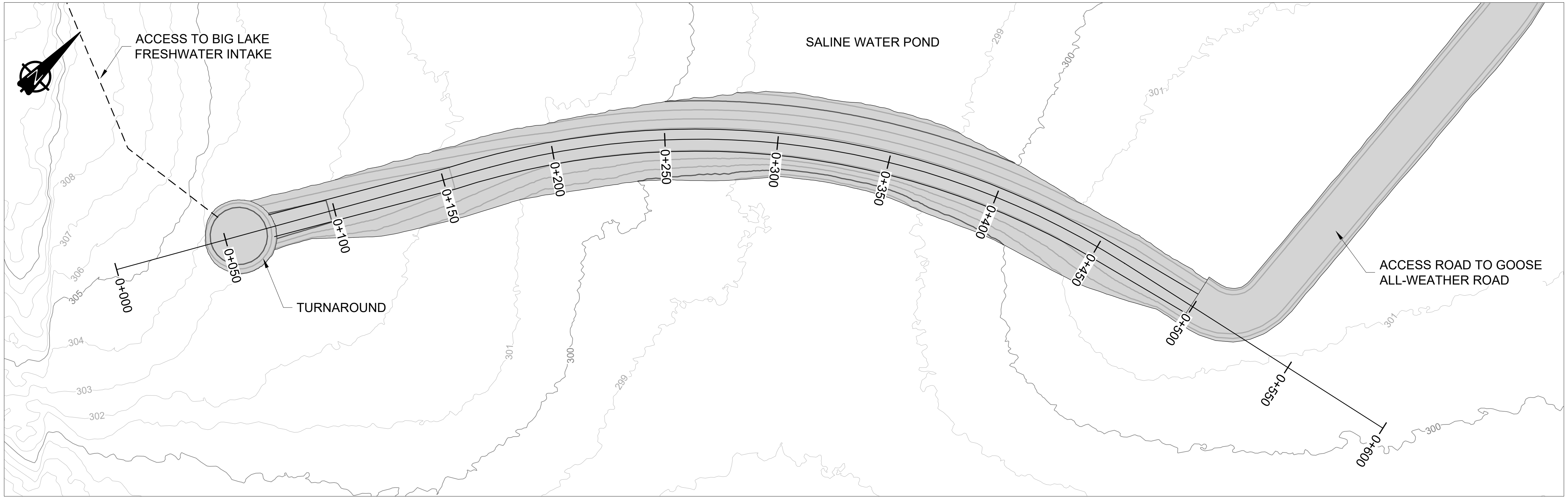
1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.18 - PRIMARY POND.DWG; TITLE: PRIMARY POND DAM PLAN AND PROFILE; DRAWING NO. A-25; DATED: 2020/06/05.

**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOURS SHOWN AT 1.0 m INTERVALS.
3. THE DOWNSTREAM AREA BETWEEN THE GOOSE ALL-WEATHER ROAD (AWR) AND DOWNSTREAM SIDE OF THE PRIMARY POND DAM TO BE FILLED WITH A MINIMUM 2.0m THICK LAYER OF BULK ROCKFILL TO ASSIST WITH THERMAL PROTECTION OF THE DOWNSTREAM TOE OF THE PRIMARY POND. EXTREME CARE MUST BE TAKEN WHEN BUILDING THE AWR IN THE AREA AND THE ROAD SHOULD BE BUILT TO A MINIMUM 2.0m THICKNESS IN THIS AREA TO ENSURE THAT THE DOWNSTREAM AREAS FROM THE PRIMARY POND DOES NOT BECOME THERMALLY DEGRADED / IMPACTED.
4. REQUIRED KEY TRENCH AND DAM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
5. COORDINATE SYSTEM: NAD83 UTM ZONE 13.

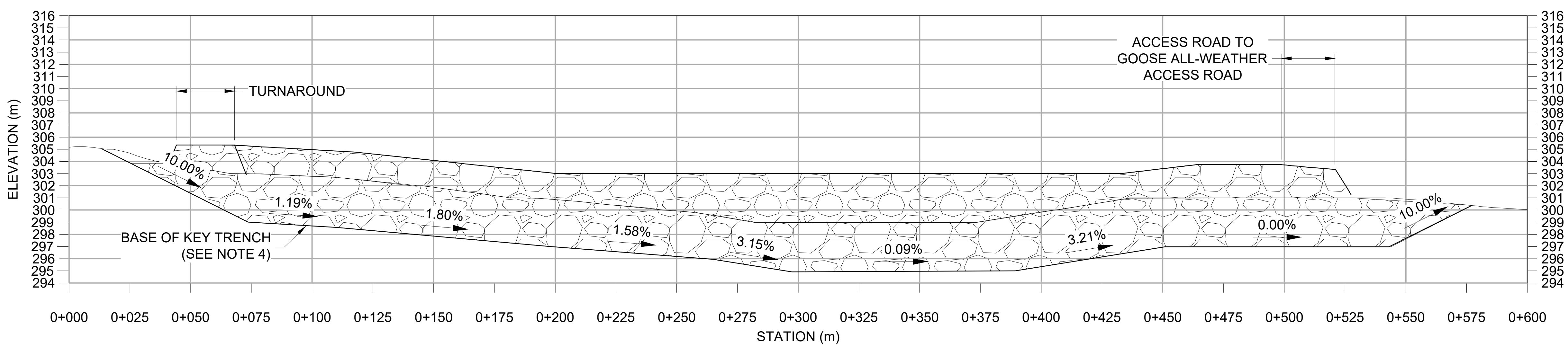
| | |
|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. |
| CONSULTANT | GOLDER MEMBER OF WSP |
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |
| PROJECT | SABINA BACK RIVER PROJECT |
| TITLE | PRIMARY POND CONTAINMENT DAM PLAN AND PROFILE |
| PROJECT NO. | 21505757 |
| PHASE/TASK | 11000/40 |
| REV. | A |
| FIGURE | A-18 |

25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B




**SALINE WATER POND CONTAINMENT DAM**

0 50 100
1:2,000 METRES




**SALINE WATER POND CONTAINMENT DAM PROFILE**

0 10 20
1:400 METRES
VERTICAL

0 50 100
1:2,000 METRES
HORIZONTAL

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

DESIGN INFRASTRUCTURE

ROCKFILL

**REFERENCES**


1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.018 - SWP.DWG; TITLE: SALINE WATER POND DAM PLAN AND PROFILE; DRAWING NO. A-26; DATED: 2020/06/05.


**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. CONTOURS SHOWN AT 1.0 m INTERVALS.
3. OVERBURDEN MAY BE PLACED OFF THE UPSTREAM FACE FOR THE SALINE WATER POND TO HELP SPREAD OUT THE SEEPAGE PATHWAY AND LIMIT LONG-TERM THERMAL IMPACTS ON THE FOUNDATION.
4. REQUIRED KEY TRENCH AND DAM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
5. COORDINATE SYSTEM: NAD83 UTM ZONE 13.

CLIENT
SABINA GOLD & SILVER CORP.

CONSULTANT
GOLDER
MEMBER OF WSP

| | |
|---|---|
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |

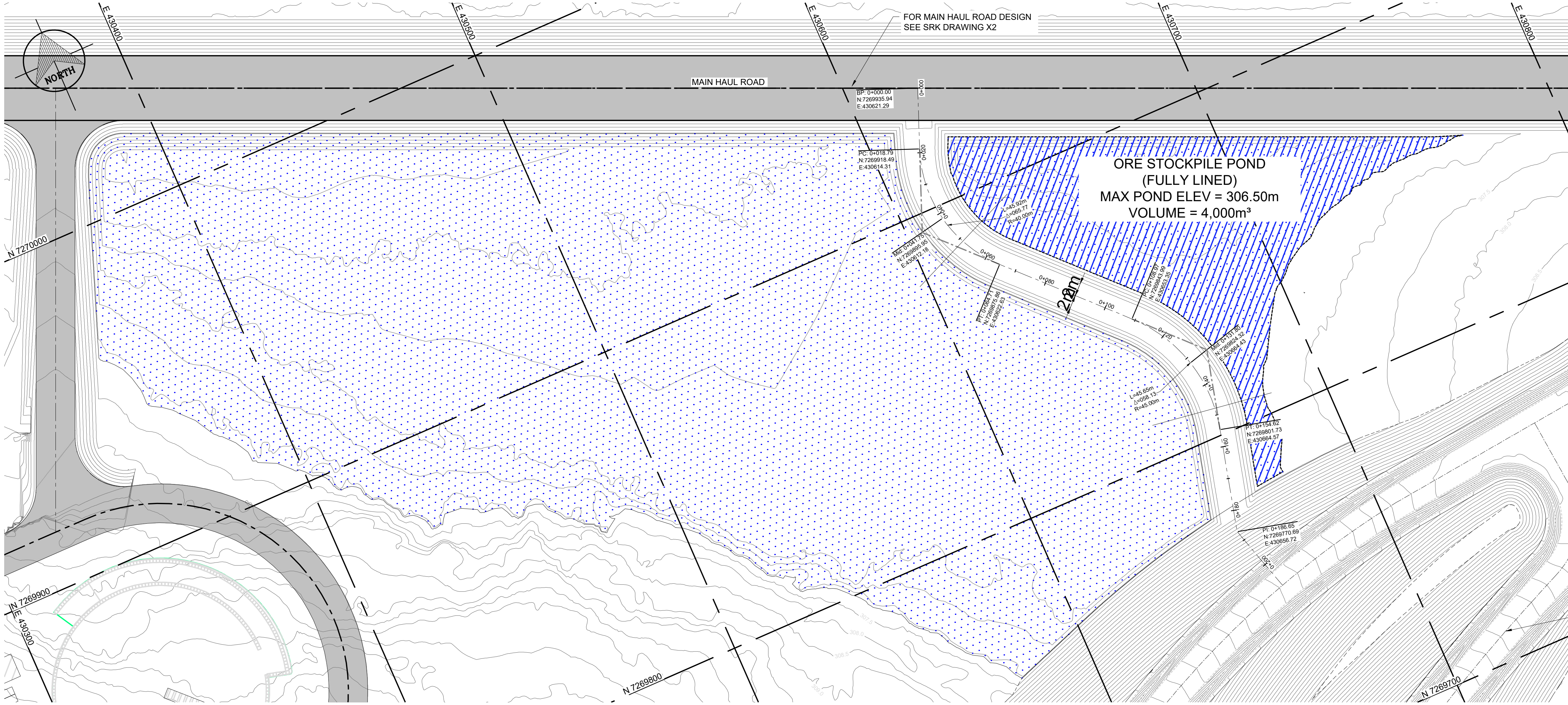
PROJECT
SABINA BACK RIVER PROJECT

TITLE
**SALINE WATER POND CONTAINMENT DAM PLAN AND PROFILE**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 21505757 | 11000/40 | A | A-19 |

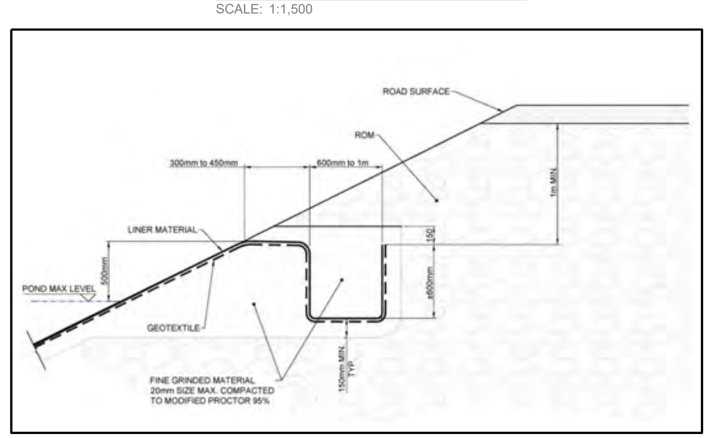
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25 mm



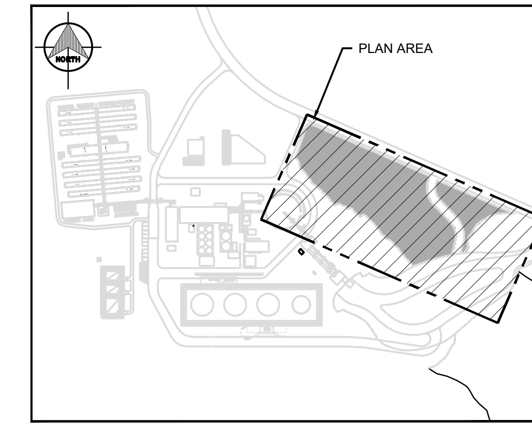

ORE STOCKPILE POND - PLAN

SCALE: 1:1,500




LINER ANCHOR DETAIL

SCALE: N.T.S.




KEY PLAN

SCALE: N. T. S.

NOT FOR CONSTRUCTION

**DRAFT**

0 25 50

1:1,500 METRES

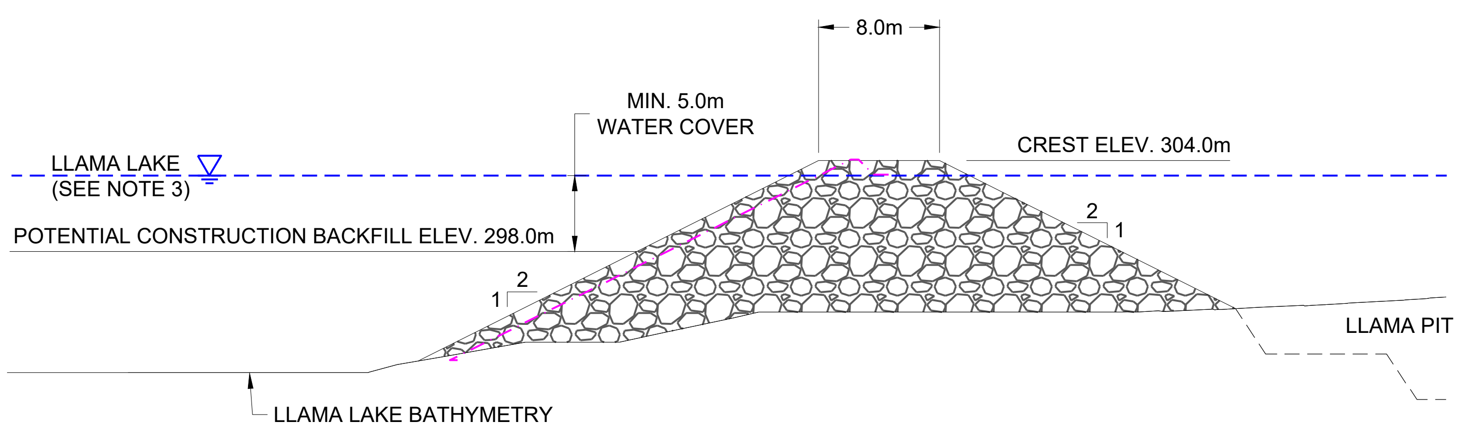

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING.
   CAD FILE: 1CS020.018 - TYPICAL SECTIONS.DWG; TITLE: TYPICAL DAM SECTIONS (SHEET 1 OF 2); DRAWING NO. A-15; DATED: 2020/06/05.
2. LINER ANCHOR DETAIL OBTAINED FROM SACRE-DEVEY ENGINEERING; DRAWING No. SBR6SDE-00-C-DET-0033; TITLE: EMERGENCE DISCHARGE POND SECTIONS & DETAILS SH.1; DATED: 2021/06/23.


**NOTES**

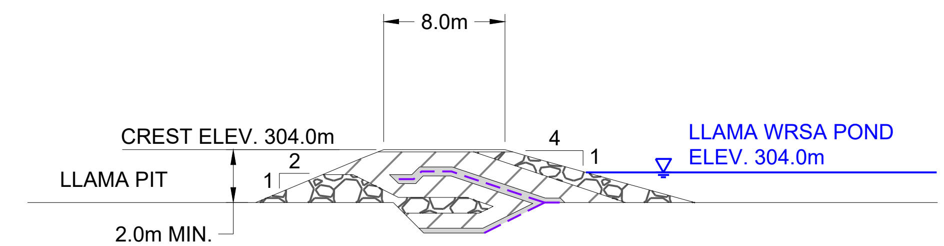
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. MAIN HAUL ROAD TO BE RAISED AS NOTED ON THIS DRAWING.
3. LINER TO BE 1.5MM (60 MIL) HDPE BLACK SMOOTH BY SOLMAX OR APPROVED EQUAL.
4. GEOTEXTILE TO BE 540 G/M² NON-WOVEN.
5. SEAMS OF THE LINER SHALL BE FIELD-MANUFACTURED USING DOUBLE WEDGE WELDING IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND SPECIFICATIONS.
6. ROAD/BERM FILL TO BE KEYED INTO FILL FOR MAIN HAUL ROAD AND DUMP POCKET ACCESS ROAD.

| | |
|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. |
| CONSULTANT | GOLDER MEMBER OF WSP |
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |
| PROJECT | SABINA BACK RIVER PROJECT |
| TITLE | ORE STOCKPILE CONTAINMENT DAM PLAN AND PROFILE |
| PROJECT NO. | 21505757 |
| PHASE/TASK | 11000/40 |
| REV. | A |
| FIGURE | A-20 |



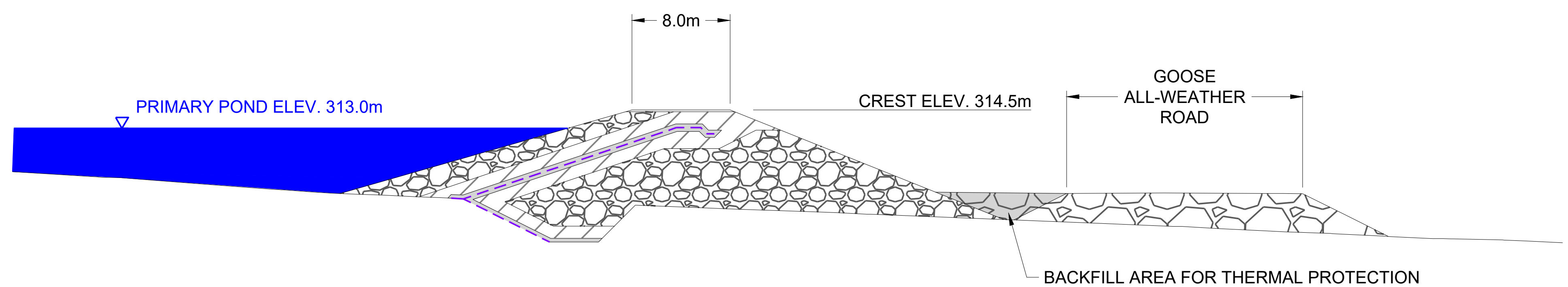

A
A-02
## CROSS SECTION A-A' - LLAMA PIT DIVERSION BERM (NORTH)

0 10 20
1:500 METRES




B
A-02
## CROSS SECTION B-B' - LLAMA WRSA CONTAINMENT DAM (WEST)

0 10 20
1:500 METRES




C
A-02
## PRIMARY POND CONTAINMENT DAM PROFILE

0 10 20
1:500 METRES

NOT FOR CONSTRUCTION
**DRAFT**

**LEGEND**

- NON-WOVEN GEOTEXTILE
- LINER SYSTEM
- FULL SUPPLY WATER LEVEL
- RUN OF MINE MATERIAL
- ROCKFILL MATERIAL
- TRANSITION MATERIAL
- BEDDING MATERIAL
- SURFACING MATERIAL

**NOTES**

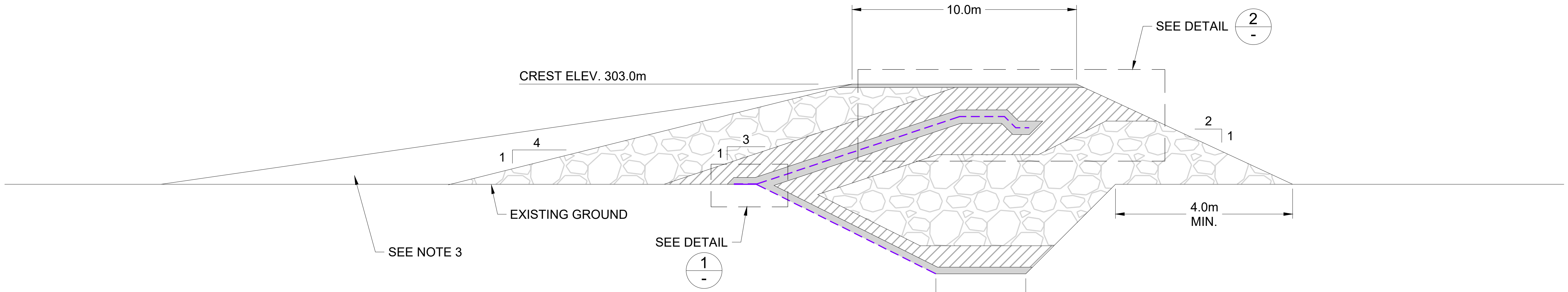
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. REMOVE 1.0M ORGANICS AT GROUND SURFACE ALONG BERM / DAM CONTACT AREA.
3. LAKE DEWATERED FOR MINING ACTIVITIES THEN BERM BREACHED AND PIT FLOODED AT CLOSURE.REQUIRED KEY TRENCH AND DAM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
4. REQUIRED KEY TRENCH DEPTH AND DAM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.018 - TYPICAL SECTIONS.DWG; TITLE: TYPICAL DAM SECTIONS (SHEET 1 OF 2); DRAWING NO. A-15; DATED: 2020/06/05.

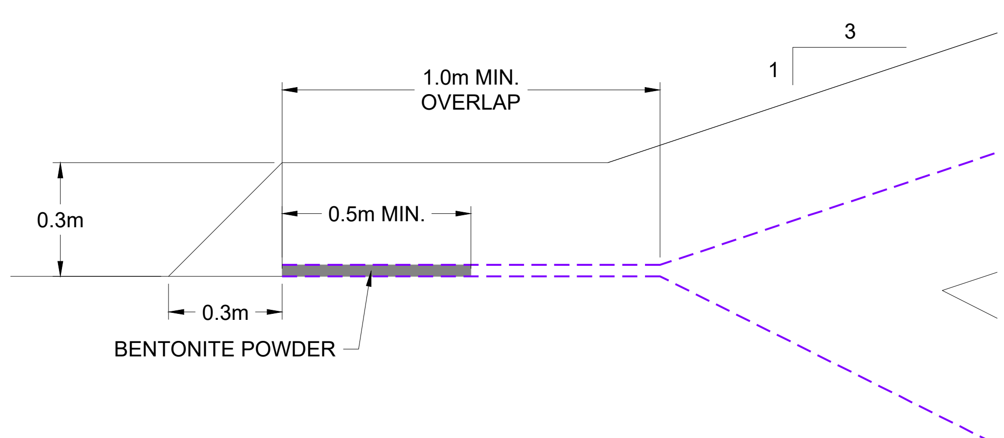
| | |
|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. |
| PROJECT | SABINA BACK RIVER PROJECT |
| CONSULTANT | GOLDER MEMBER OF WSP |
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |
| TITLE | TYPICAL DAM SECTIONS (SHEET 1 OF 2) |
| PROJECT NO. | 21505757 |
| PHASE/TASK | 11000/40 |
| REV. | A |
| FIGURE | A-21 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
25 mm



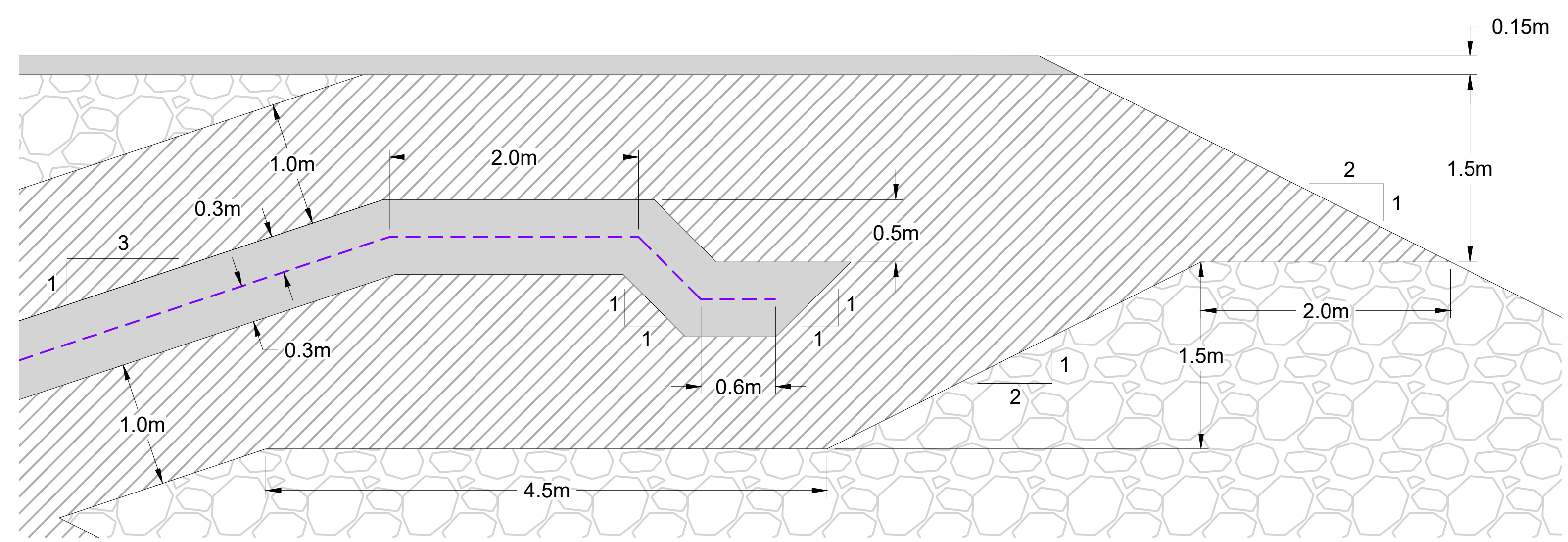

D A-02 CROSS SECTION D-D' - SALINE WATER POND CONTAINMENT DAM

0 5 10
1:200 METRES




1 - TYPICAL UPPER AND LOWER GCL JOINT DETAIL

0 0.5 1
1:20 METRES




2 - TYPICAL LINER ANCHOR TRENCH BEDDING DETAIL

0 1 2
1:60 METRES

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

- LINER SYSTEM
- FULL SUPPLY WATER LEVEL
- RUN OF MINE MATERIAL
- ENGINEERED FILL
- BENTONITE PLUG

**NOTES**

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. EXISTING GROUND IS BASED ON A 2012 LIDAR SURVEY REDUCED TO 1M HORIZONTAL RESOLUTION PROVIDED BY SABINA.
3. REQUIRED KEY TRENCH DEPTH AND DM AND BERM CROSS SECTIONS DESIGNS TO BE CONFIRMED AT DETAILED DESIGN STAGE.
4. OVERBURDEN MAY BE PLACED OFF THE UPSTREAM FACE FOR THE SALINE WATER POND TO HELP SPREAD OUT THE SEEPAGE PATHWAY AND LIMIT LONG-TERM THERMAL IMPACTS ON THE FOUNDATION.

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. CAD FILE: 1CS020.018 - TYPICAL SECTIONS.DWG; TITLE: TYPICAL DAM SECTIONS AND DETAILS (SHEET 2 OF 2); DRAWING NO. A-16; DATED: 2020/06/05.

CLIENT
SABINA GOLD & SILVER CORP.

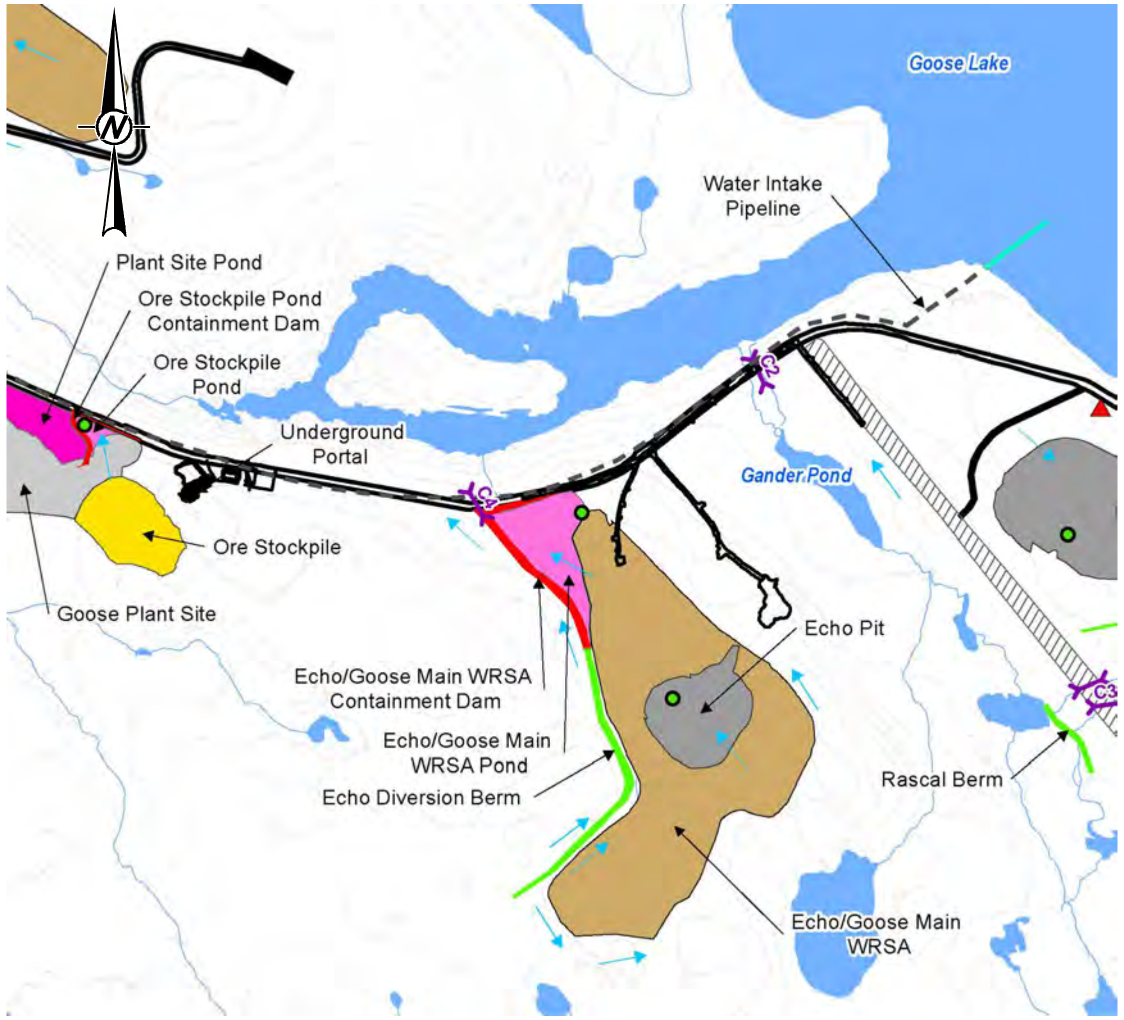
CONSULTANT
GOLDER MEMBER OF WSP

| | |
|---|---|
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |

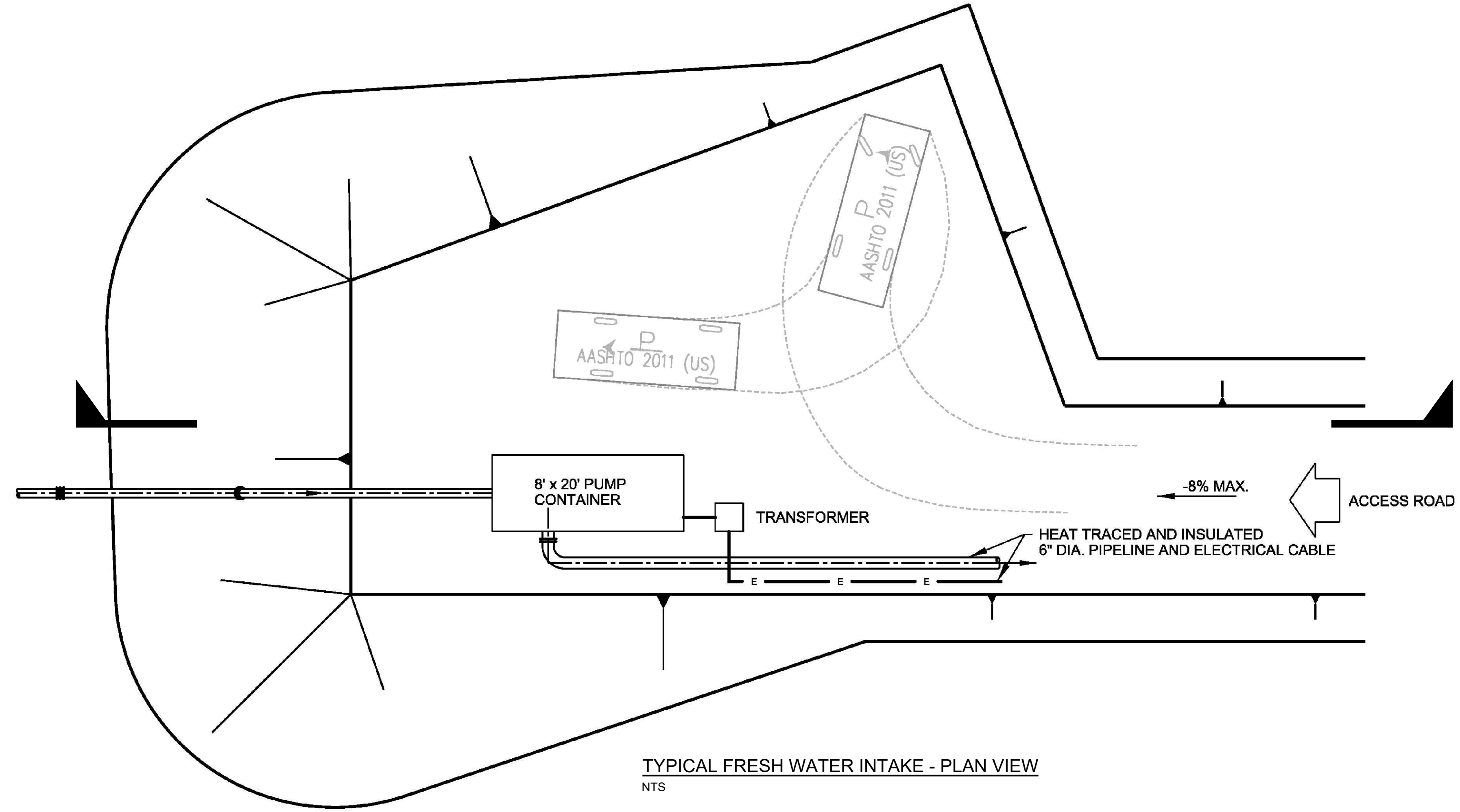
PROJECT
SABINA BACK RIVER PROJECT

TITLE
**TYPICAL DAM SECTIONS (SHEET 2 OF 2)**

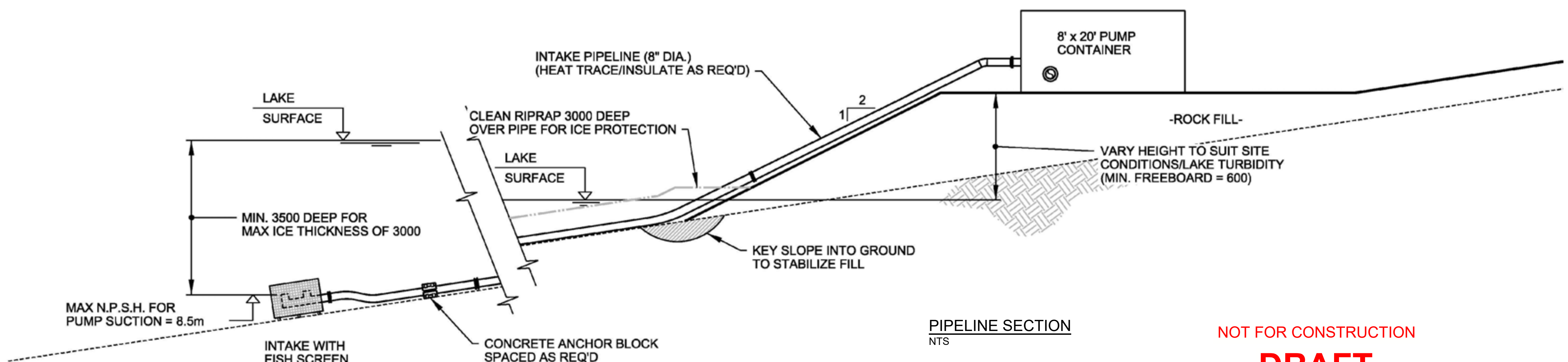
| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 21505757 | 11000/40 | A | A-22 |




KEY PLAN
NTS




TYPICAL FRESH WATER INTAKE - PLAN VIEW
NTS




PIPELINE SECTION
NTS

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

- WATER INTAKE PIPELINE
- WATER MANAGEMENT STRUCTURE
- TAILINGS EMERGENCY POND
- WATER BODIES

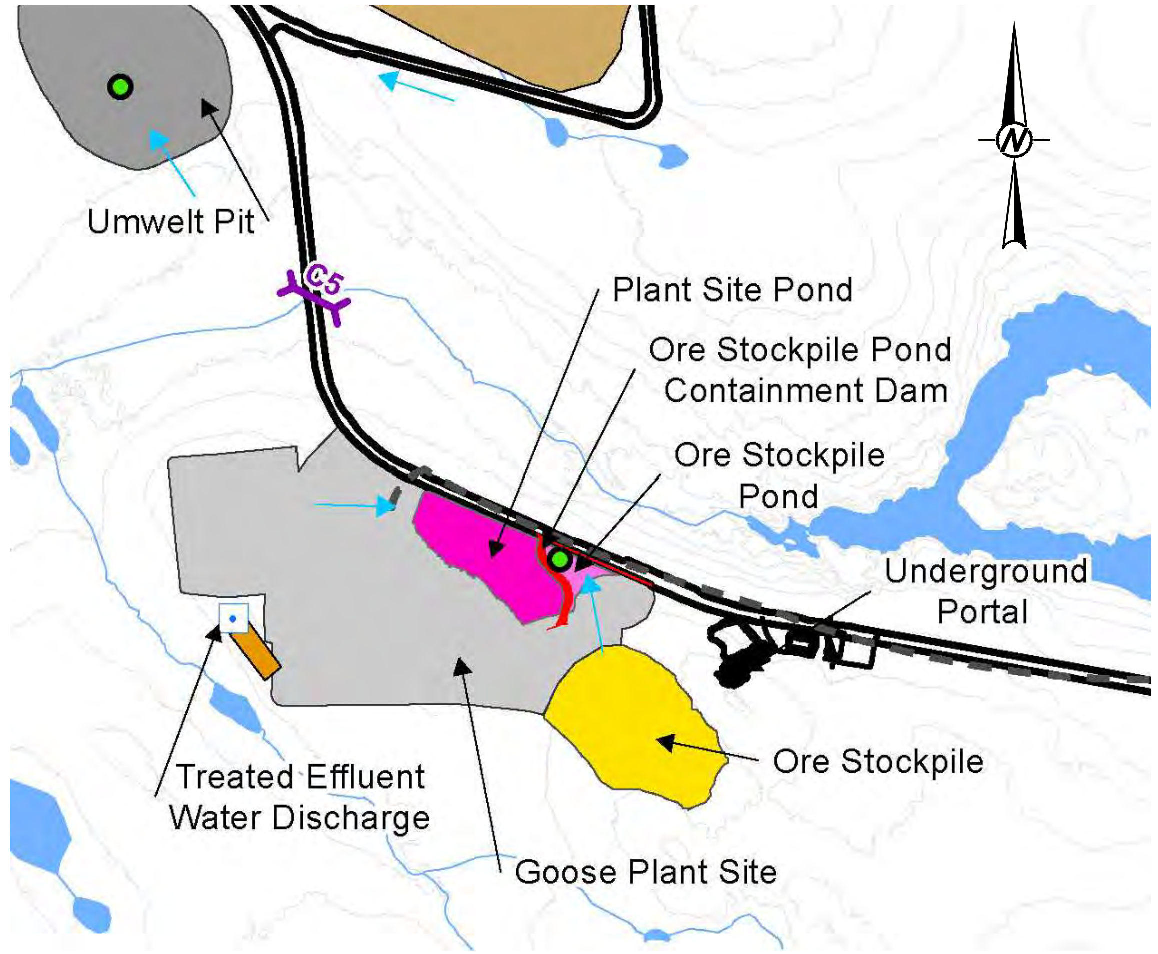
**NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ENGINEERING DESIGN IS CONSISTENT FOR ALL FRESHWATER INTAKES (GOOSE LAKE AND BIG LAKE).

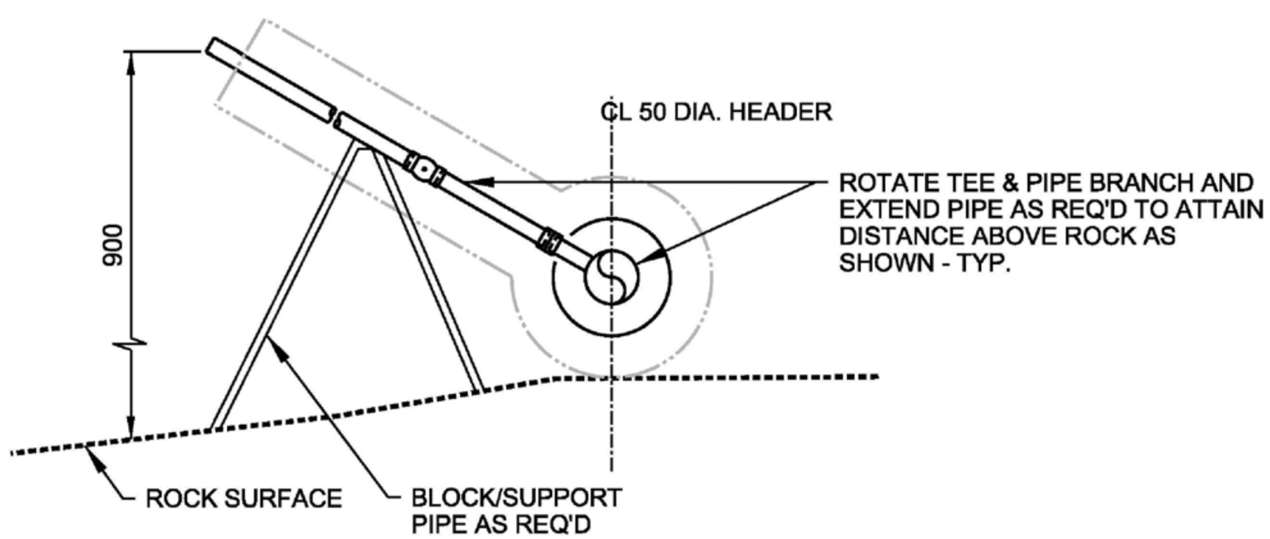
**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. FILE NAME: 1CS020.011_WMP_FIGURE_A-20.DWG. RECEIVED DATE: 2017-06-02.
2. KEY PLAN OBTAINED FROM SABINA GOLD & SILVER. FILE NAME: GSE_FEIS_NA_TAB_GOOSE_WL_2020_COPY.PDF

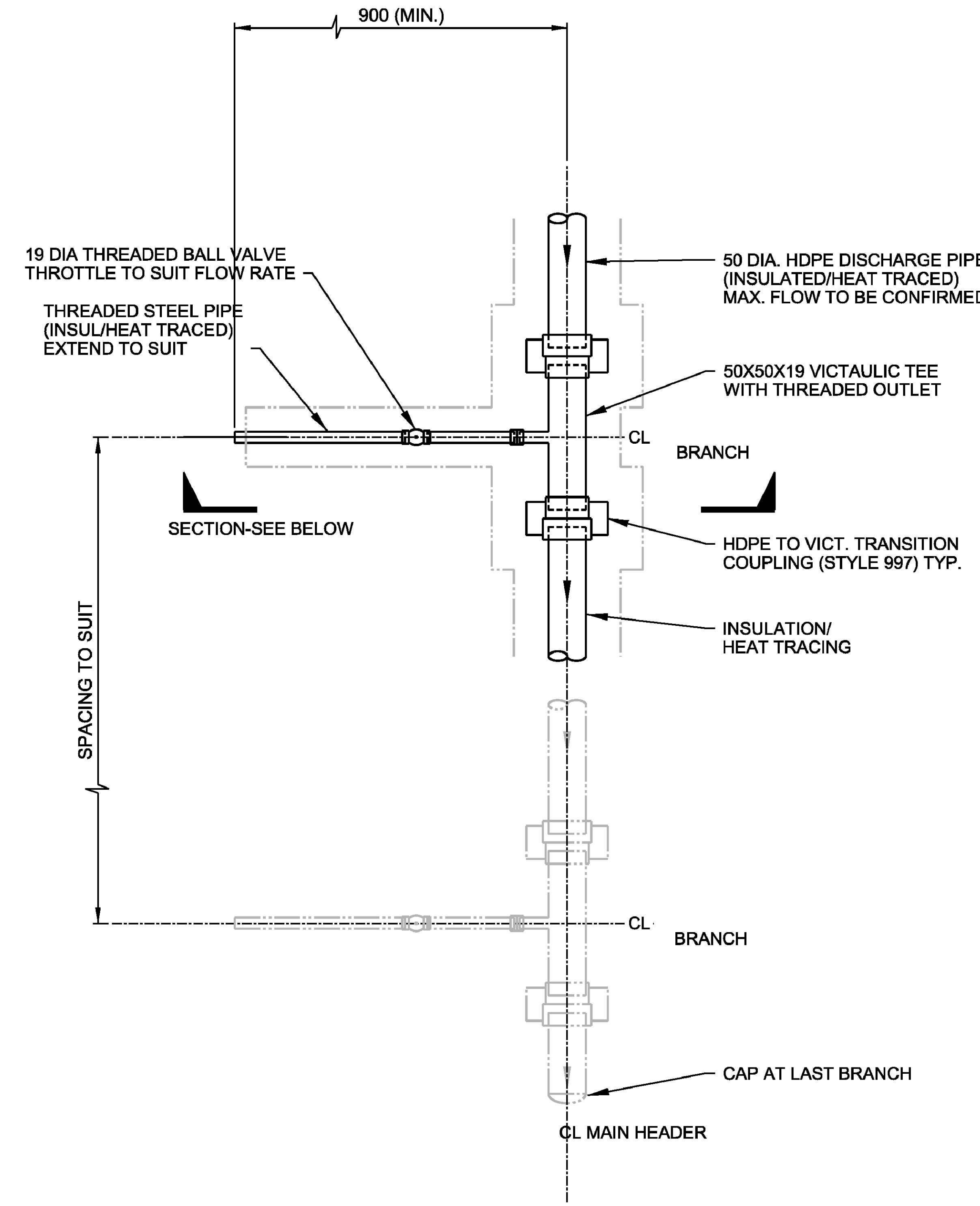
| | |
|---|---|
| CLIENT | SABINA GOLD & SILVER CORP. |
| CONSULTANT | GOLDER MEMBER OF WSP |
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |
| PROJECT | SABINA BACK RIVER PROJECT |
| TITLE | GOOSE FRESHWATER INTAKE TYPICAL PLAN AND SECTION |
| PROJECT NO. | 21505757 |
| PHASE/TASK | 11000/40 |
| REV. | A |
| FIGURE | A-23 |




PLAN




SECTION




STP TREATED WATER OUTLETS - PLAN VIEW
(# OF OUTLETS AND PIPE DIA. TO SUIT FINAL STP DISCHARGE)

NOT FOR CONSTRUCTION

**DRAFT**

**LEGEND**

- WATER INTAKE PIPELINE
- WATER MANAGEMENT STRUCTURE
- TAILINGS EMERGENCY POND
- WATER BODIES

**NOTES**

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.

**REFERENCES**

1. BASE DRAWING OBTAINED FROM SRK CONSULTING. FILE NAME: 1CS020.011_WMP_FIGURE_A-20.DWG. RECEIVED DATE: 2017-06-02.
2. KEY PLAN OBTAINED FROM SABINA GOLD & SILVER. FILE NAME: GSE_FEIS_NA_TAB_GOOSE_WL_2020_COPY.PDF

CLIENT
SABINA GOLD & SILVER CORP.

Sabina GOLD & SILVER CORP.

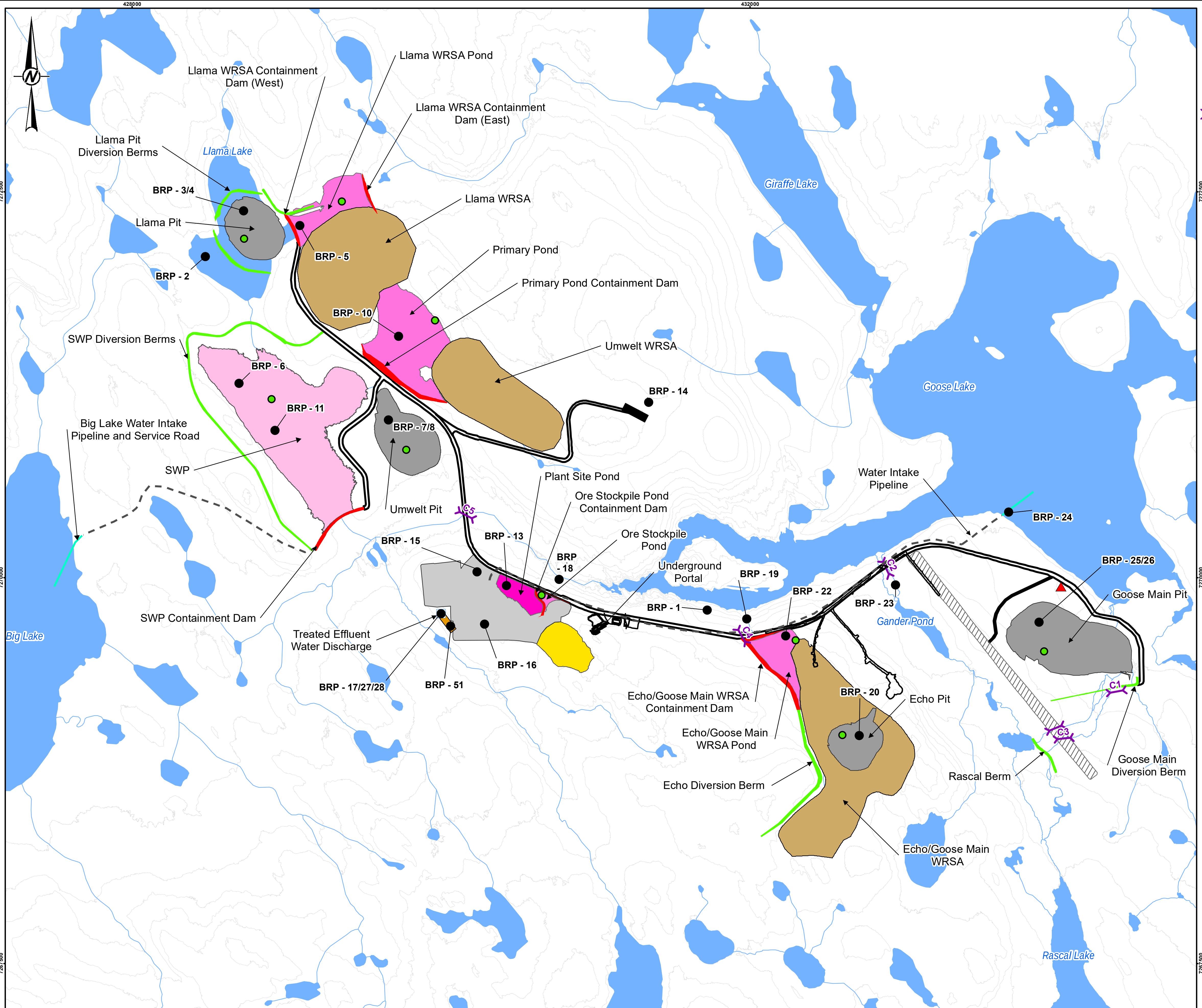
CONSULTANT
GOLDER MEMBER OF WSP

| | |
|---|---|
| YYYY-MM-DD | 2022-04-21 |
| DESIGNED | SRK |
| PREPARED | J. FUNKE |
| REVIEWED | - |
| APPROVED | - |

PROJECT
SABINA BACK RIVER PROJECT

TITLE
**GOOSE STP TREATED WATER DISCHARGE PLAN AND SECTION**

| PROJECT NO. | PHASE/TASK | REV. | FIGURE |
|---|---|---|---|
| 21505757 | 11000/40 | A | A-24 |




**LEGEND**

- EXISTING EXPLORATION CAMP
- ACTIVE MONITORING STATION LOCATION
- TREATED EFFLUENT WATER DISCHARGE
- PUMP
- CONTOUR (5 m)
- CULVERT
- WATERCOURSE
- WATER INTAKE PIPELINE
- AIRSTRIP
- CONTACT WATER POND
- GOOSE PLANT SITE
- HAUL ROAD
- OTHER INFRASTRUCTURE
- ORE STOCKPILE
- OPEN PIT
- NON-CONTACT WATER CONTAINMEMNT BERM (UNLINED)
- CONTACT WATER CONTAINMENT DAM (LINED)
- SALINE WATER POND (SWP)
- WASTE ROCK STORAGE AREA (WRSA)
- LANDFARM
- WATERBODY

**DRAFT**

0 750 1,500

1:25,000 METRES

**REFERENCE(S)**

FOOTPRINT DERIVED BY GOLDER FROM FILES OBTAINED FROM SABINA AUG. 2021, OCT. 2021 AND FEB. 2022. HYDROGRAPHY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA MODIFIED BY GOLDER. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 13N DATUM: NAD 83

| | |
|---|---|
| YYYY-MM-DD | 2022-04-27 |
| DESIGNED | AR |
| PREPARED | SG/NB |
| REVIEWED | - |
| APPROVED | - |

CLIENT
Sabina

CONSULTANT
GOLDER MEMBER OF WSP

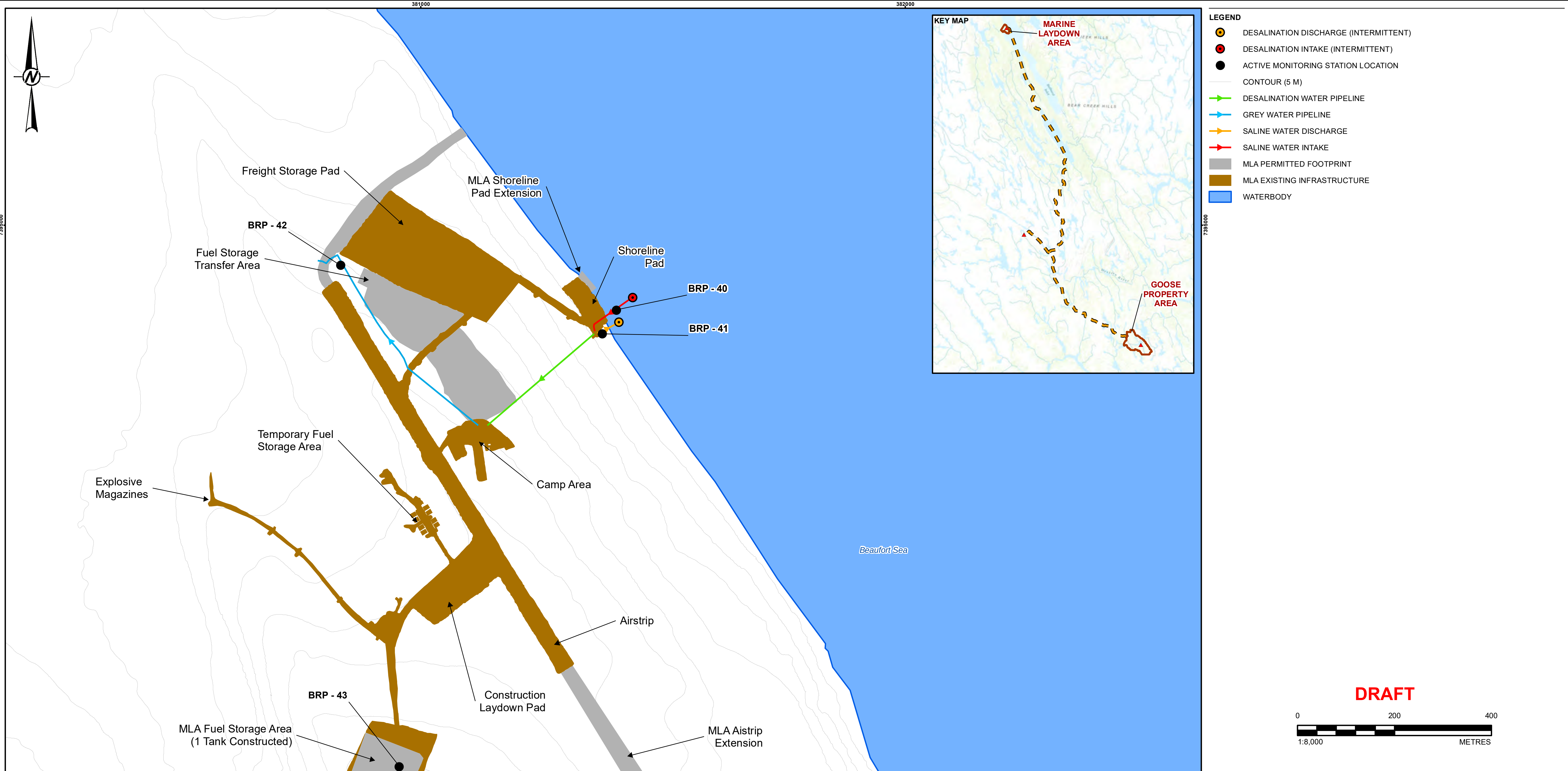
PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**GOOSE PROPERTY AREA – MONITORING LOCATIONS**

| PROJECT NO. | FIGURE | REV. |
|---|---|---|
| 21505757 | A-25 | A |

PATH: I:\CLIENTS\SABINA_SILVER\21505757\Mapping\Products\Hydrology\21505757_Figure_A25_Goose_Property_Monitoring_Location_Area_RevA.mxd PRINTED ON: 2022-04-27 AT: 1:49:36 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B




REFERENCE(S)
FOOTPRINT OBTAINED FROM CLIENTAND MODIFIED BY GOLDER.. HYDROGRAPHY DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED, MODIFIED BY GOLDER.
PROJECTION: UTM ZONE 13N DATUM: NAD 83

| | |
|---|---|
| YYYY-MM-DD | 2022-04-27 |
| DESIGNED | AR |
| PREPARED | NB |
| REVIEWED | - |
| APPROVED | - |

CLIENT: Sabina

CONSULTANT: GOLDER MEMBER OF WSP

PROJECT
SABINA BACK RIVER PROJECT, WATER LICENCE PHASE, NUNAVUT CANADA

TITLE
**MARINE LAYDON AREA – MONITORING LOCATIONS**

| PROJECT NO. | FIGURE | REV. |
|---|---|---|
| 21505757 | A-26 | A |

# Appendix B. Saline Water Management Plan

# Water Management Plan

# Appendix B: Saline Water Management Plan

April 2022

# BACK RIVER PROJECT

# SALINE WATER MANAGEMENT

## Table of Contents

## List of Tables

**TABLE** **PAGE**

# Revision Log

| Version | Date | Section | Page | Revision |
|---|---|---|---|---|
| 1 | June 2018 | All | All | Addition of Appendix C: Saline Water Management |
| 2 | May 2020 | All | All | Updated to reflect the 2020 Modification Package changes, and as a Supporting Document; submitted to the Nunavut Planning Commission (NPC) and Nunavut Impact Review Board (NIRB). |
| 3 | October 2020 | All | All | Submitted as a Supporting Document for the Type A Water Licence Amendment Application to the Nunavut Water Board (NWB). |
| 4 | April 2022 | All | All | Updated to reflect Type A Water Licence Amendment No.1 Part E, Item 2 and changes in operation/technology submitted to Nunavut Water Board (NWB) |

# Acronyms

| | |
|---|---|
| CCME | Canadian Council of Ministers of the Environment |
| MDMER | Metal and Diamond Mining Effluent Regulations |
| NWB | Nunavut Water Board |
| NIRB | Nunavut Impact Review Board |
| Project | Back River Project |
| Sabina | Sabina Gold & Silver Corp. |
| SWMP | Saline Water Management Plan |
| SWP | Saline Water Pond |
| TDS | Total Dissolved Solids |
| TF | Tailing Facility |
| WMP | Water Management Plan |

# 1. Introduction

The Saline Water Management Plan (SWMP or the Plan) is developed as an appendix to the Water Management Plan (WMP) to provide additional details related to the management of saline groundwater in compliance with the Type A Water Licence, 2AM-BRP1831 Amendment No.1. The WMP outlines the procedures required to manage the quantity and quality of water interacting with Project components throughout the Construction, Operations, Closure, and Post-Closure phases of the Project.

The SWMP outlines the procedures required to manage the quantity and quality of saline groundwater interacting with Project components throughout the mine life, and characterization of saline water inflows into the Llama Open Pit and underground workings at Umwelt, Llama, Goose Main, and Echo. The Plan also includes monitoring of thermal conditions, monitoring of saline water at the Goose Property, mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the open pits and the underground mine, and potential water treatment and disposal methods.

# 2. Scope and Objectives

The SWMP is provided as an appendix 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 SWMP applies to all phases of the Project during which saline water will be managed. The SWMP has been written to meet requirements of the Type A Water Licence (2AM-BRP1831 Amendment No.1 Part E, Item 2) and Nunavut Impact Review Board (NIRB) Project Certificate (No. 007).

The purpose of the SWMP 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.

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. Additional details related to the closure and reclamation of saline water management structures can also be found in the Interim Closure and Reclamation Plan (2AM-BRP1831 Part J, Item 1).

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

The SWMP 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

The SWMP should be read in conjunction with the following key plans, which have been approved for implementation by the NWB in accordance with the Type A Water Licence, 2AM-BRP1831 Amendment No.1 Part B, Item 13 and 14:

- Water Management Plan
- Environmental Management and Protection Plan
- Aquatic Effects Management Plan
- Quality Assurance/Quality Control Plan
- Interim Closure and Reclamation Plan

The following reports and studies have also informed the development of the SWMP:

- Hydrogeological Characterization and Modelling Report (Sabina 2017, Appendix F-5)
- Hydrology Report (Sabina 2015, Appendix V2-7B)
- Hydrology Update Memo (SRK 2021)
- Water and Load Balance Report (Appendix D of the WMP)

# 3. Applicable Legislation and Guidelines

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

Sabina is bound by the terms and conditions of its land use permits issued by the Kitikmeot Inuit Association for Inuit Owned Land, Crown-Indigenous Relations and Northern Affairs Canada for Crown Land, and the Type A Water Licence (2AM-BRP1831 Amendment No.1).

# 4. Saline Water Management Strategy

This section provides a description of the saline water management strategy throughout the Construction, Operations, and Closure phases of the Project. The saline water management strategy consists of collecting saline water from Llama Open Pit and the underground workings, and temporarily storing this groundwater in a dedicated surface storage facility, the Saline Water Pond (SWP). The saline water collected in the SWP will be treated with a reverse osmosis unit. The treated water will report to Umwelt Tailings Facility (TF) and brine effluent deposited back in the SWP to be used as reclaim in the Process Plant. Once milling production starts ramping down in Year 13, saline water encountered will be transferred to Goose Main Reservoir for permanent storage. In case of insufficient storage in the SWP before Year 13, saline water can be transferred to the Llama TF once active in Year 6, or Umwelt Underground around Year 10 and Year 12, approximately when the void space in the underground will become available.

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-02 of the WMP for the location of Goose Property infrastructure. 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.

## 4.1 PERMAFROST CHARACTERISTICS AND GROUNDWATER INFLOWS

The Back River Property is located in the continuous permafrost region of the Canadian Arctic. While permafrost may extend in excess of 400 metres below the ground surface (mbgs), it is expected that the underground workings will extend below this depth into unfrozen rock and soil. In addition, Llama Open Pit and Llama Underground will occur underneath a lake associated with an open talik. Of the proposed developments, groundwater inflow during Operations is only expected at Llama Open Pit, and the Llama, Umwelt, Goose Main, and Echo undergrounds. The other developments (Umwelt, Echo, and Goose Main open pits) are expected to be fully within permafrost and not intersect unfrozen groundwater.

As part of the Project, a groundwater model was completed to predict potential groundwater inflows during mining at the Goose Property; this model was employed in both the FEIS (Sabina 2015) and the Type A Water Licence Application (Sabina 2017). The groundwater model was recently updated to predict revised groundwater inflows for the current mine plan (WMP, Appendix D). A summary of the estimated annual groundwater inflows and concentrations of associated total dissolved solids (TDS) is summarized in Table 4.1-1 and Table 4.1-2 for the developments extending into unfrozen rock.

### Table 4.1-1. Annual Groundwater Inflows

| Mine Year | Predicted Groundwater Inflows ($m^3$/day) | | | | |
|---|---|---|---|---|---|
| | Llama Open Pit | Llama Underground | Umwelt Underground | Goose Main Underground | Echo Underground |
| Y1 | 75 | 190 | - | - | - |
| Y2 | <50 | 130 | 120 | - | - |
| Y3 | <50 | 100 | 350 | - | - |
| Y4 | <50 | 90 | 410 | - | - |
| Y5 | <50 | 80 | 350 | - | - |
| Y6 | - | 80 | 330 | - | - |
| Y7 | - | 80 | 310 | 10 | - |
| Y8 | - | 80 | 300 | 80 | - |
| Y9 | - | 80 | 290 | 70 | - |
| Y10 | - | 80 | 280 | 70 | - |
| Y11 | - | 70 | 280 | 70 | - |
| Y12 | - | 70 | 270 | 70 | - |
| Y13 | - | 70 | 270 | 60 | - |
| Y14 | - | 70 | 260 | 60 | <50 |
| Y15 | - | 70 | 260 | 60 | <50 |

### Table 4.1-2. Annual Predicted TDS in Groundwater Inflows

| Mine Year | Predicted Total Dissolved Solids Concentration (mg/L) | | | | |
|---|---|---|---|---|---|
| | Llama Open Pit | Llama Underground | Umwelt Underground | Goose Main Underground | Echo Underground |
| Y1 | <10000 | 2900 | - | - | - |
| Y2 | <10000 | 11300 | 16600 | - | - |
| Y3 | <10000 | 15200 | 32200 | - | - |
| Y4 | <10000 | 17500 | 47300 | - | - |
| Y5 | <10000 | 19500 | 54800 | - | - |
| Y6 | - | 20600 | 59300 | - | - |
| Y7 | - | 21600 | 62700 | 14900 | - |
| Y8 | - | 22800 | 66100 | 15900 | - |
| Y9 | - | 23800 | 70000 | 19500 | - |
| Y10 | - | 24700 | 73300 | 21500 | - |
| Y11 | - | 25700 | 76300 | 23000 | - |
| Y12 | - | 26500 | 78700 | 24300 | - |
| Y13 | - | 27400 | 81700 | 25400 | - |
| Y14 | - | 28200 | 83700 | 26300 | 9200 |
| Y15 | - | 28900 | 85700 | 27200 | 10700 |

Groundwater inflows predicted by the model considered the uncertainty in the assumed hydraulic properties for the bedrock based on the field investigation program results. The values presented in Table 4.1-1 and Table 4.1-2 represent the results of the higher flow values of the two simulations completed (Scenario 2; WMP, Appendix D). The TDS profile is inferred from the results of two site-specific samples, data at other mine sites, best management practices, and conservative assumptions have been applied for this profile. While a precautionary approach has been adopted, it is understood that higher or lower TDS concentrations could be encountered. During Operations, and if required, targeted sampling could be conducted from the underground once development extends into the unfrozen rock to refine groundwater quantity and quality estimates in advance of the development reaching deeper depths.

A detailed description of the recent update to the groundwater model is included in Appendix D of the WMP.

## 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 advanced 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 zones 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 WMP. 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, 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, Goose Main Open Pit is expected to be developed as meromictic; however, 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. |

**Table 4.2-1. Saline Water Management Options Considered**

| Management Option/Location | Discussion of Applicability |
|---|---|
| Closed U/G workings (Umwelt or other underground workings) | It is noted that underground workings are the main source of saline water and are a possible temporary or final disposal option. Currently, the Umwelt Underground is expect to be an option for permanent saline water storage, but this storage is not required to meet the volume management needs of the current WMP. 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 need to be managed. |
| 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 [Sabina 2015, 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. Current water management planning identifies Umwelt Lake, once dewatered (then called the SWP) as a temporary location to store saline water encounter during Construction and Operations. |
| Tailings Facility (mined-out open pit) | Supernatant pond water from the active tailings facility will be reclaimed for use in 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 tailings facility 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 tailings facility is no longer used for Process Plant reclaim (i.e., tailings deposition moved to the next tailings facility), 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. The current water management planning identifies Llama TF as a temporary option for saline water storage. |
| Man-made surface containment ponds | Similar to the modified natural containment area, man-made surface containment ponds could be constructed (or a current water management pond could be utilized) 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. |
| Treatment | Saline groundwater could be processed in a reverse osmosis (or similar) water treatment process for discharge to the environment, or reclaim on the Property. 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. Current water management planning processes saline water collected in the SWP with a reverse osmosis unit, with treated effluent reporting to Umwelt TF (to be used as reclaim in the Process Plant) and brine effluent deposited back in the SWP. |
| Transport and disposal to Bathurst Inlet | Should on-site storage volumes be insufficient, saline water, or brine effluent 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 Metal and Diamond Mining Effluent Regulations [MDMER]) 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. |

*Note: Management options shaded in grey are currently considered in the water management planning.*

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.

Should contingency measures for saline water storage in open pits or other above-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 was selected as the preferred alternative for the temporary storage of Project saline water before permanent storage capacity becomes available in the Goose Main Open Pit. Details on the SWP design are provided in Section 6 of the WMP.

The SWP will have one containment dam located south of the Umwelt Lake basin, called the SWP Containment Dam, as well as non-contact water diversion berms around the remaining perimeter to reduce the volume of natural catchment into the SWP, called SWP Diversion Berms (Figure A-02 of the WMP). 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 SWP Containment Dam was 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.

In 2018, Sabina completed a geotechnical drill program at the Goose Property that included field characterization at the SWP location at that time (which has now been updated). In part based on this drilling, the decision was made to move the SWP Containment Dam slightly south of the previously proposed location, that appears more geomorphologically favourable. Sabina will be conducting more field characterization studies in support of final design of the SWP, and further characterization, in the form of drilling and field 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 overall mine water management schedule (e.g., building of culverts, berms, and containment dams) is presented in the WMP.

During Phase 1 (Construction), Umwelt Lake will be fished out and dewatered to begin construct the SWP. The SWP Containment Dam will be constructed before the saline water level within the SWP requires containment.

For Phase 2 (Operations), saline water from the Umwelt, Llama, Echo, and Goose Main undergrounds and the Llama Open Pit will be collected and pumped to the SWP. In Year 3, saline water from the SWP will be pumped to the reverse osmosis unit. The treated water will report to the Umwelt TF (formerly Umwelt Open Pit) and the brine effluent will report back to the SWP. Saline water can be pumped into the Llama TF (formerly Llama Open Pit) starting Year 6 or Umwelt Underground at around Year 10 or 12, if additional saline water management storage is required. In Year 13, Umwelt and Llama TFs will be dewatered to Goose Main Open Pit (then called Goose Main Reservoir) to support closure filling and final saline water storage.

Following the dewatering of the SWP, sediment in the basin will be tested, and removed, if required, to meet defined discharge water quality criteria; see Section 5.2 for additional details. The containment dam 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 and Llama Lake are fished out in preparation for lake dewatering. | -2 | |
| Llama Lake (via Umwelt Lake) and Umwelt Lake are dewatered to Goose Lake to allow for mining of Llama Open Pit and construction of the SWP, respectively. The SWP Diversion Berms and Containment Dam are constructed. | -1 | Portion of water is treated for TSS. |
| The SWP receives pumped saline water from the Llama Open Pit, and Llama and Umwelt underground. | 1 | Expected until end of Year 5. |
| Saline water from the SWP are pumped to a reverse osmosis unit for treatment with treated water sent to the Umwelt TF. | 3 | Treatment continues until milling production starts ramping down in Year 13. |
| Llama TF is available for temporary saline water storage, if required. | 6 | Until Goose Main Reservoir becomes available for permanent storage (Year 13). Volumes currently conservatively assumes no saline water is pumped into the Llama TF. |
| Umwelt Underground is available for permanent saline water storage, if required. | 10 / 12 | Approximately when the void space in the underground are available. Current mine plan conservatively assumes no saline water is pumped to the underground. |
| Saline water encountered on the Property is sent to Goose Main Reservoir for permanent storage. | 13 | Approximately until the end of Operations (Year 15). |
| Surficial soils in the footprint of former Umwelt Lake lakebed are excavated and placed in the Goose Main Reservoir. | 15 | If chloride concentrations at the 2-m depth are higher than the long-term CCME guidelines, these top sediments will be removed. |
| Decommissioning of SWP including the containment dam and diversion berms. | 16 | After dewatering of SWP and removal of soils, if required. |

*Source: Water Management Plan*

# 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. Monitoring requirements are outlined in the Type A Water Licence 2AM-BRP1831 Amendment No.1 Part I and detailed in Schedule 1 with respect to parameters, location, frequency and mine phase. More detailed information on the planned monitoring programs for the Project are provided in the Environment Management and Protection Plan (2AM-BRP1831 Part I, Item 1).

## 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 (specifically Llama Open Pit) 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 PN04 and PN06 will illustrate flows downstream of the SWP and Goose Main Reservoir, respectively.

## 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 workings. The Water Quality Monitoring for the Project (Schedule I of Type A Water Licence 2AM-BRP1831 Amendment No.1) provides information on proposed water quality sampling stations to be monitored. Saline water inflows from Llama Open Pit and underground mines will be monitored. The proposed BRP-11 monitoring station at the SWP will be used to monitor the quality of water in this pond. Refer to WMP Figures A-25 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.

Water quality results will be compared to regulated water licence requirements including the MDMER (Canada Gazette 2017), Canadian Council of Ministers of the Environment (CCME), and Site-Specific Water Quality Objectives guidelines.

Sabina notes the potential for chloride concentrations within sediments encountered at the bottom of the SWP, once the saline water has been removed. Sabina has identified a number of mitigation measures to reduce chloride concentrations within the sediment, including removal of sediments for disposal within Goose Main Reservoir. Sabina will track sediment and pore water chloride concentrations for the SWP to ensure appropriate water quality for the reconnection of Umwelt Lake to surface waters. A target chloride concentration of 120 mg/L (following the CCME guideline for the Protection of Aquatic Life) would be achieved at the receiving environment (defined as per the *Fisheries Act*).

Sabina also notes the potential exists for migration of saline water from the SWP to the surrounding environment. Sabina will therefore monitor the permafrost in the locations where seepage may occur as well as monitor the condition of vegetation in the vicinity of the SWP for effects due to the presence of saline groundwater.

## 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 (or Goose Main Reservoir) at surface. 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 (2AM-BRP1831 Part I, Item 1). 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 in 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.<br>Additional sump capacity to handle higher than predicted inflows.<br>Pre-grouting of highly conductive structures prior to intersection with the mine workings.<br>Isolation of mining sections with bulkheads to control or minimize mine inflows.<br>If the average long-term groundwater inflows are higher despite these measures, the meromictic lake in the Goose Main Pit has extra capacity for saline water storage.<br>Additional storage locations could be identified, blending of saline water with other contact water may be investigated, or treatment to desalinate the water may be required. |
| Water quality in the SWP 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 SWP. | Additional storage locations will need to be identified, or treatment to desalinate the water may be required. If necessary, the meromictic lake in the Goose Main Reservoir has extra capacity for saline water storage. |
| Chloride sediments are encountered at the bottom of the SWP once the saline water has been removed. | Sediments will be excavated and deposited in Goose Main Reservoir. 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. |

The SWMP 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, Indigenous 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 Indigenous community members and discussions with Elders, both in the field and through workshops.

The SWMP 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 (2AM-BRP1831), unless otherwise directed by the NWB.

# 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 the Umwelt Reservoir using separate pumping and pipeline infrastructure during Operations.

Once the SWP has been dewatered, sediments will be tested and if the chloride content would be considered to be too high to achieve Site-specific Water Quality Objectives and/or CCME guidelines for the Protection of Freshwater Aquatic Life when the facility was re-watered, these sediment would be removed and placed in the Llama TF. Based on average hydraulic conditions, the Llama TF will take approximately six years to fill with water (i.e., the facility is expected to overflow in Year 11). Therefore, SWP sediments placed in the Llama TF will have six years to settle prior to overflows from the facility are anticipated. This is considered a sufficient length of time for the sediments 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 Water Quality Objective and/or CCME guidelines for the Protection of Freshwater Aquatic Life, the SWP Containment Dam 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 (Type A Water Licence 2AM-BRP1831 Amendment No.1 Part J, Item 1).

# 9. References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# Appendix C. Water and Load Balance Report

Pending Submission August 2022