BACK RIVER PROJECT
Quarry Management Plan

Type B Development Works Water Licence

August 2017

BACK RIVER PROJECT
QUARRY MANAGEMENT PLAN

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Acronyms

ARD	acid rock drainage
FEIS	Final Environmental Impact Statement
GN-DCH	Government of Nunavut Department of Culture and Heritage
KIA	Kitikmeot Inuit Association
ML	metal leaching
MLA	Marine Laydown Area
Mt	million tonnes
NPAG	non-potentially acid generating
NWB	Nunavut Water Board
Project	Back River Project
PAG	potentially acid generating
QMP or Plan	Quarry Management Plan
ROQ	run of quarry
Sabina	Sabina Gold & Silver Corp.
WIR	Winter Ice Road

1. Introduction

The Back River Project (the Project) is a proposed 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 (Kingaok), and 520 km northeast of Yellowknife, Northwest Territories. The Project is located predominantly within the Queen Maud Gulf Watershed (Nunavut Water Regulations, Schedule 4).

The Project is comprised of two main areas with interconnecting winter ice roads (WIR): Goose Property (Appendix A of the MASD, base Figure 2) and the Marine Laydown Area (MLA) (Appendix A of the MASD, base Figure 3) 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 interconnect these sites.

This Quarry Management Plan (QMP or Plan) outlines the construction, operation, and closure approach of approved borrow and rock quarry areas within the Goose Property and MLA. The QMP is intended to support the Type B Water Licence Application for the Project.

The Plan was prepared following the requirements of:

- the Supplementary Information Guidelines (SIG) for Mining and Milling MM3 and Water Works M1, issued by Nunavut Water Board (NWB 2010 a, b);
- the Environmental Impact Statement Guidelines issued by the Nunavut Impact Review Board (NIRB) to Sabina (NIRB 2013); and
- in accordance with best management practices and in conformance with current Federal and Territorial statutory requirements.

The information presented herein is current as of August, 2017.

2. Scope and Objectives

This Quarry Management Plan has been written to meet requirements of a Type B Water Licence and entails the management of borrow and quarry material, explosives, dust, and water in relation to the site preparation and initial development work activities as described in Table 2-1. The Plan is supported by a suite of Project-specific mitigation, monitoring, and/or management plans that set out the Project's standards and requirements for particular areas of environmental management, including the:

- Comprehensive Spill Contingency Plan (August 2017);
- Fuel Management Plan (August 2017);
- Road Management Plan (August 2017);
- Borrow Pits and Quarry Management Plan (August 2017);
- Oil Pollution Emergency Plan (August 2017);
- Environmental Management and Protection Plan (August 2017); and
- Interim Closure and Reclamation Plan and cost estimate (August 2017) specific to development works.

Included within the plans are monitoring with adaptive management measures to confirm that the Project is executed as planned, that mitigation is successful, and potential adverse effects are minimized.

Table 2-1. List of Activities

GOOSE PROPERTY
Goose Exploration Camp Operation
Ice Airstrip Construction and Operation
Mobilize Fuel, Equipment, and Supplies
Winter Ice Road Construction and Operation
Operate Airstrip Quarry
Operate Umwelt Quarry
Locate Temporary Fuel Storage
Construct All-weather Service Roads and Water Crossings
Construct Goose Plant Site and Fuel Storage Area Pad
MARINE LAYDOWN AREA
Ice Airstrip Construction and Operation
Mobilize Fuel, Equipment, and Supplies (Air)
Upgrade Temporary Exploration Camp
Operate MLA Quarry
Construct All-weather Service Roads, Laydown Areas, and Fuel Storage Area
Mobilize Additional Fuel, Equipment, and Supplies (Vessels)
Install One Steel Bulk Fuel Tank

3. Applicable Legislation and Guidelines

Specific legislation, regulations, and guidelines related to borrow pits and quarry 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 to be issued by Indigenous and Northern Affairs Canada for Crown Lands and the Kitikmeot Inuit Association (KIA) for Inuit Owned Land, and its Type B Water Licence to be issued by the NWB.

Table 3-1. Applicable Legislation to Waste Management in Nunavut

Acts	Regulations	Guidelines
Federal		
Canadian Environmental Protection Act (CEPA 1999)		
Nunavut Agreement	Article 19	
Nunavut Waters and Nunavut Surface Rights Tribunal Act (2002)	Nunavut Water Regulations (2013)	
Fisheries Act (1985)		
Territorial Lands Act (1985)	Territorial Land Use Regulations (CRC, c.1524) 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) Northern Land Use Guidelines Pits and Quarries (INAC 2010)
Explosives Act (1985)	Explosives Regulations (SOR/2013-11)	
Territorial – Nunavut		
Nunavut *Environmental Protection Act* (1988)		
Wildlife Act (1988)	Wildlife General Regulations (NWT Reg (Nu) 026-92) Wildlife Licences And Permits Regulations (NWT Reg (Nu) 027-92) Wildlife Management Barren-Ground Caribou Areas Regulations (NWT Reg (Nu) 099-98) Wildlife Management Grizzly Bear Areas Regulations (NWT Reg (Nu) 155-96) Wildlife Management Zones Regulations (RRNWT (Nu) 1990 c W-17) Wildlife Regions Regulations (NWT Reg (Nu) 108-98) Critical Wildlife Areas Regulations, R.R.N.W.T. 1990 c. W-3 Polar Bear Defence Kill Regulations, N.W.T. Reg. 037-93 Wildlife Management Muskox Areas Regulations, R.R.N.W.T. 1990 c. W-11 Wildlife Management Polar Bear Areas Regulations, R.R.N.W.T. 1990 c. W-13 Wildlife Sanctuaries Regulations, R.R.N.W.T. 1990 c. W-20 Wildlife Preserves Regulations, R.R.N.W.T. 1990 c. W-18	
Mine Health and Safety Act (SNWT (Nu) 1994, c.25)	Mine Health and Safety Regulations (NWT Reg (Nu) 125-95)	

Borrow pits and rock quarries within Inuit Owned Land require a land use licence or commercial lease and quarry permit issued by the KIA. Quarry permits from the KIA include terms and conditions specifying how operations are to be conducted.

The discovery of any deposits of carving stone on Crown lands will be subject to Article 19 of the *Nunavut Agreement*. The use of explosives will comply with the *Explosives Regulations* and the *Mine Health and Safety Act and Regulations*. Use of rock and granular material from the quarries and borrow pits will require a water licence from the NWB under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and associated water regulations. The federal *Fisheries Act* may also apply if runoff water containing deleterious substances flow from the quarries/borrow pits into fish bearing water (see Section 6.2).

Other applicable legislation from the Government of Nunavut include the permitting of archaeological surveys completed in advance of operations (see Section 6.5) and compliance with the Nunavut *Wildlife Act* with respect to impacts to raptors and terrestrial animals (see Section 6.6).

4. Planning and Implementation

4.1 PLAN OVERVIEW

The MLA and Goose Property will require quarry material to facilitate the construction of initial development works. Goose Property will draw material from the existing rock quarry (Airstrip Quarry), and from a new quarry within the footprint of the future Umwelt Pit (Umwelt Quarry). Material will also be cut and filled from the Goose Plant Site pad area. The MLA will draw material from a cut and fill in the area of the future MLA Fuel Storage Area (MLA Quarry). These will allow for the development of all-weather service roads, pads, and laydown areas. Quarries at the Goose Property are shown on base Figure 2 (Appendix A of the MASD), and the MLA Quarry is shown on base Figure 3 (Appendix A of the MASD).

4.1.1 Goose Property

Sabina proposes to construct all-weather service roads for development works (Appendix A of the MASD, base Figure 2). This road alignment, totaling approximately 6 km in length, is required to connect the existing rock quarry (Airstrip Quarry), the new Umwelt Quarry, the Goose Plant Site pad, and the existing Goose Exploration Camp. Sabina intends to utilize, wherever possible, the same footprint for the initial development works as the full-scale Goose Property site layout. Rock will be placed directly onto the tundra to preserve the permafrost, and a layer of graded surfacing material will be placed to provide a protective trafficking layer. Refer to the Road Management Plan for details on all-weather service road requirements. The initial development works will also include the construction of the Goose Plant Site pad and the Goose Fuel Storage Area pad. Once service roads to the Goose Plant Site area are established, construction material will be sourced by cutting bedrock material from the Goose Plant Site pad area.

4.1.2 Marine Laydown Area

The initial development works at the MLA requires the construction of approximately 2 km of all-weather service roads and laydown areas, as well as the construction of at least one of the bulk fuel containment areas (Appendix A of the MASD, base Figure 3). These are required to facilitate material mobilization by ocean going vessels during the open water season. Sabina intends to utilize, wherever possible, the same footprint for the initial development works as the full-scale MLA site layout. Pending the outcome of a planned 2017 geotechnical program at the MLA (which is occurring post Type B application submission) and completion of Detailed Engineering work, the MLA layout may be further enhanced. Although the layout may alter due to construction limitations or efficiencies, the activities at the MLA as presented will not change. Should significant alterations be required to the proposed MLA layout, Sabina will provide the portions of the revised layout, and any other relevant enhancements, to the NWB 60 days prior to construction.

4.2 EXISTING BORROW AND ROCK QUARRY FACILITIES

During the 2013 season (March 1 to May 15, 2013), approximately 40,000 cubic metres (m^3) of rock material was quarried from a site (called the Airstrip Quarry; KIA permit KTP11Q001) approximately 750 m west of the existing Goose Exploration Camp. The run of quarry (ROQ) material was trucked over a WIR from the quarry to crushing equipment located at the all-weather airstrip. The material was crushed to 4 inch and ¾ inch aggregate. This material was used to build a pad and containment for bulk fuel tanks at the existing Goose Exploration Camp, and to surface the all-weather airstrip and road connecting the airstrip to the Goose Exploration Camp.

Estimates indicate that there is approximately 550,000 m^3 (1.5 million tonnes [Mt]) of available material remaining within this Airstrip Quarry, of which 125,000 m^3 is currently permitted (permit KTP11Q001).

There is also an approved borrow area at the Goose Property (permit KTP12Q001) that overlaps the footprint of the existing airstrip. This borrow area was accessed in 2012 but at this time Sabina does not intend to draw material from this permitted borrow.

The 2013 Construction Summary Report, which outlines additional details of the completed quarry activities, was submitted to the NWB on August 27, 2013. The overall Airstrip Quarry current extents is shown on base Figure 2 (Appendix A of the MASD), and a detailed survey of the quarry following completion of the 2013 extraction is shown as Figure 4.2-1.

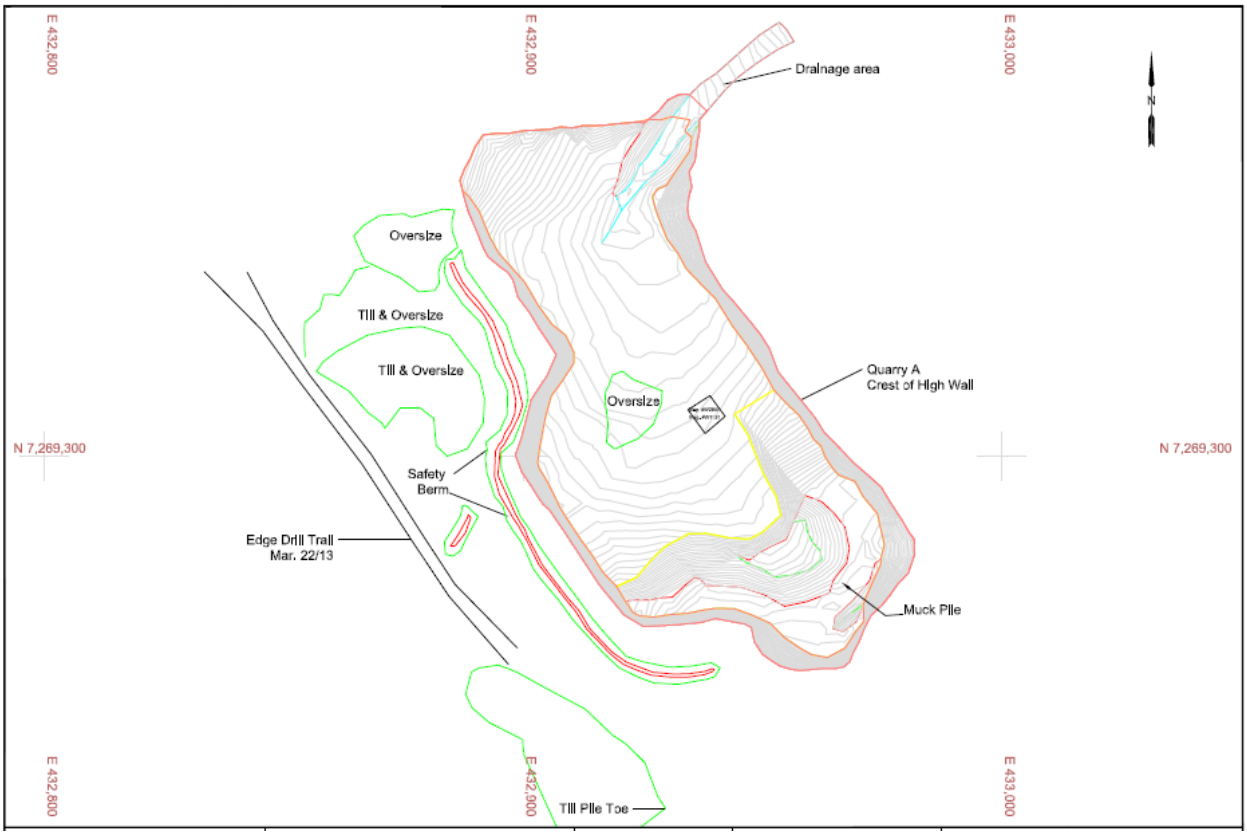

Figure 4.2-1. Existing Airstrip Quarry after Extraction in 2013

4.3 PROPOSED BORROW AND ROCK QUARRY FACILITIES

4.3.1 Goose Property Borrow and Quarry Facilities

At the Goose Property, an estimated 550,000 m^3 of ROQ will be required for initial development works. Two quarries have been identified for use: the existing quarry next to the airstrip (Airstrip Quarry) under 2BE-GOO1520, and a new quarry located within the footprint of the future Umwelt Pit (Appendix A of the MASD, base Figure 2). This 550,000 m^3 of ROQ will be extracted from one or both of these quarries, however the material used will not exceed this total volume. Overburden materials at the Goose Property

generally consist of poorly sorted till material (glacial sediments) that appear highly weathered and contain mostly refractory minerals.

4.3.1.1 Airstrip Quarry

The Airstrip Quarry is located on a rock outcrop. Further development of this existing quarry will involve drilling and blasting as was undertaken in the previous phase. A highwall will be created along the high point in the ridge along the western extent of the proposed Airstrip Quarry, and the quarry floor will be sloped to the east. A gentle slope to the quarry floor will ensure that the quarry is free-draining. The highwall may reach a height of 20 m in places, if the quarry is fully developed.

The existing quarry has minimal overburden. Any overburden generated and not used by the Project will be placed in stable stockpiles either above the highwall or along the toe of the quarry.

4.3.1.2 Umwelt Quarry

The Umwelt Quarry will be located within the footprint of the future Umwelt open pit. Quarry activities will target two large areas within the pit boundary where non-potentially acid generating (NPAG) and metal leaching (ML) waste rock has been identified (see Section 6.1).

The Umwelt deposit is overlain by overburden consisting of a mix of silt, sand, and gravel. The thickness of overburden ranges from about 2 to 6 m. The targeted areas for quarrying have a thinner overburden thickness. The general area proposed for quarrying based on geochemical characterization work is shown on base Figure 2 (Appendix A of the MASD). The final location and configuration of the quarry will be determined by the contractor.

To develop the quarry, it will be necessary to strip and stockpile the overburden. Though the ground is relatively flat across the deposit, the stockpile will be positioned on the upgradient side of the quarry so that the finished quarry can serve to collect runoff from the stockpile. Since the overburden may be frozen and therefore blasted during removal, some slumping is expected as water is released from the soil. The overburden stockpile will likely be constructed in a windrow fashion to an approximate maximum height of 6 m and sloping outward. This configuration could be modified based on observations in the field.

The final quarry design including size and depth will be determined by Sabina in consultation with its contractor, but it is likely not to exceed 30 m into the rock.

4.3.2 MLA Quarry

At the MLA, an estimated 400,000 m^3 of aggregate will be required for development of service roads, laydown pads, infrastructure foundations, and fuel storage and other containment areas. All of this material will be sourced from the cut/fill balance during development of the Fuel Storage Area, which is referred to as the MLA Quarry (Appendix A of the MASD, base Figure 3).

Overburden at the MLA generally consist of gravel to cobble sized material mixed in sand.

4.4 DEVELOPMENT AND OPERATION

The proposed areas will be developed, inspected, and maintained by Sabina or contractors charged with this responsibility under the direction of Sabina. Borrow pit and quarry locations are assessed by the geotechnical properties of the material, the geochemistry and acid rock drainage (ARD)/ML potential, available volume of material, proximity to infrastructure, and avoidance of environmentally sensitive (e.g., wildlife dens) and culturally sensitive (e.g., archaeological) areas.

4.4.1 Development Plans – Rock Quarries

Site development plans will augment this management plan with specific details. These development plans will include:

- Site layout and set-up with the following provisions:
  - minimum setback of 31 m from environmentally sensitive areas;
  - adequate room for all activities;
  - estimates of the resources to be extracted;
  - refuelling station with appropriate containment (if required);
  - confirmation of low ARD/ML potential and anticipated water quality;
  - confirmation of archeology, vegetation, and wildlife status;
  - expected permafrost conditions;
  - stockpiling location and any runoff control measures (if required);
  - equipment lists;
  - site development techniques;
  - explosive magazine locations;
  - dust and noise management;
  - waste management facilities (where applicable); and
  - water management facilities and any erosion control measures (if required).

The final quarry configuration will consist of a flat surface graded at approximately 1% in the down slope direction, adjoining a steeper angled rock surface that forms the transition to natural ground on the ridge above. Storm and snowmelt water will be diverted away from the quarry by a small berm on the upslope edges of the excavation.

4.4.2 Operations

Quarry operations may use explosives and the design, shape, and size of the blasts shall be planned with safety being the most important consideration. Should blasting be required, a predetermined pattern of drillholes will be drilled to a depth, not exceeding the overall depth of the quarry, and filled with explosives. Prior to the blast, all personnel and equipment will be moved to a safe distance. The blasted rock will be loaded into haul trucks using either a loader or a hydraulic shovel/excavator. The ROQ material is then hauled to the construction area, dumped, and placed using a track dozer and/or motor grader. This sequence is called a “drill, blast, load, haul, dump” sequence. Refer to the Spill Contingency Plan for mobile equipment spill management and other related topics.

Some of the ROQ will be moved to a crusher to produce aggregate of various sizes. The crusher will be offset from local waterways and may be shielded from the prevailing wind. When possible, the shielding will be managed by placing the crusher within the quarry behind a high wall to reduce the quantity of wind-blown dust and enabling dust to fall within the quarry boundaries.

Borrow pit operations may employ ripping methods using a track dozer. This loosens the material and allows it to be picked up using a loader or a hydraulic shovel/excavator. Standard drill and blast methods similar to quarry operations may be used in instances where ripping is not possible.

4.5 GEOCHEMICAL CHARACTERISTICS

4.5.1 Quarry Rock at the Goose Property

Detailed geochemical characterization studies to assess the ML/ARD potential of quarry rock associated with the Property were carried out; results can be found in the Geochemical Characterization Report (FEIS Volume 2, Appendix V2-7D). The testing program included acid-base accounting and trace element analyses on 40 samples from the Airstrip Quarry, and 16 samples from the Umwelt Quarry.

The Airstrip Quarry is mainly comprised of turbiditic meta-sedimentary rocks (greywacke and mudstone) with minor amounts of banded iron formation, large intrusive gabbro dykes, and smaller felsic to intermediate dykes. Results indicate that rock from the Airstrip Quarry has a variable potential for ARD (FEIS Volume 2, Appendix V2-7D). Based on these results, Sabina has committed to complete further testing within the existing quarry footprint to further delineate potentially acid generating (PAG) materials in advance of, or concurrent with, sourcing additional material from this quarry. Only NPAG quarry rock will be used for construction. The criteria that will be used to classify NPAG waste rock will be an NP/AP ratio greater than 3, or a sulphur content of less than 0.15%. The testing programs described in the Geochemical Characterization Report (FEIS Volume 2, Appendix V2-7C) show that these criteria provide an appropriate level of conservatism.

The Umwelt Quarry locations were selected to be entirely within the upper greywacke unit. The majority of these unit samples are classified as NPAG or low sulfide (S) material with a limited potential for ARD. Therefore, no special management measures are required at this location.

Refer to the 2015 Goose Property Overburden Geotechnical Investigation Program Report for additional details on drillhole logs, core photos, and hydraulic and geotechnical testing.

4.5.2 Quarry Material at the Marine Laydown Area

Preliminary geochemical characterization was completed on surface outcrop samples and sandy gravel representing quarry material that will be excavated during construction of the MLA Fuel Storage Area (MLA Quarry). These samples were described as weathered quartzite conglomerate, quartz arenite/quartzite (sandstone), and sandy gravel. The test results showed that these materials have a negligible potential for ML/ARD. Sabina intends to complete additional sampling and testing in advance of, or concurrent with, development to characterize materials from greater depths.

5. Roles and Responsibilities

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

The Operations Manager, along with their direct reports, will be responsible for the implementation of this plan including overall management of the Plan and internal reporting.

6. Environmental Protection and Mitigation Measures

The proper implementation of best management practices will ensure sound management of borrow and rock quarry material, explosives, and freshwater which will help to minimize potential impacts to the environment during the life of a quarry or borrow pit.

Table 6-1 outlines the general measures that will be considered for the development of borrow pits and quarry locations. The site development plan for each rock quarry (Section 4.4.1) will build on the proposed measures by providing site-specific details.

Table 6-1. Mitigation Measures to be Considered for Borrow Pit and Quarry Locations

Development Phase	Activities	Environmental Concerns	Mitigation Techniques
Site design and development	• Vegetation clearing • Overburden removal	• Habitat loss • Soil erosion • Sediment deposition	Minimize Project footprint Identify and avoid environmentally sensitive areas Locate the development in a well-drained area Maintain natural drainage patterns Retain vegetation buffer zones to maintain slope stability and protect waterbodies Construct ditches/diversion structures to direct runoff away from the site
Operations and monitoring	• Blasting • Excavating • Crushing • Piling material • Access road maintenance	• ML/ARD	Further delineation and segregation of PAG/NPAG quarry rock. Only NPAG quarry rock will be used for infrastructure construction
		• Soil erosion • Sediment deposition	Limit sediment movement using erosion controls (e.g., silt fence) Use rip-rap to reinforce drainage channel corners and water discharge points Use settling ponds before discharging water Revegetate and /or use riprap where required to stabilize slopes
		• Fuel spills • Blasting residue	Use proper fuel containment and explosives-handling techniques
		• Permafrost degradation	Limit pit or quarry depth to within the continuous permafrost zone Minimize in-pit water by directing surface water away from the site Thaw ice-rich material at a location where melt water will not re-enter the pit
		• Dust generation	Use water and dust skirts on conveyors to minimize dust

Modified from source: INAC (2010).

6.1 IDENTIFICATION, SEGREGATION, AND PLACEMENT OF QUARRY ROCKS

Only NPAG quarry rock will be used for construction. Sabina has committed to complete further testing within the existing Airstrip Quarry footprint to further delineate PAG materials in advance of, or concurrent with, sourcing additional material from this quarry. The confirmatory testing prior to excavation will also be completed for greater depths at the MLA Quarry, and will be considered at the Umwelt Quarry.

Identification and segregation of PAG and NPAG quarry rock from the Airstrip Quarry will either require further sampling and off-site testing in advance of quarry development, or sampling and on-site testing concurrent with quarry development. Sampling results will be provided in summary form within the annual report for the existing 2BE-GOO1520 Water Licence.

Quarry material at the MLA has been identified as having a negligible potential for ARD. However, Sabina has committed to completing confirmatory testing of samples from greater depths of excavation. In the unlikely event that PAG materials are found at the MLA, they would be consolidated and managed appropriately.

6.2 SURFACE DRAINAGE AND WATER MANAGEMENT FROM QUARRIES AND BORROW PITS

Water quality monitoring of contact water from the borrow pits and quarries serves to provide information on possible effects to the receiving environment. Surface drainage and water management procedures will be implemented at all quarry/borrow locations. A setback of at least 31 m will be established from the quarry operations and associated workings to any local waterbody. These buffers will be delineated prior to the commencement of work.

Additional management will include the grubbing of materials to expose rock surface for quarrying purposes. The principle concerns associated with grubbing and disposal of related debris are:

- Potential effects on water quality caused by erosion and sedimentation.
- Disturbance of the permafrost leading to ground failure (slumping and erosion).

All grubbing and disposal of debris near watercourses will comply with regulatory approvals. Measures that will be undertaken to minimize effects on aquatic habitat and resources are:

- Grubbing of the organic vegetation material and/or the upper soil horizons will be minimized, and left in place where possible due to the sensitivity of Arctic soils.
- If needed, the organic vegetation material and upper soil horizon material, which has been grubbed, will be spread in a manner that attempts to cover exposed areas. Any surplus of such material will be stored or stockpiled for site reclamation purposes elsewhere in the Project area. Topsoil will be stockpiled separately from overburden. The location of the stockpiles will be recorded and accessible for future rehabilitation purposes.
- During grubbing, care will be taken to ensure that the material will not be pushed into sensitive areas which are to be left undisturbed.
- Any evidence of erosion due to surface water flow from the quarries and borrow pits will be repaired by placing riprap over the affected area.

The quarry configuration will consist of a relatively flat surface graded such that water slopes to an area within, or adjacent to, the quarry boundaries. Since no extraction will occur below water level, and the

areas will be contoured to drain positively, there will be no residual ponds once the sites are closed. Any flowing water which may leave the working area will be sampled as part of ongoing monitoring and allowed to discharge to the environment if it meets discharge criteria as defined in the Type B water licence. Any problematic water will be directed away from waterbodies, or held in contact water event ponds with enough capacity to contain high runoff from the spring freshet. A notification of discharge will be submitted to appropriate regulatory parties under the land and water authorizations and also reported within annual reports.

Storm and snow melts will be diverted away from the quarry by small berms on the upslope edges of any excavation. Measures will be taken to reduce the velocity of the water (e.g., silt curtains and small dikes) and promote suspended sediments to settle out.

6.3 DUST MANAGEMENT

Crushers may be located near high obstacles to facilitate shielding from the prevailing winds and thereby reduce and restrict the quantity of dust to the quarry boundary. Run of quarry will be transported from the quarries and borrow pits within speed restrictions to help reduce dust along the road corridors.

6.4 GROUND ICE AND PERMAFROST PROTECTION

Quarry sites are expected to be free of ground ice and will not extend below the bottom limits of the continuous permafrost (up to 500 m deep). There will be some localized impacts to the surrounding active zone of the quarry locations, and any water seeps originating in the quarries as a result of permafrost melting, or precipitation events, will be monitored as part of surface water management.

Borrow pits are formed from glaciofluvial deposits and weathered bedrock. All borrows have positive topography rising about the local setting. These types of granular deposits are selected as they tend to be relatively free of ground ice. Minimal ground ice reduces the potential for thaw settlement, erosion caused by melt water, and external slumping. In the event that ground ice is prevalent, the area will be monitored and may be stabilized by covering the affected land with granular material. This would allow the permafrost to aggrade into the covering material and restrict the remaining ground ice from melting.

6.5 ARCHAEOLOGICAL PROXIMITY

At the Goose Property, one archeology site is identified as requiring mitigation based on the proposed design. At the MLA, three archeology sites are identified as requiring mitigation based on the proposed design. In all cases, this is due to the required placement of the fuel storage tanks. Other identified sites may also require mitigation. Information on exact location of archeology is not provided in this document as per guidance from the Government of Nunavut Department of Culture and Heritage (GN-DCH). However, all information on site locations has already been provided to GN-DCH in the form of annual archeology reports. A summary of sites within 1,000 m of the Goose Property and MLA can be found, along with proposed mitigation options, in the Cultural and Heritage Resources Protection Plan (FEIS Volume 10, Chapter 27).

The quarries and borrow pits were selected to avoid archaeological resources. If any potential archaeological site is identified during the operation of any quarry/borrow pit, work will stop, a professional archaeologist will be consulted, and GN-DCH will be informed of the discovery.

All equipment will remain within the boundaries of the quarries/borrow pits to ensure any nearby archaeological site is not inadvertently damaged.

Before any new quarry/borrow pit is selected, it will be surveyed for archaeological resources by a professional archaeologist registered in Nunavut. Sites with archaeological resources present will not be selected if there is a similar site devoid of archaeological resources nearby.

6.6 NATURAL ENVIRONMENT

Details on wildlife sites in proximity to the Goose Property and MLA, along with proposed mitigation measures, are provided in the Wildlife Mitigation and Monitoring Plan (Version 7, submitted with FEIS Addendum February 2017).

Noise from construction vehicles will be minimized as part of best management practices by installing noise control equipment on the vehicles, and maintaining them to operate according to specifications. Noise related to quarry/borrow pit operations will be of short duration and should be restricted primarily to the Pre-development and Construction phases of the Project. While noise can be expected to be heard in a 4 km radius, the majority of the noise should be within 1 km of the activities.

Other mitigation measures aimed at reducing effects on raptors and wildlife include reducing the Project footprint, enforcing speed limits on roads, and general housekeeping to avoid attracting wildlife and/or exposure to contaminants.

7. Monitoring

This section presents a summary of the monitoring programs that will be carried out during construction and operation activities related to quarry management.

Table 7-1 summarizes the monitoring activities for each borrow or quarry. Each monitoring activity will be further defined prior to commencing work at each quarry, and will be completed according to the approved environmental protocols. Details on other water monitoring related to the quarries are included in the Environmental Management and Protection Plan.

Table 7-1. Quarry Activities

Monitoring Component	Monitoring Frequency	Reporting
Routine visual inspections of quarries	Daily during active quarry operations; Monthly to semi-annually during inactive periods	Monitoring data will be used by Sabina internally
Elevation and geometry survey	Annually	
Quantities of NPAG quarry rock extracted and used in construction	Daily records	Monitoring data will be reported to the Regulators in the annual water licence report or annual inspection report
Geochemical monitoring to evaluate effectiveness of segregation program	A minimum of approximately one sample per 100,000 tonnes of quarry rock	
Dust monitoring	See Air Quality Monitoring and Management Plan (FEIS, Volume 10, Chapter 17)	
Geotechnical inspection by qualified Engineer	Annually	
Seepage and runoff water quality	Spring seep survey of all quarries and major infrastructure components except roads	

7.1 PIT WALL STABILITY (ROCK QUARRIES)

Regular visual monitoring of pit wall stability within active rock quarry areas will be completed and recorded. Inactive, open areas will be visually monitored (typically monthly) between July and September, and this monitoring will be recorded. Closed areas will be visually monitored annually (during the July to September period), and these observations will be recorded.

7.2 PERMAFROST AND GROUND ICE

Daily visual monitoring of permafrost and ground ice within active borrow and rock quarry areas will be completed and recorded. Inactive, but still open, areas will be visually monitored at least monthly between July and September, and this monitoring will be recorded. Closed areas will be visually monitored once the year following Closure (during the July to September period), and this monitoring will be recorded. Closed areas may require additional monitoring.

7.3 WILDLIFE

Wildlife monitoring will include maintaining a written log of species, number, and frequency of sightings near the workings. Data will be maintained by the Environmental Department and presented during inspections, and in accordance with permit conditions. More information can be found in the Wildlife Mitigation and Monitoring Plan (Version 7, submitted with FEIS Addendum February 2017).

8. Adaptive Management

The Plan will be reviewed, and if necessary, updated again prior to submission of the Type A Water Licence application. The Plan will be reviewed on a regular basis to incorporate any lessons learned, major changes to facility Operations or maintenance, and environmental monitoring results.

All employees will be informed of relevant updates, and the updated QMP will be located in a designated area at each site.

Results of water quality monitoring will be reviewed by an environmental specialist. Field water quality data and visual observations will trigger immediate corrective action if appropriate, and water quality results will be reviewed upon receipt from the laboratory. Adaptive management with respect to water quality monitoring at the quarries may include maintenance, repair or replacement of water management features, ceasing discharge of quarry water, or modifications to the handling of explosives to minimize spillage.

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

Sabina is committed to considering and incorporating Traditional Knowledge into the Plan. The incorporation of Traditional Knowledge will occur throughout all stages of the Plan, including identification of mitigation measures, monitoring study design, data collection, and follow-up programs to obtain feedback.

9. Environmental Reporting

Environmental reporting will be conducted as identified in future permits, approvals, and authorizations. The Type A Water Licence is expected to be the primary regulatory instrument governing quarry and borrow management for the Project.

An annual summary report, including results of the geochemical inventory and monitoring programs, will be prepared. Prior to Closure, the Annual Report will include total volume of material quarried, and an assessment of the need for additional monitoring and reporting through the Closure Phase.

10. Reclamation and Closure

When Operations are complete, the overall reclamation objective for the quarry/borrow areas is to return the site to a natural condition that blends in with the existing topography and surrounding landscape. Ongoing operations and closure of quarry areas will focus on progressive reclamation measures to ensure the site:

- is secure to protect humans and the environment;
- has drainage and erosion control measures to minimize runoff to local waterways; and
- is cleared of all material, equipment, debris, and hazardous/contaminated materials.

Both temporary and final closure of the quarry areas will include:

- removal of all garbage and debris;
- removal of all temporary storages/structures/equipment;
- reclamation of access roads (all-weather or winter ice roads) to ensure free flow of water during melt;
- block access (if required) and flag boundaries;
- water quality monitoring; and
- quarry wall stability monitoring.

Refer to the Interim Closure and Reclamation Plan for additional details on Closure activities.

11. References

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