BACK RIVER PROJECT
Borrow Pits and Quarry Management Plan

October 2017

BACK RIVER PROJECT
BORROW PITS AND QUARRY MANAGEMENT PLAN

Table of Contents

List of Figures

FIGURE **PAGE**

List of Tables

TABLE **PAGE**

Revision Log

Version	Date	Section	Page	Revision
1	October 2017	All	All	Supporting Document for Type A Water Licence Application, submitted to Nunavut Water Board for review and approval

Acronyms

ARD	acid rock drainage
FEIS	Final Environmental Impact Statement
GN-DCH	Government of Nunavut Department of Culture and Heritage
ICRP	Interim Closure and Reclamation Plan
KIA	Kitikmeot Inuit Association
MAD	Main Application Document
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	Borrow Pits and Quarry Management Plan
ROQ	run-of-quarry
Sabina	Sabina Gold & Silver Corp.
TSF	Tailings Storage Facility
WIR	Winter Ice Road
WRSA	Waste Rock Storage Area

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, 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) (Main Application Document [MAD] Appendix A, base Figure 2): Goose Property (MAD Appendix A, base Figure 3) and the Marine Laydown Area (MLA) (MAD Appendix A, base Figure 4) 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. Refer to the MAD Appendix A, base Figures 1 to 5 for general site layout and locations. A detailed project description is provided in the MAD.

This Borrow Pits and 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 and other management plans are intended to support the Type A Water Licence Application for the Project.

Borrow pits and quarries are defined by the type of granular material extracted and the method of extraction. Quarries consist of rock material that is typically extracted by digging, cutting, or blasting and yields large stones that may then need to be crushed (INAC 2010). Borrows pits consist of fine grained fill materials, such as sand or clay, which are normally used at a nearby site (INAC 2010).

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 to Sabina (NIRB 2013), and in accordance with best management practices and in conformance with current Federal and Territorial statutory requirements (refer to Applicable legislation and Guidelines Section 3).

This plan is a living document to be updated upon changes in related regulatory requirements, 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.

The information presented herein is current as of September 2017. An update will be initiated prior to the start of construction. The Plan will be reviewed as needed for changes in operation and technology and as directed by the NWB in the Type A Water Licence or other regulatory authorization where appropriate. Completion of review of the Plan will be documented through signatures of the personnel responsible for reviewing, updating, and approving the Plan.

A record will document all significant changes that have been incorporated in the Plan subsequent to the latest review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

Sabina will maintain a distribution list providing contact details for all parties to receive the Plan including key personnel, contractors, organizations, and external agencies.

2. Scope and Objectives

The Borrow Pits and Quarry Management Plan is one of the documents that forms part of Sabina's overall Infrastructure and Access Management Program for the Project. This plan has been written to meet requirements of a Type A Water Licence and applies to all Sabina projects in the Kitikmeot region.

This plan describes Sabina's approach to appropriate management of borrow and quarry material, explosives, dust, and water to minimize the impacts to the local environment during the life of a quarry. Implementing best-management practices and working responsibly will ensure the protection of the environment and personnel safety.

This plan is divided into the following components:

- Applicable Legislation and Guidelines (Section 3);
- Planning and Implementation (Section 4);
- Roles and Responsibilities (Section 5);
- Environmental Protection and Mitigation Measures (Section 6);
- Monitoring (Section 7);
- Adaptive Management (Section 8);
- Environmental Reporting (Section 9); and
- Reclamation (Section 10).

The Plan applies to the Construction and Operations phases of the Project during which time quarried material will be produced, as well as the Closure/Post-Closure phases as quarries will be permanent features of the landscape. The Plan is meant to ensure that the Project is conducted as proposed, predicted adverse environmental effects are promptly mitigated, mitigation measures are proven successful, and relevant laws and regulations are complied with. Closure and reclamation of borrows and quarries are also addressed in detail in the Interim Closure and Reclamation Plan (ICRP; SD-26).

The main environmental concerns related to quarry operations are the potential for metal leaching and acid rock drainage (ML/ARD), release of nutrients from explosives use, and/or total suspended solids on downstream water quality, deposition of dust emissions from the borrow / quarry sites, and protection of the permafrost.

The measures identified in this plan are intended to protect permafrost, and the Valued Ecosystem Components including, air quality, surface hydrology, water quality, sediment quality, aquatic habitat, fish, and terrestrial mammals.

Quarry operations can also impact archeological sites; management of those sites is addressed in this plan and within the Cultural and Heritage Resources Protection Plan (Final Environmental Impact Statement [FEIS] Volume 10, Chapter 27).

All volumes of quarry material presented in this plan are based on engineering design at a feasibility level, accounting for permafrost and local thermal conditions. Additional information, including longitudinal

profile estimates of embankments, site roads, and airstrips, will be provided to NWB 60 days prior to construction.

2.1 RELATED PLANS AND STUDIES

Documents within the Application for the Type A Water Licence, which support this plan include the following:

- Environmental Management and Protection Plan (Supporting Document [SD]-20);
- Mine Waste Rock Management Plan (SD-08);
- Road Management Plan (SD-02);
- Water Management Plan (SD-05);
- Spill Contingency Plan (SD-17);
- Interim Closure and Reclamation Plan (SD-26);
- Site-Wide Geotechnical Properties Report (MAD Appendix F-2);
- Geochemical Characterization Report (MAD Appendix E-3);
- Water and Load Balance Report (MAD Appendix E-2);
- 2013 Construction Summary Report (NWB submission August 27, 2013); and
- Goose Property – 2015 Overburden Geotechnical Investigation Program (Sabina 2016).

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 A 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 (1993)	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)	
Transportation of Dangerous Goods Act (1992, C.34)	Transportation of Dangerous Goods Regulations (SOR/2001-286)	2016 Emergency Response Guidebook (Transport Canada and U.S. Department of Transportation, 2016)
Territorial – Nunavut		
Nunavut *Environmental Protection Act* (1988)	Spill Contingency Planning and Reporting Regulations (NWT Reg (Nu) 068-93) Used Oil and Waste Fuel Management Regulations (NWT Reg 064-2003)	

(continued)

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

Acts	Regulations	Guidelines
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 includes 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 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 the Airstrip Quarry, 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; 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.

4.2 PROPOSED BORROW AND ROCK QUARRY FACILITIES

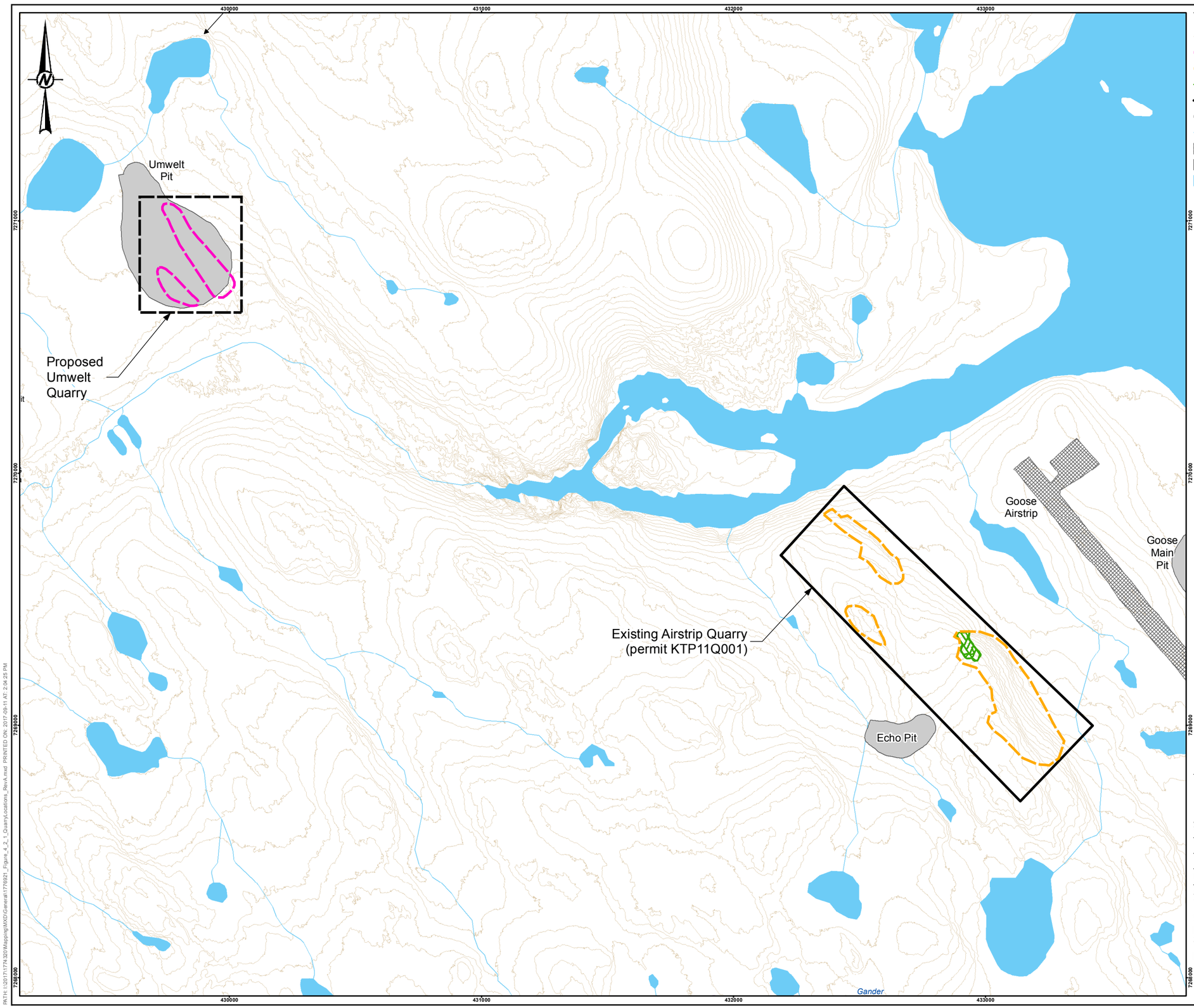
At the Goose Property, an estimated 5 Mt of ROQ will be required for construction. Of this 5 Mt, 1.5 Mt will be required to construct the Tailings Storage Facility (TSF) Containment Dam and 3.5 Mt will be required for the other Goose Property infrastructure including all-weather airstrip and roads; mine infrastructure, buildings and laydown areas; and water management infrastructure. Current and proposed quarry locations at Goose Property and MLA are illustrated on Figure 4.2-1 and 4.2-2, respectively.

Quarry operations at the Goose Property will begin with sourcing material from the existing quarry (Airstrip Quarry) for construction of the Goose Airstrip, and some all-weather roads (Figure 4.2-1). Once all-weather access to the Goose Plant Site area is established, construction material will be sourced by cutting bedrock material to create a suitable area for the Goose Plant Site and Goose Fuel Storage areas. This extracted material will be used to build roads, infrastructure pads, storage pads, and containment areas. Once all-weather access to the Umwelt open pit (Umwelt Pit) is established, the majority of construction material will be sourced from open pit operations. Initial development of the Umwelt Pit will commence early in the Construction Phase, and is referred to as the Umwelt Quarry (Figure 4.2-1).

At the MLA, an estimated 1.3 Mt of aggregate will be required for construction 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 (Figure 4.2-2).

Borrow pit and quarry locations are assessed by the geotechnical properties of the material, the geochemistry and 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.

Overburden materials at the Goose Property generally consist of poorly sorted till material (glacial sediments) that appear highly weathered and contain mostly refractory minerals. Overburden at the MLA generally consist of gravel to cobble sized material mixed in sand.



LEGEND

- CONTOUR (2 m)
- PROPOSED UMWELT QUARRIES
- ESTIMATED EXTENT OF AGGREGATE
- EXISTING QUARRY FOOTPRINT
- EXISTING QUARRY BOUNDARY
- PROPOSED UMWELT QUARRY BOUNDARY
- WATERCOURSE
- AIRSTRIP
- OPEN PIT
- WATERBODY

0 250 500

1:15,000 METRES

REFERENCE(S)

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

YYYY-MM-DD	2017-09-11
DESIGNED	JR
PREPARED	MM
REVIEWED	
APPROVED	

CLIENT: Sabina Gold & Silver Corp.

CONSULTANT: Golder Associates

PROJECT

SABINA BACK RIVER PROJECT, BORROW PITS AND QUARRY MANAGEMENT PLAN, NUNAVUT CANADA

TITLE

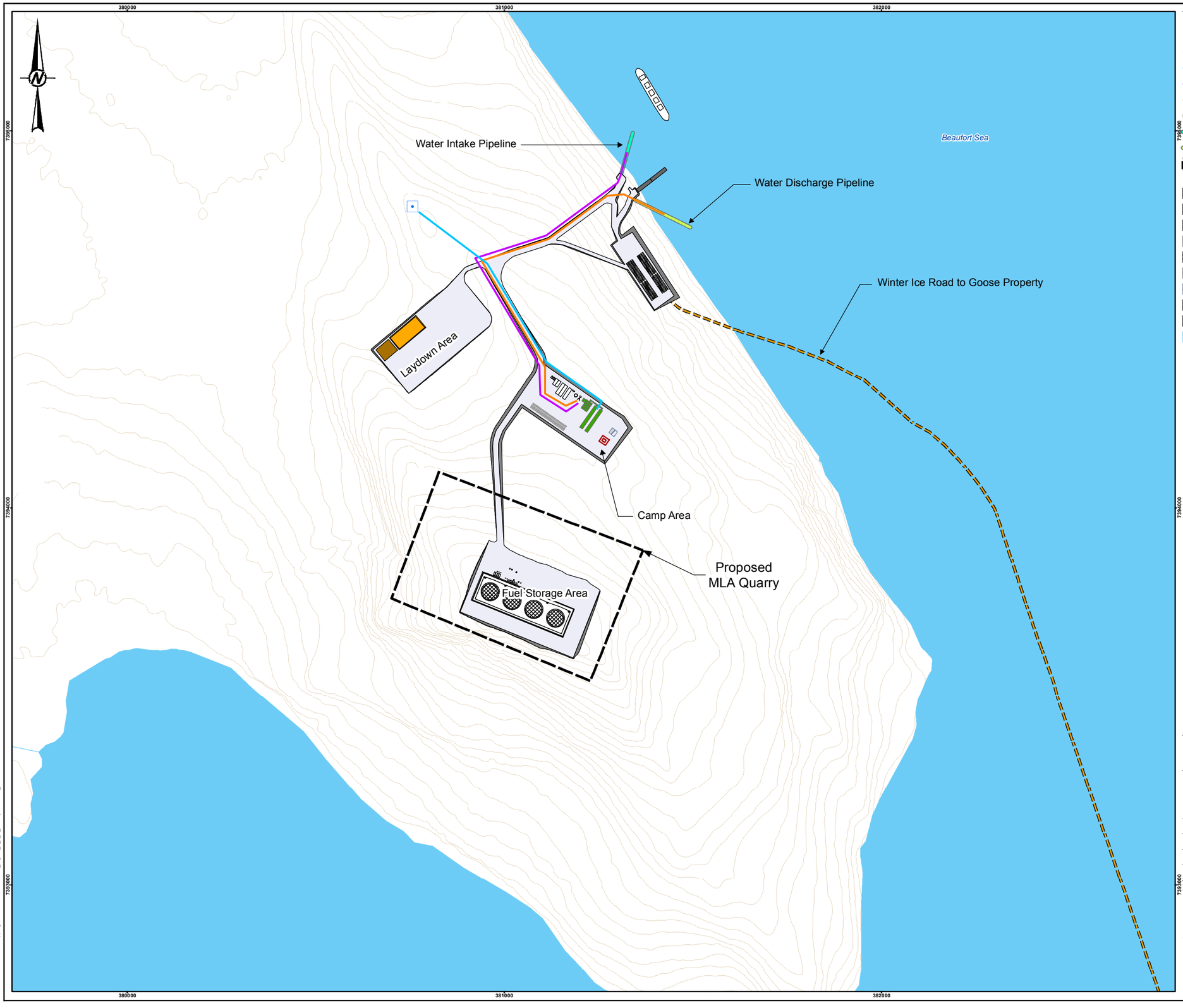
PROPOSED QUARRY LOCATIONS AND EXTENTS, PLAN VIEW

PROJECT NO.	FIGURE	REV.
1776921	4.2-1	A

PATH: I:\2017\1774\320\Mapping\MXD\General\1776921_Figure_4_2_1_QuarryLocations_RevA.mxd PRINTED ON: 2017-09-11 AT: 2:04:25 PM

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

0 25mm



LEGEND

- TREATED EFFLUENT WATER DISCHARGE
- CONTOUR (2 m)
- GREYWATER PIPELINE
- SALINE WATER INTAKE
- SALINE WATER DISCHARGE
- WINTER ICE ROAD
- WATER INTAKE PIPELINE
- EFFLUENT DISCHARGE PIPELINE (DESALINATION)
- PROPOSED MLA QUARRY

MARINE LAYDOWN INFRASTRUCTURE

- BARGE AND LIGHTER TERMINAL BARGE
- LANDFARM
- STORAGE FACILITIES
- CAMP
- FUEL STORAGE
- DOCK
- INCINERATOR
- HAZARDOUS WASTE MANAGEMENT AREA
- INFRASTRUCTURE AND ROADS
- WATERBODY

0 250 500

1:10,000 METRES

NOTE(S)

1. ALL MLA ROADS ARE SERVICE ROADS.

REFERENCE(S)

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

YYYY-MM-DD	2017-09-19
DESIGNED	JR
PREPARED	MM
REVIEWED	####
APPROVED	####

CLIENT: Sabina

CONSULTANT: Golder Associates

PROJECT

SABINA BACK RIVER PROJECT, BORROW PITS AND QUARRY MANAGEMENT PLAN, NUNAVUT CANADA

TITLE

PROPOSED QUARRY LOCATION PLAN VIEW

PROJECT NO.	FIGURE	REV.
1776921	4.2-2	A

4.3 PROJECT INFRASTRUCTURE COMPONENTS

4.3.1 Goose Property

Borrow material will be required to construct infrastructure associated with the Project development, described as follows. During Construction, the borrow material will be sourced from both the existing quarry, and a new quarry located within the footprint of the Umwelt Pit – the Umwelt Quarry. Minor amounts of material will be obtained from the cut/fill balance within the Goose Plant Site area. During operations, non-potentially acid generating (NPAG) waste rock may also be used for construction.

All-weather Airstrip and Haul Roads

The existing all-weather exploration airstrip at the Goose Property will be upgraded for use during Construction and Operations. The proposed upgrade mainly entails extending the airstrip from the current length of 914 m to 1,524 m and widening the airstrip from the current 30 m to 45 m.

The existing all-weather road network within the Goose Property will be expanded, including the construction of haul roads. Goose Property will have 4 km of service roads and 9 km of haul roads. 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. Roads will be constructed in accordance with mine haul road specifications, which require safety barricades. Refer to the Road Management Plan (SD-02) for details on road requirements.

Material to expand the airstrip and roads will be sourced from the existing quarry and the cut/fill balance of the Goose Plant Site area.

Mine Infrastructure, Buildings, and Laydown Areas

The main supporting facilities to be constructed at the Goose Property include the following:

- a crusher plant;
- Process Plant;
- explosives and ammonium nitrate storage facility;
- fuel tank farm;
- maintenance and service buildings;
- laydown area including heated, unheated, and outdoor storage;
- Goose Exploration Camp;
- two water intakes;
- one effluent discharge; and
- a diesel power plant and power utility building.

Material required during the Construction Phase to develop these facilities will be sourced from the Umwelt Quarry and the cut/fill balance of the Goose Plant Site area.

Water Management Infrastructure

Water management berms will be required during the Operations Phase at the Goose Property and will be built during the Construction Phase; this infrastructure includes non-contact water diversion berms, contact water containment and diversion berms, and saline water management infrastructure. Water intake and discharge pipelines will be constructed with small volumes of washed granular material with limited fines; no other washing of granular material is currently proposed. Additional water management structures will be constructed as the Project develops into Operations. A description of the water management berms is provided in the Water Management Plan (SD-05).

Material required to construct the various water management berms will be sourced from the existing Quarry, the Umwelt Quarry, and the cut/fill balance of the Goose Plant Site area during the Construction Phase.

Tailings Storage Facility

The tailings from the initial 2 years of production will be deposited in a purpose-built TSF located about 2 km South of the Goose Main open pit (MAD Appendix A, base Figure 3). An estimated 1.5 Mt will be required to construct the Main TSF Dam during the Construction Phase. Refer to the Tailings Management Plan (SD-09) for more details. A portion of this material will be sourced from the existing quarry (see Section 4.2). The remaining material will be sourced from the Umwelt Quarry (i.e., initial development of the Umwelt Pit).

4.3.2 Marine Laydown Area

Quarry (cut and fill) operations at the MLA include cutting bedrock material to create a suitable area for the MLA Fuel Storage and using the extracted material to build the MLA Camp Area, MLA Laydown Area, and the Freight Storage Area. This cut/fill material may also be used to build other laydowns, storage pads, containment areas, site roads, and other mitigation measures at the MLA. The MLA footprint will be minimized by maximizing the use of stripped material.

4.3.3 Winter Ice Road

Along the WIR alignment, efforts will be made to complete construction using snow and ice; if minor amounts of granular fill is required, potential borrow and quarry sites will be identified prior to the WIR construction. Sabina will seek appropriate authorization from the KIA and/or Indigenous and Northern Affairs Canada prior to use.

Suitable material locations along the WIR will be geotechnically and geochemically stable, aim to minimize transport distances, and avoid culturally and environmentally sensitive areas. Options for quarry material include local eskers, local bedrock locations in new areas, and local bedrock locations within current mine operations footprint.

4.4 GEOCHEMICAL CHARACTERISTICS

Quarry Rock at the Goose Property

Detailed geochemical characterization studies to assess the ML/ARD potential of quarry rock associated with the Property was carried out, and can be found in the Geochemical Characterization Report (MAD Appendix E-3). The testing program included ABA and trace element analyses on 40 samples from the Airstrip Quarry, and 16 samples from the Umwelt Quarry.

The Airstrip Quarry is comprised mainly of a series 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. Gabbro is NPAG, iron formation is potentially acid generating (PAG), and the other rock types (mainly greywacke and mudstone) include a mixture of material that is PAG, NPAG, or that has an uncertain potential for ARD. Sabina has committed to complete further testing within the Airstrip Quarry to further delineate PAG materials in advance of, or concurrent with, sourcing additional quarry materials. Only NPAG quarry rock will be used for construction. Consistent with the waste rock classification criteria in the Mine Waste Rock Management Plan (SD-08), the criteria that will be used to classify NPAG waste rock samples to be collected from the MLA Quarry 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 (MAD Appendix E-3) show that these criteria provide an appropriate level of conservatism for waste rock classification.

The Umwelt Quarry locations were selected to be entirely within the upper greywacke unit. The majority of upper greywacke samples collected from the Umwelt Quarry were classified as NPAG or low sulfide (S) material with a limited potential for ARD.

Two samples of contact water were collected from the Goose Airstrip as part of the waste rock geochemical characterization program (MAD Appendix E-3). Based on the results of analysis of the seepage water, contact water associated with quarry rock from both the Airstrip Quarry and the Umwelt Quarry area is expected to contain slightly elevated levels of arsenic. Arsenic loading from this material was considered in the overall assessment of environment effects, and the results from the Water and Load Balance Report (MAD Appendix E-2) indicate that infrastructure constructed using this material is a relatively minor source of arsenic loading in comparison to the waste rock storage areas (WRSAs) or the TSF. Therefore, no specific water management will be required to control arsenic loading from the quarry rock.

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

Quarry Material at the Marine Laydown Area

Geochemical characterization was completed on surface outcrop (8 samples) and sandy gravel (7 samples) 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.

Overburden

Geochemical characterization was completed on 60 samples of overburden collected from various sites at the Goose Property. The majority of overburden samples were classified as NPAG, with a low potential for acid generation. No specific overburden management measures are required for the purpose of use of this material for construction.

4.5 DEVELOPMENT, OPERATIONS, AND CLOSURE

The proposed areas will be developed, inspected, maintained, and closed by Sabina or contractors charged with this responsibility under the direction of Sabina.

4.5.1 Development Plans – Rock Quarries

A detailed procedure will be prepared before the start of development for each rock quarry and will be appended to this plan and will be provided to the NWB 60 days prior to construction. Site development plans will augment this management plan with specific details. These development plans will include:

- Site layout and setup 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 measure (if required).

The final quarry configuration will consist of a flat surface graded at approximately 1% in the down slope direction, adjoining a steeper angle 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.

4.5.2 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 (SD-17) 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.

Topsoil will be handled as run of mine waste and stored or disposed of accordingly. Overburden will either be handled as run of mine waste and stored accordingly, or segregated and used where possible in reclamation activities as capping material.

4.5.3 Quarry and Borrow Pit 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.

Sabina will continue a program of progressive reclamation per the ICRP (SD-26).

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 service roads (all-weather or WIRs) to ensure free flow of water during melt;
- block access (if required) and flag boundaries;
- water quality monitoring;
- quarry wall stability monitoring; and
- measuring extent of permafrost or ground-ice.

At this time, active revegetation of the Project footprint as part of Closure is not planned given the cold climate setting of the Project, as well as the precedent established for mine closure in Nunavut. Quantities of top soil are also very limited and such will not be viable for this purpose either. Prior to Closure, research plans will be carried out to better define the engineering and revegetation strategies necessary for closure and reclamation. Refer to the ICRP (SD-26) for additional details on Closure activities.

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 Mine Manager, along with their direct reports, is responsible for the specifics 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.

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 4.5.1) 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. • Service road maintenance.	• ML/ARD	Further delineation and segregation of PAG/NPAG quarry rock and overburden. 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. Confirmatory testing will be completed for greater depths at the MLA Quarry prior to excavation, and will be completed on an as-needed basis at other quarry (i.e., Umwelt Quarry, Goose Plant cut/fill area and other identified quarries).

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 the quarry development. Quarry development may occur under development works and results of sampling will be provided in summary form within the annual report for existing water licence 2BE-GOO1520. Detailed plans for this program will be developed as part of detailed design and provided to the NWB 60 days prior to construction.

Where possible, any areas within the quarries that are delineated as PAG will be avoided. However, if blasting of PAG material is required to access sufficient NPAG material, the PAG quarry rock will be hauled to one of the designated WRSAs for disposal.

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 (e.g., consider covering with NPAG waste rock or other cover type).

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 mat 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 mat 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 at a minimum distance of 31 m from the ordinary high water mark of any water body. Topsoil will be stockpiled separately from the 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 Project discharge criteria as defined in the Water Management Plan (SD-05). 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 this 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. Dust monitoring for the quarry and borrow pit operations will be considered for inclusion with dust monitoring programs. Refer to the Mine Waste Rock Management Plan (SD-08) for more details on dust management.

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 the 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 can 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. Both Goose Property and the MLA will require these to be mitigated in order for Project work to advance. 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 Potential

Development Area 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 are provided in the Wildlife Mitigation and Monitoring Plan (Version 7, submitted with FEIS Addendum February 2017), along with proposed mitigation measures, which are summarized below.

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 Predevelopment and Construction phases of the Project.

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 (SD-20).

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, and any PAG quarry rock disposed in WRSAs	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	

There are two types of monitoring related to mine waste management: 1) monitoring that is carried out for operational and management purposes by Sabina for day-to-day decision making, with no obligation to report; and 2) monitoring that is specified in the Type A Water Licence. The following monitoring data will be collected, compiled, and managed internally:

- During the active development of the quarries, site staff will carry out daily visual inspections in relation to the performance and condition of each structure, and to ensure compliance with design, this management Plan, permits, authorizations, and commitments. When placement activity ceases on an interim or seasonal basis, the inspection frequency will shift to monthly. Following the completion of a quarry, inspections will continue on a semi-annual basis until closure. The purpose of these inspections is to identify and document any potential hazards or risks to the facility, such as deformations, unusual seepage, slumping, local failure, etc.
- During Operations, an annual elevation and geometry survey of the quarries will be performed to verify the overall volume excavated.

The following quarry monitoring data will be reported to the NWB through the Water Licence Annual Report:

- Quantities of the NPAG quarry rock produced during quarry operations, and the amounts placed in each of the infrastructure components will be recorded on a daily basis and a monthly summary will be provided in the Annual Report. Quantities of PAG excavated and deposited in the WRSAs will also be recorded.
- Geochemical monitoring will be completed to confirm that all of the quarry rock used for construction is NPAG. Confirmatory samples will be taken at a rate of one sample per 100,000 tonnes of mined material from NPAG areas within the quarries. The collected samples will be sent to an accredited commercial laboratory for ABA tests (with NP determination using the Modified Sobek method) and NAG tests.
- Dust related to waste rock and overburden management is not expected to be an issue by employing the dust suppression measures presented in Section 6.3 through design, Operations, and Closure phases. Air quality at the mine site will be monitored during Construction, Operations, and Closure through air quality monitoring stations and reported annually.
- The performance of the quarries and infrastructure components constructed from quarry rock will be inspected and assessed during the annual geotechnical site inspection by a geotechnical engineer registered in Nunavut. The visual assessment and recommended actions to be taken related to the quarries and infrastructure will be summarized in the Annual Inspection Report.
- A spring seep survey will be completed along the downgradient side of major infrastructure components constructed from ROQ, including the Goose Plant Site, Airstrip and other pads, to verify and refine the water quality predictions for quarried material. The locations of any seeps will be marked in the field and recorded using a portable GPS. Field measurements of pH, electrical conductivity, oxidation-reduction potential, and temperature will be recorded, and samples will be submitted for acidity/alkalinity (as appropriate), sulphate, dissolved major cations (calcium, magnesium, sodium, and potassium), as well as a full suite of dissolved metals. Additionally, as part of the seep survey, if surface runoff or ponded water is observed in any of the quarry areas, samples will be collected and submitted for analysis.

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

Incidental 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

Checking and corrective action will occur through regular inspections and the evaluation of monitoring data.

Corrective action will be undertaken if inspections identify inconsistencies with this plan or with applicable legislation. Work will be stopped if necessary to implement corrective action.

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 relevant to mine waste management. 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 during Construction and Operations, with details as outlined in Section 7. For years prior to Closure, the Annual Report will include total volume of material quarried and an assessment for additional monitoring and reporting through the Closure Phase.

10. Reclamation

Final closure of the borrow pits and quarry sites will be undertaken once they are no longer needed, or when the mine closes as part of mine closure activities. Final closure of the borrow pits and quarries will consider the removal of all mobile and stationary equipment, regrade the sites so they blend with the existing topography, and water quality monitoring. Additional details pertaining to Closure are provided in the ICRP (SD-26).

11. References

BGC (BGC Engineering Ltd.). 2003. Implications of global warming and the precautionary principle in northern mine design and closure; report prepared by BGC Engineering Ltd. for Indian and Northern Affairs Canada.

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

Canada. 1985. *Territorial Lands Act.* R.S.C., 1985, c. T-7.

Canada. 1985. *Explosives Act*. R.S.C., 1985, c. E-17.

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

Canada. 1999. Canadian Environmental Protect Act. S.C. 1999, c. 33.

Canada. 2002. *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. S.C. 2002, c. 10.

GN (Government of Nunavut). 1988. *Consolidation of Wildlife Act*. R.S.N.W.T. 1988, c. W-4.

INAC (Indian and Northern Affairs Canada). 2010. Northern Land Use Guidelines: Volume 7 Pits and Quarries.

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

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

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

Sabina (Sabina Gold & Silver Corp.). 2016. Final Technical Comment Responses, Appendix G. Submitted to Nunavut Impact Review Board. March 2016.

SRK (SRK Consulting (Canada) Inc.). 2015. Goose Property – 2015 Overburden Geotechnical Investigation Program. Prepared for Sabina Gold & Silver Corp. December 2015.