



**BACK RIVER
Vegetation Monitoring Plan**

January 2020

BACK RIVER VEGETATION MONITORING PLAN

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Document Revision Record

Date	Section	Page	Revision	Prepared by:
December 2014			Original Document Prepared in support of Final Environmental Impact Statement (FEIS)	Sabina Gold & Silver Corp. (Sabina)
February 2017 (ver.1)			Conceptual Document Prepared in support of Project permitting	Sabina Gold & Silver Corp. (Sabina)
January 2020 (ver.2)	All	All	Full update of document to directly address requirements of NIRB Project Certificate No. 007	Sabina Gold & Silver Corp. (Sabina)

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 Department: Environment & Sustainability
 Title: Vice President - Environment & Sustainability

Date:

Signature:

Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AQMMP	Air Quality Monitoring and Management Plan
EIS	Environmental Impact Statement (November 2015) and Addendum (February 2017)
Licence	Type A Water Licence 2AM-BRP1831
LSA	Local Study Area (defined in EIS)
MLA	Marine Laydown Area
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
PDA	Potential Development Area
PMP	Permanent monitoring plots
RSA	Regional Study Area
SOP	Standard Operating Procedures
T&C	Terms and Conditions
The Mine	The Back River Mine
TSF	Tailings Storage Facility
VMP / Plan	Vegetation Monitoring Plan
WIR	Winter ice road

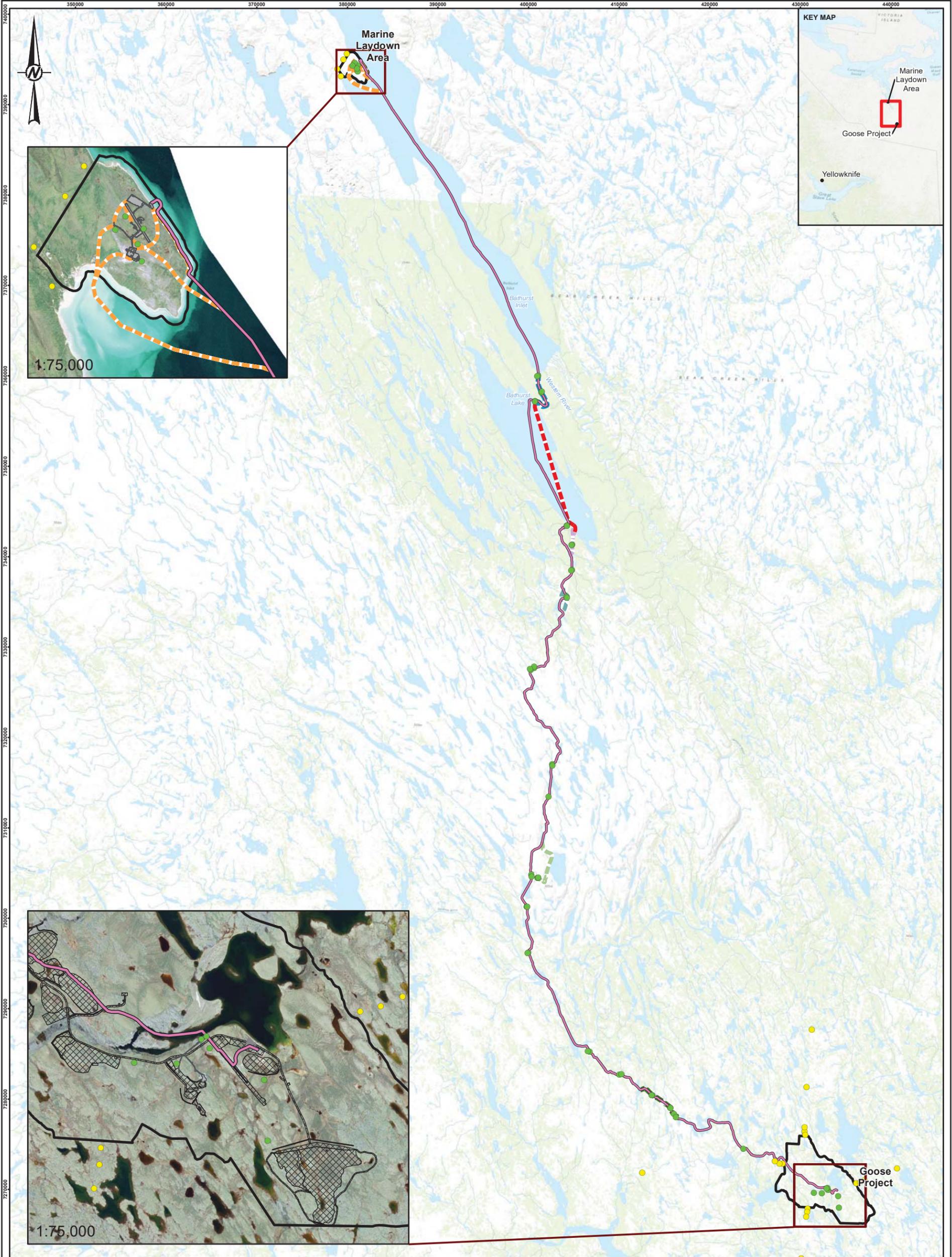
1. Introduction

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

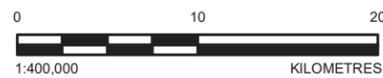
The Mine is comprised of two main areas, Goose Property and the Marine Laydown Area (MLA) with interconnecting winter ice roads (Refer to Figure 1). The majority of annual resupply will be completed using the MLA situated along the western shore of southern Bathurst Inlet, which is connected seasonally to the Goose Property via an approximately 160 km long winter ice road (WIR).

The Vegetation Monitoring Plan (VMP or Plan) outlines the approach for monitoring Mine-related vegetation impacts throughout the Mine life. The Plan has been developed following the requirements of the Nunavut Impact Review Board (NIRB) to Sabina (NIRB 2013), and to address the terms and conditions outlined in Project Certificate No. 007, as well as any commitments made by Sabina throughout the regulatory review process.

The information presented herein is current as of January 2020. The Plan will be reviewed as needed to optimize monitoring based on results, and regulatory and stakeholder feedback. As required by the Project Certificate, any changes to the Plan will be provided to the NIRB and input will be sought from the Kitikmeot Inuit Association and the Government of Nunavut. Refer to Section 3 Regulatory Requirements.



- LEGEND**
- 2019 VEGETATION MONITORING LOCATION
 - PROPOSED VEGETATION MONITORING LOCATION
 - WINTER ICE ROAD AS BUILT
 - AWR/WIR SECTIONS**
 - BATHURST LAKE REVISION
 - KM 62 BYPASS OPTION
 - LAKE 8 - LAKE 9 PORTAGE
 - MLA WIR ACCESS IMPROVEMENT OPTIONS
 - ROCK GARDEN KM 70-71 BYPASS OPTIONS
 - SADDLE IMPROVEMENT
 - Z ROUTE OPTION
 - EXISTING GOOSE AIRSTRIP
 - EXISTING GOOSE PROPERTY OR MARINE LAYDOWN AREA FOOTPRINT
 - EXISTING GOOSE CAMP LAYOUT
 - PDA
 - PROPOSED GOOSE INFRASTRUCTURE FOOTPRINT



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PROJECT
SABINA BACK RIVER PROJECT
 2019 VEGETATION PERMIT APPLICATION

TITLE
VEGETATION AND NON-NATIVE PLANT MONITORING LOCATIONS - WINTER ICE ROAD

CONSULTANT	YYYY-MM-DD	2020-01-16
	DESIGNED	CS
	PREPARED	SK/PMT
	REVIEWED	
	APPROVED	

GOLDER

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2. Scope and Objectives

The VMP is a key document that forms part of Sabina's overall Environmental Monitoring Program for the Mine. The Plan has been written to meet the requirements of the NIRB Project Certificate No. 007.

The plan is divided into the following components:

- Regulatory Requirements (Section 3);
- Roles and Responsibilities (Section 4);
- Monitoring Program (Section 5);
- Mitigation and Adaptive Management (Section 6);
- Quality Assurance and Quality Control (Section 7); and
- Environmental Reporting (Section 8).

This Plan has been developed with the core objective, to quantify (annually), the impacts of the Mine components (i.e., footprint increases) on vegetation throughout the Construction, Operations, Closure and Post-Closure phases of the Mine. The plan will not apply during care and maintenance phases of the Mine. Additionally, the Plan will support the collection of data to assist in proactively identifying and managing potential impacts to vegetation.

2.1 RELATED PLANS

Sabina has in place various management, mitigation, and monitoring plans that may supplement the VMP, including:

- Air Quality Monitoring and Management Plan;
- Wildlife Monitoring and Mitigation Plan;
- Road Management Plan;
- Water Management Plan;
- Saline Water Management Plan;
- Environmental Management and Protection Plan;
- Interim Closure and Reclamation Plan; and
- Sabina's Pre-Shipment Equipment Cleaning SOP.

3. Regulatory Requirements

Vegetation monitoring regulatory requirements are primarily outlined in the Project Certificate No. 007 issued by the Nunavut Impact Review Board (NIRB). A summary of the Project Certificate No. 007, vegetation management, mitigation, and/or monitoring related Terms and Conditions are outlined in Table 3-1.

The Type A Water Licence 2AM-BRP1831 (Licence) issued by the Nunavut Water Board (NWB), and approved by the Minister, does not include specific Terms and Conditions related to vegetation monitoring. However, the NWB takes a holistic practical approach to reclamation whereby the elements of land and water are interconnected, and what affects one part of the environment can ultimately have an impact on other environmental elements (water and vegetation, for example) (NWB 2018). Refer to future updates to the closure and reclamation plan and/or future Annual Reports to regulators for further information related to restoration research and re-vegetation initiatives at the Mine.

During the regulatory review process, Sabina (July 2018) agreed and/or committed to the following:

- Monitor Saline Water Pond Perimeter Seepage (WF-INAC-03; WTM- Commitment 12 [INAC-TRC-5])
 - Vegetation monitoring around perimeter
- Tailings Storage Facility (TSF) Perimeter Seepage (WTM-Commitment 13[NAC-TRC-6])
 - Vegetation monitoring around perimeter
- Complete a Revegetation Planning Table (WTM-Commitment 14 [INAC-TRC-27])
 - Forms a component of the Mine Closure and Reclamation Plan

There are no additional applicable legislation or guidelines related to this plan.

Table 3-1. Project Certificate No. 007, Vegetation Management, Mitigation, and/or Monitoring Related Terms and Conditions

T&C No.	Category	Objective	Term and Condition	Reporting Requirements	VMP Section Reference
19	Hydrological Features and Hydrogeology	To manage saline groundwater and minimize the impacts to permafrost, soil, surface water, vegetation and wildlife.	The Proponent shall, reflecting any direction from the Nunavut Water Board, maintain a saline water management plan which includes monitoring of thermal conditions, monitoring of saline water at the Goose site, and mitigation measures designed to address the potential for higher-than-predicted volumes of saline water inflows into the open pits and the underground mine, treatment and disposal methods. The plan should include accurate characterization of saline water inflows into the underground mine workings.	The plan should be submitted to the Nunavut Impact Review Board (NIRB) at least 60 days prior to the commencement of operations, with results submitted annually thereafter or as may otherwise be required by the NIRB.	[See Saline Water Management Plan]
29	Freshwater Aquatic Environment - Water Crossings	To mitigate impacts to fish and fish habitat.	The Proponent shall implement all applicable Fisheries and Oceans Canada best management practices to avoid and mitigate serious harm to fish as a result of water crossing construction, operation, and decommissioning for all fish-bearing water crossings. These measures should include, but are not limited to, appropriate design of water crossings to facilitate fish passage at both high and low flows, timing windows that incorporate spawning, incubation and hatch times for all species using watercourses, sediment and erosion control, <u>protection of riparian vegetation</u> , and other forms of bank stabilization.	Information regarding best management practices and/or mitigation measures implemented by the Proponent in fulfillment of this Term and Condition shall be provided in the Proponent's annual report to the Nunavut Impact Review Board.	6; [And see Water Management Plan]
32	Vegetation - Site Footprint	To minimize the impacts of the Project on vegetation.	The Proponent shall ensure that Project activities are planned and conducted in such a way as to minimize the Project footprint.	In the Proponent's annual report to the Nunavut Impact Review Board, the Proponent shall provide information regarding the current Project footprint, taking into account construction and progressive reclamation activities, and including information regarding the loss or alteration of vegetation associated with Project activities (including identifying the type of any habitat losses resulting from these effects).	3.1
33	Vegetation - Invasive Species*	To prevent the introduction of invasive species.	The Proponent shall ensure that equipment and supplies brought to the project sites are clean and free of soils that could contain plant seeds not naturally occurring in the area. Vehicle tires and treads in particular must be inspected prior to initial use in project areas. The Proponent shall also incorporate protocols for monitoring for the potential introduction of invasive vegetation species (e.g. surveys of plant populations in previously disturbed areas) into relevant monitoring and management plans for the terrestrial environment. Any introductions of non-indigenous plant species must be promptly reported to the Government of Nunavut Department of Environment.	At least 30 days prior to first shipment of equipment and supplies to the site, the Proponent's mitigation plans, protocols, monitoring and inspection program required in fulfillment of this Term and Condition shall be provided to the Nunavut Impact Review Board for review. Subsequently, information regarding inspections, monitoring results, and any reports to the Government of Nunavut Department of Environment as referenced above shall be included in the Proponent's annual report to the Nunavut Impact Review Board.	Sabina's Pre-shipment Equipment Cleaning SOP cited in Section 6; 5.3 (Protocols); 8 (Reporting)

(continued)

VEGETATION MONITORING PLAN

Table 3-1. Project Certificate No. 007, Vegetation Management, Mitigation, and/or Monitoring Related Terms and Conditions (completed)

T&C No.	Category	Objective	Term and Condition	Reporting Requirements	VMP Section Reference
34	Vegetation - Vegetation Monitoring Plan	To minimize potential impacts to vegetation along the winter road/trail routings and around project sites.	The Proponent shall have in place a Vegetation Monitoring Plan that is designed to quantify the potential impacts on vegetation from the Project, including the annual construction/ operation of the winter ice roads and trails. The plan should include all commitments discussed throughout the Review of the Project, including commitments to consult with the Kitikmeot Inuit Association, the Government of Nunavut, and other relevant parties, as well as:	The plan should be submitted to the Nunavut Impact Review Board (NIRB) at least 90 days prior to the start of construction, with results submitted annually thereafter or as may otherwise be required by the NIRB.	This Plan; 1
			a. Establishment of pre-construction and post-operation vegetation conditions annually with supporting photographs to allow for long-term comparisons of vegetation conditions along winter ice road/trail routings and around project sites;		5.5
			b. Incorporation of measures to prevent or minimize potential destabilization and erosion along winter ice road/trail routings and around project sites;		6
			c. Details on the triggers for implementing adaptive management options if effects to vegetation are observed, including potential impacts from dust deposition; and,		5.1 through 5.5 and 6
			d. Discussion of how the findings from monitoring efforts would be used to inform reclamation planning.		6
35	Vegetation - Revegetation and Reclamation	To maximize revegetation in reclaimed areas.	The Proponent shall develop a progressive revegetation program for disturbed areas that are no longer required for operations, such as a program to incorporate measures for the use of test plots, reseeding, and replanting of native plants as necessary. It is further recommended that this program be directly associated with the management plans for erosion control established for the Project.	The program and associated revegetation results should be provided within the Proponent's annual report submitted to the Nunavut Impact Review Board.	6
36	Vegetation - Mine Closure and Reclamation Plan	To maintain an up to date revegetation plan for the Project.	The Proponent shall include revegetation strategies within its Mine Closure and Reclamation Plan that support progressive reclamation, and promote natural revegetation and recovery of disturbed areas compatible with the surrounding natural environment. These strategies should include exploration of the feasibility and practicality of topsoil/ organic matter salvage through Project development. The Closure and Reclamation Plan should be updated on an on-going basis as more information becomes available from similar reclamation efforts at other northern projects, as applicable.	Within three (3) years from the commencement of construction, information regarding the revegetation strategies developed and implemented by the Proponent in fulfillment of this Term and Condition shall be included in the Proponent's annual report to the Nunavut Impact Review Board. Subsequently, information regarding the Proponent's progress in fulfillment of this Term and Condition shall be provided annually in the Proponent's annual report to the Nunavut Impact Review Board.	6

*Terminology - "Invasive Species" referred to as Non-Native Species in standard practice and throughout this Plan as per Canadian Endangered Species Conservation Council (CESCC 2010).

4. Sabina Back River Project Roles and Responsibilities

Sabina's Environmental Department is responsible for monitoring compliance with applicable regulations and permit requirements (Section 3). The responsibility of implementation of mitigation measures rests with the Construction and Operations Departments.

Compliance is achieved through ongoing monitoring, and development and implementation of operational standards, procedures, and employee training.

5. Monitoring Program

The vegetation monitoring program will be implemented during Construction, Operations, Reclamation and Closure phases of the Project. The monitoring program will be focused on objectives outlined in Section 2 and Table 3-1. Sampling locations, objectives, and the monitoring schedule for individual components of the Vegetation Monitoring Plan are presented below in Table 5-1.

Table 5-1. Monitoring Components of the Vegetation Monitoring Plan

Monitoring Component	Monitoring Location	Objective/Program Integration	Monitoring Schedule/Sampling Frequency
Footprint Monitoring	Project Footprint	<ul style="list-style-type: none"> Spatial comparison of the previous footprint to the current year's footprint Cumulative vegetation loss will be quantified by ecosystem type 	Annually during Construction and Operation
WIR Monitoring	Paired monitoring plots within six vegetation associations: <ul style="list-style-type: none"> Cottongrass Sedge Fen (WC) Dry Sparse Tundra (TH) Mesic Dwarf Tundra (TL) Raised Bog Complex (WB) Tundra Seepage (TS) Undifferentiated Tundra (TU) 	<ul style="list-style-type: none"> Document impacts to vegetation along WIR Data from reference plots can be used for vegetation monitoring, and lichen monitoring components Non-native plant surveys will be conducted as part of the WIR monitoring 	<ul style="list-style-type: none"> Photographic monitoring completed annually Field-based vegetation monitoring every three years during Construction and Operation
Vegetation Monitoring	Permanent monitoring plots located along a distance gradient from the Potential Development Area(s) at: <ul style="list-style-type: none"> 0 m from the Goose Project Area 150 m from the Goose Project Area 500 m from the Goose Project Area 1 km from the Goose Project 5 km from the Goose Project 10 to 20 km from the Goose Project 0 m from the MLA 150 m from the MLA 	Document changes (if any) in species diversity (richness) and abundance (percent cover) and health (vigour) through continued monitoring	Every three years during Construction and Operation
Non-native Plant Monitoring	Focused surveys around Goose and MLA sites Surveys conducted in conjunction with vegetation monitoring component	Document occurrences (if present) of non-native plant species as a result of Mine activities	
Lichen Monitoring	Stratified sampling sites along a distance gradient from the Potential Development Area(s), to align with Vegetation Monitoring locations: <ul style="list-style-type: none"> 0 m from the Goose Project Area 150 m from the Goose Project Area 500 m from the Goose Project Area 1 km from the Goose Project 5 km from the Goose Project 10 to 20 km from the Goose Project 0 m from the MLA 150 m from the MLA Reference sampling to be completed in conjunction with vegetation monitoring	Quantify contaminant (metal) levels in lichen (caribou forage) through continued monitoring throughout the duration of the Mine	

Footprint expansion will be monitored annually during Mine Construction and Operations, unless it can be documented that there was little to no footprint change between successive years. Photographic monitoring along the WIR will occur annually, with vegetation sampling occurring every three years and will include the paired monitoring plot to evaluate effects of the WIR to vegetation, in addition to monitoring for the detection of non-native plant species. Remaining monitoring aspects, the vegetation monitoring, non-native plant surveys and lichen tissue metal sampling, will occur in conjunction with vegetation sampling along a distance gradient from the Mine every three years during Construction and Operation phases.

Dustfall will be monitored quantitatively as part of the Air Quality Monitoring and Management Plan (AQMMP) and its relevance considered along with the results of the vegetation and lichen monitoring components.

Specific details for implementing each vegetation monitoring program are provided below. Sampling locations will be determined via a combined desktop habitat map evaluation and subsequently refined in the field to allow for issues around the scale of input data sources. Finalized sampling locations will be provided with the data reports.

5.1 FOOTPRINT MONITORING

Footprint development will be monitored annually in years of footprint expansion, unless it can be documented that there was little to no footprint change between successive years (Table 5.1-1). Evaluation will consist of a spatial comparison of the previous year’s footprint to the current year’s footprint. Annual as well as cumulative vegetation loss will be quantified by ecosystem type. A footprint loss summary table with project footprint components will be provided each year with the annual report to the NIRB.

Table 5.1-1. Footprint Monitoring Overview

Indicator	Footprint Area
Measurable Parameter	Footprint expansion
Key Mine Interaction	Direct habitat loss through footprint expansion
Goal	The minimization of Mine footprint
Objective	To quantify habitat loss by ecosystem type through monitoring of footprint expansion annually during years of construction activities
Criteria	Losses within the LSA and RSA
Scope of Monitoring Work	Evaluation to be conducted annually in years of footprint expansion

5.2 VEGETATION MONITORING

Vegetation monitoring will include monitoring of vascular and non-vascular species abundance, richness (diversity), and vigour (health). This will be conducted through the establishment of fixed area, permanent monitoring plots in dominant vegetation associations within the Local Study Area (LSA) and Regional Study Area (RSA). The Environmental Impact Statement (EIS) for the Mine determined that winds are predominantly from the south during growing season (FEIS, Volume 4), and will guide where permanent vegetation monitoring plots will be established. However, the exact locations of the

permanent monitoring plots will be finalized in the field and will be based on predictions made in the EIS, mine activity, predominant winds, and accessibility.

5.2.1 Sampling Locations

The vegetation monitoring plots will be established along a distance gradient away from the Potential Development Area (PDA) for the Goose (Figure 2) and MLA (Figure 3) sites. Implementing a gradient design, distances for sampling locations will capture potential effects of the Mine’s operations on vegetation including:

- 0 m from the Goose Project Area;
- 150 m from the Goose Project Area;
- 500 m from the Goose Project Area;
- 1 km from the Goose Project Area;
- 5 km from the Goose Project Area;
- 10 to 20 km from the Goose Project Area;
- 0 m from the MLA; and
- 150 m from the MLA.

In addition to vegetation monitoring plots established in 2019, 8 vegetation monitoring plots will be added (4 at Goose Project, 4 at MLA) at distances of 150 m from the PDA boundary to capture project related effects at this distance. Consistent with a gradient design, additional vegetation monitoring plots will be established at 500 m, 1 km, 5 km, and 10-20 km from the Goose Project PDA boundary (Table 5.2-1, Figures 1, 2 and 3).

Table 5.2-1. Vegetation Monitoring Plot Location Summary

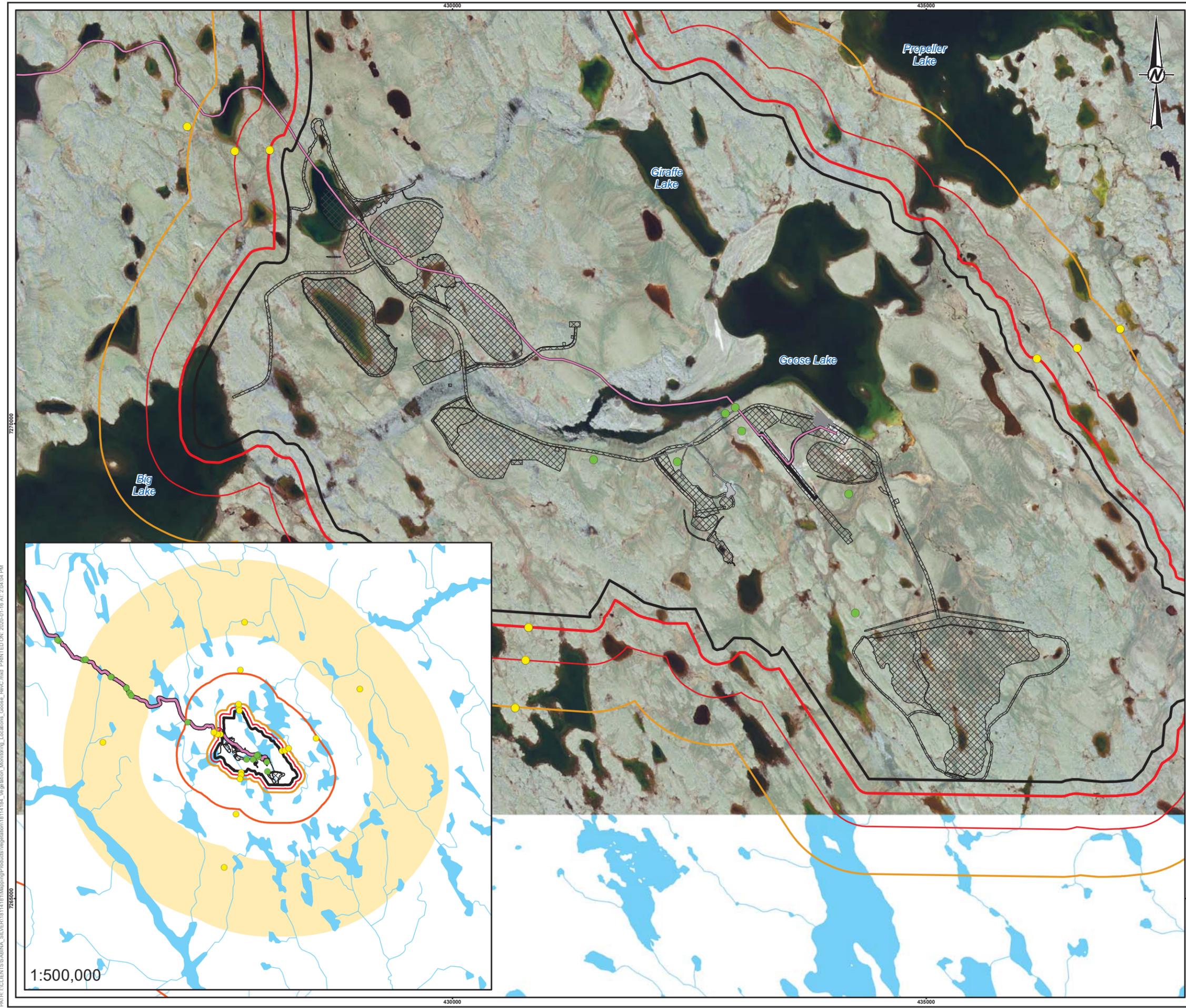
Project Component	Distance from PDA Boundary	Existing # of Plots	Proposed # of Plots	Total
Goose Project	0 m	5	-	5
	150 m	-	4	4
	500 m	-	4	4
	1 km	-	4	4
	5 km	1*	3	4
	10 - 20 km	3*	4	7
<i>Subtotal</i>	-	9	19	36
MLA	0 m	5	-	5
	150 m	0	4	4
<i>Subtotal</i>	-	5	4	9
Grand Total	-	14	23	45

* Existing WIR monitoring plots

To capture any potential effects, all vegetation monitoring plots will be established in cardinal directions surrounding the project components, in the dominant vegetation associations - mesic dwarf tundra (TL)

VEGETATION MONITORING PLAN

and dry sparse tundra (TH) vegetation associations. The gradient design is designed to capture Zone of Influences (ZOI) on vegetation with increasing distance from the Mine

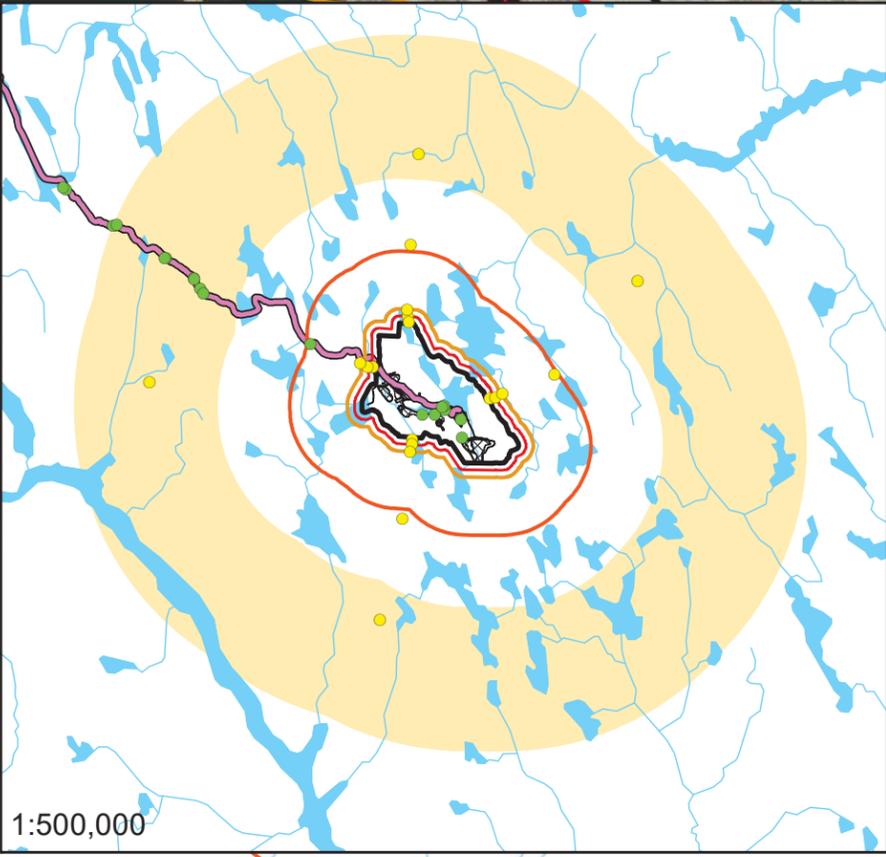
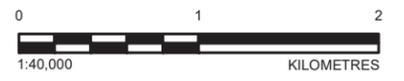


LEGEND

- 2019 VEGETATION MONITORING LOCATION
- PROPOSED VEGETATION MONITORING LOCATION
- WATERCOURSE
- WATERBODY
- WINTER ICE ROAD AS BUILT
- EXISTING GOOSE AIRSTRIP
- EXISTING GOOSE PROPERTY FOOTPRINT
- EXISTING GOOSE CAMP LAYOUT
- PROPOSED GOOSE INFRASTRUCTURE FOOTPRINT
- 10-20 km (INSET)

DISTANCE FROM PDA

- GOOSE PROPERTY PDA
- 150 m
- 500 m
- 1 km
- 5 km



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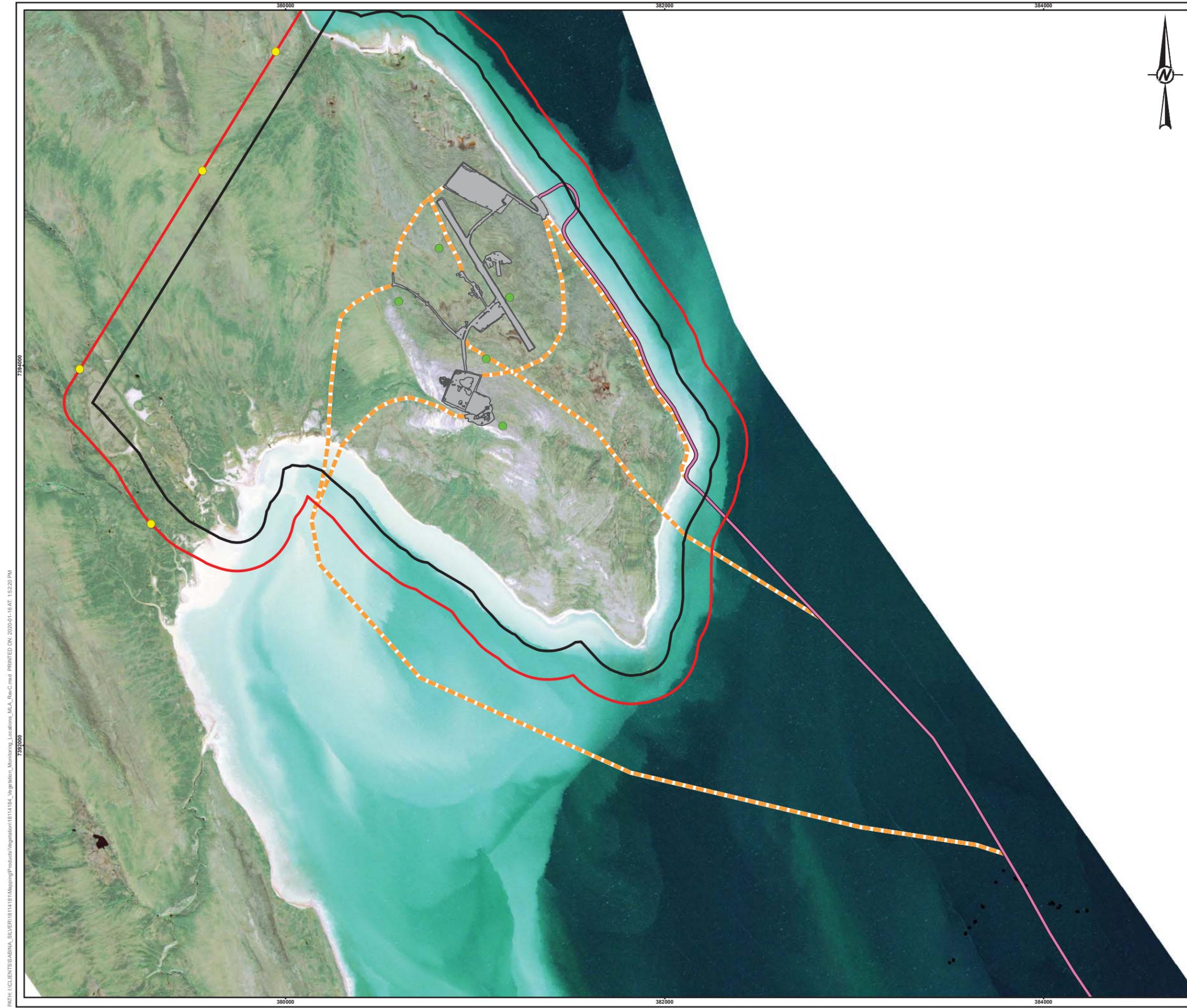
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SABINA BACK RIVER PROJECT
2019 VEGETATION PERMIT APPLICATION

TITLE
VEGETATION, NON-NATIVE PLANT AND LICHEN MONITORING LOCATIONS – GOOSE PROPERTY

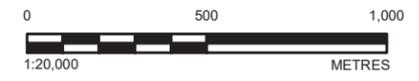
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- LEGEND**
- 2019 VEGETATION MONITORING LOCATION
 - PROPOSED VEGETATION MONITORING LOCATION
 - WINTER ICE ROAD AS BUILT
 - MLA WIR ACCESS IMPROVEMENT OPTIONS
 - EXISTING MARINE LAYDOWN AREA FOOTPRINT
- DISTANCE FROM PDA**
- MARINE LAYDOWN AREA PDA
 - 150 m



REFERENCE(S)
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APPROVED		

PROJECT
SABINA BACK RIVER PROJECT
2019 VEGETATION PERMIT APPLICATION

TITLE
VEGETATION, NON-NATIVE PLANT AND LICHEN MONITORING
LOCATIONS - MARINE LAYDOWN AREA

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5.2.2 Sampling Methods

Permanent monitoring plots (PMP) will be 1 square metre in size (1 m²) and plot corners will be identified with labelled metal tags or markers to be identifiable in future sampling events. All attributes will be collected using a plot frame with 10 cm increment demarcations. An additional 10 square centimetre (cm²) plot frame will be used to estimate relative abundance (percent cover) within each PMP to increase the accuracy and precision of relative abundance (percent cover) estimates.

Percent cover of the following biotic and abiotic attributes will also be collected in each PMP:

- each species of vascular plant;
- rock lichens;
- terrestrial (ground) lichens;
- moss species;
- bare ground;
- rock;
- litter; and
- sign of wildlife use (e.g., tracks, animal pellets, browse scars).

Vascular and non-vascular plant species that cannot be identified to the species level will be collected from outside the PMP for subsequent identification by a qualified taxonomist. Rare plants and non-native plants, if present will also be including in the documentation (Table 5.2-2). Rare plants were defined as vascular and non-vascular species listed under SARA Schedule 1 and species with “Endangered”, “Threatened”, or “Special Concern” status (Government of Canada, 2019).

Table 5.2-2. Vegetation Monitoring Overview

Indicator	Vegetation Monitoring
Measurable Parameter	Vegetation species richness (diversity), and abundance (percent cover), and vigour (health)
Key Mine Interaction	Effluent, dust and emissions released into the environment have the potential to impact vegetation. Dust affects the survival of certain plant species leading to changes in species diversity and abundance and health
Goal	The Mine will not result in observed changes in plant species diversity and abundance
Objective	To quantify vegetation abundance (percent cover), diversity (richness) and vigour (vegetation health) through continued monitoring throughout the duration of the Mine
Criteria	Changes to Measurable Parameters do not exceed predictions in the EIS.
Scope of Monitoring Work	Regional Monitoring: monitor vegetation composition/species richness, abundance, and vigour, surveys to be conducted every 3 years

As part of vegetation monitoring, vigour (vegetation health) will be assessed around the perimeter of the Saline Water Pond and the TSF for impacts due to the presence of saline groundwater and/or variations in water quality. Qualitative analytical approaches will be completed at plots using an *in-situ* vigour class scale and are used to evaluate overall plant health. Vigour classes will be evaluated as follows:

- 0 = very poor (>50% leaves necrotic);
- 1 = poor (31 to 50% leaves necrotic);

VEGETATION MONITORING PLAN

- 2 = fair (16 to 30% leaves necrotic);
- 3 = good (6 to 15% leaves necrotic); and
- 4 = very good (0 to 5% leaves necrotic).

Other attributes to record at each PMP will include dominant structural stage, moisture regime, and nutrient regime. Structural stage describes the existing dominant vegetation strata. Moisture and nutrient regimes signify the relative moisture and nutrient supply available to vegetation and are limiting factors in vegetation growth. The plant species present and soil information are used to infer moisture and nutrient regimes.

Exact permanent plot locations will be determined in the field, following an evaluation of baseline habitat map data, wind direction data, local site conditions and the finalized location of the TSF. To increase efficiency of the vegetation monitoring plan, data from reference plots established as part of the WIR monitoring component of the vegetation monitoring program, will be used to supplement the vegetation monitoring.

5.2.3 Data Analysis

Data analysis will focus on evaluating trends and determining if there are statistical differences in plant species composition and abundance as a function of distance from the Mine and from construction through closures. The variables measured will include the following:

- Plant species composition, as defined by plant species richness
- Plant species abundance, as defined by mean percent species cover

5.3 NON-NATIVE PLANT MONITORING

To minimize the potential introduction of non-native plants, Sabina has established cleaning requirements for the transport of goods to site by air or water. The requirements include the inspection and removal of any debris from any inbound equipment and bulk goods prior to transport, as well as on arrival at site (see Sabina's Pre-Shipment Equipment Cleaning SOP).

Additionally, under the VMP, non-native plant species monitoring will occur during Construction and Operation Phases of the Mine, until Closure. Monitoring will be conducted within the Goose Property, MLA, WIR footprint and adjacent habitats to ensure that non-native plant species are not introduced to the Arctic environment. Non-native plant surveys will be conducted every three years in conjunction with the vegetation monitoring, and informal observational surveys will occur on an ongoing basis (Table 5.3-1). Additional surveys may be triggered by detection of non-native species. Relevant Mine staff will be trained on non-native plant establishment pathways, species identification (e.g., photos of common invasive plants in Nunavut) and mitigation measures (see Section 6). Should non-native plant species be found, these will be promptly reported to environment department and be destroyed and, if the pathway of entry can be determined, changes will be made to reduce/eliminate the possibility of further introductions. All occurrences of non-native plant species will be promptly reported to the Government of Nunavut Department of Environment and will be included in the annual report to NIRB.

Table 5.3-1. Non-native Plant Monitoring Overview

Indicator	Non-native Plant Species
Measurable Parameter	Occurrence of non-native plant species
Key Mine Interaction	Introduction of non-native plant species
Goal	The Mine will not introduce non-native plant species to the RSA
Objective	To prevent the occurrence/establishment of non-native plant species
Criteria	No introduction of non-native plant species as a result of Mine activities
Scope of Monitoring Work	Local monitoring: Surveillance of footprint and adjacent habitat, surveys to be conducted every 3 years in conjunction with vegetation monitoring or triggered by observations non-native plants

5.4 LICHEN MONITORING

The Mine is expected to create fugitive dust through various sources, primarily by blasting and crushing rock, and road construction and traffic. As part of the AQMMP, dustfall monitoring will occur during the summer months in experimental and control areas to determine the level of dust deposition associated with the Mine site (Goose Property and MLA), as well as the WIR. Additional details of this sampling can be found within the AQMMP.

Under the VMP, dustfall impacts will also be monitored through the evaluation of lichen tissue metal concentrations. A subset of the vegetation monitoring plots outside of the footprint and representing a range of distances from Mine activities will be selected for lichen tissue metal sampling. This sampling will be conducted adjacent to the vegetation monitoring plots so as not to alter vegetation composition within the permanent plot itself, but also to provide complementary information for both monitoring programs.

Sampling locations will be established along a distance gradient away from the Mine site to allow evaluation of results relative to distance from Mine activities and coincide with vegetation monitoring locations (Table 5.2-1, Figures 1, 2 and 3). Distances for sampling locations will align with AQMMP sampling locations to capture potential effects of the Mine’s operations on lichen tissue and will include distances in the AQMMP and vegetation monitoring component:

- 0 m from the Goose Project Area;
- 150 m from the Goose Project Area;
- 500 m from the Goose Project Area;
- 1 km from the Goose Project Area;
- 5 km from the Goose Project Area;
- 10 to 20 km from the Goose Project Area (Figure 3);
- 0 m from the MLA;
- 150 m from the MLA (Figure 2).

As noted in Section 5.2, the EIS for the Mine determined that prevailing winds are predominantly southerly during the foliage season for both the Goose Property and MLA (FEIS, Volume 4, Figures 3.1-6 and 3.1-7). The distance gradient will be designed in conjunction with the AQMMP, in consideration of the Project footprint and dominant wind direction. The gradient design is designed to capture Zone of

Influences (ZOI) on lichen with increasing distance from the Mine. Exact lichen tissue sampling locations will be finalized with PMPs in the field, following an evaluation of baseline habitat map data, wind direction data and local site conditions. Lichen sampling will be conducted in close association with PMP locations, with actual sampling locations lying outside of monitoring plots (Table 5.2-1, Figures 1, 2, and 3).

Collected lichen samples will be sent to accredited laboratories for chemical analysis, focused on metals within the lichen tissue consistent with parameters collected at other northern mining projects. Data summaries will focus on parameters of potential concern, and/or those of interest as a result of dustfall analysis results. Data will be used to assess the relationship between dust and metal deposition generated from the Mine across time and space. Refer to Table 5.4-1.

Table 5.4-1. Lichen Monitoring Overview

Indicator	Dust fall
Measurable Parameter	Lichen tissue metal concentration
Key Mine Interaction	The deposition of contaminants (metals) in dust, which are absorbed by plants, can enter the food chain via ingestion by animals and humans, and may have an effect on health.
Goal	The Mine will not result in a significant increase in contaminant uptake in vegetation.
Objective	To quantify through continued monitoring throughout the duration of the Mine contaminant (metal) levels in lichen (caribou forage)
Criteria	Increase in metal concentration in lichen within the LSA and concentrations beyond the predictions of the EIS.
Scope of Monitoring Work	Regional Monitoring: Assess Lichen tissue metal concentration relative to distance form Mine, sampling to be conducted every 3 years in conjunction with vegetation monitoring

5.5 WINTER ICE ROAD MONITORING

Aside from footprint development, the WIR presents the main direct Mine impact on vegetation. Sampling locations have been established along the WIR route, as well as immediately adjacent to it, to allow for long term monitoring of winter usage of this road (Figure 1). Monitoring will consist of vegetation monitoring as described in Sections 5.2 and 5.2.2 every three years, as well as annual photographic documentation conducted in summers following winter ice road operation (Table 5.5-1). Vegetation monitoring will allow quantitative assessment of changes relative to controls and pre-operational conditions, while photographic records will provide supplementary supporting information. Photographs will be taken in July or August and will be included with the annual report to the NIRB, along with the footprint vegetation loss summary.

Paired treatment, located in the path of the WIR and control (located adjacent to the WIR) plots have been established between the MLA and Goose Mine area along the WIR. Plots are located in and replicated in several habitat types to capture variability of habitats affected by the WIR (Figure 1). Where possible, selected plots had pre-existing data available on baseline (pre-operational) vegetation conditions, to facilitate before-after as well as control-impact type comparisons. Paired monitoring plots been established in the following six Vegetation Associations (habitats) along the WIR, and monitored in 2018 and 2019, including:

- Cottongrass Sedge Fen (WC)
- Dry Sparse Tundra (TH)
- Mesic Dwarf Tundra (TL)
- Raised Bog Complex (WB)

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- Tundra Seepage (TS)
- Undifferentiated Tundra (TU)

Paired monitoring plots previously established in the different vegetation associations will be retained where replication within vegetation associations has been successful. The establishment of replicated monitoring plots within certain vegetation associations could not be completed in the 2018 or 2019 monitoring programs, typically because the vegetation association was of limited extent within the study area. Therefore, a reduced number of vegetation associations will be retained for the monitoring program, from what has been sampled to date. Vegetation associations where plots have been replicated at least three times (i.e., n=3 per vegetation association). The most common vegetation associations sampled along the WIR alignment are Dry Sparse Tundra, Mesic Dwarf Tundra, and Raised Bog Complex. The targeted vegetation association with replicated monitoring plots data subset is expected to reflect the dominant habitat types present within the WIR, but reflect variable ecological conditions (i.e., upland and wetland ecosystems).

Data analysis will focus on evaluating trends and determining if there are statistical differences in plant species composition and abundance between impacted WIR and control plots. The variables measured to evaluate trends in potential vegetation community changes will include:

- Plant species composition, as defined by plant species richness
- Plant species abundance, as defined by mean percent species cover

Table 5.5-1. WIR Monitoring Overview

Indicator	Vegetation Vigour
Measurable Parameter	Quantitative assessment of plant species richness (diversity), and abundance (percent cover), and vigour Qualitative photographic assessment of vegetation vigour
Key Mine Interaction	Direct Mine impacts due to winter ice road construction and use
Goal	The winter ice road will not reduce vegetation ground cover
Objective	To assess vegetation impacts from winter ice road construction and use
Criteria	It is anticipated that shrubby and woody plants will be damaged by winter ice road usage, but that overall vegetation ground cover will not be reduced (i.e. that ice road usage will not result in increase of exposed soils at the ground surface)
Scope of Monitoring Work	WIR and control plot vegetation surveys to be conducted every 3 years, and photographic monitoring conducted annually during Construction and Operations. WIR control plots will also serve as vegetation monitoring plots

6. Mitigation and Adaptive Management

This Plan represents an adaptive approach to understanding the effects of the Mine 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.

The following mitigation measures and best management practices will reduce the potential for loss of vegetation:

- The Mine has been designed to employ winter road-only access corridors that travel primarily over lakes and rivers, thereby minimizing potential negative effects on terrestrial vegetation and limiting dust emissions.
- The footprint has been minimized during initial Mine design. Opportunities for further footprint reduction will be evaluated during detailed Mine design and construction, thus minimizing the disturbance to the terrestrial environment.
- The clearing of vegetation and removal of soil from unique landscape features will be minimized (i.e., eskers, wetlands, exposed bedrock, cliffs, etc.). Unique landscape features often provide high value habitat to wildlife and may support sensitive vegetation communities and growth forms. Exceptions to this management will only be considered after assessing and weighing possible implications.

The following mitigation measures and best management practices will reduce the potential for degradation of vegetation related to erosion or dust generation:

- All wheeled vehicles and machinery will restrict travel to designated road surfaces, thus avoiding creation of ruts in vegetated ecosystems.
 - If off-road vehicles are required, low-pressure vehicles will be required for access.
- The design of the WIR has been optimized to minimize the distance travelled which will minimize emissions.
- WIR stream crossings and waterbody access ramps will be constructed in a manner to prevent disturbance or destabilization of banks.
- When possible, vegetation clearing and soil removal from unique landscape features will be minimized.
- Vehicles will be driven at designated speeds on the WIR and site roads.
- Site water discharges to land will be conducted in a manner that avoids erosion.

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The following mitigation measures will be implemented to prevent the establishment of non-native species:

- Expeditors will be required to ensure all equipment and bulk supplies shipped to the Mine are free of soil and debris. Equipment will be re-inspected on arrival by on-site personnel on offload and, if necessary, cleaning will be conducted as per Sabina's Pre-shipment Equipment Cleaning SOP.
- Appropriate staff will be educated on non-native plant species introduction, identification, and establishment prevention.
- Ground disturbance will be minimized, where possible.
- Any non-native plant occurrences will be promptly reported to the environmental department and to the Government of Nunavut.

The need for any corrective actions to on-site management or installation of additional control measures will be determined on a case-by-case basis. Indications of the need for corrective actions and additional control measures may include:

- If vegetation monitoring criteria are exceeded;
- If results from the Air Quality Mitigation and Monitoring Program show dustfall exceedances;
- If results from the Site Water Monitoring and Management Plan show non-compliance related to tundra discharges; or
- If results from the Wildlife Mitigation and Monitoring Program Plan, which will monitor select wildlife species and habitat around the mine infrastructure and activities, show adverse effects to wildlife or wildlife habitat.

As provided in the Project Certificate, Term and Condition No. 34 and commitment (WTM-Commitment 14 (INAC-TRC-27)) referenced in Section 2.2, Sabina is required to include revegetation strategies within its Mine Closure and Reclamation Plan that support progressive reclamation, and promote natural revegetation and recovery of disturbed areas compatible with the surrounding natural environment. Additionally, as per Project certificate, Term and Condition No.36. (Table 3.1) detailed revegetation strategies will be provided to the Nunavut Impact Review Board within 3 years of the commencement of construction. These strategies will include exploration of the feasibility and practicality of topsoil/ organic matter salvage through Mine development. The Closure and Reclamation Plan will be updated on an on-going basis as more information becomes available from similar reclamation efforts at other northern projects, as applicable. Environmental reporting on revegetation strategies are outlined in Section 8.

7. Quality Assurance and Quality Control

Quality assurance and quality control measures employed to ensure program goals and objectives (See Table 5.1-1, 5.2-2, 5.3-1, 5.4-1, and 5.5-1) can be evaluated will include the following:

- Specific work instructions will be developed for all monitoring locations, which document the requirements or expectations for field crews in selecting survey locations, plot markings, data, and if required, sample collection methods;
- Vegetation monitoring surveys will be conducted by plant ecologists familiar with identification of sub Arctic plants and plant sampling techniques. Examples of estimating plant cover will be reviewed and rules applied consistently to effective document changes (if any) to species richness, abundance and vigour within ZOIs
- Long-term monitoring sites will be identified (i.e., labelled) and marked in a manner to allow re-identification and re-assessment every three years;
- Photographs will be utilized to facilitate inter-annual comparisons through the qualitative examination of species vigour/health, species present, ground cover, and observable (anthropogenic) disturbance or general changes in vegetation cover;
- Data will be downloaded from the field upon returning to camp and manually checked by qualified personnel;
- Data will be maintained in a format to allow for comparison between years, trend analysis, and flagging out-of-compliance samples to enhance the effectiveness of the QA/QC program;
- Lichen tissue samples will be collected and handled in a manner to avoid contamination, stored in breathable sample bag and sent to an accredited laboratory for metals analysis. Laboratories may provide conditions around sample storage and submission requirements to be followed;
- Upon receipt of analytical results, analyses will be verified for accuracy. Results will be interpreted and recommended actions will be implemented, if necessary;
- Field notes will be recorded at each sampling site, including date, site ID, personnel collecting the sample, and any additional notes; and
- Data will be downloaded and checked of errors and alignment with field records.

8. Environmental Reporting

An annual Vegetation Monitoring Summary Report for the Mine will be completed and submitted with the annual report to the NIRB. This report will summarize the footprint change and photographic monitoring results, as well as the results of any vegetation sampling conducted that year. The purpose of the report will be to identify and communicate natural variation and potential mine-related changes in vegetation populations and health.

The annual report will provide the methodology, results, as well as a comparison to impact predictions or historical results. As the accumulation of data increases, trends will also be reported.

Any introductions of non-native plant species will be promptly reported to the Government of Nunavut Department of Environment and will be included in the annual report to NIRB.

9. References

Cambridge Bay Hunter Focus Group. 2012.

Canadian Endangered Species Conservation Council (CESCC). 2010. Non-Native and Invasive Species in Nunavut. Environment Canada. Available at: https://www.gov.nu.ca/sites/default/files/brochure_english_jan31-4_1.pdf

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