Blackwater Gold Project

Joint *Mines Act* / *Environmental Management Act* Permits Application

CHAPTER 4: RECLAMATION AND CLOSURE PLAN

April 2022

CONTENTS

List of Tables

List of Figures

ACRONYMS AND ABBREVIATIONS

Aboriginal Groups or Indigenous groups	Lhoosk'uz Dené Nation, Ulkatcho First Nation, Nadleh Whut'en First Nation, Saik'uz First Nation, Stellat'en First Nation and Nazko First Nation (as defined in the Project's Environmental Assessment Certificate #M19-01)
AEMP	Aquatic Effects Monitoring Program
ARD	acid rock drainage
AWSC	available water storage capacity
BACI	Before-After-Control-Impact
BC	British Columbia
BEC	Biogeoclimatic Ecosystem Classification
BGC	Biogeoclimatic
BAF	bioaccumulation factors
Blackwater or Project	Blackwater Project or Blackwater Gold Project
BW Gold	BW Gold LTD.
CANUTEC	Canadian Transport Emergency Centre
CDC	Conservation Data Centre
CEA Agency	Canadian Environmental Assessment Agency
CEO	Chief Executive Officer
CMP	Care and Maintenance Plan
CCME	Canadian Council of Ministers of the Environment
Code	Health, Safety and Reclamation Code for Mines in British Columbia
CDC	Conservation Data Centre
CFMP	Country Foods Monitoring Plan
CMMP	Caribou Mitigation and Monitoring Plan
COO	Chief Operating Officer
CPD	Certified Project Description
CSM	Conceptual Site Model
CSR	*Contaminated Sites Regulation*
CWD	coarse woody debris
CWTP	Central water transfer pond

DMP	Discharge Management Plan
DWP	Discharge Management Plan
DS	Decision Statement
EA	Environmental Assessment
EAC or Certificate	Blackwater Environmental Assessment Certificate #M19-01
EAO	Environmental Assessment Office
EC	Environment Canada
ECD	Environmental Control Dam
EM	Environmental Manager
EMA	*Environmental Management Act*
EMLI	Ministry of Energy, Mines and Low Carbon Innovation
ENV	Ministry of Environment and Climate Change Strategy
EMPR	Ministry of Energy, Mines and Petroleum Resources
ERM	ERM Consultants Canada Ltd.
ERP	Emergency Response Plan
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FMSCP	Fuel Management and Spill Control Plan
FWR	Freshwater Reservoir
ha	Hectares
IEM	Independent Environmental Monitor
IEDC	Interim Environmental Control Dam
Indigenous groups or Aboriginal Peoples	Lhoosk’uz Dené Nation, Ulkatcho First Nation, Nadleh Whut’en First Nation, Saik’uz First Nation, Stellat’en First Nation, Nazko First Nation, Skin Tyee Nation, Tŝilhqot’in Nation, Métis Nation British Columbia, and Nee-Tahi-Buhn Band (as defined in the federal Decision Statement)
IPMP	Invasive Plant Management Plan
IRT	Information Requirements Table
JAIR	Joint Application Information Requirements for *Mines Act* and *Environmental Management Act* Permits

Joint MA/EMA Application or Application	Blackwater Joint application for *Mines Act* and *Environmental Management Act* permits
km	Kilometre
KP	Knight Piésold Ltd.
LDN	Lhoosk'uz Dené Nation
LFH	surface organic soil layers
LGO	Low Grade Ore
LoM	life of mine
LPU	Local Population Unit
m	Metre
MA	*Mines Act*
MAR	Mine Access Road
masl	metres above sea level
MDMER	*Metal and Diamond Mining Effluent Regulations*
MERP	Mine Emergency Response Plan
ML	metal leaching
Mm^3	million cubic metres
MMO	Major Mines Office
MOE	Ministry of Environment
MOFR	Ministry of Forests and Range
MP	Management Plan
MPB	Mountain Pine Beetle
MTL	mineral tolerance limits
Mt	million tonnes
Mtpa	million tonnes per annum
MSDP	Mine Site Water and Discharge Monitoring and Management Plan
NFN	Nazko First Nation
NAG	non acid generating
OMS	Operations, Maintenance, and Surveillance

OVB	Overburden
PAG	potentially acid generating
PCOC	potential contaminants of concern
POC	parameter of concern
POPC	parameters of potential concern
Project	Blackwater Gold Project
PSD	particle size distribution
PSP	Permanent sample plots
QA/QC	Quality assurance and quality control
RCP	Reclamation and Closure Plan
RoW	Right-of-way
SBEB	Science Based Environmental Benchmarks
SCP	Sediment control pond
SEPSCP	Surface Erosion Prevention and Sediment Control Plan
SMP	Soil Management Plan
SMR	Soil moisture regime
t	Tonne
TARP	Trigger Action Response Plan
TEM	Terrestrial Ecosystem Mapping
tpd	Tonnes per day
TSF	Tailings Storage Facility
UFN	Ulkatcho First Nation
VMP	Vegetation Management Plan
WMMP	Wildlife Management and Monitoring Plan
WMP	Water Management Pond
WMOP	Wetland Management and Offsetting Plan
WTP	Water Treatment Plant

4. RECLAMATION AND CLOSURE PLAN

This chapter provides the Reclamation and Closure Plan (RCP) for the Blackwater Project (the Project). The RCP addresses the requirements of Section 4 of the Joint Application Information Requirements for *Mines Act (MA)* and *Environmental Management Act (EMA)* Permits (EMPR & ENV 2019). The detailed 5-year RCP is presented, along with the conceptual mine closure and reclamation plan to the end of life of mine (LoM). The chapter also addresses Condition 25 (End Land Use Plan; Appendix 4-A) in the Project's Environmental Assessment Certificate #M19-01 (EAC) as it relates to the mine site and Condition 8.19 in the federal Environmental Assessment Decision Statement (DS). Concordance tables indicating where the EAC and DS condition requirements are addressed are provided Appendix 4-A and Appendix 4-B, respectively.

Table 4-1 provides an overview of general environmental management responsibilities during all phases of the mine life for key positions that will be involved in environmental management. Other positions not specifically listed in Table 4-1 but that will provide supporting roles include independent environmental monitors, Independent Tailings Review Board, TSF qualified person, and other qualified persons and professionals.

Table 4-1: BW Gold Roles and Responsibilities

Position	Responsibility
Chief Executive Officer (CEO)	The CEO is responsible for overall Project governance. Reports to the Board.
Chief Operating Officer (COO)	The COO is responsible for engineering and Project development and coordinates with the Mine Manager to ensure overall Project objectives are being managed. Reports to CEO.
Vice President (VP) Environment & Social Responsibility	The VP Environment & Social Responsibility is responsible for championing the Environmental Policy Statement and EMS, establishing environmental performance targets and overseeing permitting. Reports to COO.
General Manager (GM) Development	The GM is responsible for managing project permitting, he Project's administration services and external entities, and delivering systems and programs that ensure Artemis's values are embraced and supported, Putting People First, Outstanding Corporate Citizenship, High Performance Culture and Rigorous Project Management and Financial Discipline. Reports to COO.
Mine Manager	The Mine Manager, as defined in the *Mines Act*, has overall responsibility for mine operations, including the health and safety of workers and the public, EMS implementation, overall environmental performance and protection, and permit compliance. The Mine Manager may delegate some of their responsibilities to other qualified personnel. Reports to GM.
Construction Manager (CM)	The CM is accountable for ensuring environmental and regulatory commitments and obligations are being met during the construction phase. Reports to GM.
Environmental Manager (EM)	The EM is responsible for the day-to-day management of the Project's environmental programs and compliance with environmental permits, updating EMS and MPs. The EM or designate will be responsible for reporting non-compliance to the CM, and Engineering, Procurement and Construction Management (EPCM) contractor, other contractors, the Company and regulatory agencies, where required. Supports the CM and reports to Mine Manager.
Departmental Managers	Departmental Managers are responsible for implementation of the EMS relevant to their areas. Report to Mine Manager.

Position	Responsibility
Indigenous Relations Manager	Indigenous Relations Manager is responsible for Indigenous engagement throughout the life of mine. Also responsible for day-to-day management and communications with Indigenous groups. Reports to VP Environment & Social Responsibility.
Community Relations Advisor	Community Relations Advisor is responsible for managing the Community Liaison Committee and Community Feedback Mechanism. Reports to Indigenous Relations Manager.
Environmental Monitors	Environmental Monitors (includes Environmental Specialists and Technicians) are responsible for tracking and reporting on environmental permit obligations through field-based monitoring programs. Report to EM.
Aboriginal Monitors	Aboriginal Monitors are required under EAC condition 17 and will be responsible for monitoring for potential effects from the Project on the Indigenous interests. Indigenous Monitors will be involved in the adaptive management and follow-up monitoring programs. Report to EM.
Employees and Contractors	Employees are responsible for being aware of permit requirements specific to their roles and responsibilities. Report to departmental managers.
Qualified Professionals or Qualified Persons	Qualified professionals and qualified persons will be retained to review objectives and conduct various aspects of environmental and social monitoring as specified in EMPs and social MPs.

BW Gold will employ a qualified person as an Environmental Manager (EM) who will ensure that throughout the Construction phase the Environmental Management System (EMS) requirements are established, implemented, and maintained, and that environmental performance is reported to management for review and action. The EM is responsible for retaining the services of qualified persons or qualified professionals with specific scientific or engineering expertise to provide direction and management advice in their areas of specialization. The EM will be supported by Environmental Monitors that will include Environmental Specialists and Technicians and a consulting team of subject matter experts in the fields of environmental science and engineering

Table 4-2 summarizes the existing areas of disturbance authorized under the *Mines Act*. The MX-13-177 and MX 13-250 authorizations include access trails, exploration and geotechnical drill, and exploration drill pad construction. Activities authorized under *Mines Act* permit M-246 include road construction, site clearing and plant site levelling, and erosion and protection works. The physical area approved by each subsequent *Mines Act* authorization are not mutually exclusive (i.e., the areas overlap), thus approved areas of disturbance by each permit cannot simply be tallied for a total. Taking this into account, the current approved total area of existing disturbance is 1,046.2 ha.

The proposed disturbance associated with this Application is approximately 2,200 hectares (ha).

Table 4-2: Summary of Existing Disturbance for the Blackwater Project

Mines Act Authorization	Approved Area of Disturbance (ha)	Area Un-reclaimed (ha)
MX 13-177	240.68	148
MX 13-250	20.0	0.201
Permit M-246	1,018.9 (including management buffers)	0[1]

[1] *No disturbance permitted by M-246 has occurred as of the date of the submission of this Application.*

New Gold provided a report to EAO on September 20th, 2019 in regards to existing disturbance at the Blackwater site (Appendix 4-C).

This RCP describes how end land use and land capability objectives will be achieved to the extent feasible by the end of the Project's Closure phase. The following subsections describe existing conditions, end land use and land capability objectives for the areas of land occupied by the various Project components. Biophysical information has been obtained from baseline studies summarized in Chapter 2, Baseline Information.

4.1 End Land Use and Capability Objectives

The closure and end land use goals for the Project on lands and waters that are disturbed by mine activities are to reclaim ecosystems to achieve an average land and water capability in these areas not less than that existing prior to Project development (see Section 4.1.1, Regulatory Context for more detail). It is a further goal of the Project to meet the EAC Condition 25 (End Land Use Plan) and mutual aspirations for end land use with Aboriginal Groups affected by the Project. To meet this goal, the following end land use objectives are proposed:

Objective 1: A mix of sustainable conditions supporting wildlife habitat (Table 4.1-1), and traditional and current use by Indigenous peoples. The end land use objectives do not require new access from trails or roads, consequently, use of the closed mine site will not include adding or maintaining trails for recreation purposes.

Objective 2: Self-sustaining vegetation that will progress to plant communities comparable to pre-disturbance ecosystems as supported by the results of the ecohydrological modelling.

Objective 3: Physical stability of post-closure mining landforms designed to incorporate controls to minimize erosion of surficial materials.

Objective 4: Control of geochemical sources to achieve stable surface geochemical conditions.

Objective 5: Water quality and flow that support fish habitat downstream from the mine site and reclamation objectives.

Table 4.1-1: Reclamation Priorities

Ecosystem Type	Site Unit	Mine Features	Wildlife Priorities**/Valued Components
Subxeric and drier ESSFmv1* site series	ESSFmv1-02, ESSFmv1-03	Uppermost portions of Upper and Lower Waste stockpiles; camp and infrastructure areas; upper-elevation borrow areas; Low Grade Ore (LGO) stockpile; TSF beaches	Caribou (*Rangifer tarandus*), Clark's nutcracker (*Nucifraga columbiana*), Grizzly bear (*Ursus arctos*), Wolverine (*Gulo gulo*), Olive-sided flycatcher (*Contopus cooperi*)
Submesic and wetter ESSFmv1 site series	ESSF mv1-03, ESSFmv1-01, ESSFmv1-04	Slopes of Upper and Lower Waste stockpiles; roads; fringes of TSF ponds; surface soil stockpile footprints	Caribou, Clark's nutcracker, Grizzly bear, Wolverine, Olive-sided flycatcher, hare (*Lepus americanus*), marten (*Martes americana*), bat species
Subxeric and drier SBSmc3 site series	SBSmc3-02, SBSmc3-03	Freshwater Reservoir; lower-elevation borrow areas	Caribou, Grizzly bear, grouse species
Submesic and wetter SBSmc3 site series	SBSmc3-01/05, SBSmc3-04/05	Surface soil stockpile footprints	Caribou, Grizzly bear, Wolverine, Olive-sided flycatcher, hare, marten, bat species

** The ESSFmvp is not listed because the majority of the ESSFmvp that is lost during mine development overlaps the open pit mine and other structures that will not be reclaimed or will be required during closure.*

*** Appendix 4-D contains the November 17, 2021 Memo (0575928-0014) that provides background material on the consideration of wildlife communities that have informed reclamation priorities and prescription development.*

End land use and land capability objectives for the Project have been integrated into Project planning and design to create a plan for successful reclamation and closure. These objectives were informed by pre-development land and water use and conditions documented through baseline studies as summarized in Chapter 2, Baseline Information. Ecohydrological modelling has been employed to ensure that ecosystem-based end land use objectives can be supported with the reclamation materials available at site under the proposed reclamation and closure designs.

Baseline terrestrial ecosystem information and information on traditional and current use of land are provided in Chapter 2, Baseline Information. The goal is to reclaim ecosystems similar to those that would be present in the area if the Project did not occur, and to achieve an average land and water capability in these areas not less than that existing prior to Project development. The reclamation program is aimed at re-establishing end land use that mitigates project effects on wildlife. The wildlife habitat end land use objectives for the Blackwater project are based on pre-development site conditions and wildlife habitat (Appendix 4-D), and the potential to recreate these conditions during reclamation. Ecohydrological modelling has been used as a tool to support achievement of this goal, thereby addressing the use of lands and resources for valued components (Section 4.1.3, Habitat for Focal Reclamation Species) that were assessed in the Project's Application for an Environmental Assessment Application / Environmental Impact Statement (Application / EIS; New Gold 2015), such as wildlife, water quality, aquatic resources, air quality, and plants.

Baseline aquatic ecosystem information and information on traditional and current use of aquatic resources are incorporated into reclamation targets. Fish use of the Project area is largely restricted to juveniles, spawning, and passage from larger lakes to Davidson Creek, Creek 7054454, Lake 01682LNRS, and the lower reaches and tributaries of Creek 661. The nearest viable fishery to the mine site is Tatelkuz Lake which supports a number of recreational areas and Tatelkuz Resort. Tatelkuz Lake supports angling species including kokanee (*Oncorhynchus nerka*) and rainbow trout (*Oncorhynchus mykiss*). Mountain whitefish (*Prosopium williamsoni*), longnose sucker (*Catostomus catostomus*), and burbot (*Lota lota*) are also incidentally angled but are generally not considered a targeted species. The information contributed to the closure and reclamation designs to achieve end land use Objective 5.

BW Gold LTD (BW Gold) engaged with Ulkatcho First Nation (UFN) and Lhoosk'uz Dené Nation (LDN) on the end land use objectives, target plant and wildlife species, and reclamation priorities. The general priorities for reclamation given end land use Objectives 1 and 2 above are summarized in Table 4.1-1 and are based on pre-mining landscapes and the expected post-closure landscape. The proposed closure strategy has also been informed by BW Gold's engagement with UFN and LDN and the predicted site conditions.

The general priorities for reclamation given end land use Objective 5 above are summarized below and are based on pre-mining landscapes and the expected post-closure landscape.

Activities associated with the construction, operation, and closure of tailings and waste stockpiles can alter surface water hydrology and quality with consequent effects on hydrological features (e.g., streams, lakes, and wetlands) as well as terrestrial and aquatic species and habitat. This is in addition to the loss of instream aquatic habitat and riparian habitat. In turn, these changes can impact fish and other aquatic organisms, including the aquatic food web resources upon which fish depend for growth and reproduction.

Reclamation priorities for water use at post-closure consider the traditional and current pre-mine land uses. LDN fish for trout preferably in Tatelkuz Lake, because trout caught in rivers "taste muddy" (LDN Elders pers. comm.). Other fishing locations downstream of the mine site include middle Chedakuz Creek (the portion of Chedakuz Creek between Kuyakuz and Tatelkuz Lake) and lower Chedakuz Creek. For the one family that resides at Tatelkus Lake IR 28, fish, including rainbow trout, suckers (*Catostomidae*), and kokanee from Tatelkuz Lake, lower Davidson Creek, and lower and middle Chedakuz Creek, are an important source of food. UFN indicated that they also fish at Chedakuz Creek and Tatelkuz Lake. Species fished include suckers, burbot (*Lota lota*), also historically referred to by locals/fisherpeople as lingcod, freshwater lingcod, freshwater ling, bubbot, and salmon (*Salmonidae*), and rainbow trout.

4.1.1 Regulatory Context

Section 10.7.4 (Land Use) of the Health Safety and Reclamation Code for Mines in British Columbia (BC) (Code; EMLI 2021) requires:

> *The land surface shall be reclaimed to an end land use approved by the chief permitting officer that considers previous and potential uses.*

Section 10.7.5 (Capability) of the Code requires:

> *Excluding lands that are not to be reclaimed, the average land capability to be achieved on the remaining lands shall not be less than the average that existed prior to mining, unless the land capability is not consistent with the approved end land use or compromises long-term physical and/or geochemical stability.*

4.1.2 Pre- and Post-mine Land Capability Assessment

To assess land capability, the pre-mine distribution of terrestrial ecosystems (i.e., biogeoclimatic [BGC] units and site series) was compared to the predicted distribution of ecosystems after the completion of mine-site reclamation.

An ecohydrological model was used to determine the reclaimed ecosystems that the post-mine landscape is most likely to support (Appendix 4-E).[1] The results of the ecohydrological model indicate that the post-mine ecosystems and land capability will shift towards drier ecosystems compared to pre-mine conditions, and that the priorities identified in Table 4.1-2 are likely to be achievable.

The purpose of the ecohydrological model is to predict the distribution of ecosystems on post-closure landforms and to develop reclamation treatments for each type of ecosystem based on the soil moisture and nutrient regimes that will be reconstructed on reclaimed lands (Baker et. al. 2020; Appendix 4-E). The steps involved in the modelling process are to first understand the pre-development (baseline) conditions in terms of soil and ecosystem presence, and then to assess the volumes and types of soil and other reclamation cover materials that will need to be salvaged to reclaim the post-mine landscape to a state that is as equivalent as possible to pre-development given the expected changes to surficial materials, topography, and hydrology.

The use of an ecohydrological model to define soil water and ecosystem occurrence for reclamation in British Columbia (BC) is relatively recent (Straker et. al. 2014, 2015; Baker et. al. 2020). The model uses the concept of relative soil moisture regime (SMR) in the biogeoclimatic ecosystem classification (BEC) system to quantify soil water availability in the post-mine reclaimed soil cover. The SMR is a relative measure of the annual soil water available to plants (Pojar et al. 1985) and includes seven classes from 0 (very xeric) to 7 (subhygric; Delong et al. 1993[2]). The ecohydrological model uses three principal inputs (Straker et al. 2014; Straker et al. 2015; Baker et al. 2020):

- Available water-storage capacity (AWSC) based on particle-size distribution (PSD), organic-matter content, and bulk density in the upper metre (m) of soil;
- Post-closure topography (i.e., slope and aspect); and
- Climatic information (regional climate as characterized by the BGC unit and historic data; Wang et al. 2016).

[1] A public version of the model used is available at qea.iegsoil.com

[2] More recent classifications include 8 classes, including a hygric class. However, Land Management Handbook 24, which describes ecosystems in the Project study area, contains a seven-class system (Delong et al. 1993).

Table 4.1-2: Summary of Pre-mine Ecosystem Areas Arranged by Biogeoclimatic Unit and Abundance

BGC Unit	Site Unit	Name	Area (ha)	%	
				Unit*	FP**
ESSFmv1	01	Subalpine fir - Rhododendron - Feathermoss	887.3	57.5	41.9
	03	Subalpine fir - Huckleberry - Feathermoss	237.1	15.4	11.2
	02	Lodgepole pine - Huckleberry - Cladonia	217.1	14.1	10.3
	Swamp	Swamp	107.1	6.9	5.1
	04	Subalpine fir - Glow moss	74.7	4.8	3.5
	Bog	Bog	14.0	0.9	0.7
	Fen	Fen	3.5	0.2	0.2
	Marsh	Marsh	1.3	0.1	0.1
	LA, PD, RI, OW	Water (Lake, Pond, River, Shallow Open Water)	0.8	0.1	0.0
ESSFmvp	WW	Whitebark pine avens	14.8	53.5	0.7
	PC	Subalpine fir / whitebark pine - Crowberry parkland	12.3	44.4	0.6
	FH	Subalpine fir - Indian hellebore	0.3	1.2	0.0
	LA, PD, RI, OW	Water (Lake, Pond, River, Shallow Open Water)	0.2	0.9	0.0
SBSmc3	03	Lodgepole pine - Feathermoss - Cladina	292.6	53.5	13.8
	01	Hybrid white spruce - Huckleberry	122.5	22.4	5.8
	Swamp	Swamp	60.5	11.1	2.9
	04	Hybrid white spruce - Huckleberry – Soopolallie	37.5	6.9	1.8
	02	Lodgepole pine - Juniper - Dwarf huckleberry	10.2	1.9	0.5
	06	Black spruce - Lodgepole pine – Feathermoss	6.6	1.2	0.3
	Fen	Fen	5.8	1.1	0.3
	Bog	Bog	5.4	1.0	0.3
	07	Hybrid white spruce - Twinberry	3.3	0.6	0.2
	LA, PD, RI, OW	Water (Lake, Pond, River, Shallow Open Water)	2.7	0.5	0.1

** Percent of area within each BGC site unit for the given time period;*

*** Percent of total area within the disturbance footprint as shown in Figure 4.1-1.*

To assess aquatic ecosystem capability, the pre-mine water quality and fish habitat was characterized as described in Chapter 2 Sections 2.7.1, Surface Water Quality and 2.9.3, Fish and Fish Habitat to inform changes to aquatic habitat as a result of operations. This formed the basis of defining the reclamation targets for the aquatic environment.

4.1.2.1 Pre-mine Land and Aquatic Ecosystem Capability

Pre-mine land capability was determined through Terrestrial Ecosystem Mapping (TEM). This mapping was completed on the mine site to document the existing ecosystems, provide information for characterizing pre-mine land capability, and inform the development of land capability objectives for reclamation (AMEC 2013a; AMEC 2013b; Section 2.10). Ecosystems in BC are described using the provincial BGC units and site series are described in the classification guidebooks for regional climates (Delong et al. 1993).

The pre-mining TEM for the mine site footprint includes three BGC units (Figure 4.1-1):

- SBSmc3 (Kluskus Moist Cold Sub-Boreal Spruce variant);
- ESSFmv1 (Nechako Moist Very Cold Engelmann Spruce-Subalpine Fir variant); and
- ESSFmvp (Nechako Moist Very Cold Engelmann Spruce-Subalpine Fir Parkland).

The SBSmc3 occurs from 975 to 1,200 metres above sea level (masl) in elevation and has a cold climate with a short growing season. Forests are typically dominated by hybrid spruce and subalpine fir with lodgepole pine occurring on drier sites (Delong et al. 1993). The ESSFmv1 occurs above the SBSmc3 from 1,150 to 1,550 masl and is the coldest BGC unit in the southwest portion of the Prince George Forest Region. It supports the same tree species as the SBSmc3. The ESSFmvp ('parkland') occurs at higher elevation than the ESSFmv1 in subalpine habitat where tree cover becomes discontinuous, interspersed with open herb or heather dominated meadows, krummholz, and tree islands. Section 4.1.4, Habitat for Focal Reclamation Species discusses wildlife habitat in relation to BGC units.

There are unique site series within each BGC unit, which are derived from edaphic conditions, including relative SMR and soil nutrient regime (SNR). Site series have seral and climax plant communities (ecosystems) that reflect the local edaphic and climatic conditions. As site series are based on SMR and SNR, they provide a basis for identifying plant species suitable for reclamation and potential future plant communities that may be established on reclaimed soils, and for defining potential future 'climax' vegetation community composition. Table 4.1-2 shows the area of all pre-disturbance site series in the mine site.

To support the identification of target wildlife species for reclamation and corresponding habitat types required in the reclaimed landscape, a review of existing data and recent field data was completed (Appendix 4-D). This document provides a framework for designing the ecosystems at closure by:

- Identifying representative wildlife species on the project site and providing an overview of habitat requirements;
- Describing the current vegetation communities and BGC units on the project site in detail and how wildlife are using these communities; and
- Providing an overview of vegetation communities; describing reclamation species for each BGC unit and site series at closure; and identifying representative wildlife and plant species present in these BGC and site units in the pre-mine landscape. The high-level vegetation and management prescriptions to meet these objectives are listed.

The pre-mine aquatic ecosystem capability was determined by considering baseline aquatic ecosystem conditions to inform the targeted post-mining aquatic conditions. The Project mine site is located in the upper extents of the Davidson Creek and Creek 661 watershed. Hydrological data were collected from the spring of 2011 through 2020 with 12 active hydrology stations (Knight Piésold 2013a, 2018a, 2021a) and a summary of hydrological data is provided in Section 2.6.1 of Chapter 2, Baseline Information. The long-term records are used to define the hydrological inputs required for water management and engineering design and to facilitate the assessment of long-term hydrologic impacts on aquatic ecosystem due to mine operations.

Streams in the area are generally characterized by high flows in late spring and early summer due to rain and snowmelt, and low flows in the winter. The baseline data suggests that higher elevation stations and smaller catchments tend to experience higher runoff during spring high flows (Knight Piésold 2021a). Runoff attenuation at stations directly downstream of a lake are related to the storage capacity of the upstream lake.

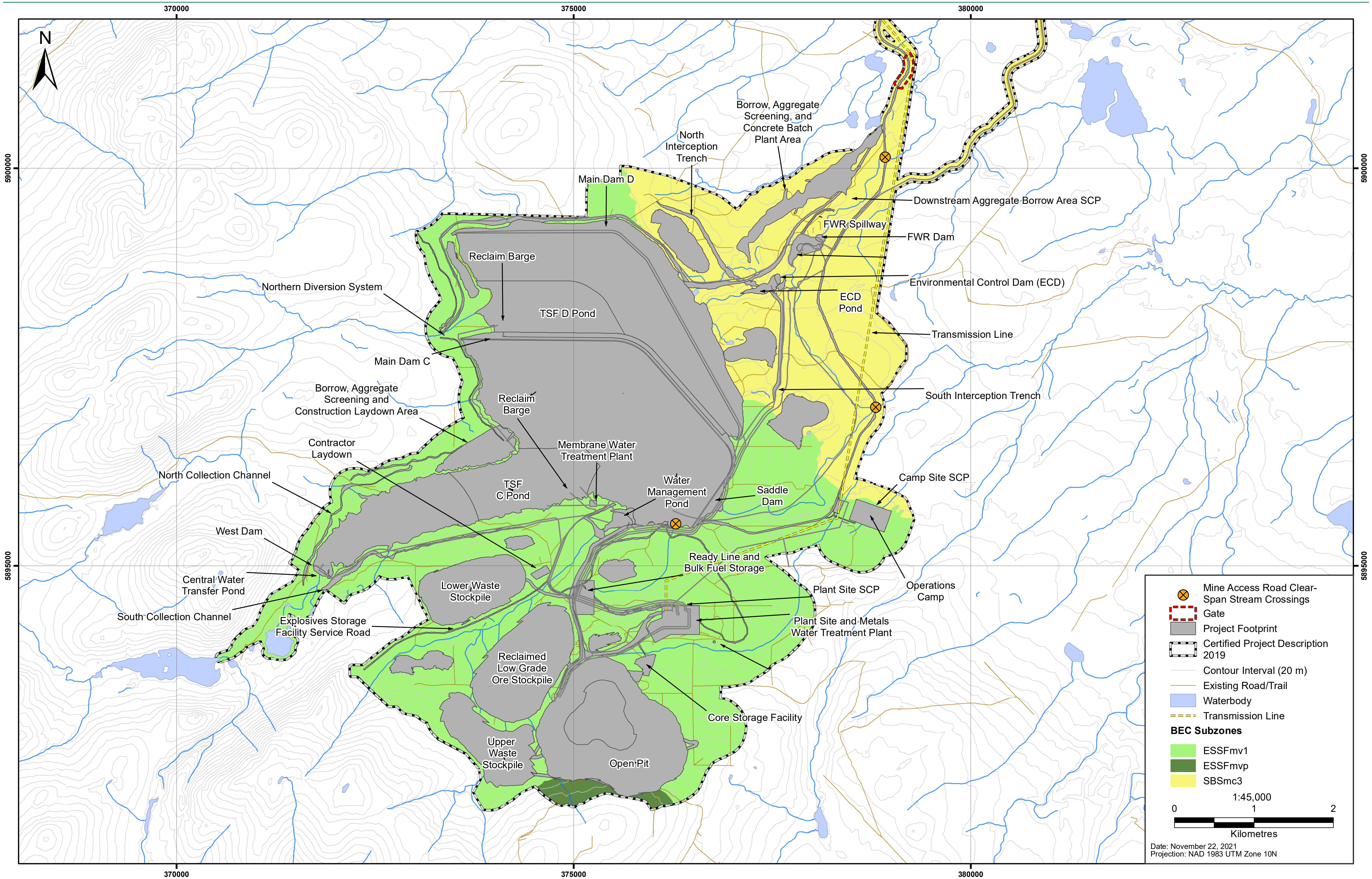


Figure 4.1-1: Biogeoclimatic Units within the Mine Site Footprint

Surface water quality monitoring within the Project area was initiated in 2011, and is ongoing, to provide baseline water quality prior to Project development (AMEC 2013c; ERM 2021). Water quality baseline observations, and baseline sediment quality observations, are summarized in Section 2.7.1 and Section 2.8 of Chapter 2, Baseline Information. Water quality results from samples collected from streams and rivers suggest that waters have neutral to low alkalinity, low hardness, low total dissolved solids, and low concentration of nitrogen species; however, these constituents tend to increase during low flow periods based on the baseline sampling program. Total suspended solids and turbidity were generally low, except during periods of increased runoff in freshet and during fall. Mean concentrations of metals were low, typically one to several orders below guidelines (BC and Canadian Council of Ministers of the Environment [CCME] Water Quality Guidelines). However, some exceedances of provincial and/or federal water quality guidelines were observed as a result of natural environmental conditions, with exceedances most frequently observed in the upper Creek 661 and Davidson Creek watersheds, proximal to the mineralized deposit area.

Measured baseline stream temperatures (23 continuous monitoring stations and in-situ measurements, Section 2.7.1.1 in Chapter 2, Baseline Information) prior to mine development are less than the BC Ministry of Environment (MOE) optimal temperature ranges for the full life history (i.e., spawning, rearing, over-wintering, and migration) of rainbow trout and kokanee, the two most common fish species in the region (AMEC 2013d).

Surveys of stream fish habitat were conducted as part of baseline studies to identify, characterize, and quantify the available habitat for fish within the mine site area, and are summarized in Section 2.9 of Chapter 2, Baseline Information. Baseline study results indicated a habitat distribution pattern typical of the central BC interior—steep, sub-alpine headwaters of naturally poor-quality fish habitat, in general, draining to lower gradient reaches of higher quality habitat that flow into large, overwintering lakes (e.g., Tatelkuz Lake).

4.1.2.2 Post-mine Land Capability

As described above, the post-mine land capability was estimated based on the AWSC of reclamation materials, post-closure topography, and climatic information. The AWSC of salvaged soils was calculated using soil information collected during baseline studies (AMEC 2013a). As discussed in Section 4.2.1, Soil Resources, three groups of reclamation materials have been identified for reclamation: glaciofluvial surface soil and mixed-mineral surface soil (i.e., non-glaciofluvial mineral soils), and organic surface soil. These reclamation material groupings were selected through iterative modeling to reduce differences between pre- and post-mining ecosystem distributions. Glaciofluvial surface soils are to be targeted for salvage to restore drier, open-forest site series with lichen favoured by caribou. Other salvaged mineral surface soils, which are dominated by morainal material (till), are considered as one group (“mixed”) due to expected soil mixing during salvage and placement. Mixed-mineral surface soils will be used to reclaim wetter submesic to mesic site series. Organic surface soils will be used opportunistically to reclaime low-lying and wetland ecosystems, or used as a soil amendment. Data sources used to represent underlying ine waste materials are outlined in Table 4.2-1 (see Section 4.2).

Post-closure topography was classified according to slope position, slope gradient and aspect classes[3] to adjust for the effects of run-on and run-off water, as well as variation in potential evapotranspiration demand due to insolation (i.e., solar radiation). Modelling of soil cover depths was completed using 10-cm intervals to determine the optimal soil cover depths (up to 1 m) to create favourable SMR conditions for the

[3] Slope positions for modelling purposes were delineated as crest, mid and toe positions. Slope gradients were defined by 8-degree bins. Aspects were sectioned into 45-degree bins centred on cardinal and ordinal directions. Modelled settings for slope gradient and aspect were equal to the midpoint of the bin intervals.

establishment of target ecosystems. For additional information on modelling methods, see Appendix 4-E and Baker et al. (2020).

Ecohydrological modelling will be periodically updated to reflect significant changes to the mine plan disturbance areas, to reflect model improvements where predicted outcomes vary significantly, and at the same time, incorporate results from ongoing sampling and laboratory testing during surface-soil salvage operations, described in Section 4.2.6.1 (Reclamation Material Monitoring during Salvage and Stockpiling) and the Soil Management Plan (Appendix 9-B). Model updates will also incorporate the results of research on reclamation covers and the ability of the prescribed depths and reclamation-material types to achieve the desired edaphic conditions (i.e., site series; Section 4.2.5, Reclamation Research). Updates will be provided in the five-year Mine Plan and Reclamation Program submissions (Section 4.13), with interim updates as available presented in Annual Reclamation Reports. Operational reclamation monitoring will assess the ability of reclaimed areas to support the desired habitats and land capability in the long term and inform maintenance and adaptive management measures (Section 4.2.6.2, Permanent Sample Plots).

It is not possible to entirely replicate the pre-development landscape and its ecosystems as a result of the substantive landscape-scale changes involved in the mining process (e.g., loss of higher-elevation areas to retained infrastructure, construction of ecosystems on a well-drained waste-rock substrate). However, substantial effort has gone into iterative attempts to reduce differences between pre-development and post-mining conditions, and BW Gold will actively look for opportunities to continue this reduction throughout the LoM through reclamation research trials and other initiatives (e.g., constructing small wetland areas and appropriate revegetation of opportunistic wetlands). Despite differences between pre-development and post-closure conditions, it is anticipated that ecosystems established on the post-mining landscape will provide value for intended land uses.

The post-mine water capability considered the predicted long-term Project-related effects on surface water quality, and loss of instream aquatic habitat and riparian habitat.

4.1.2.3 Summary of Changes to Landscape Capability

The results of ecohydrological modelling indicate that the post-mine ecosystems and land capability will shift towards drier ecosystems compared to pre-mine conditions, and that the priorities identified in Table 4.2-1 are likely achievable. The predicted changes in abundance and corresponding landscape capability of BGC units that will occur as a result of changes in SMR are summarized in Table 4.1-3 and presented on maps in Figure 4.1-2 and Figure 4.1-3.[4]

The decrease in available soil moisture results from the model assumption that water inputs will be primarily from precipitation on reclaimed landforms, without significant areas receiving near-surface, rooting-zone seepage inputs from local upslope areas (Section 4.1.2, Pre- and Post-mine Land Capability Assessment). This will result in the loss or decrease in prominence from the disturbance footprint of site series that have subhygric and wetter SMRs (i.e., wet forests and non-forested wetlands reliant on input of shallow groundwater). The Wetland Management and Offsetting Plan (WMOP) (Section 4.2.7.3, Wetland Management and Offsetting Plan) provides details on addressing wetland losses—the WMOP will evolve over the mine life as opportunities for wetland creation are identified through improved understanding of site conditions and research (Section 4.2.5, Reclamation Research). Potential impacts on caribou habitat (e.g., loss of the ESSFmvp) are addressed in the Caribou Monitoring and Mitigation Plan (CMMP) (Section 4.2.7.1, Caribou Offsetting Plan).

[4] The names in Table 4.1-5 do not reflect the full suite of plant species that will be used to reclaim these ecosystems, for example the ESSFmv1 02 (Lodgepole pine - Huckleberry – Cladonia) will include planting of whitebark pine.

Table 4.1-3: Relative Soil Moisture and Nutrient Regimes of ESSFmvp Site Units and their Presence in the Pre-mine and Post-closure Landscape

Site Unit	Description	SMR	SNR	Presence	
				Pre	Post
KC	Kinnikinnick - Cladonia	0-1	A-B		
ML	White mountain-avens - Lichen	0-1	A-B		
WW	Whitebark pine - white mountain-avens	1	A-B	x	
WK	Whitebark pine krummholz	1-2	A-B		
FB	Subalpine fir - Dwarf blueberry - Dicranum parkland	1-2	B		
TW	Two-toned sedge - Dwarf snow willow	2-3	A-B		
PC	Subalpine fir / whitebark pine - Crowberry parkland	2-3	B-C	x	
SF	Scrub birch - Altai fescue shrub steppe	3	B		
FM	Subalpine fir - Heather parkland	3-4	B-C		x
FC	Altai fescue - Cladonia lichen grassland	3-4	C-D		
MH	Mountain-heather - Slender hawkweed meadow	3-5	C-D		
VG	Sitka valerian - globeflower moist meadow	5	C-D		
FH	Subalpine fir - Indian hellebore	5-6	D	x	

Note:

SMR and SNR are taken directly where provided or estimated using professional judgment from baseline TEM mapping (AMEC 2013b).

Because ecohydrological modelling assumes uniform reclamation-cover treatments within polygons, projected reclamation polygons are larger and less heterogeneous than the pre-mine landscape. However, it is anticipated that reclamation in practice will result in more diversity and heterogeneity. This will occur through the differential timing of reclamation and revegetation programs, natural variation in cover-material properties, patterns in wind and snow redistribution, and variation in reclamation prescriptions (e.g., use of diverse planting treatments to break up large polygons with similar ecohydrological characteristics). This process (e.g., development and refinement of detailed planting prescriptions) will be guided and refined by reclamation research conducted throughout the mine life, as described in Section 4.2.5, Reclamation Research. The following subsections describe ecohydrological modelling results in more detail for each BEC subzone variant, comparing the projected post-mining ecosystems with pre-mine conditions.

SBSmc3

Site series associated with subhygric and wetter SMRs, including wetlands, are projected to be lost from disturbed areas due to changes to surface hydrology. The post-closure reclaimed topography is generally not expected to have mechanisms to retain near-surface water and release this water at lower slope positions and depressions as seepage.[5] The SBSmc3-06 (Black spruce – Lodgepole pine – Feathermoss; pre-disturbance: 6.6 ha) and SBSmc3-07 (Hybrid white spruce – Twinberry; 3.3 ha) site series will be lost from the disturbance footprint. All wetland units will also be lost as hydrologic conditions will not be conducive to replacement or maintenance of wet, organic-rich soils, including swamps (60.5 ha), bogs (5.4 ha), and fens (5.8 ha). The SBSmc3 edatopic grid is shown in Figure 4.1-4.

[5] Generally, waste-rock facilities do not support lateral downslope flow of shallow groundwater the way that landscapes on basal till do, with the exception of toes where mine wastes meet pre-existing ground, which are expected to produce near-surface seepage. These toes have been delineated on the post-closure map and treated accordingly for predicting post-closure ecosystems.

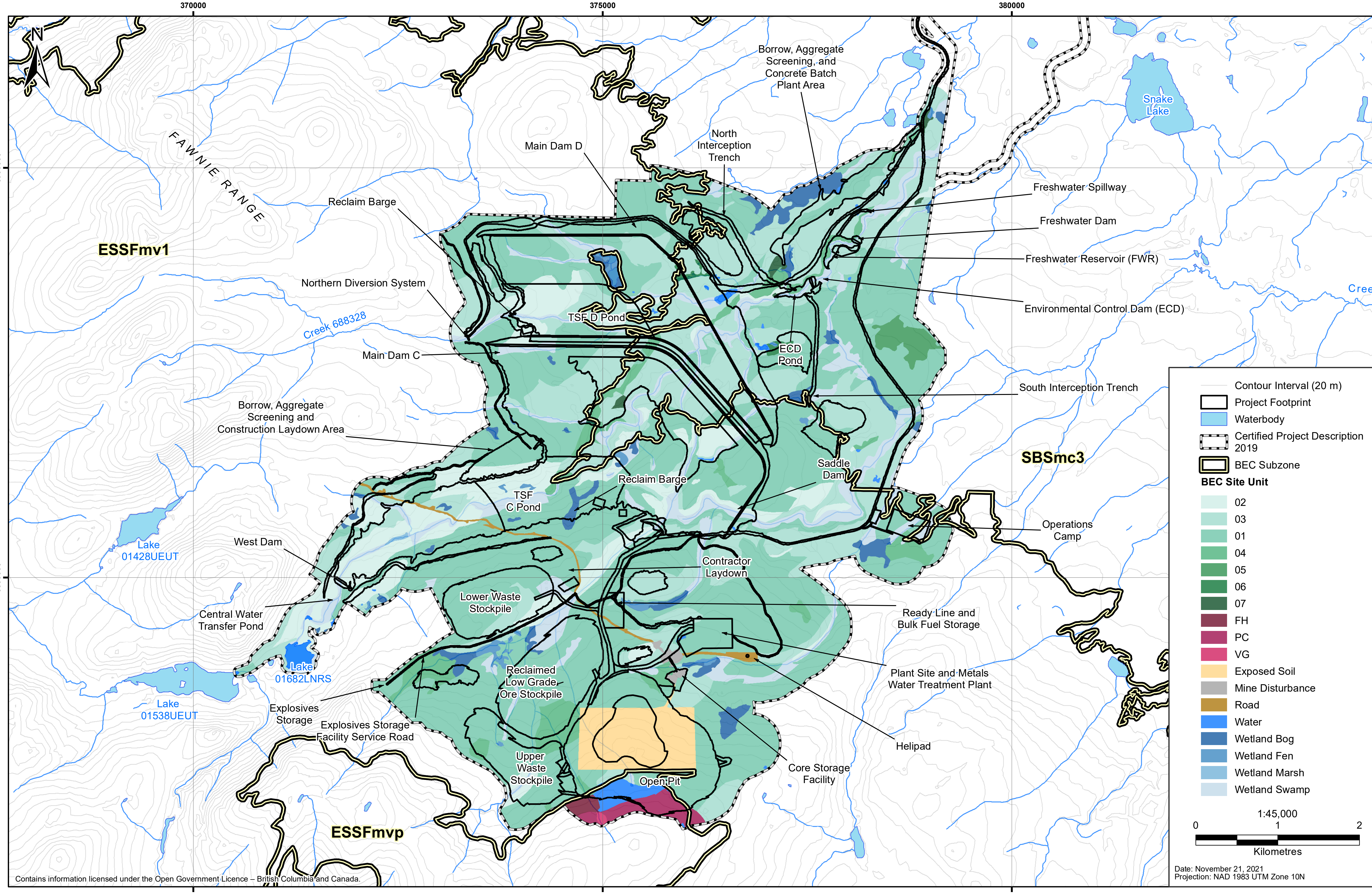


Figure 4.1-2: Pre-mine Land Capability

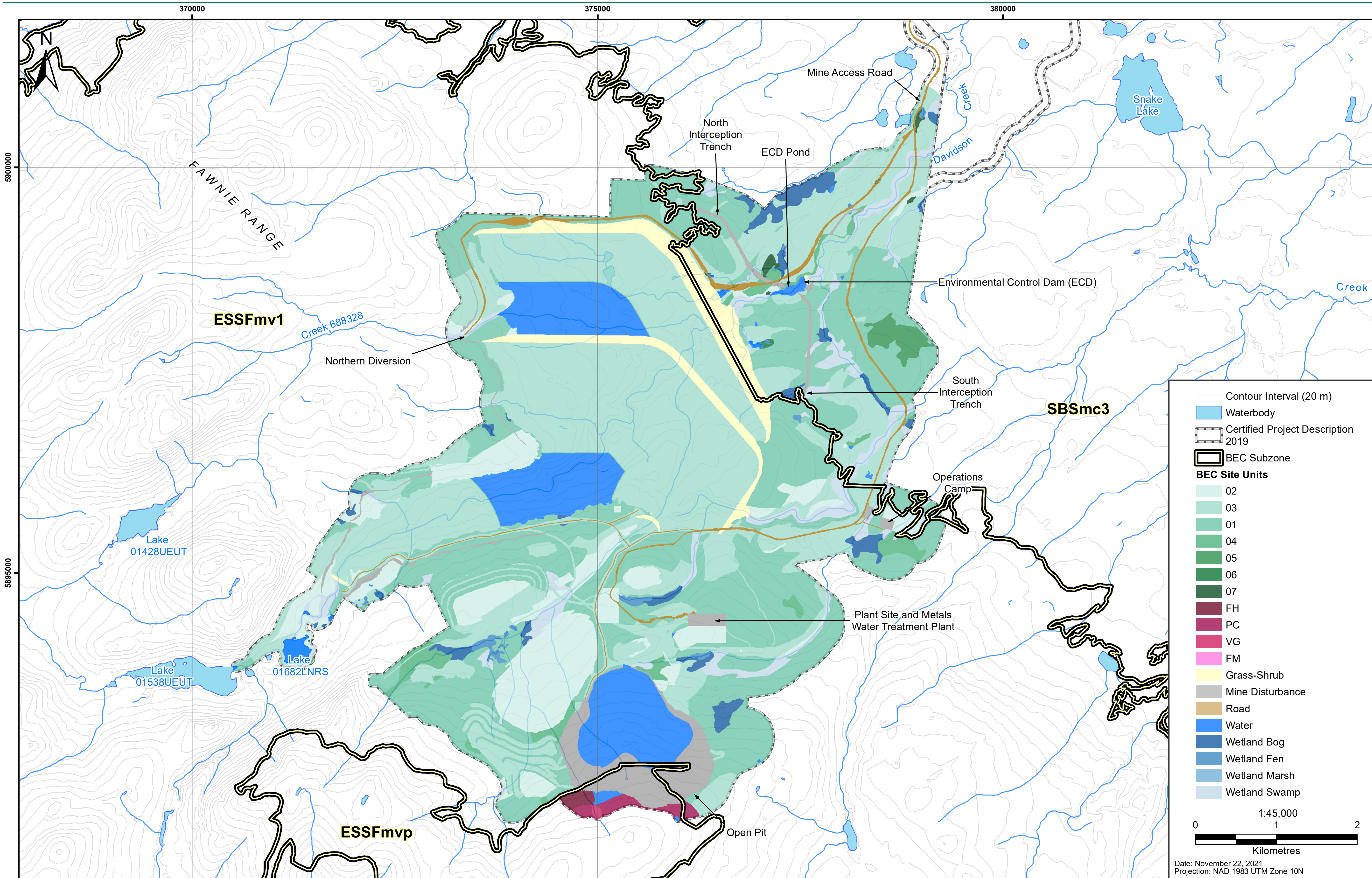


Figure 4.1-3: Post-Mine Land Capability

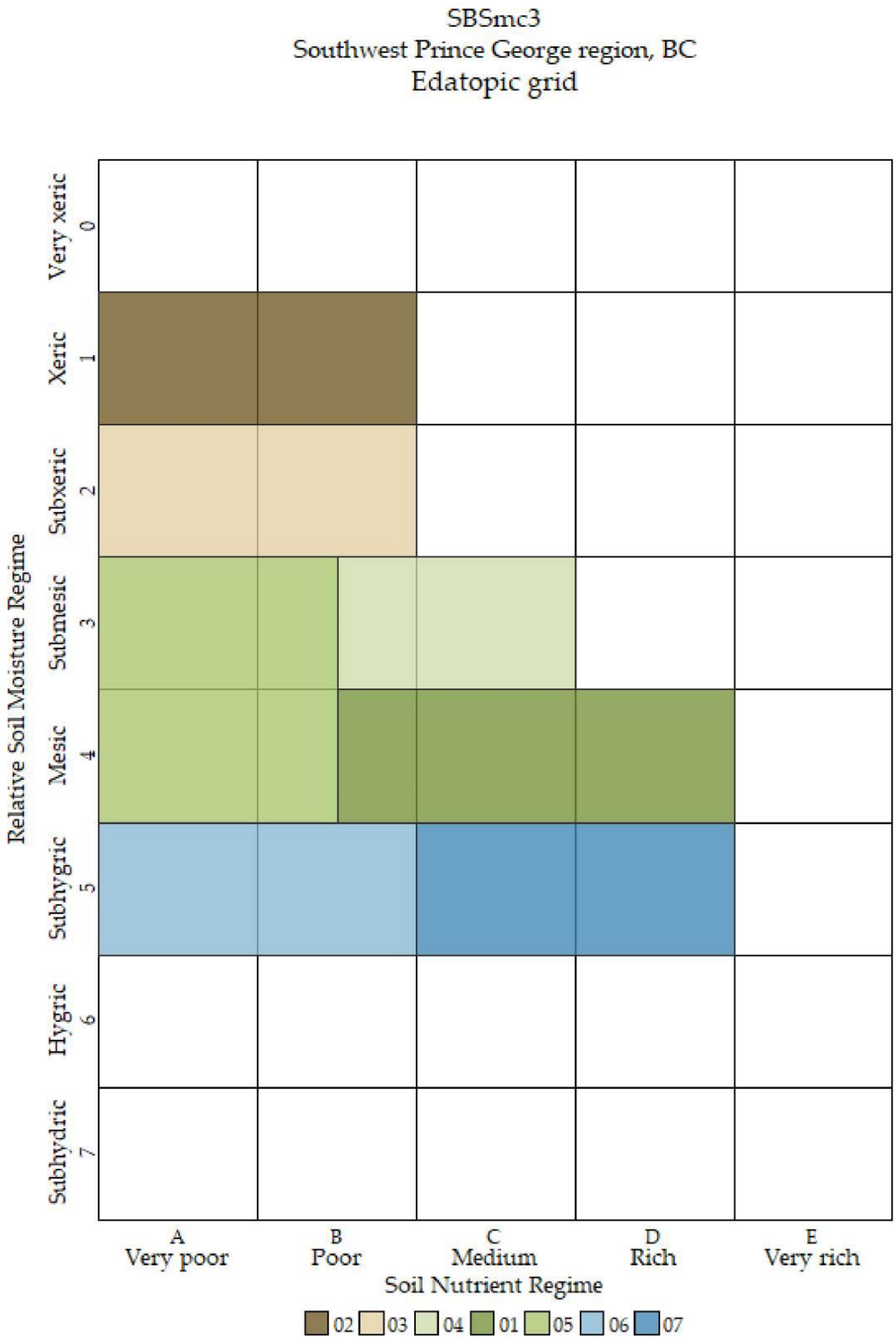


Figure 4.1-4: Edatopic Grid for the SBSmc3 Variant Showing Edaphic Characteristics of Ecosystems (adapted from Delong et al. 1993)

The most extensive pre-mine site series in the SBSmc3 is the 03 (Lodgepole pine – Feathermoss – Cladina; pre-disturbance: 277 ha), a drier site series associated with glaciofluvial surface soil that is favoured caribou habitat. The 03 site series, as well as the similar 02 (Lodgepole pine – Juniper – Dwarf blueberry; pre-disturbance: 10 ha), are intended to be reclaimed using salvaged soils from glaciofluvial deposits. Since the overall area of the SBSmc3 is being reduced on the post-closure landscape due to increases in elevation in the Tailings Storage Facility (TSF) area, which transition the TSF beach areas to the ESSFmv1 variant, it is not possible to replace all the drier site series area in the SBSmc3.

There are 287 ha of SBSmc3-02 and -03 in the pre-mine landscape compared to 240 ha of total SBSmc3 area in the post-closure landscape, 123 ha of which are non-reclaimed roads, infrastructure and water features, or dams that cannot be reclaimed to natural site series since trees and deep-rooted shrubs are not permitted due to geotechnical constraints. Of the remaining area, 50 ha of the SBSmc3 in the post-mine plan is reclaimed to the drier site series (SBSmc-02 and 03) that provide caribou (*Rangifer tarandus*) habitat. On lower elevation surface-soil stockpile footprints, the zonal 01 site series (Hybrid white spruce – Huckleberry; pre-disturbance: 123 ha) is predicted to cover 65 ha and the submesic 04 site series (Hybrid white spruce – Huckleberry – Soopolallie; pre-disturbance: 38 ha) will cover 2 ha. The modelling and physical parameters of the closed mine site indicate that the site will be slightly drier than the pre-mine environment. Given that the site will be drier overall, re-creation of wetlands may not be possible in the post-closure environment. Wetlands function as caribou habitat and some will be lost during construction of the mine. Offsetting for these lost wetlands is discussed in the Wetlands Management and Offsetting Plan (see Section 4.2.7.3). Consequently, the objective is to make the best possible quality caribou habitat given the constraints of this drier environment of the post-closure landscape.

ESSFmv1

For upland (non-seepage-associated) ecosystems, submesic to mesic SMRs and their associated ecosystems are expected to increase on the post-closure landscape, with a slight increase in subxeric to xeric ecosystems and a loss of subhygric or wetter ecosystems. As with the SBSmc3, the decrease in available soil moisture resulting in the loss of wetter ecosystems is due to the model assumption that water inputs will be primarily from precipitation on mine reclaimed landforms without significant areas of localized rooting-zone seepage inputs. The subhygric to hygric ESSFmv1-04 (Subalpine fir – Huckleberry – Gooseberry; pre-disturbance: 75 ha) site series will be reduced in size, occurring only in depressional areas of the TSF beach and on toes and lower slopes of the Upper and Lower Waste stockpiles (12 ha). All wetland units will also be lost as hydrologic conditions will not be conducive to replacement or maintenance of wet, organic-rich soils. These wetland losses include swamps (107 ha), bogs (14 ha), fens (3.5 ha), and marshes (1 ha).[6] 548 ha of the post-closure landscape will be non-reclaimed roads, infrastructure and water features, or dams that cannot be reclaimed to natural site series since trees and deep-rooted shrubs are not permitted due to geotechnical constraints.

Mesic or drier ecosystems dominate pre-mine conditions in the ESSFmv1 (1,342 ha or 87% of the ESSFmv1). The zonal 01 (Subalpine fir – Rhododendron – Feathermoss; pre-disturbance: 887 ha), which has a mesic SMR, will be less abundant on the post-mine landscape (221 ha). The next most common pre-mine site series is the 03 (Subalpine fir – Huckleberry – Feathermoss; pre-disturbance: 237 ha), which has a submesic to mesic SMR. The 03 will be the most prominent reclaimed ESSFmv1 site series as the primary component of TSF beaches and comprise 814 ha of the post-closure landscape. The 02 (Lodgepole pine – Huckleberry – Cladonia; pre-disturbance: 217 ha) is the driest site series in the ESSFmv1 and will be established in reclamation using glaciofluvial surface soil on the tops of the Upper and Lower Waste stockpiles, as well as on reclaimed camp and infrastructure areas (240 ha).

[6] Marshes are the easiest wetland type to replace in reclamation, and it is likely that it will be possible to construct at least 1 ha of marsh on the post-closure landscape. Plans to do so will be based on evolution of the mine plan, and/or observation of water retention in candidate areas.

The increase in the total area of submesic or drier ecosystems in the ESSFmv1 will favour lower tree densities and drought-tolerant tree species such as whitebark pine (Pinus albicaulis), particularly where coarse-textured glaciofluvial surface soils are used for reclamation (Section 4.2.1, Soil Resources). The increase in the drier ESSFmv1-02 and -03 site series on the post-closure landscape relative to pre-disturbance conditions (1,053 ha versus 454 ha) represents an overall increase in potential caribou habitat. The modelling and physical parameters of the closed mine site indicate that the site will be slightly drier than the pre-mine environment. Given that the site will be drier overall, re-creation of wetlands may not be possible in the post-closure environment (see also Section 4.2.7.3 for discussion of offsetting wetlands lost as a result of mine construction). Consequently, the objective is to make the best possible quality caribou habitat given the constraints of this drier environment of the post-closure landscape. Figure 4.1-5 shows the ESSFmv1 edatopic grid.

ESSFmvp

There is no edatopic grid for parkland units such as the ESSFmvp[7] in the BEC system, nor are there formal ecosystem descriptions based on soil moisture and nutrient regimes. Table 4.1-3 shows the relative moisture and nutrient regimes based on field data descriptions and professional experience for the ESSFmvp. In the post-mine landscape, all but 0.1 ha of the ESSFmvp will be exempt from reclamation as part of roads, the pit footprint, or water-diversion structures. The small parkland area (0.1 ha) that will be reclaimed is projected to support the FM site unit (Subalpine fir – Heather parkland), which was not present on the reclaimed footprint prior to mining and is not suited for whitebark pine growth. The WW site unit (Whitebark pine – white mountain-avens; pre-disturbance: 15 ha, 54%) was the most prevalent site unit on the pre-development landscape and is drier and nutrient-poorer than the reclaimed FM site unit. Whitebark pine was also supported by the PC site unit (Subalpine fir / whitebark pine – Crowberry parkland; pre-disturbance: 12 ha, 44%) in the pre-development landscape, which is also drier and nutrient-poorer than the reclaimed FM unit. The SMR of the area reclaimed as FM is similar to the PC (2-3), so species from the PC unit (e.g., whitebark pine and heather species) will be used for this area. The wetter FH site unit (Subalpine fir – Indian hellebore; pre-disturbance: 0.3 ha, 1.2%) occurs on subhydric to hygric sites and will not be present on the reclaimed ecosystems as these ecosystems require subsurface water inputs. The remainder of the ESSFmvp (0.1 ha, 0.9%) was open water on the pre-development landscape.

Table 4.1-4 also shows the changes in non-ecosystem site units due to mine development. Grass-shrub ecosystems on dams total 148 ha of the post-closure area, of which 84 ha are in the ESSFmv1 and 64 ha are in the SBSmc3. Natural water bodies, such as ponds, lakes, creeks, and shallow open water on wetlands were 4 ha of the footprint prior to mine development and all will be lost. However, anthropogenic water bodies will increase due to construction of the pit lake (122 ha), tailings ponds (208 ha), and the Environmental Control Dam (ECD) pond (4 ha). Permanent, reclamation-exempt mine disturbances such as the water treatment plant, water management infrastructure such as ditches and interception trenches, office areas, and part of the operations camp account for 153 ha. Roads that will remain after closure total 70 ha.

Current land use for traditional purposes (e.g., hunting and gathering) is predicted to change in the Post-closure phase when compared to the baseline due to changes in post-mine ecosystems (Table 4.1-4) and land capability. There is potential for decreased hunting and trapping success due to localized changes to wildlife availability (ERM 2017). Changes in hunting and trapping success will depend on the location and level of hunting and trapping activities, relative to locations where local wildlife populations may decline.

---

[7] The pre-mine baseline survey classified upper-elevation parkland sites in both the ESSFmvp and ESSFxvp1 BEC variants. Given that the parkland units occur above the ESSFmv1 and their limited portion of the disturbance footprint (30 ha), the ESSFmvp unit is used in this report for both pre- and post-mine summaries.

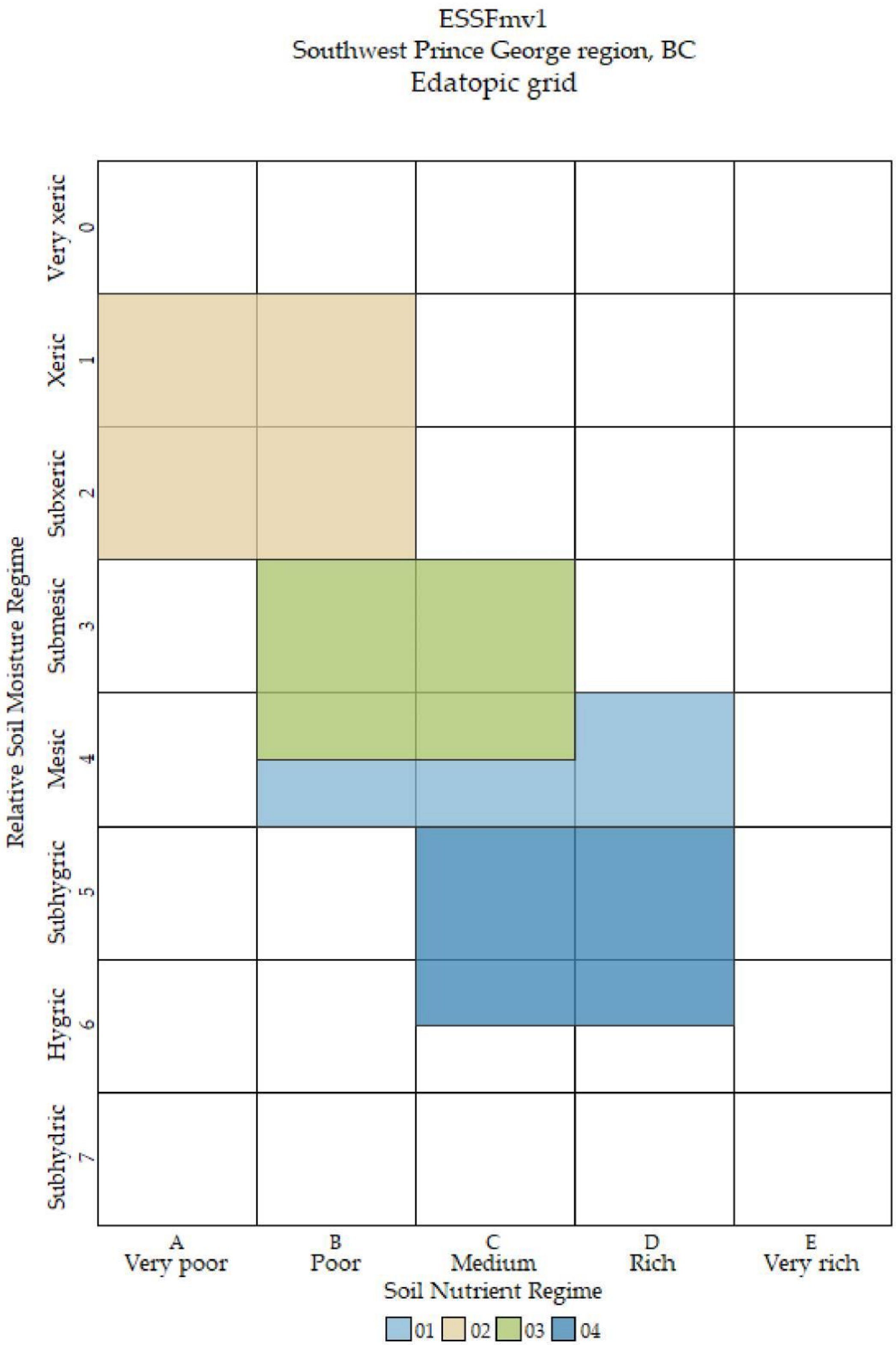


Figure 4.1-5: Edatopic Grid for the ESSFmv1 Variant Showing Edaphic Characteristics of Ecosystems (adapted from Delong et al. 1993).

Table 4.1-4: Summary of Pre-mine and Post-closure Ecosystem Areas Arranged by BGC Unit and Post-closure Abundance

BGC Unit	Site Unit	Name	Pre-mine Area (ha)	Pre-mine % Unit*	Pre-mine % FP**	Post-closure Area (ha)	Post-closure % Unit	Post-closure % FP	Difference Area (ha)	Difference % Unit	Difference % FP
ESSFmv1	03	Subalpine fir - Huckleberry - Feathermoss	237.1	15.4	11.3	813.7	44.4	38.7	576.6	29.00	27.4
	02	Lodgepole pine - Huckleberry - Cladonia	217.1	14.1	10.3	239.7	13.1	11.4	22.6	-1.0	1.1
	01	Subalpine fir - Rhododendron - Feathermoss	887.3	57.5	42.2	220.5	12.0	10.5	666.8	45.5	31.7
	PD, OW, RE	Mine water (tailings pond, other ponds, FWR)	0	0	0	208.2	11.4	9.9	208.2	11.4	9.9
	LA	Pit Lake	0	0	0	121.9	6.7	5.8	121.9	6.7	5.8
	ES, MI	Permanent mine disturbance***	0	0	0	104.3	5.7	5.0	104.3	5.7	5.0
	Grass-shrub	Grass-shrub (dams)	0	0	0	83.6	4.6	4.0	83.6	4.6	4.0
	RZ	Road (non-reclaimed)	0	0	0	30.2	1.7	1.4	30.2	1.7	1.4
	04	Subalpine fir – Huckleberry – Gooseberry	74.7	4.8	3.56	11.8	0.6	0.6	-63.0	-4.2	-3.0
	Swamp	Swamp	107.1	6.9	5.1	0	0	0	-107.1	-6.9	-5.1
	Bog	Bog	14.0	0.9	0.7	0	0	0	-14.0	-0.9	-0.7
	Fen	Fen	3.5	0.2	0.2	0	0	0	-3.5	-0.2	-0.2
	Marsh	Marsh	1.3	0.1	0.1	0	0	0	-1.3	-0.1	-0.1
	LA, PD, RI, OW	Natural water (lake, pond, river, shallow open water)	0.8	0.1	< 0.1	0	0	0	-0.8	-0.1	< 0.1
		Sub-total	***1,543.0***	***100***	***73.4***	***1,833.9***	***100***	***87.3***	***290.9***	***0***	***13.8***
ESSFmvp	ES, MI	Permanent mine disturbance***	0	0	0	27.5	99.7	1.3	27.5	99.7	1.3
	FM	Subalpine fir - Heather parkland	0	0	0	0.1	0.3	< 0.1	0.1	0.3	0.0
	WW	Whitebark pine avens	14.8	53.5	0.7	0	0	0	-14.8	-53.5	-0.7
	PC	Subalpine fir / whitebark pine - Crowberry parkland	12.3	44.4	0.6	0	0	0	-12.3	-44.4	-0.6
	FH	Subalpine fir - Indian hellebore	0.3	1.2	< 0.1	0	0	0	-0.3	-1.2	0.0
	LA, PD, RI, OW	Natural water (lake, pond, river, shallow open water)	0.2	0.9	< 0.1	0	0	0	-0.2	-0.9	0.0
		Sub-total	***27.6***	***100***	***1.3***	***27.6***	***100***	***1.3***	***0***	***0***	***0***

BGC Unit	Site Unit	Name	Pre-mine			Post-closure			Difference		
			Area (ha)	%		Area (ha)	%		Area (ha)	%	
				Unit*	FP**		Unit	FP		Unit	FP
SBSmc3	01	Hybrid white spruce - Huckleberry	122.5	22.4	5.8	64.7	25.3	3.1	-57.8	2.9	-2.7
	Grass-Shrub	Grass-Shrub (dams)	0	0	0	64.2	25.1	3.1	64.2	25.1	3.1
	RZ	Road	0	0	0	40.2	17.9	1.9	40.2	17.9	1.9
	03	Lodgepole pine - Feathermoss - Cladina	276.6	53.5	13.2	39.6	15.5	1.9	-237.0	-38.0	-11.3
	ES, MI	Permanent mine disturbance***	0	0	0	14.5	9.7	0.7	14.5	9.7	0.7
	02	Lodgepole pine - Juniper - Dwarf huckleberry	10.2	1.9	0.5	10.6	4.1	0.5	0.4	2.3	< 0.1
	PD, OW, RE	Mine water (tailings pond, other ponds, FWR)	< 0.1	< 0.1	< 0.1	4.3	1.7	0.2	4.3	1.7	0.2
	04	Hybrid white spruce - Huckleberry - Soopolallie / Black spruce - Huckleberry - Spirea	37.5	6.9	1.8	2.1	0.8	0.1	-35.4	-6.0	-1.7
	Swamp	Swamp	60.5	11.1	2.9	0	0	0	-60.5	-11.1	-2.9
	06	Black spruce - Lodgepole pine - Feathermoss	6.6	1.2	0.3	< 0.1	< 0.1	< 0.1	-6.6	-1.2	-0.3
	Fen	Fen	5.8	1.1	0.3	0	0	0	-5.8	-1.1	-0.3
	Bog	Bog	5.4	1.0	0.3	0	0	0	-5.4	-1.0	-0.3
	07	Hybrid white spruce - Twinberry	3.3	0.6	0.2	0	0	0	-3.3	-0.6	-0.2
	LA, PD, RI, OW	Natural water (lake, pond, river, shallow open water)	2.7	0.5	0.1	0	0	0	-2.7	-0.5	-0.1
		Sub-total	***531.0***	***100***	***25.3***	***240.1***	***100***	***11.4***	***-290.9***	***0***	***-13.8***
		Total	**2,101.5**	**-**	**100**	**2,101.5**	**-**	**100**	**0**	**-**	**0**

** Percent of area within each BGC site unit for the given time period.*

*** Percent of total area within the disturbance footprint.*

**** Permanent mine disturbance includes: Open Pit, Plant Site, camp, Central Diversion North, Central Diversion South and Northern Diversion Channel (ESSFmv1); Open Pit (ESSFmvp); and ECD Diversion structures, ECD spillway and Freshwater Reservoir (FWR) spillway (SBSmc3).*

4.1.3 Habitat for Focal Reclamation Species

A holistic approach and strategy to restoring biodiversity through habitat regeneration for closure is being implemented through this RCP.

This holistic approach is highlighted in Table 4.1-5, which compares and contrasts pre-mining ecosystems with projected post-mining ecosystems in regards to BGC unit, site series, SMR/SNR, area (ha), representative species, community members, key habitat features and vegetation species, focal reclamation species, expected species present at different stages of habitat regeneration, where that regeneration is expected to occur on the closed mine site and applicable reclamation research.

Due to their federal and provincial status' and value to Indigenous Nations, caribou, whitebark pine and Clark's nutcracker are the primary focal species guiding reclamation decisions in the Project, as well as rainbow trout and kokanee in relevant aquatic ecosystems. The reclamation plan also considers creating habitat for moose (non-focal species) in view of the species' importance to Indigenous nations. Wildlife studies and recent field work were used to identify current habitat use. Representative species were chosen because they are a species at risk, have been identified as culturally important by the Lhoosk'uz Dené Nation or Ulkatcho First Nation, or have been chosen as an indicator species (Appendix 4-D).

The process for updates and periodic reviews to this section of the RCP are highlighted in Section 0, Reclamation Research, Section 4.2.6, Reclamation Monitoring and Section 4.13, Plan Updates.

Whitebark Pine

Coarser glaciofluvial surface soils are planned to be used as soil covers to create drier site series with sparser tree canopies that will support whitebark pine and higher lichen cover favoured by caribou. Whitebark pine will be used as a revegetation species to the greatest extent possible, including in lower elevation areas, where they tend to be less common in the pre-mine landscape, and on submesic SMRs, where they are typically outcompeted by more vigorous tree species. While competition from other tree species may preclude them from abundant growth, whitebark pine will be given opportunities to extend their range in the Project footprint. This effort will be aided by the planned whitebark pine nursery and reclamation trials to determine optimal planting treatments (Section 4.2.5, Reclamation Research), with long-term maintenance and adaptive management measures informed by reclamation monitoring (Section 4.2.6.2, Permanent Sample Plots). All planned forested site series provide conifer stands, especially the drier 02 and 03 site series in the ESSFmv1 and SBSmc3, which have both lodgepole pine (*Pinus contorta*) and whitebark pine as planned revegetation species. In the vicinity of the FWR and camp areas, roughly 50 ha of SBSmc3 02 and 03 site series are planned using glaciofluvial surface soil. These are drier and relatively low-density forested ecosystems where lichen and whitebark pine will be prioritized for revegetation based on research trial outcomes (see Table 4.2-4) and caribou and Clark's nutcracker are expected to find foraging opportunities.

Clark's Nutcracker

The reclamation plan also considers Clark's nutcracker as a focal species. Clark's nutcracker prefers conifer stands with significant pine components for nesting and foraging.

Table 4.1-5: RCP Ecosystem Summary for Vegetation and Wildlife – Comparing Pre-disturbance Ecosystems with Projected Post-closure Ecosystems

BGC Unit	Pre-disturbance Ecosystems							Projected Post-closure Ecosystems							Mine Features	Research
	Site Series	SMR/SNR	Area (ha)	Representative spp.	Community Members	Key Habitat Features and Vegetation spp.	Reclamation Objective spp.	Area (ha)	Focal spp.*	Other Reclamation Considerations	Initiation (Structural Stages 1-3, Sparse - Shrub/Herb)	Short-term (Structural Stages 4-5, Young Forest)	Medium-term (Structural Stage 6, Mature Forests)	Long-term (Structural Stage 7, Old Growth Forest)		
ESSFmv1	02	1, 2/A, B	217.1	caribou, grizzly bear, wolverine, olive-sided flycatcher	hare, vole, squirrel	Dry lodgepole pine forest (Subalpine fir, Engelmann spruce) upper-crest; black huckleberry, Sitka alder, common juniper, birch-leaved spirea, dwarf blueberry, bluejoint reedgrass, cladina spp., Stereocaulon spp.; wind swept edge potential	caribou, grizzly bear, wolverine, olive-sided flycatcher	239.7	whitebark pine, lichen spp., black huckleberry, dwarf blueberry	alder spp.	hare, rodents, birds, pollinators	caribou, hare, rodents, birds, Clark's nutcracker	caribou, grizzly bear, wolverine, olive-sided flycatcher	caribou, grizzly bear, wolverine, olive-sided flycatcher	Uppermost portions of Upper and Lower Waste stockpiles; camp and infrastructure areas; upper-elevation borrow areas; Low Grade Ore (LGO) stockpile; TSF beaches	Native spp. Revegetation and Lichen Section 4.2.5.1; Whitebark Pine Section 4.2.5.2 and Section 4.2.6.2
	03	3,4/B, C	237.1	grizzly bear, hare, wolverine, marten, olive-sided flycatcher	hare, vole, squirrel, grouse	Mesic lodgepole pine forest (Subalpine fir, Engelmann spruce); upper slope-level; black huckleberry, rhododendron, subalpine fir, fireweed, twinflower, mosses, no terrestrial lichen; CWD potential; snow interception, boulders	grizzly bear, hare, wolverine, marten, olive-sided flycatcher	813.7	whitebark pine, lodgepole pine, subalpine fir, kinnikinnick, black huckleberry	addition of boulders and CWD to provide structure and denning opportunities	hare, rodents, birds, pollinators	hare, rodents, birds, Clark's nutcracker	grizzly bear, hare, wolverine, marten, olive-sided flycatcher	grizzly bear, hare, wolverine, marten, olive-sided flycatcher	Uppermost portions of Upper and Lower Waste stockpiles; camp and infrastructure areas; upper-elevation borrow areas; Low Grade Ore (LGO) stockpile; TSF beaches; Upper and Lower Waste stockpiles; roads; fringes of TSF ponds; topsoil stockpiles	Native spp. Revegetation and Lichen Section 4.2.5.1; Whitebark Pine Section 4.2.5.2 and Section 4.2.6.2
	01	4/B-D	887.3	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp.	hare, squirrel, shrews-voles-mice, grouse	Moist fir/Engelmann spruce forest (lodgepole pine); mid-upper slope; black huckleberry, Sitka alder, rhododendron, fireweed; high moss, arboreal lichen spp.; CWD potential; snow interception; security, boulders	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp.	220.5	subalpine fir, Engelmann spruce, highbush cranberry, black huckleberry	addition of boulders and CWD to provide structure and denning opportunities	hare, rodents, birds, pollinators	hare, rodents, birds, pollinators	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp.	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp.	Upper and Lower Waste stockpiles; roads; fringes of TSF ponds; topsoil stockpiles	Native spp. Revegetation Section 4.2.5.1
	04	5, 6/C, D	74.7	caribou, grizzly bear, moose, marten, olive-sided flycatcher, western toad, bat spp.	squirrel, rodents	Moist to wet lodgepole pine/Engelmann spruce (Subalpine fir); forest, mid-toe slope and depresions; black twinberry, black huckleberry, black gooseberry, western mountain ash, subalpine fir, arboreal lichen; high herb; CWD; security, boulders	caribou, grizzly bear, moose, marten, olive-sided flycatcher, western toad, bat spp.	11.8	subalpine fir, spruce, black twinberry, black huckleberry	deciduous tree species; addition of boulders and CWD to provide structure and denning opportunities	hare, rodents, birds, pollinators, western toad	hare, rodents, birds, pollinators	caribou, grizzly bear, moose, marten, olive-sided flycatcher, western toad, bat spp.	caribou, grizzly bear, moose, marten, olive-sided flycatcher, western toad, bat spp.	Upper and Lower Waste stockpiles; roads; fringes of TSF ponds; topsoil stockpiles	Native spp. Revegetation Section 4.2.5.1
	Wetlands	5, 6, 7	125.9	western toad, waterbirds, rusty blackbird				0								
	New: Riparian areas						moose, grizzly bear, invertebrates, pollinators, songbirds, western toad, bat spp.		spruce, willow spp., black twinberry, cow parsnip, horsetail, sedge spp., bluejoint reedgrass, prickly rose	Invite pollinators; addition of CWD to provide structure	pollinators, grizzly bear, western toad, rodents, birds	pollinators, moose, grizzly bear, western toad, rodents, birds			In areas adjacent to water, where extended periods of water in rooting zone observed (e.g., adjacent to TSF ponds and interception ditches)	Riparian Reclamation Section 4.7.1.1

BGC Unit	Pre-disturbance Ecosystems							Projected Post-closure Ecosystems							Mine Features	Research
	Site Series	SMR/SNR	Area (ha)	Representative spp.	Community Members	Key Habitat Features and Vegetation spp.	Reclamation Objective spp.	Area (ha)	Focal spp.*	Other Reclamation Considerations	Initiation (Structural Stages 1-3, Sparse - Shrub/Herb)	Short-term (Structural Stages 4-5, Young Forest)	Medium-term (Structural Stage 6, Mature Forests)	Long-term (Structural Stage 7, Old Growth Forest)		
ESSFmv1 *(cont'd)*	New: Grass-shrub (dams)		0	moose, grizzly bear, invertebrates, pollinators, dragonflies, grassland birds, deer		Water, spring feeding for bears, browse for moose	moose, grizzly bear, invertebrates (dragonflies), pollinators, grassland birds, deer	83.6	native grass - shrub spp.		moose, grizzly bear, invertebrates, pollinators, grassland birds	moose, grizzly bear, invertebrates, pollinators, grassland birds	moose, grizzly bear, invertebrates, pollinators, grassland birds	moose, grizzly bear, invertebrates, pollinators, grassland birds	Dams	Grass spp. Section 4.2.2.3
ESSFmvp	WW	1	14.8	caribou, Clark's nutcracker, birds, grizzly bear	voles	Krummholz, whitebark pine, lichen spp., security, food, nesting		0							Open pit	
	PC	2, 3	12.3	caribou, Clark's nutcracker, birds, grizzly bear	voles	Whitebark pine, crowberry, security, food, nesting		0							Open pit	
	FM	3, 4	0	grizzly bear, deer		Feeding for bears in spring/summer	grizzly bear, deer	0.1			grizzly bear	grizzly bear, deer	grizzly bear, deer	grizzly bear, deer	Haul road	Native spp. Revegetation Section 4.2.5.1
	FH	5, 6	0.3	caribou, deer, grizzly bearbirds	voles	Krummholz, security, food, nesting		0							Open pit	
SBSmc3	02	1/A, B	10.2	caribou, grizzly bear, grouse, birds	hare, vole, squirrel	Dry lodgepole pine open forest upper-slope; saskatoon berry, dwarf blueberry, strawberry, kinnikinnick, common juniper	caribou, grizzly bear, grouse, birds	10.6	lodgepole pine, kinnikinnick, common juniper, saskatoon berry, dwarf blueberry		rodents, birds, pollinators	rodents, birds, pollinators	caribou, grizzly bear, grouse, birds	caribou, grizzly bear, grouse, birds	Freshwater Reservoir; lower-elevation borrow areas, mine site access road	Native spp. Revegetation Section 4.2.5.1
	03	2/A, B	276.6	caribou, grizzly bear, grouse, birds	hare, vole, squirrel	Dry lodgepole pine forest upper-slope, crest or level; dwarf blueberry, strawberry, kinnikinnick, soopallalie, common juniper, herbs; high terrestrial lichen cover, windswept	caribou, grizzly bear, grouse, birds	39.6	hybrid white spruce, lodgepole pine, dwarf blueberry, soopolallie		rodents, birds, pollinators	rodents, birds, pollinators	caribou, grizzly bear, grouse, birds	caribou, grizzly bear, grouse, birds	Freshwater Reservoir; lower-elevation borrow areas, mine site access road	Native spp. Revegetation Section 4.2.5.1
	04	3, 4/A, B	37.5	caribou, grizzly bear, moose, marten, fisher, olive-sided flycatcher, grouse	squirrel, rodents, grouse	Mesic lodgpole pine (hybrid spruce) forest mid-upper slope; highbush cranberry, black huckleberry, sitka alder, arboreal lichen spp.; very high herb; CWD; security	caribou, grizzly bear, moose, marten, fisher, olive-sided flycatcher, grouse	2.1	hybrid white spruce, lodgepole pine, highbush cranberry, soopolallie, black huckleberry	alder spp.	moose, hare, rodents, birds, pollinators, western toad	moose, rodents, birds, pollinators	caribou, grizzly bear, moose, marten, olive-sided flycatcher, grouse	caribou, grizzly bear, moose, marten, olive-sided flycatcher, grouse	Topsoil stockpiles, mine site access road	
	01	4/B-D	122.5	caribou, grizzly bear, hare, wolverine, marten, fisher, olive-sided flycatcher, bat spp.	hare, squirrel, shrews-voles-mice, grouse	Moist hybridspruce/lodgpole pine forest; mid- slope or level; black huckleberry, subalpine fir, highbush cranberry, hybrid spruce, black twinberry, bluejoint reedgrass, dwarf blueberry, trailing raspberry; high moss, arboreal lichen spp.; CWD potential; security	caribou, grizzly bear, hare, wolverine, marten, fisher, olive-sided flycatcher, bat spp.	64.7	hybrid white spruce, lodgepole pine, highbush cranberry, soopolallie, black huckleberry, trailing raspberry		moose, hare, rodents, birds, pollinators, western toad	moose, rodents, birds, pollinators	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp.	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp.	Topsoil stockpiles, mine site access road	
	05	3, 4/A, B		caribou, grizzly bear, hare, wolverine, fisher, marten, olive-sided flycatcher, bat spp., western toad		Mesic mixed coniferous forest (lodgepole pine, black spruce, hybrid white spruce) upper slope or level; terrestrial lichen spp., dwarf blueberry, twinflower, crowberry, soopalallie, birch-leaved spirea; CWD; snow interception; security	caribou, grizzly bear, hare, wolverine, marten, fisher, olive-sided flycatcher, bat spp., western toad		hybrid white spruce, lodgepole pine, highbush cranberry, soopolallie, black huckleberry, crowberry		caribou, moose, hare, rodents, birds, pollinators, western toad	caribou, moose, rodents, birds, pollinators	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp., western toad	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp., western toad	Topsoil stockpiles, mine site access road	

BGC Unit	Pre-disturbance Ecosystems							Projected Post-closure Ecosystems							Mine Features	Research
	Site Series	SMR/SNR	Area (ha)	Representative spp.	Community Members	Key Habitat Features and Vegetation spp.	Reclamation Objective spp.	Area (ha)	Focal spp.*	Other Reclamation Considerations	Initiation (Structural Stages 1-3, Sparse - Shrub/Herb)	Short-term (Structural Stages 4-5, Young Forest)	Medium-term (Structural Stage 6, Mature Forests)	Long-term (Structural Stage 7, Old Growth Forest)		
SBSmc3 *(cond't)*	06	5/A, B	6.6	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp., western toad		Moist to wet mixed coniferous forest (lodgepole pine, black spruce, hybrid white spruce) lower slope or level; terrestrial lichen spp., black huckleberry, crowberry, dwarf blueberry, twinflower, coltsfoot and other herbs, soopalallie, Labrador tea; CWD; snow interception; security	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp., western toad	< 0.1	lodgepole pine, black spruce, hybrid white spruce, lichen spp., black huckleberry, crowberry, dwarf blueberry, twinflower, soopalallie, Labrador tea		caribou, moose, hare, rodents, birds, pollinators, western toad	caribou, moose, rodents, birds, pollinators	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp., western toad	caribou, grizzly bear, hare, wolverine, marten, olive-sided flycatcher, bat spp., western toad		
	07	5/C, D	3.3	grizzly bear, moose, rodents, hare, western toad				0								
	Wetlands		71.7	waterbirds, western toad, rusty blackbird, pollinators, dragonflies, moose				0								
	New: Riparian areas		0				moose, grizzly bear, invertebrates, pollinators, songbirds, western toad, bat spp.		spruce, willow spp., black twinberry, cow parsnip, horsetail, sedge spp., bluejoint reedgrass, prickly rose	Invite pollinators; addition of CWD to provide structure	pollinators, grizzly bear, western toad, rodents, birds, bats	pollinators, moose, grizzly bear, western toad, rodents, birds, bats	fisher, moose, grizzly bear, western toad, rodents, birds, bats	fisher, moose, grizzly bear, western toad, rodents, birds, bats	In areas adjacent to water, where extended periods of water in rooting zone observed (e.g., adjacent to TSF ponds and interception ditches)	Riparian Reclamation Section 4.7.1.1
	New: Grass-shrub (dams)		0	moose, grizzly bear, invertebrates, pollinators, grassland birds, deer		Water, spring feeding for bears, browse for moose	moose, grizzly bear, invertebrates, pollinators, grassland birds, deer	64.2	native grass - shrub spp.		moose, grizzly bear, invertebrates, pollinators, grassland birds	moose, grizzly bear, invertebrates, pollinators, grassland birds	moose, grizzly bear, invertebrates, pollinators, grassland birds	moose, grizzly bear, invertebrates, pollinators, grassland birds	Dams	Grass spp. use Section 4.2.2.3

Notes:
Pre-disturbance ecosystems that are not projected to be present post-mine are greyed out.
This table is focused on terrestrial habitats and does not include pre-mine water bodies.
Reclaimed areas in the SBSmc3 01, 04, 05, 06, which are all located on soil stockpile footprints, and special ecosystems (e.g., grass/shrubs on dams and riparian ecosystems) are not available until closure and will not have research trials.
** Please refer to Table 4.2-7 for a list of all vegetation spp. included in each BGC and site unit.*

Southern Mountain Caribou (Tweedsmuir Herd)

In the higher-elevation sections of the mine, TSF beaches, the tops of the Upper and Lower Waste stockpiles, ore stockpile footprints, and infrastructure areas are planned to provide 1,053 ha of ESSFmv1-02 and ESSFmv1-03 site series, the majority of which (663 ha) are 03 site series occurring on TSF beaches. The ESSFmv1-03 site series is more densely forested with less lichen than the ESSFmv1-02 and thus is a lower quality foraging habitat for caribou but is still expected to provide some foraging opportunities and shelter for caribou, as well as abundant pine to support Clark's nutcracker. The ESSFmv1-02 is planned for 240 ha of the reclaimed area and, of all ESSFmv1 site series, provides the best habitat for lichen, caribou, and whitebark pine.

Non-reclaimed roads present a risk to caribou as they can be used by humans for hunting access and wolves as travel corridors, leading to increased predation. While some roads must be left on the mine site after closure to facilitate ongoing monitoring and management, any reclaimed roads are planned to be revegetated as quickly as possible. Revegetation will use till-dominated, mixed-parent-material surface soil rather than glaciofluvial surface soil as it has the highest water-storage capacity of available reclamation materials and, therefore, is best suited to support quicker revegetation and denser forest coverage. BW Gold also intends to place woody debris on these corridors to facilitate faster revegetation through creation of sheltered microsites, inhibit predator travel, reduce predator sight lines, and enhance protection of caribou.

Rainbow Trout and Kokanee

Rainbow trout and kokanee are also focal species and important for traditional land use. Fish habitat compensation/offsetting focuses on known limitations to fisheries productivity in the affected watersheds. Compensation measures have been designed to alleviate productivity bottlenecks as well as restore and enhance degraded habitat (Section 4.2.7.2, Fish Habitat Compensation and Offsetting Plans).

4.1.4 Challenges for Reclaiming Target Ecosystems

This subsection provides some primary limiting factors that affect revegetation success and long-term successional trajectories, and the approaches to address these factors. Two key components for addressing these reclamation challenges are a comprehensive reclamation research program (Section 4.2.5, Reclamation Research) as well as the rigorous implementation of an ongoing reclamation monitoring program for soil, vegetation, and water (Section 4.2.6, Reclamation Monitoring).

Unfavourable post-mining soil characteristics are one of the main challenges affecting reclamation success and successional trajectories, and include soil depth, texture, bulk density, moisture availability, nutrient contents and cycling capabilities, and erosion losses. The ecohydrological model is a quantitative data-based method to objectively estimate reclamation soil properties (i.e., depth and texture) required to develop target ecosystems, given local climate, ecology and available soil materials. Using this modelling approach is a key component to ensure reclamation soil covers are capable of supporting the planned vegetation communities in terms of moisture and nutrient availability.

Creation of ecological and floristic diversity is another challenge to achieving end land use goals of creating self-sustaining ecosystems utilized by wildlife and integrated into the surrounding landscape. This challenge has been addressed through targeted approaches for the Upper and Lower Waste stockpiles, dam slopes, roads, and infrastructure pads, as discussed below.

The Upper and Lower Waste stockpiles are the major sloped components on the post-closure landscape. These sites have been designed with sigmoidal slopes to create topography similar to natural landforms that will help typical vegetation patterns along soil catenas to be expressed, and reduce erosion, which is a major threat to revegetation success on slopes. Further opportunities for landforming are intended to be pursued, where possible, as facilities are built. Topographical features on the scale of a few metres (mesotopography) to create landscape diversity are not featured in designs at this stage of Project planning but can be implemented during construction and decommissioning, particularly on level and gently sloping areas, such as roads or camp and infrastructure areas, where geotechnical stability and erosion are not concerns.

Dam reclamation presents an unavoidable challenge for the re-establishment of pre-mine ecosystems. These challenges relate to the requirement to maintain dam geotechnical stability that preclude landforming (i.e., slopes will be planar although non-planar microsites may be possible) and the restriction on re-establishing trees and deep-rooted shrubs. The proposed revegetation species for dams are based primarily on compatibility with ensuring slope stability, erosion control, and inspectability rather than creation of habitat value. Although native shrubs will be included in the revegetation of dams, the ecosystems that will be supported are not analogous to those present on the site prior to mining. As outlined in Section 4.1.2.3, Summary of Changes to Landscape Capability, 150 ha of these novel Grass-Shrub ecosystems are predicted for dams.

In terms of vegetation succession, the primary challenge to revegetation success is the presence of weedy, invasive, and agronomic species, particularly perennial grasses, which can outcompete native species and prevent desired successional patterns. To avoid this outcome, native species have been selected for use during revegetation with a preference towards trees, shrubs, and herbs, with limited use of grasses. The Invasive Plant Management Plan (IPMP; Appendix 9-G) and the reclamation post-closure monitoring plan (Section 4.2.6, Reclamation Monitoring) have been developed to monitor and treat undesired plant species should they occur on the site. In addition to the planned revegetation research trials (Section 4.2.5.1, Vegetation and Cover Trials), the reclamation monitoring program (Section 4.2.6.2, Permanent Sample Plots) will provide information on establishment of native vegetation and initiation of desired successional trajectories, with results informing implementing of maintenance and adaptive management measures (Section 4.10.10, Adaptive Management).

Additional vegetation succession challenges may result from dependency of certain species (e.g., black huckleberry [*Vaccinium membranaceum]*, twinflower [*Linnaea borealis]*) on soil and site conditions associated with later successional stages, such as well-developed soil humus layers and shade from larger vegetation. Vegetation trials will be conducted (Section 4.2.5.1, Vegetation and Cover Trials) to assess suitability of target species and adjust the species lists and planting densities provided in Table 4.2-7.

The long-term Project-related effects on surface water quality, and loss of instream aquatic habitat and riparian habitat will limit reclamation targets on the Project site. Water quality in the TSF C Pond and Pit Lake are predicted to require treatment through post-closure. However, the FWR will be drained and decommissioned at post-closure to re-establish a natural flow regime in Davidson Creek.

4.1.4.1 Climate Change Impacts

An additional challenge to the implementation of the Project reclamation plan is shifting precipitation, temperature and related growing conditions due to climate change. Climate change modelling of the current and future climatic envelopes in BC has been developed to predict how the BGC units will shift spatially under future climatic regimes across three timeframes (2011-2040, 2041-2070, 2071-2100) (Wang et al. 2016). Since reclamation will occur after a 25-year construction and operation period, the 2041-2070 (i.e., 2050s) modelling of BGC units was chosen to identify potential changes in the unit distribution as this is the time period during which most reclamation and early ecosystem succession will occur.

Projections for the study area indicate that, in comparison to the historical 1961-1990 normals, expected conditions in the 2041-2070 period include warmer temperatures (in the range of 1-3 ˚C in all seasons) and increased precipitation (in the range of 5-15% in each season) (Wang et al. 2016).[8] Predictions of lesser

[8] Modelled climate data obtained from http://www.climatewna.com based on the methods of Wang et al. (2016). Differences between historical conditions and future projections vary according to the elevation of interest and the climate change trajectory (i.e., shared socioeconomic pathway) selected.

snowpacks in the future (and the corresponding decrease in meltwater runoff during the spring) will be offset to some degree by the expected increase in precipitation during the growing season. The climate modelling predicts that the Project areas currently mapped as SBSmc3 and ESSFmv1 will have a regional climate more similar to the SBSdk and SBSmc2, respectively (Wang et al. 2016). The ESSFmvp on Mount Davidson will be replaced by the ESSFmv1, beginning close to the upper elevation extent of the mine disturbance footprint (Figure 4.1-6). These shifts in climate envelopes have particular relevance to whitebark pine that occur on Mount Davidson where increases in annual temperature will result in increased tree density and competition.

The future projected BGC unit distributions for the 2050s were not used to identify reclamation ecosystem targets for closure. Rather, the current BGC units and site series have been used. This option was chosen as it provides a clearer assessment of changes to current land capability due to mining activities and reclamation practices. This is not considered to be a risk to the validity of the ecohydrological modelling, as the primary outputs from the model are related to relative SMR, which is strictly derived from site and soil characteristics and is explicitly defined as independent of climate. For example, a moderately coarse soil on a moderate slope is always classified as a submesic SMR, no matter the regional or temporal climate, and changing climate does not alter the SMR classification rules in the ecohydrological model. Depending on the climate, this submesic site may support different vegetation communities, which means that the predicted site series and vegetation prescriptions for the post-closure area may change in time, but, most importantly for this exercise, the site's inherent capability and SMR is unaffected. The fixed nature of the SMR concept allows isolation of the impact of mine development on site capability from the wider effects of climate change.

As climate modelling predictions evolve over time and site level predictions become more refined, the ecohydrological modelling and revegetation prescriptions provided in this plan will be updated along with the updates described in Section 4.1.2.2, Post-mine Land Capability. As detailed mine closure and reclamation planning is developed in the years immediately preceding reclamation (i.e., prior to mine closure, or earlier for any areas of progressive reclamation), climate modelling predictions may have more certainty and may be employed in combination with the results of reclamation research on the site in the intervening years to further refine the reclamation practices.

The plant species selected for the reclamation prescriptions (Section 4.2.3, Revegetation Strategy) were primarily selected because they will contribute to meeting end land use objectives. In addition, they were selected based on drought tolerance for predicted warmer conditions and because they have wide ecological amplitudes which make them suitable for changing conditions. Many of these species also occur in the SBSmc2, which is predicted for much of the upper mine elevations in the 2050s. The species that are exceptions to this include alpine fescue (*Festuca altaica)* and whitebark pine.

Whitebark pine is included in the reclamation prescriptions on sites in the ESSmv1 with SMR classes drier than mesic, as these conditions will reduce competition with other tree and shrub species (McCaughey et al. 2009). If available, rust resistant whitebark pine stock will be used to improve the probability of survival. Whitebark pine occurs in the mine vicinity primarily in the ESSFmvp, as well as in the ESSFmv1. However, climate change projections indicate that the ESSFmvp BGC unit will be mostly lost from the mine site by 2050 (Figure 4.1-6) and conditions in the higher elevations of the SBSmc3 variant may not be as suitable for whitebark pine under future climate conditions. These implications will be considered and accommodated as much as possible in future iterations of the reclamation plan, but some whitebark pine habitat loss appears inevitable due to climate change processes external to the impact of Project development. Considerations to address the shift in climate and potential effects to whitebark pine include the use of whitebark pine to reclaim exploration roads in the ESSmvp in areas that currently do not have whitebark pine.

The influence of potential changes in future climate on surface water and fish and fish habitat reclamation has been considered in the development of the prediction models (water balance and water quality). The capacity of water treatment plant is expected to be sufficient for treatment of water from the TSF C Pond and Pit Lake under variable climate conditions through post-closure.

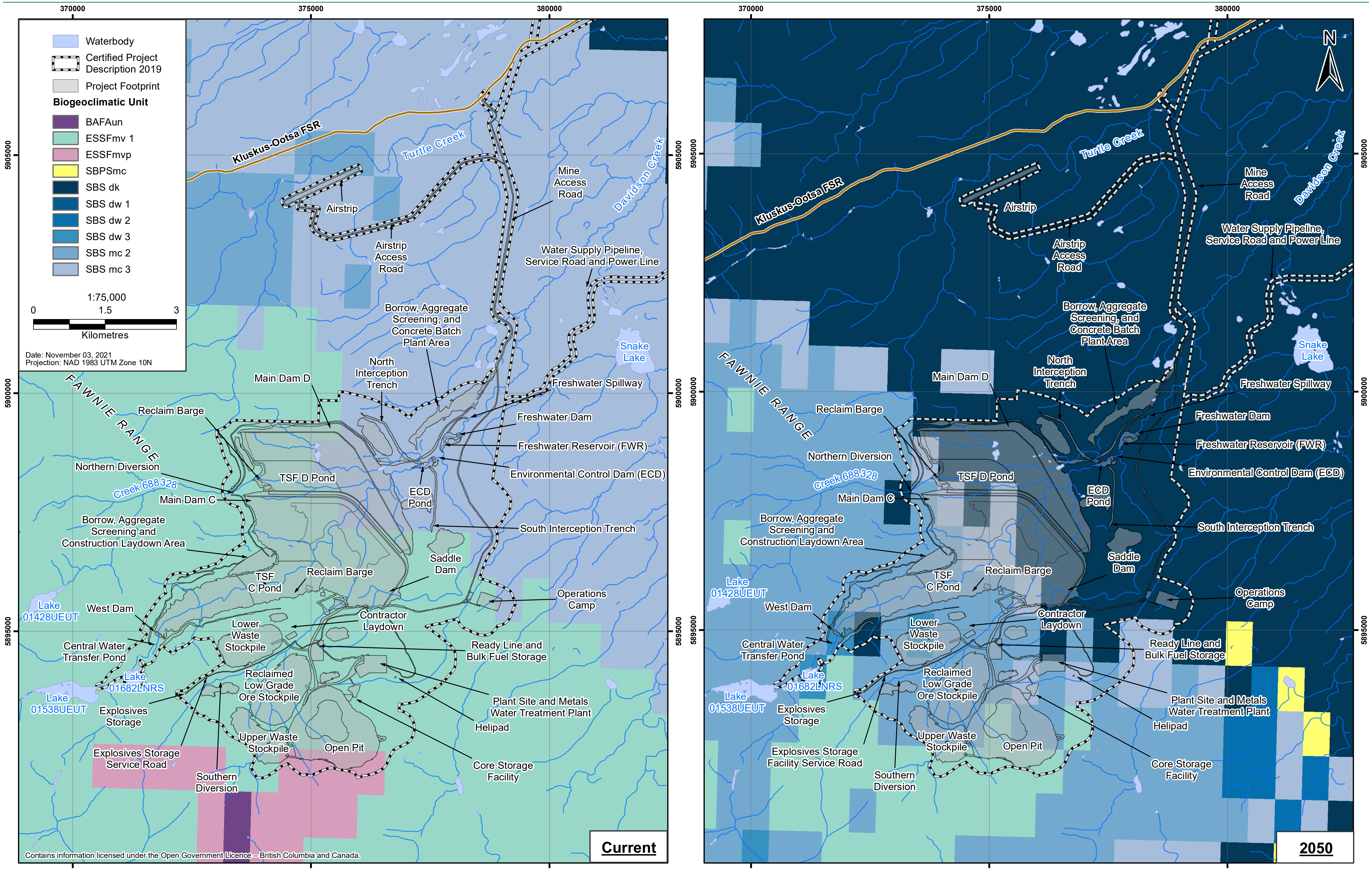


Figure 4.1-6: Predicted Climate Change Effects to Current and 2050 Biogeoclimatic Unit Distribution

4.2 Reclamation Approaches

Reclamation of the Blackwater Project is based on the results of the ecohydrological model (Section 4.1.2, Pre- and Post-mine Land Capability Assessment), with ecosystem targets informed by pre-mine ecosystems on the Project site and wildlife habitat priorities derived from valued components considered in the Application / EIS (New Gold 2015) and consultation with Aboriginal Groups (Table 4.1-1). The model was then used to develop soil prescriptions to support the targeted balance of ecosystems.[9] While the pre-development landscape informs reclamation targets, the post-closure landscape will not be identical to the pre-development landscape, as described in Section 4.1.2.3, Summary of Changes to Landscape Capability and highlighted in Table 4.1-5 RCP Ecosystem Summary for Vegetation and Wildlife – Comparing Pre-disturbance Ecosystems with Projected Post-closure Ecosystems.

4.2.1 Soil Resources

Reclamation cover depths and material types were determined through ecohydrological modelling as described in Section 4.1.2, Pre- and Post-mine Land Capability Assessment and the Soil Management Plan (SMP) in Appendix 9-B. The following subsections:

- Evaluate the suitability of reclamation materials;
- Summarize the reclamation cover designs for the Project;
- Present a material balance confirming sufficient volumes of reclamation materials are available to achieve cover designs; and
- Present reclamation material stockpiling and replacement plans.[10]

Reclamation materials referred to throughout this section and the RCP are defined as follows:

- **Reclamation materials** – surface soil and OVB that will be salvaged and used in reclamation.
- **Overburden** – overburden (OVB) is defined as unconsolidated soil and non-soil surficial materials that underlies surface soils (i.e., OVB occurs > 0.5 m below the interface between organic and mineral soil horizons). These materials have not undergone pedogenesis, except the uppermost OVB (e.g., 0.5 to 1.0 m below the interface between organic and mineral soil horizons), which has undergone a lesser degree of pedogenesis than surface soil and has lower organic-matter (OM) content. Overburden within the Project area consists primarily of morainal deposits. Overburden, in the context of reclamation materials and this RCP does not include any waste rock material.
- **Organic soil** – soils classified to the Organic soil order. The Organic order comprises soils with greater than 40-cm deep litter (L), fermented (F) and/or humic (H) horizons, greater than 40-cm deep Of horizons, or greater than 60-cm deep Om or Oh horizons.
- **Mineral soil** – soils classified to non-organic soil orders (e.g., from colluvial, morainal, and glaciofluvial parent materials). Mineral soil orders may have L, F, and/or H horizons, but these organic horizons will be mixed in with the underlying mineral soil during salvage and are grouped under mineral surface soils in this RCP.

---

[9] In order to meet prescribed cover-soil volume limitations, constrained ecohydrological modelling runs using reduced cover depths were evaluated against unconstrained results (i.e., 100-cm cover depth on all areas), with reduced cover depths applied where results were similar or better for achieving target ecosystems. Thinner covers are better for achieving reclamation objectives in some parts of the Project where drier forested ecosystems are planned for caribou-focused habitat.

[10] For further detail on these soil resource aspects, refer to the SMP (Appendix 9-B).

- **Surface soil** – surface soils include organic horizons, if present, and the upper 0.5 m of mineral horizons underlying organic horizons. Surface soils have undergone pedogenesis, which includes accumulation of organic matter. For mineral soils, the organic layers are thin (< 0.1 m), while the organic layers of organic soils are approximately 1 m deep in the Project area.[11]
- **Mixed-mineral surface soil** – surface soils from colluvial, fluvial and morainal parent materials combined. Moraine (till) is expected to make up approximately 80% of this material. This term represents a grouping of surface-soil types that will be combined during salvage operations.
- **Mixed-parent-material surface soil** – surface soils from organic and mixed-mineral surface soils (i.e., non-glaciofluvial surface soils). This term is used to group non-glaciofluvial surface soils for the purposes of material-balance calculations.

4.2.1.1 Reclamation-cover Design

Data sources used to represent underlying mine waste materials in the ecohydrological modelling (Section 4.1, End Land Use and Capability Objectives) for each Project component are presented in Table 4.2-1.

Table 4.2-1: Data Sources of Mine Waste Materials Used for Ecohydrological Modelling

Waste Material	Project Components for Application	Notes
OVB	Lower and Upper Waste stockpiles; TSF beaches and dams; ore stockpile footprints, surface soil stockpile footprints	16 samples from two drill holes were available. Sampled material was morainal. Further testing during OB salvage should be conducted to verify overall properties. Fine-fraction organic matter content of this material was estimated at 0.5% and it is assumed that it is placed at a non-compact bulk density.
Waste rock	Non-TSF dams	Shells of non-TSF dams are expected to be waste rock. The expected waste rock PSD was provided based on ore characteristics and blasting parameters. Fine-fraction organic matter content of this material was estimated at 0.5% and it is assumed that it is placed at a non-compact bulk density.
Road- and infrastructure-associated materials	Roads; camps; laydowns; reclaimed portions of mill site	To remain conservative (i.e., dry and nutrient-poor), materials in these areas are assumed to have negligible organic matter and nutrients, and to be coarse and dense and contribute very little to soil profile AWSC values.

The design depths and material types of reclamation covers for Project components based on the ecohydrological model in Section 4.1, End Land Use and Capability Objectives are shown in Figure 4.2-1 and summarized in Table 4.2-2. These covers, combined with local climate and post-mining landforms, are projected to generate the post-closure ecosystems presented in Section 4.1, End Land Use and Capability Objectives. As discussed in Section 4.1.2, Pre- and Post-mine Land Capability Assessment, there is expected to be a loss of wetter ecosystems that rely on groundwater inputs. Therefore, the focus of reclamation designs has been to replace upland ecosystems in proportions similar to pre-mining conditions.

[11] Terrain polygons with organic soils either had a surface expression code of veneer (Ov) or blanket (Ob) in the baseline survey (AMEC 2013), indicating that the organic horizons of organic soils were either less than 1 m deep or between 1–2 m deep, respectively.

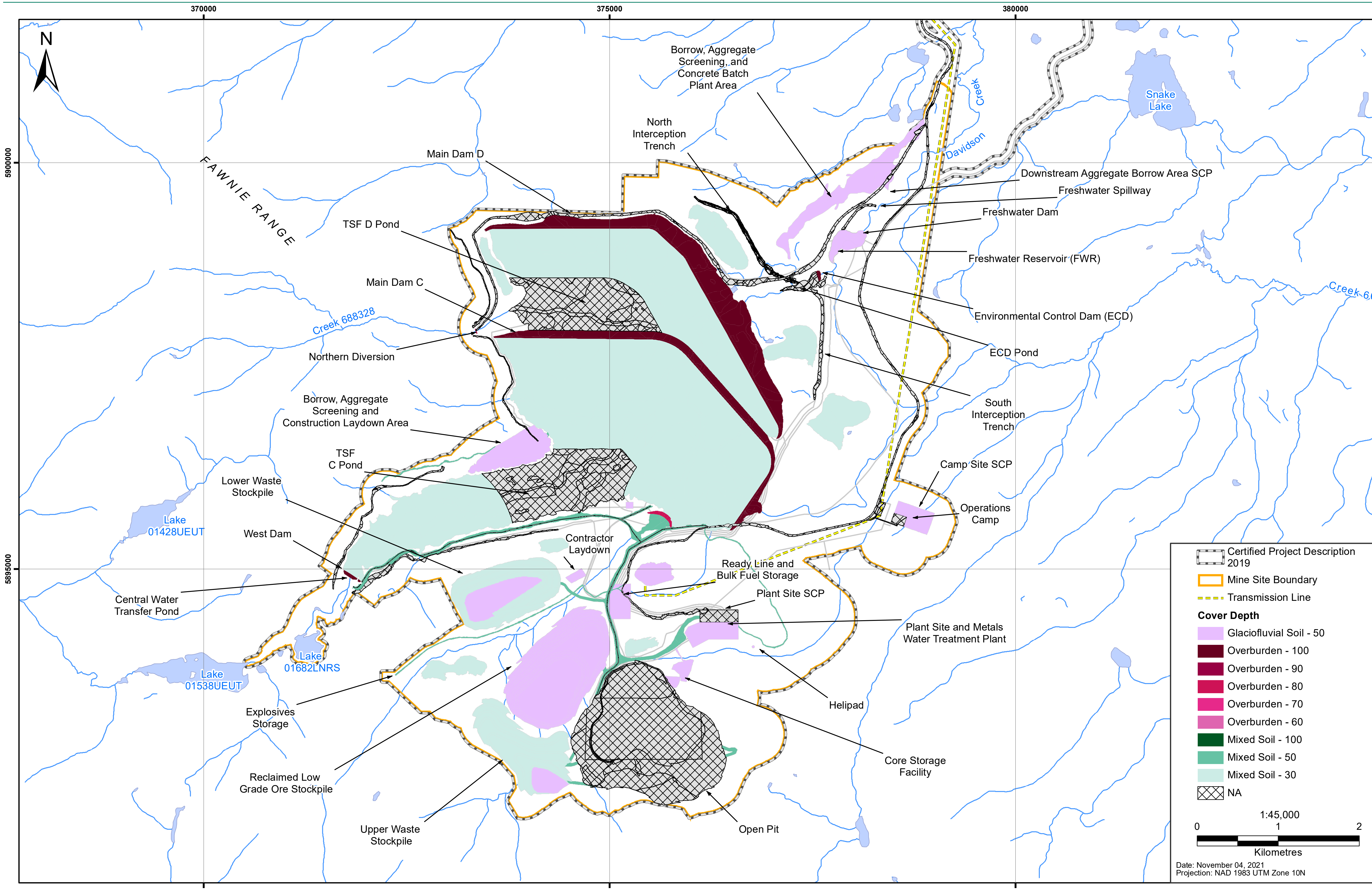


Figure 4.2-1: Reclamation-Material Depths for Mine Closure

Table 4.2-2: Reclamation Cover Depths and Material Types

Reclamation Material	Cover Depth Ranges (cm)	Facilities	Notes
Surface soil – glaciofluvial parent material	50	Waste stockpiles (upper plateaus and crests), ore stockpile pads, camp, plant areas, infrastructure areas, borrow pits	Glaciofluvial surface soils will be used where reclamation is targeting dry, lichen-rich ecosystems that are high-quality habitat for caribou and whitebark pine.
Surface soil – mixed parent materials (till-dominated)	30	TSF beach	Use of mixed-parent-material surface soil on TSF beaches serves the dual purpose of re-creating submesic-mesic ecosystems and mesic-subhygric ecosystems (wetter ecosystems generally lost in post-closure) in depressional areas. If a membrane treatment plant is required at closure, surface-soil application and revegetation on the TSF surface would cause fouling of the treatment membrane, thus, revegetation would not be permitted. This uncertainty is to be addressed through reclamation research (Section 4.2.5, Reclamation Research).
	30	Waste stockpiles (slopes)	Mixed-parent-material (not glaciofluvial) surface soil will be placed on slopes to facilitate quicker revegetation for erosion control.
	50	Roads	Mixed-parent-material (not glaciofluvial) surface soil will be placed on roads to facilitate quicker revegetation in an attempt to reduce the use of these linear features as ungulate-predator corridors.
	50	WMP	Portions of this feature have linear characteristics. Mixed-parent-material (not glaciofluvial) surface soil will be placed to facilitate quicker revegetation in an attempt to reduce the use of these linear features as ungulate-predator corridors.
OVB	30	TSF beaches	OVB will be placed over a 30-cm geochemical barrier of slurried non-acid generating tailings and covered with mixed-parent-material soil (see above).
	70	TSF beaches (growth media)	The TSF beach cover will be placed with truck and dozer, which will be tested in reclamation research trials (Section 4.2.5, Reclamation Research).
	60–100	Dams (Environmental Control Dam, WMP Dam)	OVB will be placed on the outer surfaces of dams as per the engineering designs. OVB is sufficient to support the non-treed vegetation communities required on dams for geotechnical reasons.[1]

[1] *A minimum of 1 m of OVB will already be present as a shell material on TSF dams as per engineering designs and is not accounted for here.*

Updates to reclamation-cover designs will occur as research and monitoring are conducted to verify the properties of reclamation materials (surface soil and OVB; Section 4.2.6.1, Reclamation Material Monitoring during Salvage and Stockpiling). Further refinements will occur based on research targeted to evaluate cover design with respect to the ability of the prescribed depths and reclamation-material types to achieve the desired edaphic conditions (i.e., site series) and support the corresponding ecosystems/habitat types (Section 4.2.5, Reclamation Research).

4.2.1.2 Reclamation-material Demand

The volume demands for reclamation materials were calculated by spatially applying the cover designs developed with the ecohydrological model, as described in the section above, to the post-closure landscape[12] and converting depths to volume based on the areas of Project components.[13] It is estimated that 10.73 million cubic metres (Mm^3) of reclamation materials will be required as follows:

- Salvaged glaciofluvial surface soil – 1.46 Mm^3;
- Salvaged mixed-parent-material surface soil – 3.43 Mm^3; and
- Overburden – 5.84 Mm^3.

The volume demand estimate for reclamation material is conservative (i.e., affords extra soil). In ecohydrological modelling, predicted SMR classes are downgraded (i.e., made drier) by a quarter class, increasing calculations of required soil depths, which are then rounded up to the next 10-cm increment (e.g., 52 cm is rounded to 60 cm). These adjustments in the modelling process are incorporated to ensure conservatism in reclamation materials demand-side estimates (i.e., to ensure that adequate volumes of reclamation materials are salvaged and stored for use in reclamation, and that requirements are not underestimated).

The OVB demand volume excludes the material required to generate the 30-cm NAG waste rock and OVB cover over the tailings beach (see Section 4.2.2, Landform Design and Erosion Control) but includes 5.84 Mm^3 of OVB for the 70-cm growing-medium cover on the tailings beach areas. BW Gold intends to complete site-specific research to support an engineered cover over the tailings beaches in lieu of a complete water cover with the intent of moving toward a drier TSF (Section 4.2.5, Reclamation Research). OVB required for the upper lifts of the TSF dams is not included, as these volumes are accounted for separately in the mine plan (Section 3.3.2.2, Overburden). As per Section 4.7.1, Schedule, at least 0.5 m of OVB will cover residual concrete foundations, pads, voids, and pedestals prior to placement of prescribed cover materials. These volumes are not included in OVB-demand calculations, but, given the large OVB surplus, there is expected to be sufficient volumes to satisfy this closure requirement (Section 4.2.1.4, Reclamation-materials Balance).

4.2.1.3 Reclamation-material Supply

Reclamation-material supply was evaluated to support development of a reclamation-materials balance (Section 4.2.1.4, Reclamation-materials Balance) and confirm that sufficient reclamation materials are available to meet demands and implement the designed reclamation covers.

Soil

Table 4.2-3 summarizes the available salvageable area and corresponding volumes of surface soils for each Project component, arranged in descending order of salvage volume. Surface soils were classified according to their parent material from terrain polygons (BC Government GeoBC Data Distribution via AMEC 2013a) and assigned to one of the three soil parent material categories that will be segregated during salvage: organic, glaciofluvial, and mixed-mineral surface soils.

---

[12] Excluding facilities and Project components that will not be reclaimed during closure, such as the water treatment plant and roads being retained for monitoring and maintenance access (Section 4.7.1; Section 4.7.7).

[13] A detailed summary of reclamation-material demands by Project component is included in the SMP (Appendix 9-B).

Table 4.2-3: Available Salvage Areas and Volumes of Surface Soils within the Project Footprint, by Project Component Based on Salvage Depths of 0.5 m for Glaciofluvial Surface Soil, 1.3 m for Organic Surface Soil, and 0.3 m for Mixed-mineral Surface Soils

Project Component[1,2]	Area (ha)	Glacio-fluvial Volume (Mm^3)	Organic Volume (Mm^3)	Mixed-mineral Volume (Mm^3)	Total Volume[3] (Mm^3)	Proportion of Salvage Volume (%)
Site C Tailings	577	353,485	306,542	1,447,024	2,107,052	29.6
Site D Tailings	238	475,950	222,697	378,413	1,077,060	15.2
Low Grade Ore Stockpile	125	42,895	43,956	339,585	426,436	6.0
Surface soil stockpile footprints	105	225,036	25,080	174,083	424,198	6.0
Site D Tailings Dam	92	223,050	59,231	127,780	410,061	5.8
Open Pit	116	0	44,826	336,695	381,521	5.4
Site C Tailings Pond	106	30,000	54,600	287,400	372,000	5.2
Site D Tailings Pond	92	52,000	44,200	235,893	332,093	4.7
Upper Waste Stockpile	74	0	37,750	212,273	250,023	3.5
Lower Waste Stockpile	80	0	0	238,721	238,721	3.4
Borrow Source	43	163,500	11,700	28,200	203,400	2.9
Site C Tailings Dam	47	30,370	18,192	117,993	166,555	2.3
Mine Site Roads	35	12,351	13,980	95,015	121,347	1.7
Camp	21	33,663	34,727	34,663	103,053	1.5
Aggregate Screening Area	28	0	20,121	78,683	98,805	1.4
Haul Roads	26	3,376	2,132	76,761	82,270	1.2
Plant Site	21	0	0	62,474	62,474	0.9
ECD Diversion Structure	14	32,507	3,906	21,438	57,851	0.8
Freshwater Pond	8	0	9,100	21,900	31,000	0.4
Ready Line and Bulk Fuel Storage	9	0	0	26,735	26,735	0.4
Central Diversion (South)	7	0	5,536	18,614	24,150	0.3
ECD Pond	5	13	6,083	12,652	18,749	0.3
Diversion Road	4	11,624	2,600	3,831	18,054	0.3
Pit Lake	5	0	0	15,641	15,641	0.2
Central Diversion (North)	4	5,000	0	9,000	14,000	0.2
Water Management Pond	3	788	32	8,968	9,789	0.1
Reclaim Barge	1	0	7,800	1,200	9,000	0.1
Diversion Structure (Northern)	1	15	1,301	3,721	5,036	0.1
Contractor Laydown	2	0	0	4,571	4,571	0.1
Explosives Storage	1	1,221	0	2,930	4,151	0.1
Freshwater Reservoir Spillway	1	0	1,300	2,700	4,000	0.1
Site C West Tailings Dam	1	0	1,300	2,700	4,000	0.1
Core Storage Facility	1	0	0	2,081	2,081	< 0.1
Membrane Water Treatment Plant	< 1	0	0	921	921	< 0.1

Project Component[1,2]	Area (ha)	Glacio-fluvial Volume (Mm^3)	Organic Volume (Mm^3)	Mixed-mineral Volume (Mm^3)	Total Volume[3] (Mm^3)	Proportion of Salvage Volume (%)
Freshwater Dam	< 1	0	88	183	271	< 0.1
Total	**1,892**	**1,696,844**	**978,781**	**4,431,444**	**7,107,069**	**100**
Total assuming 15% not salvageable	**1,608**	**1,442,317**	**831,964**	**3,766,727**	**6,041,00**	**-**

[1] Areas for pipeline right-of-ways were not available at the time of writing and were not included.

[2] ECD = Environmental Control Dam

[3] Arranged in descending order of salvage volume.

The following constraints were applied to the salvageable area estimates in Table 4.2-3:

- Areas classified as water, disturbed land (anthropogenic) and bedrock were excluded.
- Project components beyond the boundary of the current Project application were excluded, including the airstrip, airstrip access road, portions of the Mine Access Road (MAR) and powerline right-of-way.

Salvage depths of 0.3 m for mixed-mineral surface soils, 0.5 m for glaciofluvial surface soils and 1.3 m for organic surface soils were assigned. For mineral soils, these depths are not inclusive of surface organic layers (i.e., L, F, and/or H horizons), which will be additional and mixed with underlying mineral layers.[14]
It was assumed that 15% of available material will not be operationally salvageable because of inaccessibility for equipment due to steep slopes based on baseline terrain stability assessments (AMEC 2013). Factoring in this assumption, 7.1 Mm^3 of surface soils are estimated to be available within the Project disturbance footprint (1.7 Mm3 of glaciofluvial surface soil and 5.4 Mm^3 of organic and mixed-mineral surface soils). Salvage areas are presented in Figure 4.2-2. Polygons designated as "not suitable for salvage" in Figure 4.2-2 are water bodies, Project components beyond the boundary of the current Project application, or areas that have already undergone anthropogenic disturbance.

Overburden

Over the LoM, 83 Mt of OVB are projected to be stripped from the Open Pit footprint (Section 3.3.2.2 Table 3.3-1, Overburden). Following use of OVB in construction of the mine site and TSF dams, approximately 9.8 Mt will be stored in the Upper Waste Stockpile and 28.7 Mt will be stored in the Lower Waste Stockpile (Section 3.3.2.2, Overburden). Assuming a dry density of 2.10 t/m^3, this corresponds to 4.7 Mm^3 of OVB in the Upper Waste Stockpile and 13.7 Mm^3 of OVB in the Lower Waste Stockpile. OVB for use in reclamation will come from the Lower Waste Stockpile.

4.2.1.4 Reclamation-materials Balance

Table 4.2-4 summarizes the required and available volumes of reclamation materials from Section 4.2.1.2, Reclamation-material Demand and Section 4.2.1.3, Reclamation-material Supply, respectively, to generate a reclamation-materials balance. Sufficient volumes of reclamation materials are anticipated to be salvaged to meet reclamation needs with surplus materials available as a contingency.

A 1% (0.02 Mm^3) shortfall in glaciofluvial surface soil is projected, however we anticipate that classifying 15% of these soils as operationally inaccessible is likely conservative, as glaciofluvial soils are typically in low-lying outwash and esker deposits that are accessible by equipment. In the event of a shortfall, surpluses of mixed-parent-material surface soil and OVB are projected to compensate.

[14] Rationale for depth selections is presented in Section 4.2.1.5, Reclamation-material Suitability and Salvage.

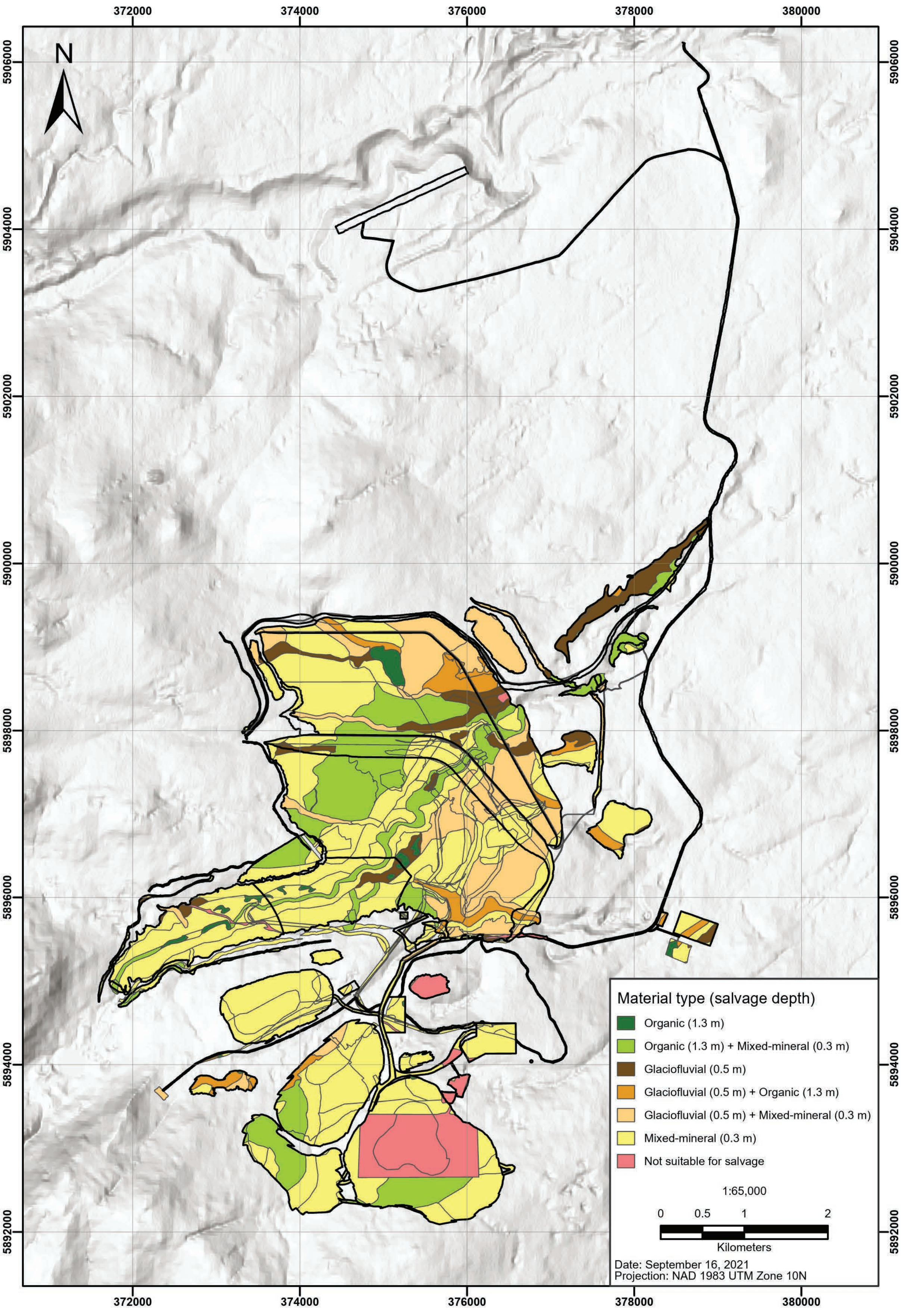


Figure 4.2-2: Surficial Soil Salvage Areas by Material Type for the Blackwater Gold Project

Source: IEG (2021).

Table 4.2-4: Reclamation-materials Balance

Reclamation Material	Potentially Salvageable (Mm^3)	Operationally Unsalvageable (Mm^3)	Non-suitable (Mm^3)	Suitable for Salvage (Mm^3)	Required (Mm^3)	Balance (Mm^3)	Surplus (%)
Glaciofluvial surface soil	1.70	0.25	0.00	1.44	1.46	-0.02	-1
Mixed-mineral surface soil	4.43	0.66	0.75	3.01	3.43	0.42	12
Organic surface soil	0.98	0.15	0.00	0.83			
OVB	13.7	NA	Data not available	13.7	5.84	7.86	135

** 15% of the salvage area is assumed to be operationally unsalvageable, as per Section 4.2.1.3.*

Without application of suitability criteria (i.e., quality thresholds), a 34% (1.17 Mm^3) surplus of mixed-parent-material surface soil (organic surface soils and non-glaciofluvial mineral surface soils) is projected. Suitability criteria that classify the 20% lowest-quality mixed-mineral surface soil as unsuitable and not requiring salvage are presented in Section 4.2.1.5, Reclamation-material Suitability and Salvage, and reduce the surplus of mixed-parent material surface soil to 12% (0.41 Mm^3). The suitability criteria, which are primarily based on coarse-fragment content and soil water storage capacity, are not intended for glaciofluvial surface soils because the ecosystems they will be used to target (lichen-rich, open-forests on xeric to submesic site series) exist on the coarsest surface soils in the pre-disturbance landscape. Similarly, no suitability criteria will be applied to organic surface soils; all available organic surface soils will be salvaged, given the high reclamation value of this material.[15]

Given the large surplus of stockpiled OVB (13.7 Mm^3 available versus 5.8 Mm^3 required), it is expected that suitability criteria to remove the coarsest OVB can be applied without inducing shortages. The projected surpluses of mixed-mineral and organic surface soils and OVB provide a buffer to allow for minor adjustments to reclamation prescriptions and the mine disturbance footprint.

4.2.1.5 Reclamation-material Suitability and Salvage

This section summarizes work detailed in the SMP (Appendix 9-B) using ecohydrological modelling to evaluate potential reclamation-material suitability relative to the properties of mine-waste materials. Monitoring of soil and OVB during salvage is planned to reduce uncertainties regarding soil properties and spatial distribution of soil types across the Project area (Section 4.2.6.1, Reclamation Material Monitoring during Salvage and Stockpiling). Results from the monitoring program will feedback to inform revisions of the reclamation material balance, ecohydrological model, and reclamation-material cover designs as described in the SMP (Appendix 9-B) and Section 4.1.2.2, Post-mine Land Capability.

Soil

Suitability of soil materials for salvage within the undisturbed portion of the Project footprint was evaluated from soil-survey data from TEM fieldwork conducted between 2011 and 2013 (AMEC 2013a). Using soil-survey data for horizon types, depths, fine-fraction textures, coarse-fragment contents, and organic-matter

[15] Ecohydrological modelling was conservatively done using the AWSC of mixed-mineral surface soil. Organic surface soil can be applied in select locations where wetter site series (or wetlands) are projected to form, or can substitute a portion of the applied mineral surface soil to act as a soil amendment.

contents (AMEC 2013a), AWSC was calculated for the upper 50 cm of each sample pit.[16] The range of AWSC values for surface soil by parent material type is presented in Table 4.2-5. For comparison, the AWSC of estimated Blackwater waste rock (Moose Mountain Technical Services, pers. comm.) and OVB (Knight Piésold 2013) are also presented in Table 4.2-5.[17]

Table 4.2-5: Summary of Available Water Storage Capacity (AWSC) of Surface Soils by Parent Material and Mine Wastes (OVB and Waste Rock)

Primary Parent Material	AWSC Values (Mm/M)		Soil Pits Surveyed		Salvageable Area	
	Range	Median	Number	Proportion	Surface (ha)	Proportion
Colluvial	38 - 180	77	6	2%	147	9%
Fluvial	28 - 249	100	14	5%	102	7%
Glaciofluvial	14 - 177	75	59	20%	322	20%
Morainal	2 - 313	109	188	66%	944	60%
Organic	160 - 300	280	21	7%	59	4%
OVB*	50 - 206	81	16	-	-	-
Waste rock*	2 - 7	4	5	-	-	-
Total	**-**	**-**	**288**	**100%**	**1,574**	**100%**

Note:

Surface soil survey coverage is presented based on the available salvage areas presented in Table 4.2-3.

** Overburden and waste rock values are not from soil pits but from samples, or in the case of waste rock an estimated envelope around a mean sample provided by Moose Mountain Technical Services. The waste materials are not included in the summary row at the bottom or the survey coverage columns.*

No AWSC suitability criteria will be applied to organic or glaciofluvial surface soils. Beneficial properties of organic soils, including high AWSC (Figure 4.2-3, Table 4.2-5) and high organic-matter content, extend through the full depth of the organic-soil profile and are typically higher with depth from surface. Organic soils at the site are, on average, 1 m deep (AMEC 2013a). Therefore, an average salvage depth of 1.3 m is recommended to capture the organic matter plus an additional 0.3 m to include the underlying mineral soil, which is likely enriched in fine soil particles due to the landscape position, and in nutrients due to the overlying organic layers.

Glaciofluvial materials deposited by glacial meltwater are characterized by stratified gravel and sand with minor components of silt and clay. The coarser glaciofluvial surface soils have a lower AWSC and are typical of xeric to submesic ecosystems on the pre-mine landscapes. Glaciofluvial surface soils will be salvaged to support reclamation of these ecosystems and lower-AWSC materials do not need to be avoided, All operationally-accessible glaciofluvial surface soils will be salvaged to a depth of 0.5 m to meet reclamation volume needs (Section 4.2.1.4, Reclamation-materials Balance).

---

[16] Greater salvage depths are planned for organic surface soil, but the 50 cm depth was used to enable equivalent comparisons across parent material types, particularly since many sample pits lacked data from depths below 50 cm and mineral soils will not be salvaged beyond 50 cm.

[17] The AWSC of waste rock was calculated from a synthetic dataset of estimated PSDs based on a projected PSD provided by Moose Mountain Technical Services (pers. comm.). OVB AWSC was calculated using 16 OVB samples from two site-investigation drill holes (Knight Piésold 2013). These limited waste rock and OVB datasets introduce uncertainty. Modelling will be updated as operational data becomes available during the LoM.

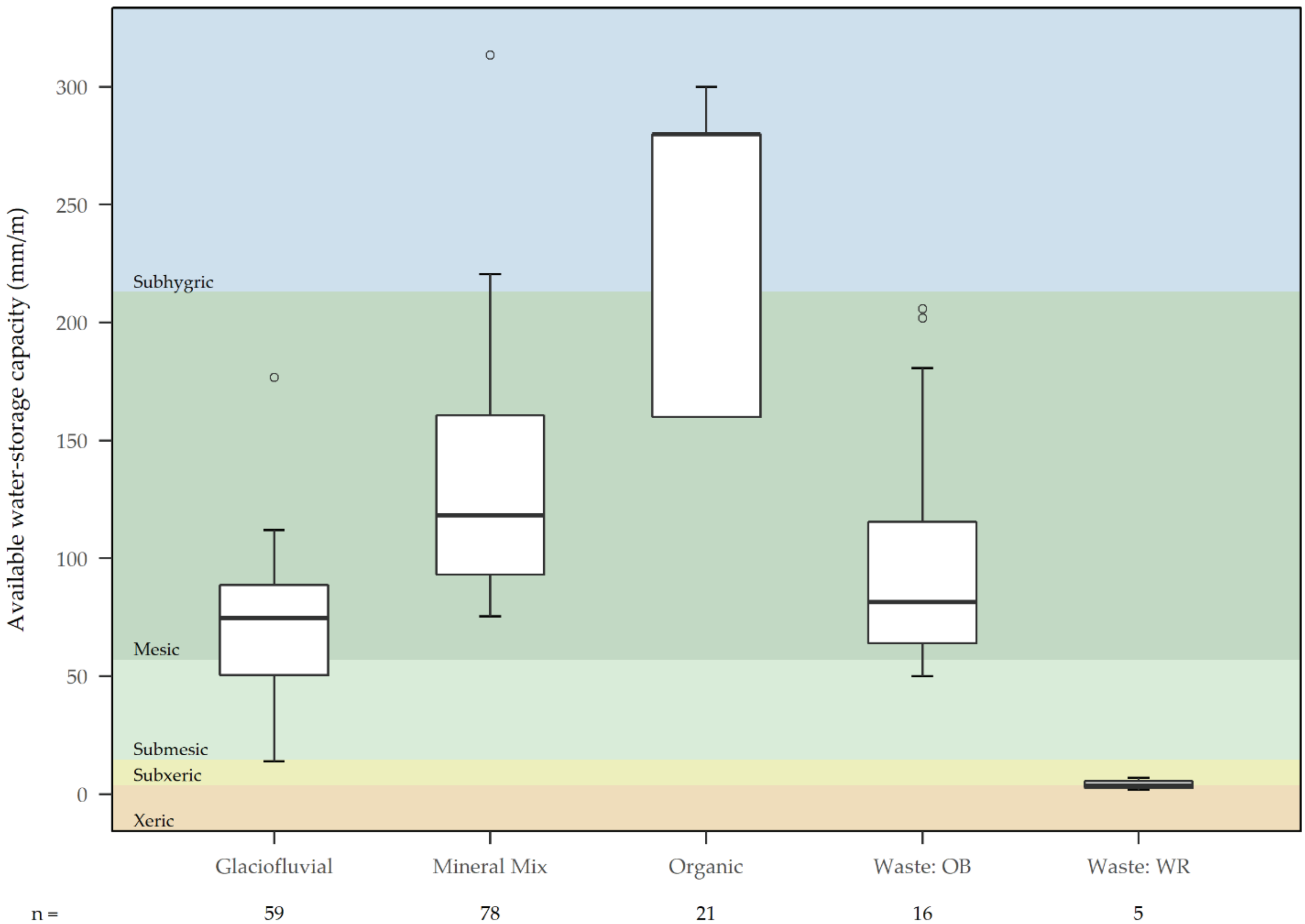


Figure 4.2-3: Available Water-storage Capacity of Salvageable Soils (by salvage grouping type), Overburden and Waste Rock

Suitability criteria will be applied to the remaining mixed-mineral surface soils (from colluvial, fluvial, and morainal parent materials). AWSC was selected as the primary suitability criterion because soil-water supply is a dominant control on the characteristics of an ecosystem, including its nutrient regime (Pojar et al. 1987; Baker et al. 2020). It is proposed that the 20% of these materials with the lowest AWSC (i.e., the coarsest 20%) can be excluded from salvage for reclamation, which still conservatively allows for a surplus. This suitability threshold results in the minimum AWSC of mixed-mineral surface soils being comparable to the median AWSC of OVB samples. Thus, mixed-mineral surface soils with consistently higher AWSC than OVB (i.e., that can support wetter, richer ecosystems) will be selected for use in reclamation covers to recreate more mesic ecosystems in accordance with ecohydrological modelling results and post-mine land use planning.

The SMP (Appendix 9-B) provides details on the development of an operationally-feasible threshold for excluding the 20% lowest-AWSC mixed-mineral surface soils, which was determined to be at an AWSC threshold of 75 mm/m that corresponds to ≤ 60% coarse fragments (> 2 mm).[18] Prior to application of the threshold, the median AWSC of mixed-mineral surface soil was 103 mm/m (21–249 mm/m), which increased to 119 mm/m (75–249 mm/m) after exclusion. This AWSC range falls mostly within the levels associated with the mesic SMR class, which means that this material is well-suited for the reclamation of zonal site series. The upper 0.3 m of mineral material plus the overlying organic layers of mixed-mineral surface soils will be salvaged in a single lift. The depth of 0.3 m was selected because this portion of the soil profile has the greatest organic matter and nutrient content and highest biological activity, and deeper salvage is not required to meet reclamation-material volume demands (Section 4.2.1.4, Reclamation-materials Balance).

Figure 4.2-3 presents the AWSC range of the mixed-mineral surface soil following removal of the lowest 20% of AWSC values in comparison to glaciofluvial surface soil, organic surface soil, OVB, and waste rock. Our analysis shows that the available reclamation materials have a range of AWSC suitable for creating the desired post-closure ecosystems. Mixed-mineral surface soil and organic surface soil have the greatest AWSC values (higher than OVB), suitable for establishing mesic ecosystems, while glaciofluvial surface soil has a low AWSC, consistent with desired materials for re-establishing xeric to submesic site series. All reclamation materials have AWSC values far exceeding waste rock, which has negligible water-holding capacity and would be expected to have a very limited ability to support vegetation if left uncovered. Tailings are not included in this suitability analysis because they are scheduled to be covered with 1 m or more of OVB and/or soil, which means they will not be present within the primary rooting zone of target vegetation species.

Limited data were available on elemental concentrations from baseline soil surveys, but the reclamation-materials monitoring program will help address this knowledge gap (Section 4.2.6.1, Reclamation Material Monitoring during Salvage and Stockpiling). Soil samples from all parent material types will be taken during salvage operations to confirm that all measured elements have concentrations less than or equal to CCME parkland thresholds for soil and *Contaminated Sites Regulation* (BC CSR) soil standards (Schedule 3.1 of B.C. Reg. 375/96) for reverted wildlands.[19] Because baseline condition disturbance levels are low in the Project area, any elevated concentrations should be interpreted as reflecting natural mineralization of surface soils rather than contamination, and will not affect suitability ratings for reclamation. Soil pH and electrical conductivity criteria have not been proposed for salvaged soils because the soils at site are currently supporting healthy forests that are similar to those being proposed for revegetation.

---

[18] For operational simplicity, this calculated threshold of 63% has been rounded to 60%. The SMP gives further instructions as to how salvage thresholds can be improved for operational deployment with the collection of samples for laboratory PSD testing.

[19] Element concentration thresholds should be evaluated relative to ranges of natural variation in soils within the Project area as soil salvage samples are collected. In cases where baseline conditions exceed CCME parkland thresholds for soil and *Contaminated Sites Regulation* (BC CSR) soil standards (Schedule 3.1 of B.C. Reg. 375/96) for reverted wildlands, thresholds may need adjustment.

In summary, the suitability criterion for surface soil salvage is: the volume of coarse fragments larger than 2 mm in diameter in mixed-mineral surface soils will be less than 60%.

Overburden

Overburden will be used as the primary reclamation material on dams and potentially TSF beaches[20], and will be part of the upper metre of reclamation covers underlying salvaged soils on the waste stockpiles. Although salvaged soil is typically a preferable growing medium to OVB because it has greater soil organic-matter and nutrient content and contains viable plant propagules (Mackenzie and Naeth 2010), use of OVB as a reclamation material on select areas due to operational considerations[21] is not expected to be an obstacle for reclamation given that OVB has an AWSC in the range of glaciofluvial and mixed-mineral surface soils (Figure 4.2-3).

In order for OVB used as rooting-zone (i.e., uppermost 1 m) material in reclamation and meet the specifications used in ecohydrological modelling, it must be as fine or finer than the samples in the modelled dataset. For operational purposes, these thresholds have been set using coarse-fragment sizes that can be visually identified in the field. Namely, the volume of coarse fragments larger than 100 mm and 25 mm in diameter must be less than 5% and 20%, respectively. Furthermore, the OVB must appear to be morainal in origin, as identified by predominance of sub-rounded and sub-angular coarse fragments and sandy loam, loam, or silt loam fine-fraction (< 2-mm) textures (BC MOFR and BC MOE 2015).

For dams, which will primarily be revegetated with grass, herbs, and shrubs (not trees) for geotechnical reasons, nutrient limitations in OVB can be overcome with broadcast fertilization, as the risk of fertilized grasses and forbs out-competing non-nitrophilic tree species is not a concern. For the TSF beaches, to address uncertainty regarding direct revegetation of OVB, trials will be conducted to verify the revegetation potential of OVB as described in the RCP (Section 4.2.5.1, Vegetation and Cover Trials). Sufficient surface soil is planned to be salvaged to place a 30-cm cover of mixed-parent-material surface soil on the TSF beaches if necessary.

Preliminary suitability criteria for selection of OVB that is appropriate for use as a reclamation material are:

- The volume of coarse fragments larger than 100 mm and 25 mm in diameter will be less than 5% and 20%[22], respectively;
- Must appear to be morainal in origin, as identified by predominance of sub-rounded and sub-angular coarse fragments and sandy loam, loam, or silt loam fine-fraction (< 2-mm) textures;
- Element concentrations are less than or equal to CCME parkland thresholds for soil and BC CSR soil thresholds for reverted wildlands (or alternate Project-specific criteria if elevated concentrations of surface soils are detected at baseline);
- pH between 4.5 and 8; and
- Electrical conductivity <1 dS/m.[23]

Additionally, as per the Metal Leaching and Acid Rock Drainage Management Plan (Appendix 9-D), OVB will be monitored to verify that it is not non-acid generating.

---

[20] If a surface soil cover is not operationally feasible or if revegetation is not permitted due to issues with fouling the membrane WTP.

[21] Dams have been designed for geotechnical stability to have an outer shell of OVB.

[22] The 25-mm threshold is inclusive of all coarse fragments greater than 25 mm in diameter, i.e., including the 5% of coarse fragments greater than 100 mm.

[23] The proposed thresholds for pH and electrical conductivity in OVB should be evaluated relative to the baseline range of natural variation to be assessed as samples of salvaged soil and OVB samples are sent for laboratory testing.

Guidelines for Salvage Operations

Recommended monitoring of soil and OVB salvage and stockpiling operations to verify that reclamation materials meet suitability criteria is described in Section 4.2.6.1, Reclamation Material Monitoring during Salvage and Stockpiling and the SMP (Appendix 9-B). During Salvage and stockpiling, monitoring programs will provide data to support ongoing refinement of soil suitability criteria, including proposed coarse-fragment thresholds and ranges of natural variation for pH, electrical conductivity, and element concentrations. The SMP also describes the equipment to be used for salvage, guidelines for supervision of salvage operations by trained personnel and qualified professionals, and best management practices to be implemented to maintain reclamation material quality and protect the adjacent environment. Best management practices to be implemented are accompanied by a Trigger Action Response Plan (TARP) to guide implementation.

4.2.1.6 Reclamation-material Stockpiling

BW Gold intends to pursue opportunities for direct placement of salvaged material on newly completed areas during the LoM for reclamation research and progressive reclamation (Section 4.2.4, Progressive Reclamation/Sequencing). However, the majority of the salvaged material will be stockpiled and placed after completion of the Operation phase. An estimated 5.29 Mm^3 of salvaged surface soil will be stockpiled, consisting of 1.44 Mm^3 of glaciofluvial surface soil, 3.01 Mm^3 of mixed-mineral surface soil, and 0.83 Mm^3 of organic surface soil (Table 8.3-1). Mixed-mineral and glaciofluvial surface soil volumes do not include the surface organic (LFH) layers that will be salvaged—salvage depths are measured from the organic-mineral interface. Surface organic layers are estimated to constitute an additional 0.16 Mm^3 of surface soil that will be mixed into the salvaged soils and stockpiled (0.02 Mm^3 with glaciofluvial surface soils and 0.14 Mm^3 with mixed-mineral surface soils).[24] The resulting total volume of salvaged surface soil is 5.45 Mm^3, which is within the projected stockpile capacity of 7.89 Mm^3. An estimated 0.42 Mm^3 of the projected salvage volume will already be present at soil stockpile locations in the existing soils. Surface soil stockpile volumes and sources are presented in Table 4.2-6. Details on stockpile design for reducing erosion, blending in with the surrounding topography, and minimizing loss of biological propagules are provided in the SMP (Appendix 9-B).

Table 4.2-6: Surface Soil Stockpile Dimensions and Soil Sources

Stockpile	Volume (Mm^3)	Surface Soil Source
TS-1	0.13	Open pit, Low Grade Ore Stockpile, Plant Site, Ready Line and Bulk Storage area
TS-2	0.73	Upper Waste Stockpile, Lower Waste Stockpile, Low Grade Ore Stockpile, Explosives Storage Facility
TS-3	0.20	Open pit, Low Grade Ore, Plant Site, Ready Line and Bulk Storage area
TS-4A	2.57	Lower Waste Stockpile, Contractor Laydown Area, southern areas of the TSF C Pond
TS-4B	2.01	Infrastructure below Main Dam D
TS-5	2.02	Tailings Storage Facility C and D
TS-6	0.23	Tailings Storage Facility C

[24] Average depths of LFH layers for each parent material from baseline surveys were weighted by the relative salvage area of each parent material type.

Locations of surface soil stockpiles are shown in Figure 4.2-4. Glaciofluvial, organic and mixed-mineral surface soils will be stored in separate stockpiles or separate zones of individual stockpile areas to avoid mixing and dilution of their specific properties. Overburden for reclamation will be stockpiled in the Lower Waste Stockpile location such that it remains recoverable. Road construction during the Early Works disturbance resulted in the creation of windrows along road edges. These windrows will be transferred to soil stockpiles for use in reclamation. Any new roads that are created during the life of the Project will be salvaged and stockpiled (i.e., not stored in windrows) to ensure that this material is not degraded or lost.

Regular inspections and updates to stockpile volume and location tracking will be carried out during active stockpiling operations. Stockpiling best practices, including practices to reduce erosion and the establishment of invasive plants, will be implemented and are detailed in the SMP (Appendix 9-B; accompanied by a TARP) and IPMP (Appendix 9-G). Signage will be installed to mark stockpiles and prevent inadvertent contamination, burial, or removal. Semi-annual inspections of stockpiles will be conducted to assess revegetation status, presence of invasive or non-desirable species, and evidence of erosion, as well as to confirm that signage is intact.

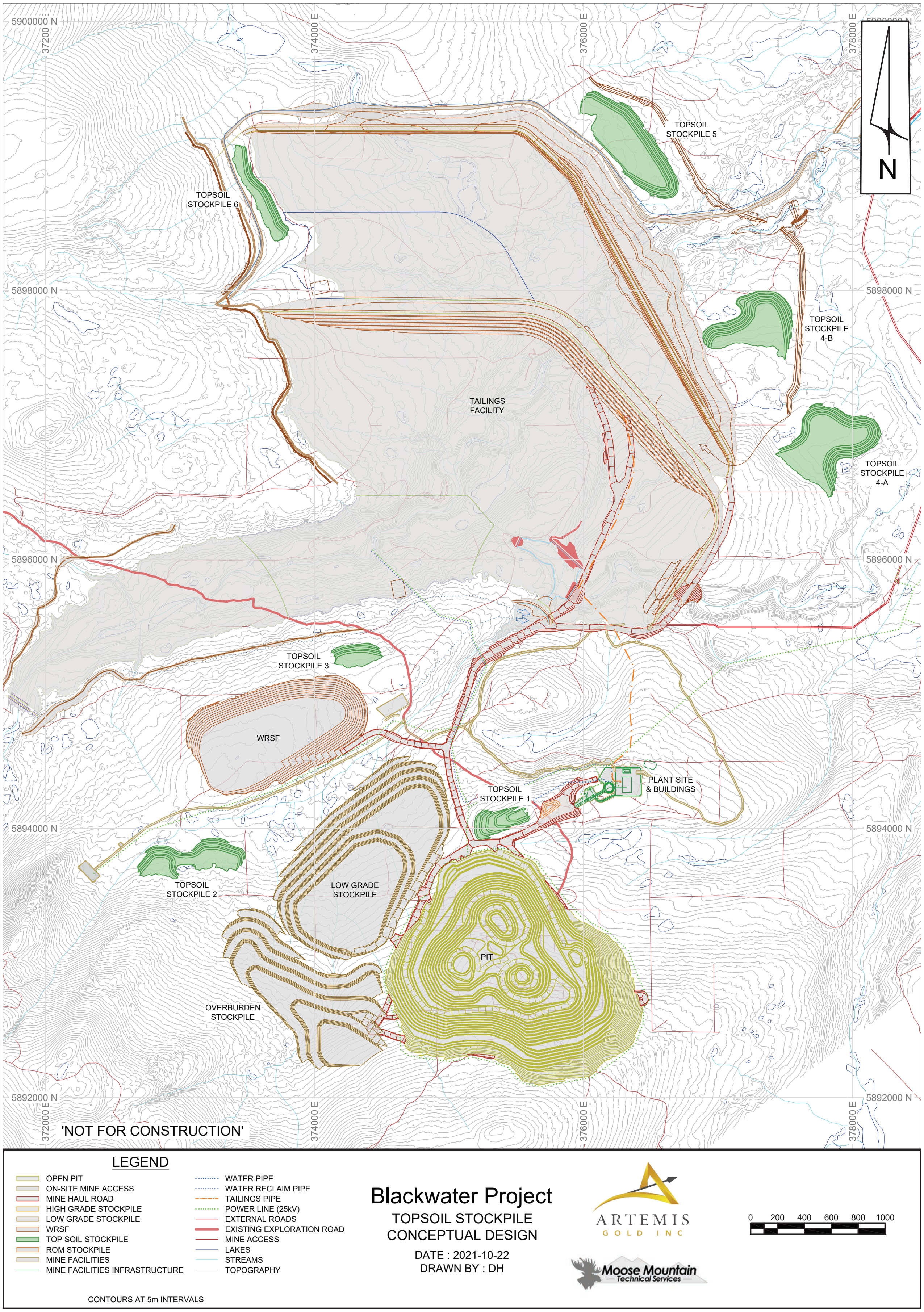
4.2.1.7 Reclamation-materials Replacement

Reclamation materials will be placed as facilities acquire their final topography through deposition and landform grading. Placement within +/- 20 cm of target depths is acceptable, and achievement of target ecosystems is not expected to be compromised as long as overall average depths for each hectare are in line with specifications.

Placement of reclamation materials will be accomplished using large equipment, primarily bulldozers and loaders with shovels, in a manner that generates microtopography to improve microsites for plants and reduces erosion. Equipment operators should not seek to create planar surfaces with exact material depths, rather it is preferable to have surface roughness and undulations. The ‘rough and loose’ technique (Polster 2009), ripping, surface loosening with an excavator bucket, or other means of site preparation may be applied if additional decompaction is necessary or further creation of microtopography is desired. The following considerations will inform selection of appropriate decompaction and/or site preparation techniques:

- Excess water is removed from a site through infiltration or surface flow. While surface flow may cause erosion, forced infiltration into underlying waste materials may not be desirable depending on the geochemical properties of the underlying waste. Risks and trade-offs of runoff versus infiltration will be considered.
- Site preparation techniques that create large microtopography (e.g., large mounds) may reduce the accessibility for wildlife or land users, thus end land use objectives will be considered.
- The risk of larger-scale cover system failures caused by pooling water (e.g., cascading failures from larger depressions) will be considered.
- Soil properties, such as texture, influence water storage and infiltration, and will be considered.

To the maximum extent practicable, placement operations will avoid excessively dry conditions to reduce dust generation and excessively wet conditions to reduce the risk of erosion and compaction. All placement areas will be tested prior to planting to confirm acceptable densities for reclamation (e.g., a fine-fraction post-placement density ≤1,600 kg/m^3). Use of a nuclear densometer is recommended for this testing, as it is the most efficient and reliable method for taking numerous density measurements in materials with high coarse-fragment contents. The recommended sample intensity is one sample per hectare. Placed reclamation materials will also be checked for placement depths and erosion risks. Additional best practices and an associated TARP that will be implemented during placement of reclamation materials are detailed in the SMP (Appendix 9-B).



Source: Moose Mountain Technical Services (2021).

Figure 4.2-4: Stockpile Locations for Salvaged Reclamation Materials

Post-placement sampling of reclamation materials (Section 4.2.6.2, Permanent Sample Plots) will document changes in soil properties due to salvaging and identify potential deficiencies that need to be addressed or monitored, such as changes in pH or decreases in organic-matter and nutrient content. Where nutrient deficiencies are identified, fertilization for revegetation purposes will be implemented as described in Section 4.2.3.3, Fertilization.

4.2.2 Landform Design and Erosion Control

The design of the Blackwater Project considered closure objectives throughout the initial planning phases, environmental assessment, and development of the permit applications. Closure considerations for the three of the largest features of the mine development that will remain at closure (the Open Pit, waste stockpiles and TSF) are as follows.

- Once mining of the Open Pit[25] has ceased, it will be allowed to fill with water through natural processes, and water pumped from the TSF ponds. The key objective for filling the Open Pit is to submerge the majority of the pit wall surface below water to minimize the oxidation of sulphide minerals in exposed pit walls, and thus reduce the generation of metal leaching/acid rock drainage (ML/ARD) from the pit wall rock. Active pumping of surplus water in the final years of operations is likely to increase the rate of, and reduce the duration for, filling of the Open Pit. The water elevation in the Open Pit will be maintained below the natural spill point, which will reduce the seepage from the upper benches of the pit.
- The Lower and Upper Waste stockpiles are designed to receive waste materials scheduled to be excavated from the Open Pit, as described in Section 3.5.4. These stockpile(s) only receive NAG materials so that long-term drainage chemistry from these stockpiles can be directed to the TSF without the need for active collection and pre-treatment. Designs consider the long-term geotechnical stability of each stockpile, as well as resloping of each stockpile to apply growth medium prior to revegetation. Some of the waste rock and OVB will be used for reclamation activities across the site, particularly reclamation of the TSF. Through the excavation of these stockpiles to meet these site requirements, there is good opportunity to reshape the remaining waste rock and OVB so that the smaller remaining stockpile(s) blend into the natural terrain. The resloping and reshaping will also afford the ability to create surface drainages that align with pre-mining hydrology upstream and downstream of the stockpile(s).
- The TSF has been designed to manage all potentially acid generating (PAG) waste rock and all tailings throughout the LoM. The key design concept to prevent the onset of ARD/ML from the PAG waste is to co-dispose these materials with the tailings, such that they are submerged within a year of placement within the TSF. Placing the PAG waste rock and submerging it within the TSF provides the best long-term strategy to minimize oxidation of sulphide minerals and thus reduce ARD/ML from these materials. The tailings generated throughout operations are also classified as PAG. The continual submergence of the tailings throughout operations minimizes ARD/ML from the tailings. The closure strategy for the PAG tailings includes processing NAG waste rock and OVB to create a slurry made of NAG waste rock and OVB to cover the PAG tailings. The NAG waste rock and OVB slurried cover will minimize ARD/ML from the underlying PAG tailings in the long-term. A surface pond in both TSF C and TSF D will remain for a portion of the overall tailings surface, which will receive surface runoff into the TSF basins. The ponds will provide a secondary mitigation to minimize ARD/ML from the PAG tailings in the long-term. Surface drainage will be conveyed to the ponds, and if the water quality is suitable to discharge, it will be released via the closure spillway. If water quality is not suitable for direct discharge, it will be directed to the Water Treatment Plants (WTPs) for treatment and release. The ECD and associated infrastructure

[25] Section 4.7.1, Schedule further describes Open Pit closure.

will collect seepage from the TSF throughout operations, closure, and post-closure. Water from the ECD is planned to be treated in post-closure prior to release to Davidson Creek.

A LoM water balance was conducted, starting in construction and continuing through operations, closure, and post-closure. The water balance is a watershed model that considers both runoff and groundwater recharge across the entire mine site. The catchment discretization is presented in Section 5.3, Site-wide Water Balance Model, as are the results of the water balance model.

4.2.2.1 Landform Design

The Upper and Lower Waste stockpiles, the Low-Grade Ore (LGO) Stockpile footprint, and the TSF represent the primary landform elements of the post-closure landscape.

Both the Upper and Lower Waste stockpiles have conceptual closure designs intended to resemble natural topography by minimizing straight lines and planar slopes, in order to create a heterogeneous landscape more conducive to wildlife use. The slopes between each lift have been designed to create a concave slope that transitions from the 39% of the main slope to 20% (Figure 4.2-5). This design creates the typical shape of a receiving slope of more mature landforms. The top of the lifts will also have a gentler convex slope typical of natural landforms (Carson and Kirkby 1972). The sigmoidal slope, with gentler concave lower slopes, helps reduce erosion rates and creates more complex edaphic conditions that may support greater ecosystem diversity (Ayres et al. 2006). Gentler slopes are easier for wildlife to navigate, which is an important consideration given the end land-use target of caribou habitat at the top of the waste rock stockpile sites. The upper convex slopes will tend to be drier and soil moisture content increases downslope, with the wettest ecosystems forming in the convex toe slopes (Delong et al. 1993). In addition, the top of the Lower Waste Stockpile includes a 50-60 m wide gently sloping, linear landform at the top, similar to an esker, intended to encourage caribou use by providing shelter from wind and predator sightlines. The total height is approximately 10 m with gentle 20% slopes. The feature runs parallel to the prevailing winds so that snow accumulation is minimized.

The LGO Stockpile is planned to be milled by the time of mine closure leaving behind a footprint that blends with natural topography. Dams on site required to remain in place through post-closure will not become landforms because they must function as a geotechnically stable engineered structure to contain the materials within the TSF. Thus, the dams require planar, straight slopes. On TSF beaches, landform design has not been proposed at this stage, particularly with cover-soil placement techniques requiring further research (Section 4.2.5, Reclamation Research). However, use of landforms such as swales, hummocks, and esker-like features should be used to create relief on the scale of several metres on these large structures in order to increase habitat diversity for vegetation and wildlife.

4.2.2.2 Long-term Stability

The design of facilities considers both long-term physical and geochemical stability as follows:

- Physical stability of the TSF is achieved primarily through construction of the embankments as per the design that meets the current state of practice (Appendix 3-J, Section 1.5).
- Physical stability of the downstream slope of TSF C is also enhanced through the placement of PAG waste rock in TSF D.
- Geochemical stability of the TSF is achieved through management of PAG waste rock that is covered by the saturated tailings throughout operations. The tailings generated through the operations phase of the mine are also classified as PAG.

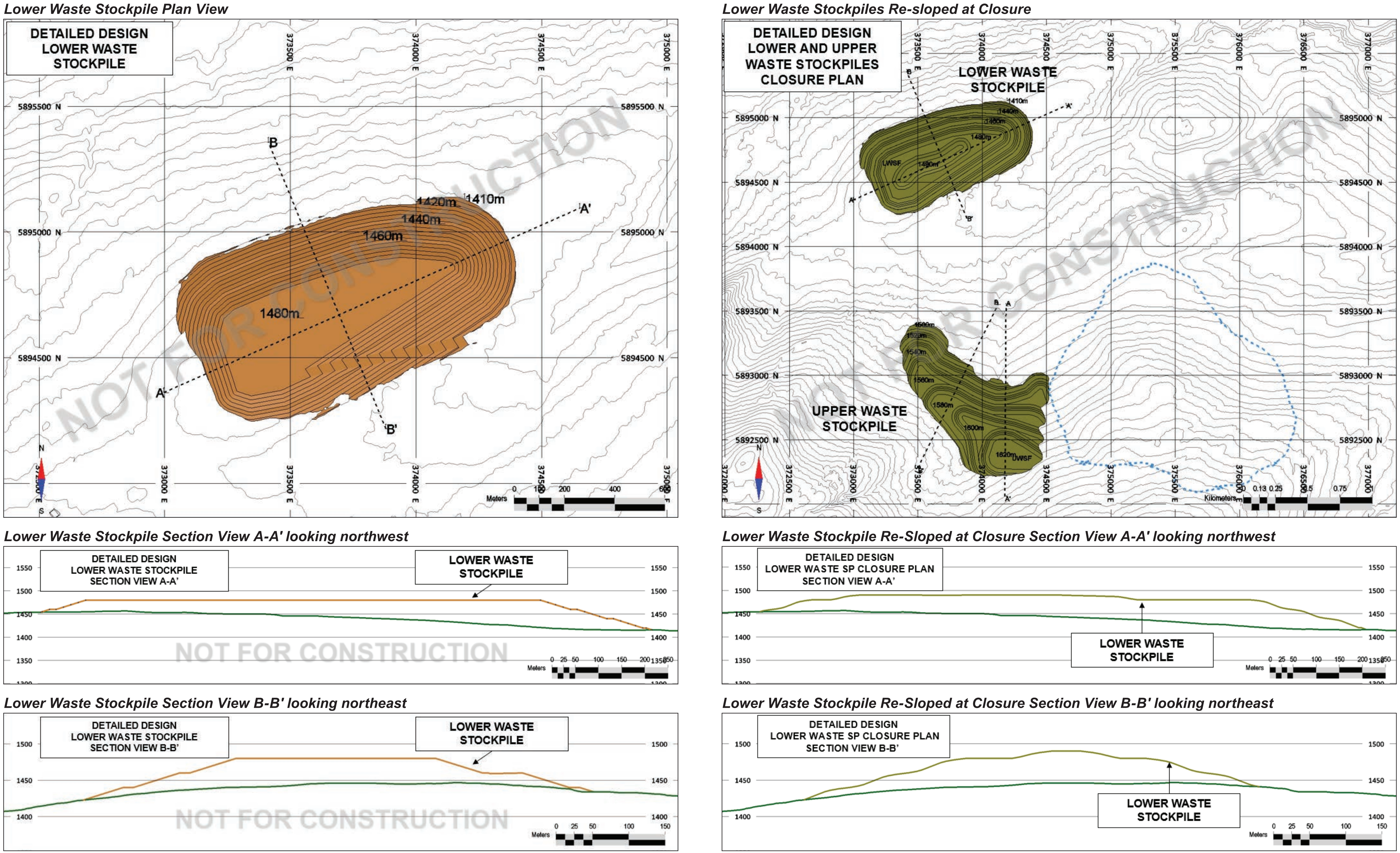


Figure 4.2-5: Original and Re-designed Lower Waste Stockpile

Source: Moose Mountain Technical Services (2021).

- Geochemical stability of the PAG tailings is achieved through placement of a NAG waste rock and OVB slurried cover at closure (see Section 4.2.2, Landform Design and Erosion Control), as well as a water pond that covers a portion of the TSF as well, maintaining saturated conditions for buried PAG and tailings.
- Physical stability of the Upper and Lower Waste stockpiles are achieved through a bottom-up design, as well as flat overall slopes that meet the design criteria. Approximately two-thirds of the Lower Waste Stockpile is scheduled for use in the closure and reclamation plan, so a much smaller and resloped Lower Waste Stockpile will exist in post-closure.
- Geochemical stability of the Upper and Lower Waste stockpiles is created through the placement of only NAG materials (OVB and waste rock) in these facilities.

4.2.2.3 Erosion and Sediment Control

Erosion controls will be the primary means of preventing degradation of downstream aquatic and terrestrial resources. Further, sediment controls will act as a contingency plan, to be installed after all erosion control opportunities have been implemented. The primary mechanisms of erosion management and sediment control will consist of stabilizing land surfaces to minimize erosion by resloping and reshaping landforms to their final configuration, establishing vegetation cover and reclaiming the final surfaces in accordance with this Plan, establishing diversion and collection ditches to manage surface water runoff, and restoring natural hydrological regimes to minimize sediment transport to downstream environments. Rapid establishment of vegetation and development of self-sustaining ecosystems on erosion-prone landforms during Closure and Post-closure phases will be an important component of long-term erosion control.

The Surface Erosion Prevention and Sediment Control Plan (SEPSCP; Appendix 9-A) provides a detailed list of best management practices for sediment and erosion control on the mine site. Erosion controls specifically related to landform design are summarized below:

- Surface roughening – creation of microtopography can be accomplished through a number of methods (e.g., dozer or excavator ripping, excavator mounding) that act to reduce flow-path lengths and runoff velocity, and thus reduce erosion, particularly in areas where vegetation is not yet established. Discussion of site preparation methods is provided in Section 4.2.1.7, Reclamation-materials Placement.
- Mulching – applying a layer of straw, wood fiber, wood chips, or other appropriate material to landforms to protect the landform surface from forces of raindrop impact, facilitate the growth of vegetation, increase infiltration, reduce evaporation, insulate the soil, and suppress weed growth.
- Rolled erosion control products – where erosion risk is high, erosion control blankets, nets, and matting can be used to reduce erosion, stabilize the surface, and facilitate vegetation establishment.
- Polyethylene cover – sheets can be temporarily used to stabilize newly exposed surfaces if there is no time to implement other erosion control practices and erosion risk is high.

While the goal of reclamation is to establish stable landforms that naturally control erosion and sediment transport, there is a need to utilize sediment controls during initial periods of reclamation and until vegetation is well established. Sediment controls to direct water over and around landforms and limit sediment deposition in downstream environments can include:

- Sediment control pond (SCP) sand basins;
- Culverts;
- Diversion ditches and structures;

- Collection ditches;
- Rock and straw bale check dams;
- Energy dissipators;
- Slope drains;
- Filter bags;
- Waterbars;
- Floating silt curtains; and
- Silt retention structures.

Prior to construction, a suitable grass/forb mix will be developed in conjunction with local Indigenous communities, and erosion control and wildlife habitat professionals to control erosion and sedimentation of exposed soils that will not be reclaimed as part of progressive reclamation. These include areas such as temporary disturbances and road edges. Native grass and plant species will be preferred over non-native species unless erosion and sediment control risk cannot be safely addressed, in which case non-propagating agronomics will be considered. Self propagating, non-native grass species that have the potential to compete with plant species used during reclamation will be avoided. To limit conflict with wildlife, species that are noted attractants to wildlife will be avoided. The seed mix will be refined through monitoring of vegetation establishment and cover at sites where this seed mix is applied.

An example of a potential native species seed mix that could be used on site is:

- 71%[26] slender wheatgrass (Elymus trachycaulus);
- 21% Rocky Mountain fescue (Festuca saximontana);
- 5% tufted hairgrass (Deschampsia caespitosa); and
- 3% northern sweetvetch (Hedysarum boreale).

This mix could be supplemented with mulch and/or a non-propagating agronomic, such as fall rye (*Secale cereale*) to reduce erosion during early establishment of the seeded native plants. For example, ~3,000 kg/ha of mulch, 39 kg/ha of all rye, and 14 kg/ha of native seed mix could be applied. A tackifier may also be used to prevent mobilization of the seed.

4.2.2.4 Water Management

An integral component of meeting reclamation and closure objectives is to design site drainage to be consistent with the surrounding landscape. This component will assist with stabilizing soil and preventing erosion. Re-establishing as many pre-disturbance drainage pathways as possible for the post-closure phase assists in achieving these objectives. Another approach is to align new upstream drainage pathways with existing downstream drainages.

The Northern Diversion upstream of the TSF will be decommissioned for post-closure, thus allowing the catchment to report to the TSF area as it did prior to the mine development. The new drainage pathway from the TSF area are the spillways which report to Davidson Creek downstream of the ECD, designed to safely pass flows around the permanent embankments. The embankment slopes are designed for long-term physical stability. The water management features from the embankment slopes of Main Dam D will be aligned with the downstream drainages reporting to Davidson Creek.

[26] Percent by weight.

While the waste stockpiles are designed to achieve long-term physical stability, surface grading of the final stockpiles will allow for the creation of drainage pathways so they report to the pre-development drainage pathways. The footprint of the LGO Stockpile will also be graded to allow the area to drain in the same direction prior to development (i.e., the TSF area).

Two areas that are planned to have active water management in post-closure include the Central Diversion and the Open Pit. Collection channels that convey water to the CWTP, and pumps from the CWTP to convey water to the TSF C spillway, are intended to limit water inflow to the TSF, should the TSF pond water require active treatment. This water management component also directs the western-most portion of the Davidson Creek catchment around the TSF, as the final elevation of the TSF prevents the natural drainage path eastward of this portion of the catchment. As the Open Pit exists in a surplus water condition post-closure, the Pit Lake will be actively managed at an elevation below its natural decant, via a pumping system, as the Pit Lake water is anticipated to require water treatment.

Water management downstream of the TSF area in post-closure primarily focuses on the active treatment and release of water from the Membrane WTP. It will treat water from the ECD, the Pit Lake, and potentially TSF C Pond, prior to discharge to Davidson Creek.

Section 3.11.3 of the WMMP of the details the specific wildlife (migratory birds and amphibians) management and mitigation actions that will be implemented for the TSF and other facility waterbodies through post-closure.

4.2.3 Revegetation Strategy

The proposed revegetation strategy is based on the projected post-closure ecosystems and the corresponding wildlife habitats (described in detail in Appendices 4-D and 4-E). Each post-closure ecosystem has an associated suite of plant species that are adapted to its climatic and edaphic conditions, and thus, there are specific revegetation strategies linked to each post-closure ecosystem.

Reclamation of the post-closure landscape will re-establish basic ecological processes (e.g., biochemical functions, water cycling) and relatively simple structural diversity and native plant communities that will support end land uses. Ecohydrological modelling results indicate edaphic conditions required to support a given ecosystem in the long-term; however, ecosystems will take a long period to resemble their climax potential. The processes, structure, and plant communities established through early reclamation will create conditions for the development of the targeted native plant communities (i.e., site series) to become self-sustaining over the long-term. The objective for all reclamation treatments is to establish a diverse landscape with habitats that will persist and continue to develop into more complex communities over time based on natural successional pathways to support wildlife species.

4.2.3.1 Revegetation Species

Revegetation for the Project footprint is focused on the return of locally common native plants which support wildlife. This focus aligns with the end land use objectives to:

- Develop self-sustaining vegetation that will progress to plant communities similar to pre-disturbance ecosystems to support key wildlife species; and
- Support wildlife habitat and traditional and current land use by Indigenous peoples.

The selection of plant species for revegetation is based on engagement with Indigenous nations as well as on native plant species that occur within the ESSFmvp, ESSFmv1, and SBSmc3, which have been refined according to projected edaphic conditions (SMR and SNR) of reclaimed sites. Preference will be given to native plant species, and non-native species that may be used, will be shared with First Nations for consideration and for the opportunity to identify comparable native species. Furthermore, the selection of plant species for revegetation is also based on creating habitat for the wildlife species listed in Section 4.1.3, Habitat for Focal Reclamation Species and to support biodiversity on the reclaimed landscape as further demonstrated in Table 4.1-5. Within lists of candidate plant species, those with greater ecological amplitude were selected to provide the best opportunity for successful revegetation with respect to creating long-term successional trajectories similar to those that occur after natural disturbances such as fires, flooding, and avalanches.

Appendix 4-D provides specific ecosystem characteristics, species lists, and representative wildlife species for each predicted post-closure ecosystem.[27] Species lists for each ecosystem type were developed using *A Field Guide for Site identification and Interpretation for the Southwest Portion of the Prince George Forest Region* (DeLong 1993) and species observed during wildlife surveys of the mine site (Appendix 4-D). In addition, the species list was informed by Indigenous Groups based on their desired end land uses, including reclamation of caribou and whitebark pine habitat. Refer to Appendix 4-F for the full list of planned revegetation species, including scientific and Ulkatcho names.

Revegetation species and the required soil conditions were targeted with special consideration to create habitat for caribou. An iterative process was used based on the results of the ecohydrological model. The results were used to identify soil and site characteristics required for the establishment of edatopic conditions that typically support open forest and lichen habitat. To create these conditions, salvaged glaciofluvial surface soils were identified as the preferred reclamation material through a data-based modelling process (Section 4.2.1, Soil Resources; SMP in Appendix 9-B). These xeric to submesic SMRs predicted from glaciofluvial covers are also favourable for whitebark pine, another key focal species targeted in reclamation. Establishment of lichen will be done by methods consistent with current research in climatically similar areas (e.g., Ronalds and Grant 2018), which will be tested in reclamation research (Section 4.2.5, Reclamation Research). The species lists represent a range of species that could be successful based on predicted edaphic conditions (Table 4.2-7). Some species will be better adapted to surviving the challenging conditions of reclamation environments than others; therefore, revegetation trials are proposed to test the establishment and survival of different plant species at Blackwater (Section 4.2.5.1, Vegetation and Cover Trials). The goal of these revegetation trials is to identify species that are both suitable for target ecosystems and capable of establishing in reclaimed areas given soil and climate conditions in early reclamation. BW Gold will continue to engage with Indigenous Groups on the results of revegetation trials and how they pertain to their preferred species for revegetation.

Revegetation on dams is to be guided primarily by the goal of minimizing erosion and stabilizing slope surfaces. Geotechnical constraints dictate that trees will not be grown on dams and will require manual removal where they occur from natural regeneration. TSF dams will be reclaimed at closure with a mix of native grass, forb, and shrub species.[28] Alder species such as Sitka alder (*Alnus viridis*), which fix nitrogen, and willows (*Salix* spp.) are shrubs that may be planted to improve soils through litter deposition and nitrogen fixation (alder only), while providing structural diversity and habitat elements for birds and small mammals.

[27] Refer to Figure 4.1-5 and Table 4.1-4 for the distribution of post-closure ecosystems in the Project footprint.

[28] Composition of seed mixes may be revised in consultation with local Indigenous communities, and erosion control and wildlife habitat professionals.

Table 4.2-7: Vegetation Prescriptions for Projected Post-closure Ecosystems

BGC Unit	Site Series	Vegetation Association	Representative Wildlife Species	Cover Depth	SMR	Landscape Position (aspect/ slope)	Lifeform	Species[1]	Planting Density (stem/ha)
SBSmc3	02	Lodgepole pine - Juniper - Dwarf huckleberry	Caribou, grizzly bear, grouse species	70 cm of glaciofluvial surface soil	Xeric	Flat and gently sloping areas	Tree	lodgepole pine	1,000 - 1,500
							Shrub	kinnikinnick	100 - 1,000
								common juniper	100 - 1,000
								soopolallie	100 - 1,000
								saskatoon	100 - 1,000
								prickly rose	100 - 1,000
							Dwarf shrub / Herb / Lichen	bunchberry	200 - 500
								twinflower	200 - 500
								wild strawberry	200 - 500
								lichen species	To be determined
								dwarf blueberry[2]	200 - 500
	03	Lodgepole pine - Feathermoss - Cladina	Caribou, grizzly bear, grouse species	70 cm of glaciofluvial surface soil	Subxeric	Flat and gently sloping areas	Tree	hybrid white spruce	300 - 500
								lodgepole pine	1,000 - 2,000
							Shrub	kinnikinnick	100 - 1,000
								common juniper	100 - 1,000
								soopolallie	100 - 1,000
								prickly rose	100 - 1,000
							Dwarf shrub / Herb / Lichen	birch-leaved spirea	100 - 1,000
								bunchberry	200 - 500
								dwarf blueberry[2]	200 - 500
								twinflower	200 - 500
								wild strawberry	200 - 500
								arctic lupine	To be determined
								lichen species	To be determined
	01/05	Sxw - Huckleberry	Caribou, grizzly bear, wolverine, Olive-sided flycatcher, hare, marten, bat species	80 cm of mixed-parent-material surface soil on surface soil stockpile footprints	Mesic	Flat and gently sloping areas	Tree	lodgepole pine	1,000 - 2,000
								hybrid white spruce	1,000 - 2,000
							Shrub	Sitka alder	100 - 1,000
								highbush cranberry	100 - 1,000
								kinnikinnick	100 - 1,000
								prickly rose	100 - 1,000
								highbush cranberry	100 - 1,000
								black huckleberry	100 - 1,000
								soopolallie	100 - 1,000

BGC Unit	Site Series	Vegetation Association	Representative Wildlife Species	Cover Depth	SMR	Landscape Position (aspect/ slope)	Lifeform	Species[1]	Planting Density (stem/ha)
SBSmc3 *(cont'd)*							Dwarf shrub / Herb	bunchberry	200 - 500
								crowberry	200 - 500
								dwarf red raspberry	200 - 500
								sweet coltsfoot	100 - 500
								aster species	200 - 500
								dwarf blueberry[2]	100 - 500
								twinflower	200 - 500
								arctic lupine	To be determined
							Grass	bluejoint reedgrass	To be determined
	04/05	Sxw - Huckleberry - Soopolallie	Caribou, grizzly bear, wolverine, Olive-sided flycatcher, hare, marten, bat species	80 cm of mixed-parent-material surface soil on surface soil stockpile footprints	Submesic	Flat and gently sloping areas	Tree	hybrid white spruce	1,000 – 1,500
								lodgepole pine	500 - 1,000
							Shrub	Sitka alder	100 - 1000
								highbush cranberry	100 - 1,000
								kinnikinnick	100 - 1,000
								common juniper	100 - 1,000
								soopolallie	100 - 1,000
								black huckleberry	100 - 1,000
								crowberry	100 – 1,000
								prickly rose	100 - 1,000
							Dwarf shrub / Herb	bunchberry	200 - 500
								sweet coltsfoot	100 - 500
								aster species	200 - 500
								birch-leaved spirea	100 - 1,000
ESSFmv1	01	Subalpine fir - Rhododendron - Feathermoss	Caribou, Clark's Nutcracker, grizzly bear, wolverine, Olive-sided flycatcher, hare, marten, bat species	30-50 cm of mixed-parent-material surface soil on Upper and Lower Waste stockpiles; 80 cm mixed-parent-material surface soil over roads; 100 cm OVB on TSF beaches	Mesic	Steeper north-facing slopes (stockpiles); flat areas, gentle slopes (roads, TSF)	Tree	subalpine fir	300 - 1,000
								Engelmann spruce	300 - 500
								lodgepole pine	500 - 1,000
								whitebark pine	200 - 400
							Shrub	Sitka alder	200 - 500
								kinnikinnick	200 - 500
								highbush cranberry	100 - 1,000
								birch-leaved spirea	200 - 500
								black huckleberry	200 - 500
							Dwarf shrub / Herb	twinflower	200 - 500
								fireweed	200 - 1000
								dwarf blueberry[2]	100 - 500
								bunchberry	200 - 500

BGC Unit	Site Series	Vegetation Association	Representative Wildlife Species	Cover Depth	SMR	Landscape Position (aspect/ slope)	Lifeform	Species[1]	Planting Density (stem/ha)
ESSFmv1 *(cont'd)*							Grass	alpine fescue	To be determined
								bluejoint reedgrass	To be determined
	03[3]	Subalpine fir - Huckleberry - Feathermoss	Caribou, Clark's Nutcracker, grizzly bear, wolverine, Olive-sided flycatcher	100 cm of OVB on TSF beaches; 80 cm mixed-parent-material surface soil over roads; 100 cm glaciofluvial surface soil on ore stockpile footprints; 50 cm mixed-parent-material surface soil on waste stockpiles	Submesic	Flat areas, gentle slopes (roads, TSF, ore stockpiles); steeper east and east-facing slopes (waste stockpiles)	Tree	whitebark pine	400 - 700
								lodgepole pine	400 - 700
								subalpine fir	400 - 700
							Shrub	Sitka alder	200 - 500
								birch-leaved spirea	200 - 500
								kinnikinnick	200 - 500
								black huckleberry	200 - 500
							Dwarf shrub / Herb	twinflower	200 - 500
								fireweed	200 - 1000
								bunchberry	200 - 500
							Grass	alpine fescue	To be determined
								bluejoint reedgrass	To be determined
	02	Lodgepole pine - Huckleberry - Cladonia	Caribou, Clark's Nutcracker, grizzly bear, wolverine, Olive-sided flycatcher	70 cm of glaciofluvial surface soil on camp and infrastructure areas; 100 cm glaciofluvial surface soil on ore stockpile footprints; 30-40 cm mixed-parent-material surface soil on waste stockpiles	Xeric to subxeric	Flat areas, gentle slopes (camp, infrastructure, ore stockpiles); steeper south-facing slopes on waste stockpiles	Tree	whitebark pine	400 - 700
								lodgepole pine	400 - 700
							Shrub	Sitka alder	200 - 500
								common juniper	100 - 1,000
								kinnikinnick	200 - 500
								birch-leaved spirea	200 - 500
								black huckleberry	200 - 500
							Dwarf shrub / Herb	dwarf blueberry[2]	100 - 500
								twinflower	200 - 500
							Grass/Lichen	alpine fescue	To be determined
								bluejoint reedgrass	To be determined
								lichen species	To be determined
	04	Subalpine fir - Huckleberry - Gooseberry	Caribou, Clark's Nutcracker, grizzly bear, wolverine, Olive-sided flycatcher, hare, marten, bat species	40-50 cm of mixed-parent-material surface soil cover on waste stockpiles	Mesic to subhygric	Steeper north-facing slopes at mid to toe slope positions	Tree	subalpine fir	400 - 1,000
								lodgepole pine	400 - 1,000
								Engelmann spruce	300 - 600
							Shrub	black huckleberry	200 - 500
								black twinberry	200 - 500
							Dwarf shrub / Herb	twinflower	200 - 500
								rayless alkali aster	200 - 500
								five-leaved bramble	200 - 500
							Grass	alpine fescue	To be determined
								bluejoint reedgrass	To be determined

BGC Unit	Site Series	Vegetation Association	Representative Wildlife Species	Cover Depth	SMR	Landscape Position (aspect/ slope)	Lifeform	Species[1]	Planting Density (stem/ha)
Riparian areas (ESSFmv1 and SBSmc3)	-	Riparian	Caribou, Clark's Nutcracker, grizzly bear, moose, wolverine, Olive-sided flycatcher, hare, marten, bat species	-	Subhygric to hygric	In areas adjacent to water, where extended periods of water in rooting zone observed (e.g., adjacent to TSF ponds and interception ditches)	Tree	hybrid white spruce	1,000 - 2,000
							Shrub	willow species[4]	200 - 500
								black twinberry	200 - 500
								prickly rose	200 - 500
							Herb	cow-parsnip	100 - 1,000
								common horsetail	100 - 1000
							Grass	sedge species	100 - 1000
								bluejoint reedgrass	To be determined
Grass-Shrub (dams)	N/A	Grass-shrub	Forage for bear and birds; nesting opportunities for migratory birds	OVB shells (> 1 m) of all dams	Submesic	All	Shrub	Sitka alder	200 - 500
								willow species	200 – 500
							Herb	To be determined*	To be determined
							Grass	To be determined*	To be determined
								Non-propagating grasses (e.g., fall rye)	Only as required for erosion control

Note:

This table contains species lists only for site series projected for > 0.1% of the disturbed footprint.

[1] See Appendix 4-F for scientific, Ulkatcho and English names.

[2] Dwarf blueberry should only be planted in reclaimed ecosystems that are well established, where soils have experienced preliminary development.

[3] ESSFmv1-03 ecosystems are expected on north-facing subxeric SMR sites, as well as submesic SMR sites in other topographical positions.

[4] Both willow and sedge seeds should be collected from wetter ecosystems (e.g., 08 or 09 site series).

** To be determined based on results of reclamation research and progressive reclamation, as well as seed and seedling availability at the time of seeding.*

Wetland reclamation may also occur in the TSF and in the vicinity of the ECD and FWR. However, the reclamation strategy currently assumes these areas will support upland forested ecosystems, not wetland ecosystems. If successful wetland reclamation strategies are possible through the proposed reclamation research (Section 4.2.5.1, Vegetation and Cover Trials) and are further supported as potential wetland restoration sites supported by favorable water quality monitoring results, then reclamation prescriptions for these areas will be revised, provided there is no interference with higher-priority water management goals. The proposed closure water management strategy is to treat contact water on site for sulphate, ammonia, and certain metals using membrane treatment, which may be fouled by organic materials (OMs) produced in wetlands. This is a particular concern for the TSF and ECD from which water will require treatment, as opposed to the FWR for which water treatment is not an anticipated requirement. BW Gold intends to conduct research trials to demonstrate where wetlands may be appropriate, with particular focus on TSF water treatment needs (Section 4.2.5.3, Use of Wetlands to Treat Water).

While there is a revegetation prescription proposed for riparian areas in Table 4.2-7, these areas are not explicitly mapped on the post-closure Project area, due to uncertainties of final watercourse morphology and hydrology as described in Section 4.7.11, Watercourses. These areas will provide important habitat elements on the reclaimed landscape that support important wildlife forage species, such as sedges (*Carex* spp.), provide shelter with planted hybrid white spruce (*Picea engelmannii x glauca*) and willow, and stabilize streambanks from erosion.

4.2.3.2 Vegetation Sources and Types

Based on current knowledge, the most likely method for establishing the majority of plant species for reclamation is planting of propagated container seedlings from appropriate seed provenances. Some species may be established through broadcast seeding (or potentially hydroseeding in special cases), but, in general, seed for most target shrubs and herbs is not readily available commercially, and it is more cost effective to establish them via planting of container seedlings than through direct seeding. As such, only planting densities are provided in Table 4.2-7. Seeding rates for select species, particularly grasses if required, can be determined by working with representatives of seed suppliers and erosion control experts.

Seed collection programs in areas adjacent to the mine site, with LDN and UFN involvement, should be initiated to improve availability of target species, and seedlings from this stock will have the added benefit of being adapted to local climate conditions. Small-scale nursery and/or field trials as part of the reclamation research program are recommended to test germination rates and vigour of seedlings grown from collected seeds well before the date at which seedlings are required for large-scale reclamation planting (Section 4.2.5.1, Vegetation and Cover Trials).

Commercial tree species are readily available from nurseries, provided they are ordered two to three years in advance. Seed provenances will be selected using the province’s climate-based seed transfer approach (O’Neill et al. 2017). Seedlots for whitebark pine are not currently available from the local Project area, therefore, seed will be salvaged during clearing where feasible and from adjacent stands. A whitebark pine nursery will be established on site as part of the Whitebark Pine Management Plan[29] and may supply planting stock for use during reclamation. Whitebark pine seed stock will be screened for rust resistance, as per the Whitebark Pine Management Plan.

[29] DS Condition 8.20 requires the development of a Whitebark Management Plan prior to construction and in consultation with Indigenous groups.

4.2.3.3 Fertilization

Stockpiled reclamation materials are expected to have low levels of organic matter and nutrients, which is typical of BC interior forest soils (Brockley 2001). Should assessment of stockpiled surface soil through the reclamation monitoring program (Section 4.2.6.2, Permanent Sample Plots) confirm low levels of organic matter and nutrients, then fertilization augmentation will be considered. Fertilization is expected to improve initial survival and establishment of planted seedlings.

Local native plant species targeted in revegetation planning are generally not nitrophilic. Therefore, broadcast fertilization tends to favour establishment of weedy or non-target species over target species. The only locations scheduled to receive broadcast fertilization during the initial planting stage will be dam slopes, which require quick revegetation for erosion control. Since dam slopes will not have trees for geotechnical reasons, competition from fertilization is not expected to be a problem. The use of in-hole slow-release fertilization bags is preferred over broadcast fertilization methods in all other reclamation areas to target individual plant plugs and avoid fertilizing undesired or invasive species. Site-preparation techniques that produce microtopography on the surface of reclaimed sites will also reduce the loss of nutrients and water while providing microsites beneficial to the establishment of vegetation. Once tree covers are established (~15 to 25 years) aerial fertilization in line with standard forestry practices may be employed, based on results from vegetation monitoring and as guided by a qualified professionals. This should not be done in early years due to risk of runoff to surrounding waterbodies and of fertilizing non-desired species that will compete with trees.

4.2.4 Progressive Reclamation/Sequencing

Due to the Project's construction and operation schedule, there will be limited opportunities for progressive reclamation. The primary reclamation-related activities during Construction and Operations Phases will consist of salvaging and stockpiling reclamation materials from the Project footprint, including both surface soils, OVB and woody debris.

Two areas around the FWR provide opportunities for progressive reclamation beginning in Y+1: a borrow area used for construction of the FWR (~3 ha) and a material stockpile from the excavation of the FWR (~3 ha) beginning in year +1 (Figure 4.2-6). Progressive reclamation of these areas will be carried out as part of the reclamation research program and details of planned reclamation are presented in Section 4.2.5.1, Vegetation and Cover Trials.

Prior to closure in Y+24, final landform configurations will be completed for several mine features and progressive reclamation can begin in these areas. The Lower Waste Stockpile will be completed in Y+11; however, this OVB material is earmarked for reclamation purposes and therefore the stockpile will not be progressively reclaimed.

Other landforms that will be completed prior to closure and can be progressively reclaimed include:

- Upper Waste Stockpile (Y+19);
- Ex-pit haul roads (Y+19); and
- Explosive storage facilities (Y+19).

While these mine features will be reclaimed within five years of closure, they may still provide useful information on early vegetation establishment and ecosystem development that can be used in reclamation planning at closure. BW Gold will continue to look for additional opportunities for progressive reclamation during the LoM and will describe these in subsequent revisions of the RCP.

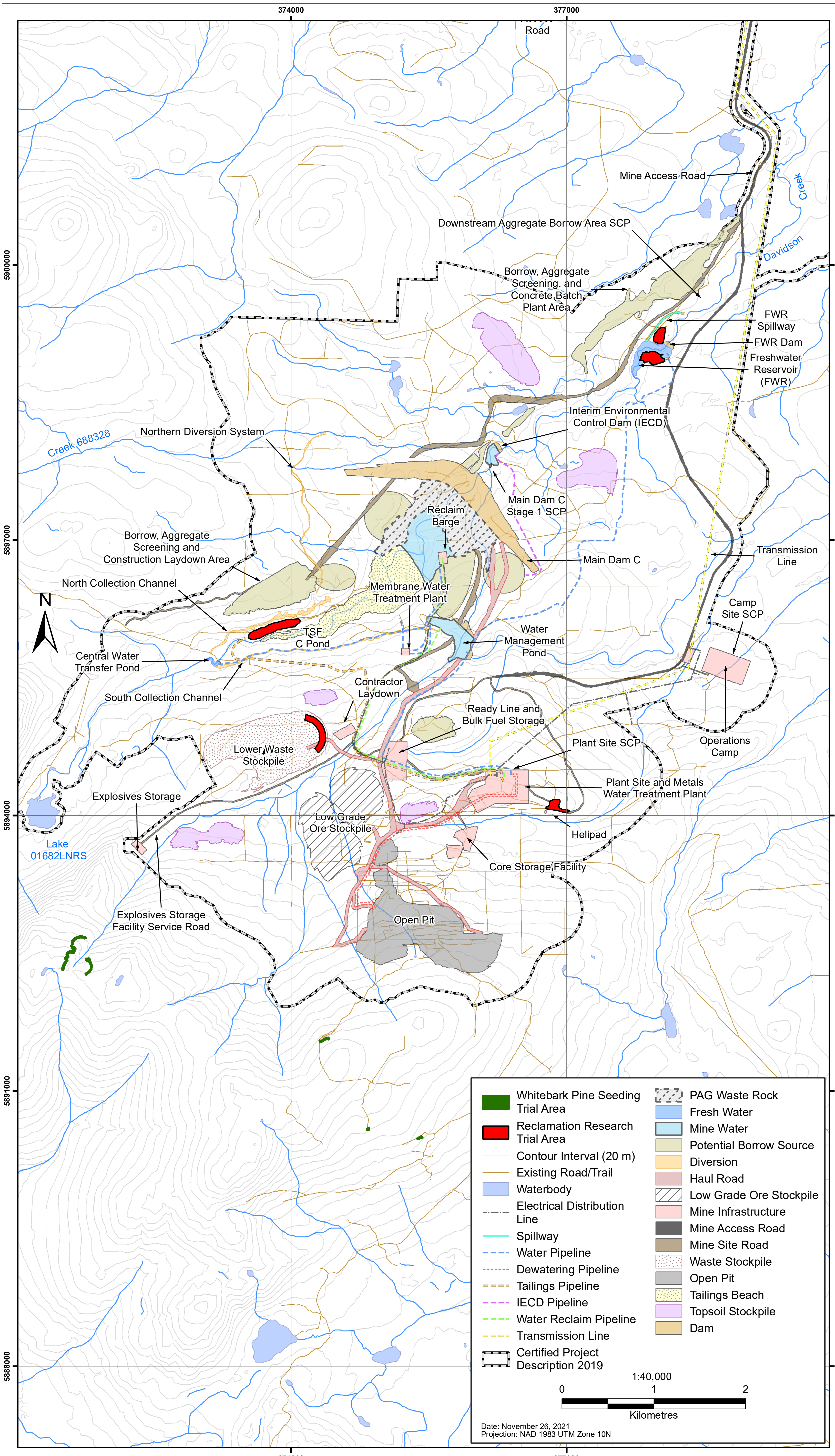


Figure 4.2-6: Reclamation Research Trial Locations

4.2.5 Reclamation Research

The focus of the reclamation research and monitoring programs is the reduction of reclamation gaps and uncertainties, and testing of reclamation assumptions over time. The objective of these programs is to investigate opportunities to improve the RCP, with the overall intent of refining reclamation and closure designs to meet the end land use objectives (Section 4.1, End Land Use and Capability Objectives). The sequence of the research and monitoring programs starts with this RCP; key reclamation uncertainties and assumptions are identified, and research and monitoring programs are planned—and implemented as early as feasible—to address these key uncertainties and assumptions. Over time, results are evaluated against these key uncertainties: results are interpreted with respect to identified uncertainties, and updates on remaining/new uncertainties and assumptions are provided regularly through the reporting cycle (e.g., in five-year updates). Through this process the amount of information related to reclamation increases over time, and uncertainties are decreased. As this RCP is the initiation of this sequence, there are still uncertainties related to the details of reclamation implementation, but the clear intent is to treat this as an active, iterative and adaptive process.

Table 4.2-8 provides the summary of uncertainties identified throughout this RCP, the approach(es) for addressing these uncertainties, and where that content is provided within the RCP. Uncertainties will be addressed through three primary work streams: (1) research trials, (2) monitoring and (3) off-site work including desktop studies and community engagement. It is important to note that monitoring is an inherent component of research trials; the monitoring referred to in this context is planned operational monitoring conducted outside of research trials.

As discussed above, reclamation research planning and implementation at Blackwater will be based on the following process:

- Identify current key gaps, uncertainties and assumptions in the reclamation plan;
- Develop research and monitoring programs to reduce these uncertainties and test assumptions;
- Interpret research and monitoring results to assess the current state of knowledge;
- Collaborate with local Aboriginal Groups and regulators to review results and revisit uncertainties on a regular basis (through the Environmental Monitoring Committee, Annual Reclamation Reporting and, every five years, updates to the Blackwater *Mine Plan and Reclamation Plan*);
- Use results to re-evaluate remaining key uncertainties and assumptions, and revise/renew research and monitoring programs; and
- Regularly and formally update and communicate results in the Annual Reclamation Report and five-year updates to the Blackwater *Mine Plan and Reclamation Plan.*

The following subsections provide an overview of the reclamation research program and the reclamation research studies proposed to address uncertainties, including general methodology, proposed study locations, and tentative schedules for each of the proposed studies. Item numbers from Table 4.2-8 are referenced to link the various research trials with identified uncertainties. Research trial results will be presented in Annual Reclamation Report and incorporated into future reclamation planning. BW Gold will continue to look for additional opportunities for progressive reclamation during the LoM and will describe these in subsequent revisions of the RCP.

Table 4.2-8: Uncertainties and Approaches for Addressing

Category	Item No.	Uncertainty	Section(s) Where Uncertainty is Identified	Approach for Addressing Uncertainty	Section(s) Outlining Approach for Addressing Uncertainty
Reclamation materials	1	Properties of OVB and surface soil at baseline and following stockpiling (see parameters in Table 4.2-9)	Section 4.2.1.5 Section 4.2.1.7	Monitoring	Section 4.2.6.1
	2	Available volumes of reclamation materials (i.e., accuracy of baseline mapping and estimates of operational accessibility on which estimates are based)	Section 4.2.1.5	Monitoring	Section 4.2.6.1
	3	Concentrations of metals and other elements in OVB and surface soil at baseline, following stockpiling, and over time at reclamation sites	Section 4.2.1.5	Monitoring	Section 4.3
Ecohydrological model/ cover design	4	Tailings Storage Facility cover ▪ Effectiveness of geochemical barrier ▪ Reclamation cover design and vegetation prescriptions	Section 4.2.1.1 Section 4.2.1.2	Research	Section 4.2.5.1
	5	Accuracy of waste and reclamation-cover properties used in modelling	Section 4.1.2.2	Monitoring	Section 4.2.6.1
	6	Accuracy of ecohydrological modelling (i.e., if cover designs will achieve the projected SMRs)	Section 4.1.2.2 Section 4.2.1.1	Research	Section 4.2.5.1 Section 4.2.6.2
	7	Effects of climate change on projected post-closure ecosystems	Section 4.2.4.1	Desktop (modelling)	Section 4.13
Revegetation	8	Additional Traditional Use information that may become available	Section 4.13	Engagement	Section 4.13
	9	Appropriate seed mix for sediment and erosion control	Section 4.2.2.3	Monitoring	Section 4.2.2.3
	10	Appropriate native species revegetation prescriptions that will be successful in primary successional conditions and support end land use objectives	Section 4.1.3 Section 4.1.4 Section 4.2.3	Research	Section 4.2.5.1
	11	Potential for implementation of an operational-scale seed collection and propagation program	Section 4.2.3.2	Research	Section 4.2.5.1
	12	Fertilization requirements	Section 4.2.3.3	Monitoring	Section 4.2.6.2
	13	Ability to re-establish lichen	Section 4.2.3.1	Research	Section 4.2.5.1

Category	Item No.	Uncertainty	Section(s) Where Uncertainty is Identified	Approach for Addressing Uncertainty	Section(s) Outlining Approach for Addressing Uncertainty
Revegetation *(cont'd)*	14	Ability to re-establish whitebark pine	Section 4.1.3 Section 4.2.3.1	Research	Section 4.2.5.1 Section 4.2.5.2
	15	Understanding of successional trajectories	Section 4.1.4	Monitoring	Section 4.2.6.2
	16	Risk of invasive plant establishment	Section 4.1.4	Monitoring	Section 4.2.6.2
	17	Detailed plan for creation of ecosystem heterogeneity within ecohydrological model projections (i.e., within areas projected to be a single site series)	Section 4.1.2.3	Desktop (modelling)	Section 4.7
	18	Identify new areas for reclamation research	Section 4.2.5	Desktop	Section 4.2.5 Section 4.13
Land capability/ habitats	19	Ability to reclaim ecosystems to achieve the end land use and capability objectives	Section 4.1.2.2	Research Monitoring	Section 4.2.5.1 Section 4.2.6.2
	20	Confirmation of pre-existing habitats through wildlife monitoring outlined in the WMMP	Section 4.1.3 Appendix 4-D	Monitoring	WMMP
	21	Ability to create drier, low-density forests that support lichen and whitebark pine (for caribou and Clark's nutcracker)	Section 4.1.3	Research Monitoring	Section 4.2.5.1 Section 4.2.6.2
	22	Potential of areas for wetland reclamation and appropriate revegetation prescriptions	Section 4.2.3.1	Monitoring/ mapping Research	Section 4.2.3.1 Section 4.2.5.1
	23	Potential areas for riparian reclamation	Section 4.7.11	Monitoring/ mapping	Section 4.7.11
Water treatment	24	Potential for using wetlands to treat water	Section 4.7.4.1	Research	Section 4.2.5.3
	25	Potential for amendments to pit lakes to reduce concentrations of PCOC	Section 4.7.7.1	Research	Section 4.2.5.4

4.2.5.1 Vegetation and Cover Trials

Vegetation and cover trials will test the reclamation prescriptions provided in Table 4.2-7 for projected post-closure site series (as well as other species identified as important by Indigenous Groups) in small-scale trials, and will test growing media and cover designs to improve the likelihood of success when these prescriptions are applied at an operational scale. Initial species establishment and ecosystem development will be monitored to identify species that are good operational reclamation candidates and demonstrate that the proposed species will be successful in supporting the end land use objectives for traditional land use by Indigenous Peoples, and/or self-sustaining vegetation habitats that support wildlife. These research trials will help address uncertainties 6, 10 and 19 in Table 4.2-8.

Vegetation trials will be an opportunity to assess the feasibility of seed collection programs in areas adjacent to the mine site (ideally with LDN and UFN involvement; uncertainty 11 in Table 4.2-8). Small-scale nursery trials may supplement the field trials described above to test germination and vigour of seedlings grown from collected seed.

The ability of different reclamation cover depths and materials to support vegetation assemblages associated with target site series will also be assessed to validate ecohydrological modelling projections. Different vegetation prescriptions will be paired with varying cover depths and/or materials to support validation and refinement of cover designs. While site preparation methods are not proposed to be explicitly tested, site preparation to reduce compaction and create improved microsites for revegetation will be applied at all sites, with the appropriate site preparation method selected by a qualified professional as described in Section 4.2.1.7, Reclamation-materials Replacement.

Data collected from reference ecosystems as part of the reclamation monitoring program will also be compared to vegetation trial data to evaluate ecosystem trajectories between reclaimed and reference ecosystems at similar seral stages. If recommended species for a given reclaimed ecosystem consistently perform poorly, they will be removed from the prescription for that site series, or reclamation approaches will be adapted to improve species survival (e.g., delaying planting species that require shade until a forest canopy has been established).

Detailed assessment approaches will be developed specifically for each reclamation trial; however, these will likely include evaluation of soil properties, vegetation species, diversity and abundance, and element concentrations in soils and vegetation. Where possible, assessment of research trials will use methods that are consistent with proposed monitoring methods for operational reclamation areas to facilitate comparison between reclamation areas across the mine (refer to Section 4.2.6, Reclamation Monitoring and Section 4.3, Trace Element Update in Soils and Vegetation).

Vegetation trials are proposed for four areas that encompass a range of conditions projected to be present on the post-closure landscape (Figure 4.2-6), including both BEC subzone variants (ESSFmv1 and SBSmc3). All site series projected to be present on the post-closure ecosystem are included in vegetation trials except SBSmc3-01, 04, 05 and 06, however they will only be present on surface soil stockpile footprints, which will likely require less intensive intervention to reclaim.[30] Site series that are on a variety of slopes and aspects are included for the ESSFmv1, while only a flat trial area is planned for the SBSmc3 because all post-closure features in this zone will be flat (< 8°). Site characteristics of the trial areas are provided in Table 4.2-9 and additional details on the planned research trials are below.

[30] Riparian species will be tested separately as described in Section 4.2.5.1, Vegetation and Cover Trials and future research conducted to address associated uncertainties tracked in Table 4.2-8. Riparian species will also be monitored through the WMOP offsetting work happening at Mathews Creek. The grass/shrub ecosystem on dams is also not included in a specific trial but results from seed mix development for erosion control will inform reclamation of this ecosystem type (Section 4.2.2.3, Erosion and Sediment Control). Results of non-tree plant species tested in the vegetation trials will also inform revegetation of dams.

Table 4.2-9: Revegetation and Cover Research Trial Site Characteristics

Trial Area	Size (ha)	Year Available	BGC Unit	Elevation (masl)	Slope	Slope Position	Aspect
Existing Camp	1.6	Y-2	ESSFmv1-02, 03	1,460	Flat	LV	NA
Lower Waste Stockpile	3	Y+2	ESSFmv1-01, 02, 03, 04	1,420–1,440	Flat, 8–24°	LV, CR, MD, TO	NA, NE, E, SE
FWR*	6	Y+1	SBSmc3-02, 03	1,160–1,175	Flat	LV	NA
North Collection Channel	2	Y+3	ESSFmv1-01, 03	1,290	Flat	LV	NA
TSF Beach Cover	TBD	Y+3	ESSFmv1 (site series TBD)	1,344–1,353	Flat	LV	NA
TSF Wetlands for Vegetation	TBD	Y+2	NA	1,344–1,353	Flat	LV	NA
Whitebark Pine	TBD	Ongoing since 2016	ESSFmv1 / ESSFmvp	1,650–1,740	8-24°	CR	NE, N, SE

Note:

LV = level; CR = crest; MD = mid-slope; TO = toe

** The FWR has a terrace and bench design and is primarily flat areas separated by steep (> 45°) sections.*

Existing Camp – This 1.6-ha trial area located near the existing exploration camp will be available for research in Y-2. Because this trial area is a pre-existing exploration area scheduled for reclamation, the trial can generate more than 20 years of data prior to the Closure phase, and can be monitored into the Post-closure phase. It will receive a glaciofluvial cover, and vegetation will be planted according to vegetation prescriptions associated with ESSFmv1-03 and 02 site series, making the results applicable to operational reclamation of the low-grade ore stockpile footprint, the tops of the waste stockpiles, and plant/camp/infrastructure areas.

This trial will provide an opportunity to test the ability of glaciofluvial surface soil to create drier site series that support sparser tree canopies, greater terrestrial lichen cover, and provide caribou habitat (uncertainties 13 and 21 in Table 4.2-8). Lichen is an important food source for caribou, and lichen dispersal methods will be an important focus on this trial area. The Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) has been leading lichen restoration trials in west-central BC along the north side of Tetachuck Lake, approximately 75 km from the Project (Ronalds and Grant 2018). Blackwater will conduct lichen restoration trials pertinent to post-mining conditions, potentially in collaboration with FLNRORD researchers. Detailed methods for the trial will be developed, however the current methods used in research trials include aerial distribution (using helicopters and a hopper system) and manual distribution, which currently has more favourable results (Ronalds and Grant 2018). If trials are trending toward the development of dense conifer stands over time that do not support lichen establishment, tree thinning could be used to provide slow-growing species more time to become established, or other reclamation approaches may need to be investigated to create drier ecosystems, such as decreasing the cover thickness or mixing NAG waste rock with OVB to create a coarser reclamation cover. This trial area will also evaluate if whitebark pine can be grown on site and support ongoing use by Clark's nutcracker (uncertainties 14 and 21 in Table 4.2-8).

Lower Waste Stockpile – This 3-ha trial location will receive a mixed-mineral surface soil cover, and the bench and slope design of the stockpile will allow testing of multiple ESSFmv1 vegetation prescriptions (01, 02, 03, 04) depending on slope position and aspect. Prior to soil cover application, density of the OVB surface will be tested to identify potential compaction issues. In addition to helping refine cover designs and vegetation prescription for the waste stockpiles, this trial will evaluate:

- Methods for placing OVB to avoid compacting the surface and creating material densities that are not conducive to rooting;
- Whether additional site preparation is required for successful vegetation establishment and erosion control, for example, mounding or using coarse woody debris (CWD) to create microsites for seedlings;
- The ability of the designed covers to create 02 and 03 site series and the success of whitebark pine prescriptions on these sites;
- Whether organic amendments are needed to support vegetation; and
- How the development of vegetation on waste stockpiles influences runoff and infiltration of water into underlying materials.

This trial will commence in Y+2 and be disturbed once reclamation cover-material is required to reclaim final landforms in the Closure phase.

Freshwater Reservoir – Two areas around the FWR provide opportunities for research and are available in Y+1: a borrow area used for construction of the FWR (~3 ha) and a material stockpile from the excavation of the FWR (~3 ha). Because this trial area is also a progressive reclamation area, the trial will generate more than 20 years of data prior to the Closure phase, and can be monitored into the Post-closure phase.

The FWR trial locations will provide an opportunity to test the ability of glaciofluvial surface soil to create drier site series that support sparser tree canopies and higher lichen cover favoured by caribou (uncertainties 13 and 21 in Table 4.2-8). Specifically, creation of the SBSmc3-02 and -03 site series will be targeted in soil cover designs and plant species associated with those site series will be planted. The proposed glaciofluvial surface soil cover and revegetation prescriptions are applicable to all the reclamation areas in the SBSmc3 except surface soil stockpile footprints. Whitebark pine will be included in the trial to assess the potential survival and establishment of whitebark pine in the SBSmc3 (uncertainties 14 and 21 in Table 4.2-8). There is research to suggest that whitebark pine may successfully grow up to 150 metres below currently indicated elevations for the species (Arno et al. 1993). This will provide information on whitebark pine survival given the uncertainties of survival associated with climate change that will affect the ESSFmv1 and parkland. Lichen dispersal methods will be an important focus on this trial area. Lichen establishment research will be conducted as described for the "Existing camp" research area, with detailed methods developed prior to implementation of the trial.

North Collection Channel – This 2-ha tailings deposition area near the North Collection channel will be used to test the ability of vegetation to establish on a cover of OVB, or OVB and surface soil, placed on NAG waste rock and OVB slurried over PAG tailings (see Section 4.2.2, Landform Design and Erosion Control). Vegetation species from the ESSFmv1-03 site series and, to a lesser extent, vegetation from the ESSFmv1-01 site series, will be planted. This trial will commence in Y+3 and be covered by tailings after five years as the TSF fills. However, information from the first phase of this trial will be incorporated into the second phase, which will begin after construction of TSF D is completed and will last through the majority of the Operations phase.

TSF Beach Cover – This research will help address uncertainty 4 in Table 4.2-8 and describes research that will be conducted to demonstrate that the TSF closure strategy will serve to reduce net percolation and oxygen ingress into unsaturated tailings, as well as generate clean runoff (i.e., runoff with water quality characteristics acceptable for discharge to local receiving environments). The closure strategy assumes oxidation of the tailings beach will be minimized through a combination of saturation with water and placing 70 cm of OVB by truck and dozer on top of 30 cm of slurried NAG waste rock and OVB slurried cover (assuming the surface is trafficable by heavy equipment; see Section 4.2.2, Landform Design and Erosion Control), resulting in a total cover depth of 100 cm. An additional 30 cm of surface soil may be placed over this cover to support revegetation; however, if a membrane WTP is required at closure, soil application on and revegetation of the TSF surface may cause fouling of the treatment membrane, thus, revegetation may not be permitted.

The functionality of the OVB with respect to preventing oxidation and supporting vegetation needs to be assessed with field studies. Research trials will be conducted to refine design specifications for the cover to be placed on the TSF tailings beaches. It is envisioned that field trials can commence within the first three years of operation upon identification of suitable areas within TSF C and/or upstream of the ECD. Test plots can be initiated once mill tailings become available. Test plots will be installed and monitored to evaluate:

- Net percolation and oxygen ingress with varying depths of OVB thickness;
- Net percolation and oxygen ingress with varying degrees of compaction;
- If vegetation can be planted given observed geochemical conditions;
- If OVB is a suitable growing medium or if application of surface soil and/or other organic amendments is required (this will also inform opportunities for varied soil covers to support ecosystem diversity);
- Revegetation prescriptions (i.e., species selection); and
- Element uptake in vegetation.

The trial will also provide an opportunity to assess trafficability of the tailings and test construction approaches for applying cover material to TSF beaches.

Tailings Wetland Trial – This trial will help address uncertainties 10 and 22 identified in Table 4.2-8. Wetlands and wetter site series are projected to decrease on the post-closure landscape compared to pre-mining. Trials to create such ecosystems on tailings are proposed to occur initially at the greenhouse and/or mesocosm scale, with further research scaled up, if appropriate, depending on the results. The trial will evaluate:

- Geochemical characteristics of the tailings and pore water;
- The potential for tailings to retain sufficient water to support vegetation characteristic of wetlands and or wetter site series (e.g., subhygric to hydric SMRs);
- Revegetation prescriptions; and
- Vegetation element uptake.

4.2.5.2 Whitebark Pine

Trials and monitoring for whitebark pine commenced during exploration work and are scheduled to continue throughout construction and operations to inform reclamation practices during closure and provide ongoing assessments of the health of whitebark pine on Mount Davidson. This research is being conducted to help address uncertainty 14 in Table 4.2-8. The ongoing trials and monitoring being conducted on Mount Davidson are described below. In addition to existing trials, proposed trials that include whitebark pine are discussed in Section 4.2.5.1, Vegetation and Cover Trials.

White Pine Blister Rust Monitoring

Permanent health transects were established in 2013. The data collected in the inventory plots provides data to support ongoing assessments of stand health and identify changes to whitebark pine health and survival related to white pine blister rust. The transects will be re-measured prior to construction and every five years throughout operations. The timeline for re-measurement may be decreased based upon trial results.

Mountain Pine Beetle Monitoring

During white pine blister rust monitoring, mountain pine beetle (MPB) (*Dendroctonus ponderosae*) incidence will be monitored. This will inform the use of verbenone patches, if required, to address effects of MPB on whitebark pine.

White Pine Blister Rust Resistance Screening Trials

Whitebark pine screening rust trials have been initiated using two separate screening programs to assist in intensive screening. Seed from one tree has been sent to the United States Department of Agriculture screening program in Coeur d’Alene in 2014, and seed from four trees (30 seeds per tree) were sent to the Ministry of Forest Lands and Natural Resource Operations program at Kalamalka in 2016. Results from these trial programs will not be known for three to five years (Moody and Clason 2016).

Whitebark Pine Reclamation Trials

Reclamation trials were initiated in 2016 on Mount Davidson (Whitebark trial area in Table 4.2-9) to determine the suitability of reclaimed material and soils for whitebark pine reclamation. Three hundred seedlings were planted on 12 reclamation plots (25 seedlings /plot) on two slope positions on OVB or undisturbed soils (Moody and Clason 2016). Visits were made to several reclamation sites during 2018 reclamation program (Avison 2018). Several sites of whitebark pine seedling plantings in the areas of highest elevation on Mount Davidson were visited. It was anecdotally observed that the specimens planted in disturbed (machine-reclaimed) areas seemed more robust and more likely to have survived than those planted in the undisturbed soil (Avison 2018). At the time of these observations, the seedlings had survived through two full seasons since their planting in September of 2016.

Planting whitebark pine is proposed during mine reclamation on dry to mesic sites related to mine infrastructure that will be reclaimed in the ESSFmv1. Based on the results of the reclamation and rust screening trials, BW Gold will consider the reclamation potential of historic exploration areas in the ESSmv1 and ESSFmvp for future reclamation work.

The existing and additional whitebark pine reclamation trial areas (Existing Camp and Lower Waste Stockpile; Table 4.2-9) will be monitored during operations and remeasured for seedling growth (height) and health every five years until closure. Monitoring will continue throughout operations (Table 4.2-9). The timeline for re-measurement may be changed based upon trial results.

Whitebark Pine On-site Nursery

A whitebark pine nursery will be established either on the mine site or in one of the nearby communities to grow seed collected from the local area and adapted to local climatic conditions. These seedlings will be used in reclamation planting. The location of the nursery has not yet been confirmed.

Reporting

BW Gold will report on the trials and monitoring, and share this information with relevant agencies and stakeholders to ensure that the dissemination of the findings assists in meeting the goals of the *Recovery Strategy for Whitebark Pine in Canada* (ECCC 2016). During monitoring, additional factors affecting whitebark pine will be noted, such as MPB beetle attacks. Reporting will be included in the annual reclamation report.

4.2.5.3 Use of Wetlands to Treat Water

This research will help address uncertainty 24 in Table 4.2-8 and describes research planned to investigate if wetlands can be used for post-closure water treatment. The proposed closure water management strategy is to treat contact water on site for sulphate, ammonia, and certain metals. The treatment technology proposed is nanofiltration, which includes a brine by-product. In the very long-term, it would be better to have a more passive system to support all of end land use objectives.

Although a specific area has not yet been designated for reclamation research, wetland trials will be conducted within TSF C and upstream of the ECD during operations to assess:

- The ability of wetland systems to remove PCOCs;
- The uptake of PCOCs by wetland vegetation;
- Operational costs for managing wetlands; and
- Hydrologic and hydraulic limitations for wetland treatments.

Laboratory trials can commence during early operations once tailings pond supernatant becomes available. Field trials can commence within first three years of operation in suitable area(s) identified within TSF C and/or upstream of the ECD. Results from research trials will help guide the approach to constructing both passive treatment wetlands and habitat-focused wetlands on the post-closure landscape.

4.2.5.4 Pit Lake Water Treatment

This research expands on uncertainty 25 in Table 4.2-8. Treatment of Pit Lake water *in situ* offers a potentially effective means to reduce soluble metal concentrations, thereby reducing loadings to the WTP and local groundwater system through seepage pathways. In-pit treatment may be conducted during the filling period and/or in the long term (when the pit is at maximum operating water level). The proposed closure water management strategy includes treating pit lake water before it is discharged to Davidson Creek and managing the pit lake surface water elevation. In the long-term, Pit Lake water treatment will reduce reliance on the membrane WTP. The objective of this research will be to demonstrate if and how amendments can be added to the Pit Lake to reduce concentrations of potential contaminants of concern (PCOC) from the surface layer of the Pit Lake.

In-pit treatment options include both biological and chemical methods. The *in situ* bioremediation of mine site pit lakes typically involves the addition of organic matter and/or nutrients to create conditions conducive to contaminant removal. This form of remediation removes metals from the surface layer through a two-stage process: (1) phase transfer from dissolved to particulate via algal assimilation and/or adsorption to organic surfaces; and (2) particle agglomeration and settling. The *in situ* bioremediation of pit waters has been applied at full scale for a number of sites world-wide to treat a spectrum of metals and metalloids (McCullough 2008; Wielinga 2009). Chemical methods involve the addition of inorganic reagents to promote metal removal through adsorption and/or precipitation. Chemical amendments applied at full scale in pit lakes include lime, ferric salts, and alum (Serediak et al. 2002, Delgado et al 2016).

The time scales of pit filling (greater than 25 years) offer the ability to conduct field trials during the filling period. Specifically, whole-lake experiments and/or discrete manipulations of the water column using mesocosms could be used to address the following:

- The ability of algae to proliferate in response to nutrient addition;
- The magnitude of metal removal in response to biological and chemical amendments;
- The best means to distribute the amendment to the Pit Lake; and
- The potential for generation of harmful by-products in response to in situ treatment.

Field trials can commence within the first three to five years in the Post-closure phase once a pit lake of suitable size has formed. Results from research trials will help guide the approach to inform the design and merits of full-scale application.

4.2.6 Reclamation Monitoring

The primary objective of the reclamation monitoring program is to track reclamation development trajectories over time and compare these trajectories to selected success criteria based on data from reference ecosystems.

Details of the monitoring plan, including criteria and indicators of reclamation success and associated measures and thresholds will be developed as more detailed reclamation planning and implementation is conducted, and based on ongoing collaboration with Aboriginal Groups. The reclamation research and monitoring programs will be integrated into the overall design.

4.2.6.1 Reclamation Material Monitoring during Salvage and Stockpiling

Physical properties of mine waste (e.g., tailings and waste rock) and reclamation-materials (e.g., salvaged soil and OVB) will be determined through *in situ* sampling. Ongoing sampling of reclamation-material stockpiles during salvage will assist in capturing the range of variability in material properties. These data will be used to update the ecohydrological modelling and, if necessary, re-evaluate reclamation cover designs and the reclamation-material balance.

A minimum sampling intensity of one sample for every 50,000 m^3 of salvaged surface soil is recommended on average over the life of mine, with higher-intensity sampling occurring during early salvage operations to address any uncertainties regarding surface soil properties, followed by a decrease in sample intensity over time as confidence in surface soil properties increases[31]. For OVB, the sampling intensity should be determined by intended final usage for reclamation; materials buried deeply in stockpiles that will not be used for reclamation (e.g., the base/interior of the waste stockpiles) do not require sampling, whereas OVB that is likely to be either in the outer 2 m of final reclaimed stockpiles (i.e., in or near rooting zones) or is scheduled to be placed on the surface of other mine facilities (e.g., the TSF beaches and dams) should be sampled at same intensity described for surface soil above. Samples will be analyzed for the parameters in Table 4.2-10, and one in five samples should be sent for extra testing as indicated in the ‘subset’ column. The properties to be tested include PSD, OM and total Kjeldahl nitrogen, which are the required inputs for AWSC calculations. If potential issues are detected in any of these tests, then sampling intensity may be increased, as guided by a qualified professional.

[31] This sampling intensity corresponds to 29 glaciofluvial surface soil samples, 60 mixed-mineral surface soil samples, and 17 organic surface soil samples.

Table 4.2-10: Soil Properties to be tested during Soil and OVB Salvage

Soil Property	Tests to Perform		Suitability Criteria	Notes
	All Samples	Subset[1]		
Particle-size distribution	100, 5, 2, 1, 0.5, 0.25, 0.1, 0.05, 0.002 mm		Mixed-mineral surface soil: coarse fragments (> 2 mm) less than 60% OVB: coarse fragments > 100 mm and > 25 mm will be less than 5% and 20%, respectively.	Input for AWSC calculations. Coarse fragment thresholds should be re-evaluated as data from salvage and mine wastes become available.
Organic matter content	Loss on ignition		No criteria required; data should be collected for baseline information and to build datasets for ecohydrological modelling.	Input for AWSC calculations. If inorganic carbon is suspected due to mineralogy, testing should be done by Walkley-Black method.
Nutrients	Total Kjeldahl nitrogen	Olson available phosphorus	No criteria required; data should be collected for baseline information and to build datasets for ecohydrological modelling.	Input for AWSC calculations. Fertilization can supplement low soil nutrients during early establishment.
Soil chemistry		pH, electrical conductivity	OVB pH: 4.5-8 OVB EC: <1 dS/m	Criteria apply to OVB only.
Element concentrations	Standard metals (Al, B, Ca, Cu, Fe, K, Mg, Mn, Mo, S, Zn) + trace metals (Ag, As, Ba, Be, Cd, Co, Cr, Hg, Ni, Pb, Se, Sn, Sr, U, V)[2]	(Refer to note 2)	OVB: Element concentrations below CCME thresholds for parkland soils (or alternate Project-specific criteria)	Element concentration thresholds should be re-evaluated as operational data become available.

[1] *The subset of tests is to be performed on one in five samples.*

[2] *Initially, all samples should be tested for the full suite of metals to determine whether any specific metals are frequently elevated in reclamation materials. As reclamation materials are characterized more thoroughly, the metals analysis can be reduced to standard metals plus any trace metals that are frequently elevated above suitability criteria, as guided by a qualified professional.*

4.2.6.2 Permanent Sample Plots

To assess the success of reclamation and compare the trajectory of reclaimed sites relative to baseline and reference conditions, permanent sample plots will be established on site in reclaimed areas and at reference locations offsite.

Permanent sample plots (PSP) will be installed in reclaimed areas as soon as they are established to track ecosystem development over time. Reference plots will be installed early in the Operation phase to support the development of success criteria to evaluate reclamation on the mine site. The site series projected to occur on the post-closure landscape will be targeted for reference locations. Site selection will target recently disturbed reference sites, where possible, to provide insight on successional trajectories.

On reclaimed areas, the target plot density will vary over time as reclamation progresses. Beginning at a density of one plot per 2 ha for a recently initiated reclamation treatment (e.g., glaciofluvial surface soils with a target site series of SBSmc3-03), monitoring plot density will decrease over time to a long-term density based on reclamation success assessment and adaptive management outcomes. It is important to have a higher density of plots in early reclamation phases as these early data can help improve practices for later reclamation. Plot densities will be reduced as more area becomes reclaimed, to spread data collection across all reclaimed areas. Plots can also be dropped from the monitoring schedule as they meet reclamation success criteria.

On-site plots will be visited following reclamation in Y+1, +2, +3 and +5 and every five years thereafter, to capture potential rapid changes in vegetation during early establishment, allow for early intervention if required, and measure vegetation development trajectories over time. Reference sites will be visited at 5-year intervals. Monitoring will continue post-closure until monitoring criteria have been achieved and agreed-upon reclamation objectives met.

The following data will be collected at each PSP:

- **Site characteristics (elevation, aspect, coordinates, etc.)** – Contributes to SMR and SNR designations; site notes may offer explanations for the relative success of the site.
- **Soil profile description and sampling** – Including soil placement depth, particle-size distribution, and chemistry data required to calculate soil properties (e.g., AWSC, SMR, SNR, soil fertility). When a PSP is installed, a soil pit will be dug to 1 m, surveyed by standard methods (BCMOE 2015), and sampled for laboratory analysis of PSD and nutrients. Ongoing monitoring of reclamation soils can be relatively minimal, consisting of observational data collection on the extent of erosion over time, as well as decadal sampling for organic matter content and nutrients. Further soil monitoring is not expected to be necessary except in areas where growth issues are observed or any contamination is suspected, which shall be determined by qualified professionals.
- **Vegetation cover** – Estimates of percent cover by species to provide information on changing species compositions, proportion of native and exotic species covers, species richness, and diversity.
- **Forest characterization –** Estimates of tree densities, mensuration, and site index to provide information on forest stand development, as appropriate.
- **Soil and forage tissues chemical composition** – Forage species and soil will be tested for element concentrations. Soil samples will be collected at the time of plot installation. Additional samples may be collected over time to determine if dust from TSF beaches or other mine-related sources is being deposited on the surface of reclaimed areas at rates that cause changes in soil element concentrations. Vegetation tissue samples will be collected and tested for element concentrations at each visit, provided that plants are large enough to allow sample collection without substantial negative impacts to the sampled individuals. These samples will be used to determine whether any element concentrations present in forage vegetation are potentially harmful to wildlife (Section 4.3, Trace Element Uptake in Soils and Vegetation).

Additional solid-phase ML/ARD monitoring is not required during reclamation and closure as all disturbed material would have been previously characterized during operations as per the ML/ARD Management Plan (Appendix 9-D). Waste rock and tailings will be submerged under water cover or covered by OVB. Any OVB used for reclamation must be classified as NAG with low ML potential.

A detailed description of measures that could be assessed and used to develop reclamation success indicators is provided in Appendix 4-G.

4.2.6.3 Water Quality Monitoring

The Mine Site Water and Discharge Monitoring and Management Plan (MSDP Appendix 9-E) and Aquatic Effects Monitoring Program (AEMP Appendix 7-A) describe water quality monitoring during the Construction, Operations, Closure and Post-closure phases, which are expected to provide an indication of the effectiveness of reclamation activities.

At a minimum, surface water quality monitoring locations as listed in Table 7.3-1 of the MSDP will include but are not limited to:

- Seepage from toes of Upper and Lower Waste stockpiles;
- TSF ponds;
- TSF ditch systems;
- ECD; and
- Pit Lake.

The following parameters will be measured:

- pH and conductivity (field and laboratory);
- Alkalinity;
- Anions (sulphate, chloride, bromide, fluoride);
- Nitrogen species (nitrate, nitrite, ammonia);
- Cyanide species (total Cyanide, Weak Acid Dissociable Cyanide); and
- Total and dissolved metals.

EAC Condition 26 (Water Quality Management) requires:

> a) *During Construction, Operations, Closure, and Post-Closure, the Holder must ensure the Project does not cause downstream water quality to exceed BC Water Quality Guidelines, unless the Holder has developed and ENV has accepted one or more Science Based Environmental Benchmarks (SBEBs), in which case the accepted SBEB must not be exceeded. Downstream water quality includes water quality in, at a minimum, Davidson Creek and Creek 661, as monitored in accordance with paragraph (d) of this Condition.*
>
> b) *If the Holder develops SBEBs, these must be developed:*
>
> *i) in consultation with ENV and Aboriginal Groups;*
>
> *ii) in accordance with ENV's "A Framework for the Development and Use of Freshwater Science-Based Environmental Benchmarks for Aquatic Life in Environmental Management Act Permitting for Mines" (March 2016, or as updated or replaced from time to time); and*
>
> *iii) in consideration of Yinka Dene Water Law (YDWL) for Davidson Creek, and in consideration of any other water policies from Aboriginal Groups made available to the Holder for Davidson Creek and/or Creek 661;*
>
> *and submitted to the EAO, ENV and Aboriginal Groups within the time set out in Condition 10, the Document Submission Plan.*

Any SBEBs developed for closure and post-closure must meet this condition.

4.2.7 Habitat Compensation Works

In accordance with the federal DS and Certificate issued for the Project, compensation/ offsetting plans have been prepared to mitigate Project impacts to fish and fish habitat (DS Condition 3.11), wetlands (DS Condition 5.3 and EAC Condition 24) and southern mountain caribou (DS Condition 8.18 and EAC Condition 22). Summaries of these plans are provided below.

4.2.7.1 Caribou Offsetting Plan

The Project mine site overlaps the eastern boundary of the Tweedsmuir local population unit of mountain caribou (Rangifer tarandus caribou; BC FLNRORD 2020). The local population unit (LPU) is listed as threatened under Schedule 1 of the *Species at Risk Act* (Government of Canada 2021), a special concern by Committee on the Status of Endangered Wildlife in Canada, and blue-listed by the province (BC CDC 2020). A summary of baseline caribou data is provided in Section 2.10.3.9, Species at Risk and residual effects assessment is provided in Section 6.5, Terrestrial Environment -Terrestrial Ecosystems of this Application.

BW Gold has developed a Caribou Mitigation and Monitoring Plan (CMMP) to avoid, reduce, and offset the Project's adverse effects on caribou and its critical habitat as defined in the Recovery Strategy for the Woodland Caribou, Southern Mountain population (Rangifer tarandus caribou) in Canada (Environment and Climate Change Canada (ECCC 2014). The CMMP has been developed in consultation with FLNRORD, ENV, EMLI, ECCC, and Indigenous Nations and was submitted on August 12, 2021. The CMMP is under review by applicable Indigenous Nations and regulators. On October 8, 2021, EAO issued a letter to BW Gold directing that an updated CMMP be submitted no later than 60 days prior to the start of construction.

In its August 12, 2021 CMMP, BW Gold followed the mitigation hierarchy to reduce potential effects on caribou, including (1) avoid, (2) minimize, (3) mitigate, and (4) restore. After following the mitigation hierarchy, BW Gold concluded there would be a residual effect of habitat loss and alteration for caribou, but that this effect would be not significant (negligible) for the Tweedsmuir caribou herd. The contribution of the Project to cumulative effects on winter habitat for caribou is assessed as not significant (negligible). The confidence is high because the area of habitat loss and alteration is small (<0.35%) in relation to the LPU and the unoccupied habitat around the Project is isolated from other occupied areas of habitat, separated by a large swath of disturbed habitat supporting predators. Based on the satellite collar data collected between 1983 and 2020 (see Section 2 of the CMMP), there is low evidence of use of the mine site by caribou historically (when caribou numbers were high) and currently, there is low potential for future use even without the Project. Time series modelling, which was completed as part of the cumulative effects assessment, predicts a steady state of 80% undisturbed low elevation winter habitat available to caribou after the 2050s for the foreseeable future. The contribution of the Project is negligible to these pre-existing effects, and the characterization of the potential residual effects is therefore the same with or without the Project. This conclusion, derived using ECCC methodology, is consistent with those made in the Application / EIS, and with supplemental analyses provided in September 2016 and March 2018. As a result, it is concluded that the Project will not affect habitat supply for caribou over the short term and will not affect habitat supply or recovery targets over the long term. These conclusions also support the finding that the Project will not contribute to ongoing population decline or impede future potential for recovery. These conclusions are made with high confidence because they are supported by over 30 years of telemetry data, habitat modelling conducted during the environmental assessment review using federal definitions of critical habitat that was also verified by provincial habitat supply models.

While BW Gold acknowledges potential uncertainty, the weight of evidence indicates that the Project will not interact with caribou or consistently occupied caribou habitat. This result notwithstanding, BW Gold recognizes that the Project will have a residual effect on caribou habitat in the Tweedsmuir LPU and concerns that underscore recent declines, primarily associated with natural disturbances and forestry across the Tweedsmuir LPU. As a result, BW Gold is taking a conservative approach and proposing a habitat securement-based offsetting plan for caribou habitat as well as non-habitat measures as described in the August 12, 2021 CMMP.

As part of the habitat-based offsetting measures, BW Gold committed to offset for impacts at an offsetting ratio of 5:1. The habitat-based offset is proposed to include a land securement within BW Gold's mineral tenures and restoration within the land securement. The proposed habitat securement offset location was selected from eight candidate offset locations/polygons within BW Gold's mineral tenures which were proposed in a framework during the EA. The non-habitat measures are not intended to specifically address the Project's residual effects on caribou habitat loss and alteration, but rather act as a commitment by BW Gold to collaborate on caribou stewardship initiatives with Indigenous Nations and provincial and federal governments.

4.2.7.2 Fish Habitat Compensation and Offsetting Plans

The Blackwater Project will require an Authorization under section 35(2)(b) of the *Fisheries Act,* and a Schedule 2 amendment of the *Metal and Diamond Mining Effluent Regulations* (MDMER, under section 36 of the *Fisheries Act*). Fisheries and Oceans Canada (DFO) administers section 35 of the *Fisheries Act* and Environment and Climate Change Canada (ECCC) oversees the Schedule 2 amendment process.

Two separate fish habitat compensation/offsetting plans are required as follows:

- Fish habitat offsetting plan to offset the harmful alteration, disruption and destruction of fish habitat and death of fish associated with proposed Project works, undertaking or activities (e.g., development of Project infrastructure and alteration of flows).
- A fish habitat compensation plan to offset the loss of fish and fish habitat due to the deposition of deleterious mine waste into fish bearing waterbodies. A Schedule 2 amendment of the MDMER would designate portions of Davidson Creek, unnamed tributaries of Davidson Creek, and portions of Creek 704454 and Creek 668328 as Tailings Impoundment Areas.

Fish habitat compensation/offsetting measures are designed to address known limitations to fisheries productivity in the affected watersheds.

The Blackwater Fish Habitat Offsetting Plan includes the following measures:

- Channel restoration and enhancement of fish habitat to address impacts from cattle-trampled banks and stream bed, historic riparian vegetation clearing, dilapidated crossings, exposed banks, and flow obstructions/impediments at Murray Creek and Greer Creek. Construction of two off-channel ponds to help address the availability of overwintering habitat as a limiting factor for rainbow trout abundance in the study area, including at Creek 661 Upper Pond; and Mid-Mathews Pond 2. The FWR will function to augment flows in Davidson Creek downstream of the Project, and thereby offset the loss of habitat in Davidson Creek that would otherwise occur from development of the project in the upper catchment and subsequent reduction in catchment area. Creation of a connector channel between Lake 16 (the headwater lake of Davidson Creek) and Lake 15 (to the west of Lake 16) to offset the loss of fish habitat in upper Davidson Creek, and provide additional habitat for the rainbow trout population in Lake 16 which would otherwise become isolated.

The Blackwater Fish Compensation Plan includes the following measures:

- Further, the Blackwater Fish Habitat Compensation Plan includes measures to offset instream and riparian habitat loss: (1) Mathews Creek channel restoration/enhancement; and (2) Mathews Creek off-channel pond creation (Palmer 2021).

4.2.7.3 Wetlands Management and Offsetting Plan

EAC Condition 24 and DS Condition 5.3 require BW Gold to develop a wetlands management and offsetting plan prior to construction, in consultation with Indigenous groups, FLNRORD and ECCC. The plan is intended to offset the Project's impacts on wetland functions during the Construction, Operations, and Closure phases. The development of the plan must take into account Canada's Federal

Policy on Wetland Conservation (Government of Canada 1991), Canada's Operational Framework for Use of Conservation Allowances (Environment Canada 2012), and habitat needs for migratory birds, moose (*Alces alces*), and listed species at risk.

BW Gold has followed the environmental mitigation hierarchy of avoidance, minimization, restoration, and offsetting to identify mitigation measures (BC MOE 2014a, BC MOE 2014b). As required by DS Condition 5.1, BW Gold has avoided the loss of wetlands and wetland function over minimizing adverse effects on wetlands over compensating for lost or adversely affected wetlands where possible. Measures to mitigate wetland impacts have taken into account British Columbia's Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia (Cox and Cullington 2009), and Riparian Management Area Guidebook (BC MOF 1995).

BW Gold has undertaken pre-construction wetland surveys within the EAC CPD boundary (with the exception of the transmission line which was surveyed in 2017) during the summer and fall of 2021 to fulfill DS Condition 5.5.1. The survey objectives were to confirm the absence of red-listed or blue-listed wetlands and assess wetland type, function, and extent. As required by EAC Condition 24(b) (Wetland Management and Offsetting Plan), these results will be used to confirm the wetlands lost or altered on the mine site and to provide a detailed description of each wetland. This description l included an assessment of each wetland and wetland function that would be lost or altered (Mackenzie and Moran 2004) and the location and extent of these wetlands in relation to the local watershed. The Wetland Management and Offsetting Plan (WMOP) is in the process of being updated in Q4 2021 to incorporate the 2021 survey results, produce wetland mapping, and update the wetland balance. There is also a plan and commitment to undertake an additional field season in 2022 to identify additional offsetting sites and make further updates to the WMOP.

The Mathews Creek wetland complex was selected as the main offsetting site because there has been intensive agriculture and livestock grazing for the past 50 years which has resulted in degradation of the natural wetland ecosystem. Wetland disturbance along the middle reaches of Mathews Creek, due to cattle ranching, drainage, and hay production have resulted in lowered water tables, altered wetland vegetation, soil rutting, and erosion of riparian areas.

4.3 Trace Element Uptake in Soils and Vegetation

This section provides a high-level summary of Blackwater's trace element uptake in soils and vegetation program; details are provided in Appendix 4-H.

Trace elements such as metals, are naturally occurring in soil and other sub-surface geological materials. Soil metal concentrations can be affected by Project-related activities through the deposition of dust (particulate matter) containing metals, through waste rock and tailings deposition, and through spills during mining-related activities. Metal concentrations in plant tissues can be affected by the deposition of dust generated by Project activities, and can be accumulated from the soil through uptake of metals through their roots.

To quantify pre-construction trace element (metal) concentrations in soil and vegetation, baseline sampling was conducted in 2011 and 2012, and again in 2021. During the 2011 and 2012 years, soil and vegetation samples were collected from 46 sites both within and outside the CPD boundary and analysed for a suite of trace metals. The baseline trace metals program was expanded in 2021 to include edible berries, medicinal plants, and wildlife forage species (soopolallie, black huckleberry, blueberry, Labrador tea [*Rhododendron greonlandicum*], willow, and sedge (wetland areas). Results of the updated baseline sampling are not yet available, but a cumulative baseline report that includes data from all soil, plant, and berry samples from 2011, 2012, and 2021 will be prepared, including statistical summaries, early in 2022, subject to data availability.

Monitoring of trace element uptake in soils and vegetation during the Construction, Operations, and Closure phases will include sampling programs both within the mine site as part of the Reclamation Monitoring Program and in areas surrounding the mine site (defined as the areas outside of the CPD boundary, which is equivalent to the mine disturbance footprint). The objectives of the trace element monitoring in soil and vegetation are described below.

For the reclamation monitoring program (within the mine site):

- To establish baseline concentrations of trace elements in cover materials recently placed in reclaimed areas of the mine site;
- To monitor potential effects of windblown dust transported from mine-related dust sources on the concentrations of elements in soil and vegetation in reclaimed areas; and
- To determine the degree to which metals accumulate in specific plant species proposed for use in reclamation, with the intent to use these data to guide the selection of appropriate species for use in revegetation during reclamation and closure.

For the CFMP (outside of the CPD boundary):

- To determine whether concentrations of metals have changed in soil or vegetation tissue because of Project activities; and
- To determine whether concentrations of metals measured in the future are within the range expected based on predictive modelling completed to support the human health risk assessment (HHRA) appended to Chapter 6, Environmental Assessment Predictions of the Application (Appendix 6-A).

For both programs:

- To determine if the metal concentrations measured in soil or vegetation will be suitable for achieving end land use objectives; and
- To confirm that metal concentrations measured in soil or vegetation tissue will not adversely affect vegetation, wildlife, or human health.

The objectives listed above will be achieved by robust soil and vegetation sampling programs. Outside of the CPD boundary, sampling at near-field, mid-field, and control (reference) sites will be completed under the CFMP at a frequency of one to three years, depending on sampling results, as described in Appendix 4-H. Within the CPD boundary, permanent sample plots will be established in reclaimed areas throughout the site in the revegetation monitoring program (Section 4.2.6.2, Permanent Sample Points) and vegetation will be sampled until the reclamation success criteria are achieved (possible success criteria are provided in Appendix 4-H).[32] Soil samples will be collected from the surface and at regular intervals down the soil profile when the permanent sample points are initially established, with further soil samples collected as required to characterize any dust deposition. Target vegetation species will be synchronized between reclaimed areas and outside the CPD boundary where possible and/or selected based on evidence of wildlife browsing.

Appendix 4-H provides greater detail on baseline data, potential sources of metal contamination, sampling locations and frequencies, and sampling methods. Results and adaptive management responses for sampling within the mine site will be reported in the Annual Reclamation Report in each year that data are collected, while sampling outside of the CPD boundary will be reported in the CFMP reports.

[32] Soil samples will be collected throughout the soil profile during Permanent Sample Plot installation, with additional sampling directed by a qualified professional if dustfall may have occurred.

4.4 Contaminated Sites and Human Health and Ecological Risk Assessment

The Project is proposed at a greenfield site where there are no existing operations or historical workings. Pre-existing activity has been restricted to exploration and geotechnical site investigations. Annual reports on exploration activities under existing MX permits have reported no spills of hazardous materials. Accordingly, there are no recorded or suspected areas of anthropogenic contamination that would make any areas within the Application area subject to the BC CSR.

Once mining operations end and before the Project can be considered closed, any areas of known or suspected contamination need to be identified and remediated, removed, or otherwise resolved (e.g., through human health and ecological risk assessment). Although some components or infrastructure associated with the mine site may not be subject to the BC CSR, the policies and technical guidance developed by BC ENV to support the CSR can still be used to guide site investigations and closure plans for the mine site. The overall objective is to ensure that end land use objectives are met and there are no areas of environmental concern or parameters of concern (POC) that could pose a risk to human or ecological receptors in the long term.

Components and infrastructure for the Project that could be sources of POCs include:

- Open Pit and dewatering system;explosives manufacturing facility; process plant and associated facilities (mill, reagent, adsorption, primary crusher, cone crusher and screen, and gold room); TSF, spillways, and TSF seepage collection system, including the ECD;waste stockpiles;LGO, including diversion channel, low permeability foundation, and seepage collection system;contact water management infrastructure;water treatment plants, ponds, pumps and piping;borrow areas and quarries; sewage treatment system, incinerator (existing), and solid waste facilities;haul and service roads and the MAR, including vehicle or equipment use; andhydrocarbons, hazardous materials, or other industrial wastes that are used, stored, or produced within the mine site (see Table 4.5-1).

In addition to parameters of potential concern[33] (POPCs) from products in Table 4.5-1, there is the potential for mining-related POPCs such as metals, anions, or nitrogen-containing blasting residues to be released from the Project within the mine site and into the surrounding environment due to Project activities or discharges.

Key potential sources of POPCs and transport pathways to outside the mine site were described in the conceptual site model for Construction and Operations phases (Section 5.10, Conceptual Site Model and Appendix 5-I, Conceptual Site Model report). The CSM included identification and description of sources and transport pathways for Project-related POPC, relevant biological receptors, exposure media, and exposure pathways for biological receptors or ecosystems, with the primary focus on areas outside of the mine site (Section 5.10, Conceptual Site Model and Appendix 5-I, Conceptual Site Model report). However, the CSM (Section 5.10, Conceptual Site Model and Appendix 5-I, Conceptual Site Model report) was used to guide the effects assessments for biological receptors (Chapter 6, Environmental Assessment Predictions) and did not consider future areas of potential environmental concern or POPCs within the mine site that would not be accessible to receptors during Construction or Operations phase.

The CSM in Appendix 5-I will be updated and refined to support closure and reclamation planning using results of monitoring programs conducted within the mine site (e.g., MDSP, Appendix 9-E), the operational history of site contamination incidents during Construction and Operations phases, and site investigations. The CSM will need to be updated throughout the LoM to reflect the actual mine site

---

[33] BC ENV Contaminated Sites Division often uses the terminology “potential contaminants of concern (PCOC)”, while the CSM in Section 5.2 of the Joint Application uses the terminology “parameters of potential concern (POPC)” which is used by BC ENV Environmental Protection Division. These terms have the same meaning and, for consistency with the CSM in Section 5.2, POPC is used here.

conditions at closure regarding types or sources of Project POPCs, transport pathways, receptors of concern, or operable exposure routes. The updated CSM can guide adjustments to monitoring programs needed to support closure planning (e.g., to address uncertainties), the site investigations within the mine site in the Closure and Reclamation phase, as well as provide a foundation for human health and ecological risk assessment if one is required.

During the closure phase, a site investigation (Stage 1 preliminary site investigation and if necessary, Stage 2 detailed site investigation; BC ENV 2016a, 2016b) will be completed to identify any areas of environmental concern where concentrations of parameters are greater than the standards prescribed under the BC CSR (BC ENV 2009). The BC CSR includes standards for soil, groundwater, and surface water quality for various categories of land use and different biological receptors. The applicable standards will be based on the proposed end land and water use(s) for the Project.

If concentrations of POPCs are found to be higher than the applicable BC CSR standards (or are higher than background concentrations, when background is higher than the applicable BC CSR standard), the parameter will be identified as a POC. Additional site reclamation, remediation (e.g., removal of contaminated environmental media, onsite or in situ treatment), and/or human health and ecological risk assessment may be required to further characterize or address the areas of environmental concern.

By the end of the Closure and Reclamation phase, any areas of environmental concern are expected to be addressed through remediation and/or risk assessment to ensure that biological receptors are protected from the potential for adverse effects in the long term and that end land use objectives can be met.

4.5 Disposal of Chemicals, Reagents, Hazardous Materials, and Contaminated Materials

Prior to Closure, mine site employees will undertake an inventory of chemicals, reagents, hazardous materials, and contaminated materials that remain on site. During the ramp down process, these materials will be consumed, with the intent of having the correct amount of reagent to process remaining ore and other substances to support this activity. At Closure, any remaining materials that require disposal will returned to the supplier, recycled, or taken to an authorized disposal facility. Strategies for disposal of chemicals, reagents, and hazardous materials from the mine site are presented in Table 4.5-1.

Table 4.5-1: Chemical, Reagent, and Hazardous Material Disposal

Substance	Disposal Method
Diesel	Consume in vehicles used for Closure until tanks are empty; decommission tanks
Jet B Aviation Fuel	Consume in aircraft until tanks are empty; decommission tanks
Motor Oil/ Hydraulic Oil/ Transmission Fluid	Collect and ship to recycling facility
Unleaded Gasoline	Consume in vehicles used for Closure until tanks are empty; decommission tanks
Propane	Consume in mill processing, heating; decommission tanks
Ammonium Nitrate	Return to supplier
Laboratory Chemicals	Individual reagents will require specific disposal according to Safety Data Sheet
Ethylene Glycol	Collect and ship to recycling facility
Sodium Nitrite	Return to supplier
Varsol	Collect for offsite disposal
Automotive Grease	Collect for offsite disposal
Borax	Collect for offsite disposal

Substance	Disposal Method
Carbon	Consume in mill processing
Copper Sulphate	Consume in mill processing
Flocculent	Consume in mill processing & water treatment plant
Grinding Media	Consume in mill processing
Hydrochloric Acid	Consume in mill processing
Quick Lime	Consume in mill processing
Hydrogen Peroxide	Consume in mill processing
Nitre	Consume in mill processing
Silica	Consume in mill processing
Sodium Carbonate	Consume in mill processing
Sodium Cyanide	Consume in mill processing
Sodium Hydroxide	Consume in mill processing
Sulphur Dioxide	Consume in mill processing
Radiation Sources	Package each nuclear source according to regulations and return to a licenced facility
Batteries – Lead Acid	Remove consumed batteries and ship to authorized recycling facility

4.5.1 Contaminated Materials

Contaminated site remediation requirements for mining projects in British Columbia focus on "non-core" mine components (Part 5. Remediation of Mineral Exploration Sites and Mines, Chapter 53, *Environmental Management Act* [2003]). Non-core Project components include, but may not be limited to, the Maintenance/ Truck Shop, storage facilities (including the Bulk Fuel and Ready Line), camps, and the Processing Plant.

There is not expected to be a significant amount of contaminated soils requiring treatment during Closure. Once all structures have been removed, soil samples will be collected and tested by a qualified professional at locations where fuel and chemicals were handled extensively during construction and operation. Any areas found to have contaminated material will be cleaned up, potentially requiring excavation of material. In areas of contamination from spills, Part 4 of the *Environmental Management Act* (2003) may apply.

4.6 Groundwater Well Decommissioning

Groundwater well decommissioning is described in Appendix 4-I.

4.7 Reclamation and Closure Prescriptions

The reclamation and closure prescriptions described in this section have been developed in accordance with Section 10 of the Code to support the end land uses described in Section 4.1, End Land Use and Capability Objectives. Cover designs and planned ecosystems have been developed through ecohydrological modelling (Section 4.1, End Land Use and Capability Objectives; Section 4.2.1, Soil Resources; Section 4.2.3, Revegetation Strategy). This section presents detailed reclamation prescriptions for the key mine components and infrastructure based on the overarching reclamation approaches presented in Section 4.2, Reclamation Approaches. Ongoing reclamation research (Section 4.2.5, Reclamation Research) and monitoring (Section 4.2.6, Reclamation Monitoring) will inform refinement of detailed prescriptions over the LoM. For example, revegetation research results will be integrated with reclamation sequencing to support landscape-level planning, such as creating greater heterogeneity of ecosystems and incorporating considerations of habitat patch size and connectivity.

4.7.1 Schedule

The general scheduling approach to reclamation and closure for this Project is to:

- Conduct progressive reclamation and reclamation research where possible during Construction and Operations phases (Y-2 to Y+23);
- Document the status of mine site disturbance, reclamation, reclamation materials inventory, research trials, monitoring programs, and other related results in the Annual Reclamation Report;
- Provide updated five-year detailed Mine Plans with updated closure cost estimates;
- Implement final reclamation and closure measures at the cessation of mine operations and after decommissioning mining infrastructure (Y+24 to Y+25), beginning in the Closure phase (Y+24 to approximately Y+45, when the Open Pit has filled) and continuing into the Post-closure phase (Y+46 and onwards);
- Implement post-closure water treatment, as required, to achieve water quality objectives; and
- Complete post-closure monitoring to demonstrate that closure end land use objectives have been achieved.

Progressively more detailed reclamation and closure schedules will be developed as cessation of operations approaches, as the level of design and operating detail increases, and as data from progressive reclamation and reclamation research become available. A high-level sequence of reclamation and closure events during Construction, Operations, Closure, and Post-closure phases is illustrated in Table 4.7-1.

Table 4.7-1: Reclamation and Closure Schedule

Year	Reclamation Event
Y-2 to Y+18	Surface soils are salvaged from the project footprint and stockpiled Limited progressive reclamation, vegetation treatment used to stabilize exposed soils Metals and membrane WTP stop operating in Year 18, metals WTP decomissioned
Y+11	Reclamation begins on the Lower Waste Stockpile
Y+19	Reclamation begins at: ■ Upper Waste Stockpile ■ Reclamation begins at ex-pit haul roads Reclamation of explosives storage facilities
Y+24	Reclamation maintenance, if needed, at: ■ Upper and Lower Waste stockpiles ■ Ex-pit haul roads ■ Explosives storage facilities Reclamation begins at LGO Stockpile Decommissioning of Processing Plant begins
Y+25	Reclamation begins at: ■ Helipad ■ Truck shop/mine dry/office ■ Ready line and bulk fuel storage Decommissioning of Processing Plant is completed Ongoing reclamation monitoring and maintenance

Year	Reclamation Event
Y+26	Reclamation begins at: ■ Processing plant ■ Camp facilities ■ Construction laydown areas ■ Waste management facilities ■ Potable and fire water supplies ■ Operation and maintenance of roads needed for the Closure phase, decommissioning and reclamation of other roads ■ Operation and maintenance of power supply and distribution as required for the Closure phase, decommissioning and reclamation of other components of the power supply Ongoing reclamation monitoring and maintenance
Y+44	Removal of final building structures Membrane WTP re-commences operating at new location adjacent to ECD All mobile equipment removed Ongoing reclamation monitoring and maintenance

4.7.2 Structures and Equipment

Mine reclamation during the Closure phase will begin with the systematic removal of structures and equipment, except those that are required to support ongoing monitoring and maintenance, particularly in regards to water management. The specific buildings and equipment to be retained, repositioned or constructed during Closure will be finalized as final closure approaches, and are likely to include the following items and areas, or portions thereof:

- Membrane WTP and associated infrastructure near the ECD;
- Office/lab/administration building;
- Mobile equipment, parts and tools storage building; maintenance buildings and supplies;
- Security control buildings;
- Fuel tanks;
- Site communications and power distribution systems;
- Power supply (transmission line); light vehicles;
- Mobile generators; and
- Potable and freshwater supply systems.

All structures and mine-owned equipment (stationary and mobile) associated with the Project that are not required for ongoing use will be dismantled and disposed of as described in Section 4.5, Disposal of Chemicals, Reagents, Hazardous Materials and Contaminated Materials. The overall approach will include the following:

- Identification, salvage and off-site shipment of equipment, buildings and building components that are confirmed as having re-sale, re-use or donation value;
- Identification, salvage and off-site shipment of value-added recyclable materials;
- Tear down of buildings, tanks and structures according to detailed tear-down plans and safe work practices;

- Dismantling of mine-owned mobile equipment according to detailed tear-down plans and safe work practices;
- Removal of site power distribution systems and off-site power supply systems;
- Cleaning of residual hazardous materials (i.e., fuels, lubes, etc.) from tanks, pipelines and equipment as required to enable safe and efficient disposal; disposal of non-hazardous solid wastes into the on-site demolition landfill (see Section 4.8.1, Year -1) or an authorized off-site facility;
- Disposal of hazardous waste at an authorized off-site facility (Section 4.5, Disposal of Chemicals, Reagents, Hazardous Materials and Contaminated Materials); and
- Covering of residual concrete foundations, pads, voids and pedestals with at least 0.5 m of OVB prior to placement of prescribed reclamation covers.

The post-closure map (Figure 3.3-15 in Chapter 3, Mine Plan) indicates that approximately 11 ha of the process plant, camp and other infrastructure will remain after Closure and 133 ha will be reclaimed. These are preliminary projections but the balance of reclaimed to remaining areas is not expected to change significantly; the vast majority of these areas will be reclaimed.

The reclamation approach for structure and infrastructure areas is to cover them with 50 cm of glaciofluvial surface soil with the intent of supporting caribou habitat. These areas are projected to support 02 site series in the ESSFmv1 (84 ha) and a mix of 03 and 02 site series in the SBSmc3 (39 and 11 ha, respectively) (Section 4.2.3.1, Revegetation Species). The reclamation prescriptions for these areas are scheduled to be trialled in the vicinity of the existing camp (ESSFmv1) and FWR (SBSmc3) as part of progressive reclamation beginning in the first five years of mine life (Section 4.2.5.1, Vegetation and Cover Trials).

Soil placement and preparation for planting will be done in a manner that minimizes compaction and leaves surfaces uneven (Section 4.2.1.7, Reclamation-materials Replacement). Woody debris will be used strategically to restrict corridors for predators to access, move within, and see across caribou habitat, to create sheltered microsites for vegetation establishment, and to provide erosion control on any sloped areas.

4.7.3 Waste Stockpiles

4.7.3.1 Design and Construction

There are two stockpiles planned to remain in the post-closure landscape. The Lower Waste Stockpile is 83 ha in size and will primarily contain OVB from the open pit footprint. The Upper Waste Stockpile is 74 ha in size and will primarily contain NAG waste rock, which will make up 68% of its final volume. The final configuration of these stockpiles is shown in Figure 3.3-15 in Chapter 3, Mine Plan.

While the Upper Waste Stockpile will contain NAG waste rock, the outer surface will consist predominantly of OVB[34] as this OVB is a component of the rooting zone modelled for the planning of soil covers and vegetation prescriptions. There will be two types of soil cover used on the waste stockpiles: glaciofluvial surface soil will be used on the uppermost plateaus and crests to create caribou-focused habitat in upper elevations, while mixed-parent-mineral surface soil covers will be used on the remainder in order to facilitate quicker revegetation and erosion control on slopes. Glaciofluvial covers will be placed at 50-cm depths, while mixed-soil covers will be placed at 30-cm depths as guided by ecohydrological model results (Figure 4.2-1).

[34] Waste rock contents shall be no more than 10% by volume of the upper 1 m of the stockpile surface prior to soil cover placement. Areas with higher waste rock contents will be covered by OVB to a depth of 1 m before cover soil is placed.

The profile of the waste stockpiles has been engineered to minimize planar surfaces and create sigmoidal slopes with 20% gradient toe slopes, 30 to 40%-gradient short main slopes, and rounded crests similar to natural landforms. This design will help reduce erosion, which is a threat to achieving revegetation success, especially during early reclamation. The design will also create a pattern of soil moisture and nutrient regimes with increasing moisture and nutrient availability on the lower receiving slopes as a function of downslope water transfer. It is expected that over time, the vegetation community will reflect the variation in soil moisture and nutrients, which will increase species diversity on the site, and this has been reflected in the initial revegetation prescriptions.

4.7.3.2 Post-closure Ecosystems and Habitat

- The uppermost plateaus and crests with glaciofluvial surface soil covers are expected to predominantly support the ESSFmv1-02 site series (34 ha) with minor amounts of the ESSFmv1-03 (2 ha).
- The ESSFmv1-02 is a less densely forested site series that supports lichen for caribou foraging, and both the ESSFmv1-02 and -03 site series will be planted with whitebark pine.
- On the remainder of the stockpile sites, which will be covered with mixed-parent-mineral surface soil, crests are predicted to support the ESSFmv1-03 and ESSFmv1-01 site series (11 ha and 5 ha, respectively) with minor amounts of ESSFmv1-02 (< 1 ha).
- Benches will support a mix of the drier ESSFmv1-03 (41 ha) and the mesic ESSFmv1-01 (10 ha).
- Slopes will support a diversity of ecosystems, with the most common being the ESSFmv1-01 (25 ha), while slope gradient and aspect will determine the balance of ESSFmv1-03 (18 ha), ESSFmv1-04 (9 ha), and ESSFmv1-02 (< 1 ha). Toes of the stockpile sites are predicted to support mostly wetter ESSFmv1-04 (2 ha) with lesser amounts of ESSFmv1-01 (< 1 ha) and ESSFmv1-03 (< 1 ha).[35]

Habitat diversity is a key component of the waste stockpile reclamation plan. The planned ecosystems listed above represent the full range of site series possible in the ESSFmv1 variant and all are relatively well -balanced with 72 ha of 03, 40 ha of 01, 34 ha of 02, and 11 ha of 04 site series. The lower north-facing slopes and toes of the stockpile sites are one of the few places on the reclaimed footprint where the ESSFmv1-04 site series is expected, which provides good forage opportunities for moose and bear, as does the ESSFmv1-01 but to a lesser degree for moose. The 02 site series expected on stockpile tops is the highest quality ESSFmv1 unit for caribou and whitebark pine habitat, while the predominant 03 site series also supports these species as well as forage opportunities for bears.

Soil placement and preparation for planting will be done in a manner that minimizes compaction and leaves surfaces uneven (Section 4.2.1.7, Reclamation-materials Replacement). Woody debris will be used strategically on dump sites to restrict corridors for predators to access, move within, and see across stockpile-top caribou habitat (EC 2014), as well as create sheltered microsites for vegetation establishment and provide erosion control on sloped areas.

Reclamation trials are planned for the Lower Waste Stockpile and near the existing camp site (Section 4.2.5.1, Vegetation and Cover Trials), where both glaciofluvial and mixed-soil cover systems and their associated revegetation prescriptions can be tested with findings feeding into subsequent reclamation of waste stockpiles. Of particular interest for these trials will be strategies for lichen establishment and whitebark pine planting on plateau and upper crest areas, as well as the use of woody debris to facilitate quicker revegetation and reduce erosion.

[35] Revegetation species for these site series are detailed in Section 4.2.3.1, Revegetation Species and Table 4.2-7.

4.7.3.3 Post-closure Water Management

The two waste rock dumps that remain in post-closure are the Upper and Lower Waste stockpiles. The post-closure water management plan is shown in Figure C.6 of KP (2021).

The post-closure water management plan for the Upper Waste Stockpile involves decommissioning of collection ditches around the stockpile and grading the surface of the stockpile to connect surface drainages with those of the downstream terrain. The Upper Waste Stockpile catchment will report to TSF C following its pre-development drainage path.

The post-closure water management plan for the Lower Waste Stockpile involves decommissioning of the collection ditches around the stockpile. As with the Upper Waste Stockpile, the surface will be graded to connect surface drainages with those of the downstream terrain. The catchment will report to TSF C, following its natural drainage pathway that existed pre-development.

4.7.4 Tailings Storage Facility Reclamation

4.7.4.1 Design and Construction

The final configuration of the TSF is shown in Figure 3.3-15 in Chapter 3, Mine Plan and includes a slurried NAG waste rock and OVB cover surface across all PAG tailings (see Section 4.2.2, Landform Design and Erosion Control). A surface pond will exist in both TSF C and TSF D. The Main Dam C downstream embankment will mostly be submerged by the waste rock and tailings placed in TSF D. Only the final upstream and downstream embankments of Main Dam C above the waste rock and tailings will remain exposed, as will the crest of Main Dam C. Main Dam D will have a small upstream embankment and the crest exposed, and the entire downstream embankment will be exposed. The final downstream embankment of Main Dam D will require the most reclamation of the engineered TSF structures.

No resloping of any of the TSF dams is required for closure. The constructed slopes are those applicable for closure. TSF dams are to be built with final slope angles predominantly between 12˚ and 20˚, while TSF beaches will be roughly flat.

Tailings will be deposited strategically in TSF C and TSF D to create the final pond configuration. Specifically, the final years of tailings will be distributed in a manner to ensure the ponds are located adjacent to the spillways for each facility. Thus, runoff on the final tailings surface will drain to the respective ponds. Water will then either be directed to treatment or released naturally via the closure spillways. Mapped TSF pond locations in Figure 3.3-15 in Chapter 3, Mine Plan are approximate based on current water-balance and hydrology modelling. In ecohydrological modelling, a 10 m buffer has been mapped from expected pond perimeters onto beach surfaces to represent areas that are likely to have subsurface water inputs and, thus, form wetter ecosystems. The reclamation approach for the water in the TSF is to treat the seepage water using a membrane WTP. TSF seepage water will be captured in the ECD.

The NAG waste rock and OVB cover (approximately 30 cm) will be placed, most likely slurried (like tailings placed during operations; see Section 4.2.2, Landform Design and Erosion Control). A growth medium cover of OVB (approximately 70 cm) overlain by 30 cm of mixed-parent-material surface will be placed by truck and dozer, dumped, and spread to cover the above-water beaches. The total depth of the cover is planned to be approximately 130 cm. The current cover design assumes the TSF beach will be trafficable by heavy equipment. In addition, if a membrane WTP is required at closure, soil application on and revegetation of the TSF surface may cause fouling of the treatment membrane, thus, revegetation may not be permitted (in which case surface soil would not be applied). The TSF cover design will be refined based on continued development of closure water management plans and reclamation research (Section 4.2.5.1, Vegetation and Cover Trials). Similarly, due to the risk of excess nutrients potentially reducing the treatment effectiveness of membrane treatment, the current reclamation strategy does not include wetlands within the TSF. Research trials will study this possibility if a membrane treatment plant is required at closure, as outlined in Section 4.2.5.3, Use of Wetlands to Treat Water.

The overall intent of the reclamation prescriptions for the TSF is to optimize geotechnical stability (i.e., minimize extent of ponded zones) while minimizing the potential for ARD and ML. From a geochemical perspective, the currently acceptable approach is to maintain the PAG and ML waste rock and tailings in a saturated and suboxic condition, thereby preventing acidic drainage and minimizing the potential for ML. Geotechnically, the preference is to store less water in the TSF.

The prescription for small-ponded zones in TSF C and D reflects a “drier” closure design that will serve to optimize geotechnical stability. However, this design also implies the need to manage unsaturated materials. Specifically, while the majority of PAG waste rock and tailings will be maintained in a saturated state, unsaturated conditions will persist for materials in zones above the final water table elevation (e.g., exposed tailings beaches). Mitigation of ARD and ML for these zones will be achieved via a layered cover, the final depths to be confirmed through research trials, but nominally via the application of a 130 cm cover (30 cm NAG waste rock and OVB slurried material overlain by 70 cm of OVB and 30 cm of mixed-parent-material surface soil as a growth medium), which will serve to reduce both net percolation and oxygen ingress into underlying PAG materials. In the event this drier approach is not deemed environmentally optimal from a geochemical perspective based on operational monitoring data, final pond size/configuration may be modified (e.g., larger pond area and smaller beach area). For the purposes of closure planning, BW Gold has assumed the “drier” closure design will be proven through research trials so that sufficient reclamation materials are stockpiled throughout construction and operations.

4.7.4.2 Post-closure Ecosystems and Habitat

A summary of projected post-closure ecosystems and habitat are presented in Table 4.1-5 – RCP Ecosystem Summary for Vegetation and Wildlife – Comparing Pre-disturbance Ecosystems with Projected Post-closure Ecosystems as well as in Appendix 4C – Reclamation and Closure Planning for Wildlife.

As a summary, with the exception of the TSF Dam D, which is in the elevation range of the SBSmc3 BEC variant, the remainder of the TSF is within the ESSFmv1 variant. On roughly 290 ha of the northeast part of the TSF, the ESSFmv1 has replaced the lower elevation SBSmc3 since the post-closure elevations are above the elevation threshold that separates the BGC units. For geotechnical stability reasons, the TSF dams are not to be reclaimed as equivalent local ecosystems since tree growth is not permitted. These areas are covered by the ’Grass-shrub’ revegetation treatment and total 146 ha on TSF dams. On TSF dams, there may be potential for broadcast fertilizer use if required to increase the pace of revegetation for erosion control. However, this option will be avoided, if possible, to enable native species establishment and to avoid issues with algal blooms that could negatively affect water treatment operations.

TSF ponds cover 208 ha, which leaves 831 ha for reclamation of terrestrial ecosystems on TSF beaches. The majority of the reclaimed TSF beach is projected to support the submesic-to-mesic ESSFmv1-03 site series (663 ha), with a smaller proportion of mesic ESSFmv1-01 site series (167 ha). In pond buffers, ESSFmv1-01 will be most common although the ecohydrological model predicts there will be areas transitional to the ESSFmv1-04 (1 ha). Revegetation species for these site series are detailed in Section 4.2.3.1, Revegetation Species and Table 4.2-7.

In later iterations of reclamation planning, especially once the post-closure trafficability of the TSF is better understood, consideration should be given to creation of habitat diversity through the placement of materials to create berms, swales, ditches, and other non-linear landform features. This can be accentuated through the use of cover materials of varied properties (e.g., mixed-mineral, organic, and glaciofluvial surface soils. Landform diversity will also help to constrain sightlines, particularly during early reclamation, which is important for protecting ungulate populations from wolf predation (EC 2014). CWD can be used to achieve similar outcomes for ecological diversity and sightline reduction.

Soil placement with trucks and dozers should be done in a manner that minimizes compaction and leaves surfaces uneven (i.e., placement equipment should minimize number of passes and not aim for planar surfaces). Rough placement of soil creates microsites conducive to plant establishment and helps control erosion (Section 4.2.1.7, Reclamation-materials Replacement).

4.7.4.3 Post-closure Water Management

Two spillways will be constructed in the right abutment of the Saddle Dam and Main Dam D to convey water from the TSF to the downstream environment. The spillways will be designed to pass the probable maximum flood. Should the water quality in the TSF require treatment post-closure, a pumping system will be installed in the supernatant ponds to actively pump water to the membrane WTP located adjacent to the ECD. Once treated, the water will be discharged to Davidson Creek.

The Northern Diversion will continue to function in post-closure, although the water management plan, water balance and water quality predictions for post-closure assume that some water will be directed into the TSF to achieve the closure objectives for the TSF. The Central Diversion, including the North and South Collection Channels and the CWTP, will continue to function in post-closure as well, which will continue to collect and divert some non-contact water around the TSF. The outflow of water from the CWTP will report to the TSF C spillway, which will then report to Davidson Creek.

The berm at the outlet of Lake 16 installed during the Construction phase will remain in post-closure, so that the Lake 16 catchment is permanently diverted to Lake 15 as part of the Fish Habitat Offsetting Plan.

The North and South Interception trenches will continue to function in post-closure to direct water to the ECD, which will also function in post-closure. The water in the ECD is predicted to require treatment in post-closure. The membrane WTP is located adjacent to the ECD in post-closure, and will treat and release water from this facility, with the treated water being discharged to Davidson Creek and the sludge being pumped to the Open Pit.

4.7.5 Low Grade Ore Stockpile

By the end of mine life, the LGO stockpile will be milled, fully exhausting all remaining ore, and its footprint will require reclamation. The liner beneath the stockpile components will be removed and disposed of in accordance with Section 4.5, Disposal of Chemicals, Reagents, Hazardous Materials, and Contaminated Materials. OVB underlying the liner will be tested for contamination in accordance with Section 4.3, Trace Element Uptake in Soils and Vegetation and Section 4.4, Contaminated Sites and Human Health and Ecological Risk Assessment, and any necessary disposal of contaminated material will be done as per Section 4.5, Disposal of Chemicals, Reagents, Hazardous Materials, and Contaminated Materials. The site will be covered in 50 cm of glaciofluvial surface soil and is expected to support the ESSFmv1-02 site series (117 ha), which is lichen-rich, open-forest caribou habitat, and ESSFmv1-03 (6 ha). Revegetation species for these site series are detailed in Section 4.2.3.1, Revegetation Species and Table 4.2-7.

Since the dry ESSFmv1-02 site series requires well-drained soils, compaction in the underlying OVB should be examined prior to soil placement with target bulk density levels based on hydraulic conductivity requirements determined by a qualified professional to ensure prevention of standing water in the upper 50 cm of soil during the main growing season (June 1 to August 31). The site's underlying slope will help to drain water from the rooting zone, so compaction assessments should focus particularly on level, backsloping, and depressional areas.

Surface soil placement and site preparation for planting should be done in a manner that minimizes compaction and leaves surfaces uneven (Section 4.2.1.7, Reclamation-materials Replacement). Ripping of the surface following liner removal and prior to soil placement may be required to decompact the reclamation area. Landforming should be done in a manner that ensures continuity with the surrounding landscape, and the contours of the underlying landscape should be utilized to create heterogeneous landform features, such as undulations, swales, berms, and mounds, in order to break predator sightlines and to create microsites to encourage vegetation diversity. Irregular placement of woody debris across the area is expected to similarly enhance ecosystem diversity, inhibit use by predators, and create sheltered microsites to boost revegetation success (BW Gold 2021; CMMP).

As much as operationally feasible, the LGO Stockpile footprint will be progressively reclaimed as ore is milled. This will offer opportunities to develop methods for liner removal and site preparation and soil placement to efficiently create landform diversity, and to assess and adjust planting prescriptions for subsequent reclamation. Additionally, the use of glaciofluvial covers to create caribou habitat, will be tested in progressive reclamation and research trials near the existing exploration camp (ESSFmv1) and in the vicinity of the FWR (SBSmc3) beginning in the first few years of the mine life, which will help to refine reclamation plans for the LGO stockpile (Section 4.2.5.1, Vegetation and Cover Trials).

4.7.6 Surface Soil Stockpiles

Surface soil stockpiles occupy 106 ha of the Project footprint with 67 ha in the SBSmc3 and 39 ha in the ESSFmv1. As Closure progresses, stockpiled soil will be hauled to other areas for reclamation. Surface soil will already be present at the stockpile locations, however, spreading of residual remaining surface soil or minor re-contouring may be required depending on the final stockpile configuration and level of disturbance of pre-existing soil. Site preparation for planting on the surface soil stockpiles should be done in a manner that minimizes compaction and leaves surfaces uneven (Section 4.2.1.7, Reclamation-materials Replacement). Landforming should promote continuity with the surrounding landscape, and the underlying topography can be utilized to create heterogeneous landform features, such as undulations, swales, berms, and mounds, in order to break predator sightlines and to create microsites to encourage vegetation diversity. Irregular placement of woody debris across the area is expected to similarly enhance ecosystem diversity, inhibit use by predators, and create sheltered microsites to boost revegetation success (BW Gold 2021; CMMP).

Post-closure ecosystems were modeled as containing 30 cm of mixed-parent material surface soil (i.e., assuming remnants of mixed stockpiled surface soils and/or mixed pre-existing soil types) over OVB. Surface soil stockpiles in the SBSmc3 are expected to support the 01 and 04 site series (65 ha and 2 ha, respectively), while in the ESSFmv1 they are expected to support the 03 and 01 site series (31 ha and 8 ha, respectively).

4.7.7 Open Pit

4.7.7.1 Design and Construction

The reclamation strategy for the Open Pit is to flood the pit to create a Pit Lake. A portion of the walls are predicted to be PAG; therefore, the approach is to expedite the backfilling of the pit with water once open pit mining ceases in Year +18. In this regard, water from the TSF and ECD will be pumped into the Open Pit from Year +18 and it is expected to take approximately 27 years to fill the Pit Lake.[36] The water elevation in the Pit Lake will be managed via pumping to the membrane WTP so as to reduce seepage to the local groundwater system via the upper benches of the pit.

[36] See Chapter 5, Modelling, Mitigation and Discharges of the Application for additional details of water management.

Water flow into the Open Pit will include natural rainfall and runoff, groundwater, and the brine by-product from the membrane WTP. The brine will be pumped to the bottom of the Pit Lake to promote meromixis. Specifically, the high density of the brine as compared to other water types entering the pit will promote permanent stratification in the water column that will serve to physically and chemically isolate brine water from the surface system. The predicted water quality in the Pit Lake is presented in Chapter 5, Modelling, Mitigation and Discharges, based on simplified water column stratification assumptions.

As described in Section 4.2.5.6, In-pit Treatment Trials, BW Gold plans to conduct the research trials on potential amendments that could be added to the Pit Lake to reduce the WTP requirements.

4.7.7.2 Post-closure Ecosystems and Habitat

The Open Pit will be flooded at closure. Any remaining exposed highwalls are exempt from reclamation requirements but will be examined for opportunities to create unique habitat features. With time, ravelling or small local slope failures will create fine talus slopes that will accumulate on benches. These features may provide habitat to wildlife such as small mammals and birds, in addition to non-vascular plant species. Natural ingress of woody species and slow development of xeric, rock outcrop ecosystems (BGC site unit RO) is expected on any unsubmerged pit highwalls. Limited re-vegetation is proposed given the inaccessibility of these areas, however, helicopter seeding with an appropriate native seed mix suitable for the dry conditions common on these sites will be considered, particularly for areas of exposed OVB.

Any riparian areas adjacent to Pit Lake edges will be reclaimed using riparian treatments (Table 4.2-7), and those for grass-shrub ecosystems should be followed for any areas requiring erosion control. Reclamation treatments to establish aquatic vegetation will be developed for any littoral areas associated with the Pit Lake.

Trace element uptake in vegetation should be assessed in accordance with Section 4.3, Trace Element Uptake in Soils and Vegetation, and qualified professionals consulted to develop management and mitigation plans as necessary.

4.7.8 Environmental Control Dam and Pond

The ECD (< 1 ha) will be constructed like the TSF dams (Section 4.7.4.1, Design and Construction) with an OVB shell and planar slopes for geotechnical stability. As with TSF dams, the grass-shrub reclamation treatment is planned for the ECD (Section 4.7.4.2, Post-closure Ecosystems and Habitat). The ECD Pond (4 ha) will remain to collect seepage from the TSF via the North and South Interception trenches. As the ECD will be one of several structures remaining in post-closure, it will be subject to regular monitoring, inspections, and reporting along with the other permanent structures, such as Main Dam C, Saddle Dam, West Dam, and Main Dam D.

4.7.9 Water Management Pond and Dam

The WMP Dam will be constructed like the TSF dams (Section 4.7.4.1, Design and Construction) with an OVB shell and planar slopes for geotechnical stability. As with TSF dams, the grass-shrub reclamation treatment (2 ha) is planned for the Water Management Dam (Section 4.7.4.2, Post-closure Ecosystems and Habitat). At the end of the Closure phase, the 5-ha WMP will be decommissioned and a mixed soil cover will be applied at a depth of 50 cm, which is expected to support the ESSFmv1-03 and ESSFmv1-01 site series (4 ha and 1 ha, respectively). A portion of this facility has a linear configuration, so mixed-parent-material surface soil will be used instead of glaciofluvial surface soil to promote faster revegetation and discourage formation of a predator corridor.

4.7.10 Freshwater Dam and Reservoir

At the end of the Closure phase, the Freshwater Dam will be decommissioned, breached, and a portion of its earthen material will be removed leaving only its footprint (< 1 ha) to be reclaimed. The Freshwater Pond (9 ha), which is scheduled to be a borrow pit during construction, may become both a terrestrial reclamation area and wetland after dam removal. Due to uncertainty about the quality of material remaining in these areas and possible compaction issues, particularly in the areas used as a construction borrow area, the underlying materials in these areas have been modelled as having near-zero contributions to water- and nutrient-retention in ecohydrological modelling. These areas are scheduled to be covered with glaciofluvial surface soils at a depth of 50 cm and expected to support a mix of SBSmc3-03 (7 ha) and SBSmc3-02 (2 ha) ecosystems, which are lodgepole pine forests that support lichen for caribou.

4.7.11 Watercourses

As watercourses such as diversions and collection ditches are constructed and hydrologic characteristics understood, riparian revegetation prescriptions (Table 4.2-7) can be adapted for use in reclamation of these features. The species assemblages supported by riparian areas are dependent upon channel morphology and seasonality of water flow, with the width of effective riparian areas for revegetation purposes also being influenced by lateral seepage patterns. For these reasons, watercourses have not been explicitly mapped as revegetation units in Figure 3.3-15 in Chapter 3, Mine Plan at this stage of closure planning. Updated mapping of riparian areas will be conducted closer to closure, with reclamation prescriptions refined in consultation with appropriate groups.

General practices to be implement include the following. Where watercourses are built with rip rap, areas outside of expected annual flood levels should have voids filled with soil prior to planting to facilitate revegetation success. Establishment of willows using staking and wattles should be used as qualified professionals deem necessary to facilitate quicker establishment and limit erosion along watercourse banks. Critical vegetation functions and habitat elements in riparian areas are listed below with key species:

- **Bank stability and erosion control** – woody species, primarily willow and spruce;
- **Water temperature regulation** – woody species providing shade, primarily willow and spruce;
- **Forage for wildlife** – cow-parsnip, horsetail, sedges (bears and moose), willow, horsetail; and
- **Shelter for wildlife** – trees and shrubs.

During the Closure phase, stream crossings shall be reduced in quantity to only those required for ongoing monitoring and maintenance, particularly on any fish-bearing streams, with stream restoration taking place to ensure habitat quality.

4.7.12 Road Reclamation

On the post-mine landscape there are scheduled to be 70 ha of unreclaimed roads that will remain to facilitate site access for monitoring and maintenance (Figure 3.3-15 in Chapter 3, Mine Plan). This leaves 47 ha of roads scheduled to be reclaimed with 50 cm of mixed-parent-material surface soil. Most of the roads to be reclaimed are in the ESSFmv1 variant, with ESSFmv1-03 expected to be the most common site series on roads (37 ha), followed by the ESSFmv1-01 (5 ha) and ESSFmv1-01 (4 ha). A small portion of reclaimed roads fall into the ESSFmvp variant and all are expected to be reclaimed as the FM/PC site unit (< 1 ha). Revegetation species for these site series are detailed in Section 4.2.3.1, Revegetation Species and Table 4.2-7. All roads in the SBSmc3 portion of the mine are currently scheduled to remain after closure.

All roads will be decompacted by ripping prior to being covered with mixed soils to facilitate quicker and denser revegetation, and discourage the use of roads by wolves to access caribou habitat. Mixed-parent-material surface soil instead of glaciofluvial surface soil will also promote faster revegetation to reduce sightlines. The use of CWD along roads can also constrain predator sightlines and impede their travel.

In order to be conservative in model projections, reclamation of roads has been modelled by considering the water- and nutrient-retention capabilities of the road materials themselves to be near-zero (Section 4.2.1, Soil Resources). Decompaction will occur prior to soil placement using appropriate heavy equipment (e.g., excavator or dozer with ripping attachment). If there is any remaining compaction on roads that leads to impeded drainage, this would increase water availability and possibly create wetter site series but it has not been accounted for. Soil placement and preparation for planting should be done in a manner that minimizes compaction and leaves surfaces uneven (Section 4.2.1.7, Reclamation-materials Replacement). In applicable areas, cut-faces upslope of roads will be resloped by excavators to better blend reclaimed roads with the existing topography. Culverts and other water control installations will be removed.

4.8 Detailed Five Year Mine Reclamation Plan

This section describes reclamation activities scheduled to take place during the first five years of the mine plan, including two years of Construction (Y-2 and Y-1) and three years of Operations (Y+1, Y+2, and Y+3). As discussed in Section 4.2.4, Progressive Reclamation/Sequencing, and Section 4.2.5, Reclamation Research, there will be limited opportunities for reclamation during this period, and the primary focus of reclamation activities will consist of salvaging and stockpiling surface soil and OVB from newly disturbed areas of the Project footprint and establishing erosion and sediment controls on reclamation-material stockpiles. Projected surface soil salvage volumes for the final footprint of each project component are provided in Table 4.2-3 in Section 4.2.1, Soil Resources.

Throughout the five-year period, ML/ARD monitoring of waste rock, ore, OVB and tailings will be conducted as these materials are produced (Chapter 9.3, ML/ARD Management Plan). Salvage and sampling of surface soil and OVB, and maintenance of reclamation-material stockpiles will be carried out in accordance with the SMP (Appendix 9-B). Erosion control measures that will be used to maintain reclamation-material stockpiles and prevent loss of material include surface roughening, mulching and revegetation. Where surface soil stockpiles have reached their maximum volume and will remain unused for at least five years, trembling aspen and/or alder will be planted to stabilize the stockpile surface, add organic matter to the soil through leaf litter inputs, and contribute plant propagules to the soil that have the potential to regenerate after the material has been placed.

4.8.1 Year -2

A detailed description of all activities scheduled for Y-2 are presented in Section 3.4.1, Year -2, and the general arrangement is presented in Figure 3.3-5 in Chapter 3, Mine Plan. This section provides an overview of major developments and activities related to reclamation occurring in Y-2. Generally, reclamation activities in Y-2 will consist of salvaging reclamation material from newly disturbed areas where mine infrastructure is being constructed and installing erosion and sediment controls to prevent the loss of reclamation material from stockpiles.

Vegetation clearing, grubbing, and salvaging and stockpiling surface material for use in reclamation (including both woody debris, soil and OVB) will occur in the following areas:

- Most infrastructure sites, including the crusher area, stockpile feed conveyor, coarse ore stockpile, plant site, explosives storage areas, operations camp, and two contractor laydown areas.
- The entire Open Pit footprint that was not previously disturbed as part of the Early Works permit.

- Borrow pits and aggregate and concrete batch plants, including the mine site borrow area, the borrow, aggregate screening and construction laydown area, the TSF C additional borrow area, the TSF C North borrow area, the TSF C South borrow areas, the TSF D borrow areas, the FWR borrow area, and the borrow, aggregate screening and concrete plant area.
- Roads that were under the *Mines Act* permit M-246 (Early Works) that will be widened to their operational width for the LoM.
- Roads that will be constructed under this Application, including the Central Mine Site Service Road, East Processing Plant Service Road, West Processing Plant Service Road, TSF Service Road, Borrow and Preparation Area Service Road, Northern Diversion Road, Lower Waste Stockpile Haul Road, Main Dam C Haul Road, and any additional roads that may be required but are not currently included in Chapter 3, Mine Plan.
- The footprints of any surface soil stockpiles that will be developed in Y-2.
- The Lower Waste Stockpile footprint.
- Stockpiling of OVB in the Lower Waste Stockpile (which will be used for future reclamation) will start, as will stockpiling of surface soils at surface soil stockpiles TS1, TS2, TS3, TS4B, and TS5. In addition to stockpiling newly salvaged material, any soil that was windrowed during the Early Works will be transported to stockpiles and stored for use in reclamation.

Vegetation trial near existing camp can be commenced.

4.8.2 Year -1

A detailed description of all activities scheduled for Y-1 are presented in Section 3.4.2, Year -1 and the general arrangement is presented in Figure 3.3-7 in Chapter 3, Mine Plan. Key reclamation activities in Year -1 consist of salvaging and stockpiling reclamation material from newly disturbed areas. ML/ARD monitoring of waste rock, ore, OVB, and tailings will be conducted as these materials are produced, as described in the ML/ARD Management Plan (Appendix 9-D).

Surface soil will be salvaged from the following areas and stockpiled in Year -1 for use in reclamation:

- Disturbed areas associated with the Main Dam C construction;
- Construction borrow pits;
- The interim ECD;
- Footprints of any additional surface soil stockpile areas that will be developed in Y-1;
- The LGO Stockpile footprint;
- A helipad along the East Processing Plant Service Road; and
- OVB stockpiling in the Lower Waste Stockpile will continue.

4.8.3 Year 1

Year 1 (Y+1) is the first year of the Operations phase and the first year that progressive reclamation is scheduled to take place. Additional information on specific activities occurring in Y+1 can be found in Section 3.4.3, Year -1 in Chapter 3, Mine Plan, and the general arrangement (Figure 3.3-8) provides disturbance footprints of Project components.

As outlined in Section 4.2.4, Progressive Reclamation/Sequencing, two disturbed areas around the FWR have been identified as potential reclamation research locations that will be available beginning in Y+1.

These areas will be reclaimed using a glaciofluvial surface soil and provide an opportunity to test the ability of this material to create drier SBSmc3 site series with sparse tree canopies and high lichen cover favoured by caribou. A description of the planned research trial is presented in Section 4.2.5.1, Vegetation and Cover Trials.

Year 1 reclamation activities include salvaging and stockpiling reclamation material from disturbances scheduled for Y+1, such as:

- Construction associated with the Main Dam C;
- Construction or widening of mine service and haul roads; and
- Salvage of OVB from Open Pit and transport to stockpiles.

4.8.4 Year 2

Information on specific activities occurring in Y+2 can be found in Section 3.4.4, Year -2 in Chapter 3, Mine Plan, and the general arrangement (Figure 3.3-9) provides disturbance footprints of Project components. Reclamation activities scheduled for Y+2 include establishing a vegetation trial on a 3 ha bench and slope section of the Lower Waste Stockpile as described in Section 4.5.2.1, Vegetation Trials. Results from this trial will be used to adjust cover designs and vegetation prescriptions for the waste stockpiles. The research trial in the FWR area initiated in Y+1 will continue to be monitored.

Reclamation-material will be salvaged and stockpiled from newly disturbed areas associated with the TSF C Pond disturbance, OVB from the Open Pit, and any new or established roads that are widened.

4.8.5 Year 3

Information on specific activities occurring in Y+3 can be found in Section 3.4.5, Year -3 in Chapter 3, Mine Plan, and the general arrangement (Figure 3.3-10) provides disturbance footprints of different mine components. In Year 3 (Y+3), a reclamation trial will be initiated in the TSF that will allow the planned cover placement and revegetation techniques for TSF beach reclamation to be tested (Section 4.2.5.1, Vegetation and Cover Trials). The reclamation trial in the FWR area initiated in Y+1 and the reclamation trial on the Lower Waste Stockpile will continue to be monitored.

4.8.6 Activities Required for Early Closure Scenario

In the event of early closure during the first five years of Project development, the activities required to begin reclamation of disturbed areas will commence based on the approaches described in Section 4.7, Reclamation and Closure Prescriptions, and Section 4.2.3, Revegetation Strategy. The reclamation materials salvaged and stored in stockpiles at the end of Y+3 are expected to be sufficient to cover the existing disturbance footprint because the vast majority of soil salvage operations will have taken place by Y+3 while the largest planned disturbances on site (e.g., the TSF, Waste stockpiles, and LGO Stockpile) will be at an early stage of development. Early closure is likely to present challenges related to sourcing of seeds and planting stock (Section 4.2.3.2, Vegetation Sources and Types) as these materials require lead time for seed collectors and nursery operations. Immediately upon early closure, seed collection and nursery programs would need to be initiated. Revegetation will likely be done in stages over several years, with all available stock planted and seeded immediately and subsequent rounds of planting and seeding as stock becomes available.

The water management for an early closure scenario will differ from that of full closure, as the mine site facilities will be much smaller, and many will not have been constructed. A spillway will be constructed on the right abutment for Main Dam C, which will convey water to Davidson Creek. Like the full closure scenario, should the water quality in the TSF pond require water treatment, a pumping system will be installed to direct the water to the membrane WTP located adjacent to the Interim Environmental Control Dam IECD. The IECD will function in post-closure, as the ECD would do in the full closure scenario.

The Central Diversion, along with North and South Collection channels and CWTP, will continue to function in post-closure for the early closure scenario, directing non-contact water to the Main Dam C spillway. The North Diversion Channel may remain in post-closure for the early closure scenario; an evaluation will need to be conducted to determine whether it is preferable to make that diversion permanent or decommission it and allow the upstream catchment to report to the TSF.

The WMP and FWR will be decommissioned at the end of the Closure phase, as is the plan with the full closure scenario.

Under an early closure scenario, the open pit will fill with contact water from the TSF, IECD and other sources of contact water. An evaluation will be conducted to determine the appropriate elevation within the open pit to fill to.

4.9 Temporary Shutdown

Temporary shutdown is described in Appendix 4-J.

4.10 Post-closure Monitoring and Maintenance

The following subsections describe long-term monitoring and maintenance programs that will continue into post-closure.

4.10.1 Surface Water Quantity and Quality

4.10.1.1 Monitoring

Monitoring of water in the Closure and Post-closure phases will be a continuation of the majority of the monitoring proposed for the Operations phase. Water quality model predictions in the receiving environment indicate that water quality monitoring stations and frequency should be maintained through closure and post-closure phases (see Appendix 7-A, the Aquatic Effects Monitoring Plan). Mine site water will continue to require treatment into the Post-closure phase until water quality meets water quality guidelines (see Chapter 5, Modelling, Mitigation and Discharges and Appendix 5-D, Water Quality Model Technical Report). However, discharge of treated mine contact water will be from the plunge pool instead of the FWR. Details of the proposed water quality monitoring within the Mine Site is detailed in the MSDP (Appendix 9-E Table 7.3-1). The following mine site water quality sampling locations will be monitored in closure and post-closure:

- Upper and Lower Waste stockpiles' SCPs; and
- Pit Lake;TSF C;West Dam seepage sump;TSF D; andECD pond.

Monitoring will continue at the above locations in addition to the monitoring of the membrane WTP (nano-filtration) influent and effluent to assess the treatment efficiency prior to pumping to the plunge pool.

The Central Diversion System water transfer pond will continue to be monitored (water quality and quantity) through closure prior to pumping to the TSF C spillway.

4.10.1.2 Maintenance

During post-closure a number of management and maintenance activities will be continued from operations at the Project site to maintain water quality at concentrations less than applicable water quality guidelines for water that is safe to drink by people and wildlife as well as for the protection of aquatic life (see Appendix 7-A):

- The surface water elevation of the Pit Lake will be maintained below the spillway invert elevation through withdrawal water sent to the membrane WTP (nano-filtration).
- Seepage from the Pit Lake will be collected where possible (into the TSF D Pond or TSF Closure Spillway channel and directed to the plunge pool; or into the Pit Lake seepage collection system for conveyance to the membrane WTP [nano-filtration]).
- Maintenance of the Central Water Transfer Pond (and collection channels), while the pond continues to receive inflows from Davidson Creek and the Phase 2 North and South Collection Channels.
- The ECD will continue to manage Main Dam D seepage and storm water inflows and will convey water to the membrane WTP (nano-filtration) prior to conveyance to the plunge pool. The dam will be maintained in a dewatered condition to the maximum extent practical.
- The surface runoff from the lower waste stockpile will be directed to the TSF and seepage to groundwater from the lower waste stockpile footprint will contribute to the TSF C Pond and ECD.
- The membrane WTP will treat water using nano-filtration membrane that is transferred from the ECD, Pit Lake, and TSF C with the brine by-product recycled to the Pit Lake. An onsite operator will be required to confirm the WTP effluent meets water quality guidelines prior to conveyance to the plunge pool and discharge to Davidson Creek. Maintenance of the WTP will be completed as per operations (see Chapter 5.6, Mitigation Methods).

4.10.2 Groundwater Quantity and Quality

4.10.2.1 Monitoring

Groundwater monitoring wells will remain upgradient and downgradient of the TSF and Open Pit at closure and will continue to be monitored in the Post-closure phase at the same frequency as proposed for the Operations phase. The monitoring wells, type, and frequency are shown in Table 4.10-1. Results of the monitoring program will be included in the Annual Report for the *Mines Act* permit and the *Environmental Management Act* permits.

Table 4.10-1: Post-closure Monitoring Wells, Type and Frequency

Rationale	ID	Monitoring Type	Monitoring Frequency
Davidson Creek Headwater	MW12-05D/S MW12-13S	Field & Analytical Chemistry, Water Level	Annual
Background Well	MW-A (S/D)	Field & Analytical Chemistry, Water Level	Quarterly
Downgradient of Stockpiles	MW12-02S MW-B (S/D) MW-C (S/D)	Field & Analytical Chemistry, Water Level	Quarterly
Downgradient of Deposit	MW12-03D MW-E (S/D)	Field & Analytical Chemistry, Water Level	Quarterly
Downgradient of TSF Saddle Dam	MW-K (S/D) MW12-12D/S MW-N (S/D)	Field & Analytical Chemistry, Water Level	Quarterly

Rationale	ID	Monitoring Type	Monitoring Frequency
Downgradient of TSF D Main Dam	MW-F (S/D) MW-G (S/D) MW-H (S/D) MW-I (S/D) MW-J (S/D) MW-L (S/D)	Field & Analytical Chemistry, Water Level	Quarterly
Downgradient of Borrow Site	MW-M (S/D)	Field & Analytical Chemistry, Water Level	Quarterly
Downgradient of ECD	MW12-08D/S MW12-09D/S	Field & Analytical Chemistry, Water Level	Quarterly
Downgradient of TSF Closure Spillway	MW-O (S/D)	Field & Analytical Chemistry, Water Level	Quarterly

The annual reports will summarize, interpret, and discuss the results of all environmental monitoring as required in the associated discharge permit. This includes:

- Monitoring program description;
- Sampling methodology and equipment used, noting any variations in data collection;
- Description of the Quality Assurance (QA) measures and procedures used;
- Hydrogeological and water elevation monitoring results;
- Water quality monitoring results (including summary statistics); and
- Data interpretation (e.g. identifying any permit limit exceedances, the environmental risk the non-compliance posed, what was done to deal with the non-compliance, etc.).

4.10.3 Geotechnical Stability Monitoring and Maintenance

The OMS Manual that will be developed for the TSFwill serve as the primary document outlining monitoring and maintenance for the operations and closure phases of the TSF. A key component of the OMS Manual focuses on geotechnical stability, but covers many other areas as well. A number of structures will remain in post-closure that will require ongoing monitoring, annual site visits, and reporting, such as the West Dam, Saddle Dam, Main Dam C, and Main Dam D. As a result, much of the maintenance and surveillance that will be developed for the operations phase will continue for the post-closure phase as it relates to the TSF.

The monitoring of stockpiles during operations and closure will also be documented in an OMS Manual specific for those features. The operational monitoring is greater than that required in post-closure, as the stockpiles are no longer actively receiving material. Those stockpiles that remain in post-closure, specifically the Lower Waste Stockpile and the Upper Waste Stockpile, will have reduced monitoring, site inspections, and reporting associated with them. The reduction will be outlined in the OMS Manual that will be developed as a condition of the *Mines Act* prior to construction of each stockpile.

Geotechnical stability monitoring of the Open Pit is most intensive during operations, as the pit expands and personnel are actively working with the facility. This program will be outlined in an OMS manual, which includes regular site inspections and an annual report. For closure and post-closure, the monitoring and site inspection frequency will decrease substantially, as the risks are much less during these phases of the mine. The OMS manual developed for the pit prior to excavation in the pit will outline the proposed monitoring and reporting program for the Operations phase, an initial reduction during the Closure phase when the pit is filling, and the Post-closure phase, when the Pit Lake is at equilibrium.

No geotechnical stability monitoring and reporting is planned for post-closure for any other features on the site other than those listed above.

4.10.4 ML/ARD

4.10.4.1 Monitoring

During Post-closure, waste rock and tailings will be covered or flooded and will not require sampling. Waste rock placed in the TSF impoundments will be flooded and other areas containing waste rock, including the TSF dams and waste stockpiles, will be reclaimed or in the case of waste stockpiles, used as a source of reclamation material. Tailings beaches will be covered with a post-closure cover. Inspection of covers in the TSF will be conducted on an annual basis. The results of this inspection will be included in the Annual Reclamation report.

Water quality sampling to monitor ML/ARD in the mine site area for the Operations phase is presented in the MSDP (Appendix 9-E), and Post-closure monitoring will largely follow monitoring prescribed therein. Monitoring adjustments specific to the Post-closure phase will be required due to physical changes to exposed contact areas (e.g., covers or subaqueous deposition) and water management. Specifically, monitoring locations will include the TSF ponds, Pit Lake, ECD, nano-filtration WTP influent and effluent, and seepage. Water quality sampling frequency will initially continue consistent with mine site water monitoring plan for the Operations phase; however, monitoring locations and frequency will be evaluated annually following a review of the monitoring results. A reduced sampling frequency is expected to be implemented for the majority of sampling stations with more frequent monitoring for WTP influent and effluent. Analytical parameters will be consistent with those listed in Section 4.2.6.3, Water Quality Monitoring. Results will be reported in the Annual Reclamation report.

4.10.4.2 Maintenance

Maintenance of any damaged reclamation covers observed during inspections will be conducted as needed.

4.10.5 Reclamation

4.10.5.1 Vegetation and Soil Monitoring

Vegetation and soil monitoring will be conducted in reclaimed areas to track ecosystem development trajectories over time. Key ecosystem parameters identified through the reclamation monitoring program will be compared to reference ecosystems to evaluate the ability of reclaimed ecosystems to meet the end land-use objectives identified in Section 4.1, End Land Use and Capability Objectives. A detailed description of measures that could be assessed and used to develop reclamation success indicators is provided in Appendix 4-G. Monitoring will consist of installing permanent sample plots in reclaimed areas across the mine site using a fixed area-based intensity. To improve understanding of performance of reclamation prescriptions during the early stages of operational reclamation (during the Closure phase), plots will be installed in the first 20 ha of a reclamation treatment (e.g., glaciofluvial surface soils with a target site series of SBSmc3-03) at a density of one plot per 2 ha, with sample locations selected through a systematic (e.g., grid) approach. As prescriptions that work well in reclaimed areas are identified and successfully applied in other areas, plots will be installed at lower densities of one plot per 8 ha for the next 40 ha for each reclamation treatment. Beyond 40 ha for a given treatment, plots will be installed at their intended long-term monitoring density of one plot per 20 ha.

Long-term reclamation monitoring in the Post-closure phase will be conducted at a density to be determined of up to one plot per 20 ha in order to measure long-term stability and habitat complexity of reclaimed ecosystems. Plots that are considered successful based on meeting the selected indicators of reclamation success[37] after two consecutive samplings can be removed from the monitoring program to decrease plot densities in heavily sampled early-reclamation areas. Plots will continue to be dropped from the monitoring roster until an evenly spaced density of approximately one per 20 ha is reached. Monitoring results will be analyzed and presented in the Annual Reclamation Report.

4.10.5.2 Invasive Species Management

Invasive species management is required during the Closure and Post-closure phases to track the movement of invasive species across the site and identify measures to prevent the introduction, establishment, and spread of invasive plants on the Blackwater mine site. Invasive plant monitoring and management will be conducted in accordance with the Invasive Alien Plant Program (IAPP) standardized methods as described in the IPMP, and monitoring results and management activities will be reported in the Annual Reclamation Report.

4.10.5.3 Trace Element Concentrations in Soil and Vegetation in Reclaimed Areas

Trace element monitoring in soil and vegetation in reclaimed areas will be conducted in accordance with Section 4.3, Trace Element Uptake in Soils and Vegetation. Changes in sample frequency and location will be consistent with the changes in reclamation monitoring described in Section 4.11.5.1, Vegetation and Soil Monitoring, with the total number of plots decreasing over time as reclaimed ecosystems become successfully reclaimed. If elemental concentrations in soil and vegetation are elevated compared to applicable CCME and BC CSR standards as well as baseline and/or reference concentrations (as per the reclamation success criteria in Appendix 4-G), contingency and adaptive management measures will be implemented as described in Appendix 4-G and Section 4.10.10, Adaptive Management.

4.10.5.4 Reporting

BW Gold will be required to submit an Annual Reclamation Report to EMLI as a condition of the *Mines Act* permit. This report outlines reclamation work and research trials undertaken during the previous year, and proposed reclamation activities. All reclamation-related monitoring programs will be included in this report as detailed in Section 4.12, Reporting and Record Keeping.

4.10.5.5 Maintenance

If reclamation success indicators suggest that ecosystem development has stalled within a reclamation treatment, interventions may be required to re-establish ecosystem developmental trajectories and achieve the desired end land-use objectives. The following interventions may improve reclamation performance:

- Fill-planting areas of poor growth or high initial mortality, including consideration of alternate plant species if site conditions (e.g., SMR) deviate from the original design. Non-native species that may be used, will be shared with First Nations for consideration and for the opportunity to identify comparable native species;

[37] Details of the monitoring plan, including criteria and indicators of reclamation success and associated measures and thresholds will be developed as more detailed reclamation planning and implementation is conducted, and based on ongoing collaboration with Aboriginal Groups.

- Broadcast fertilizing where not expected to increase densities of undesired species and competition to native plants, aerial fertilization of closed-canopy stands, or planting fertilizer bags beside chlorotic, poorly performing trees;
- Seeding non-propagating agronomic grasses in areas where native vegetation has not established sufficiently quickly to reduce erosion and slumping or rilling has been observed;
- In areas where a tree canopy has established, understory species that are adapted to shade (e.g., dwarf blueberry, twinberry) can be planted to increase diversity and provide important habitat elements to wildlife, such as thermal cover for small mammals;
- In areas where open conifer stands are the target ecosystem, tree thinning may be required; and
- Invasive species management may be required to control the spread of invasive species on the mine site.[38]

4.10.6 Fish and Aquatic Ecosystems

4.10.6.1 Monitoring

Based on water quality model predictions and the intent to continue with water treatment into the Post-closure phase until water quality meets water quality guidelines (see Chapter 5, Modelling, Mitigation, and Discharges and Appendix 5-D, Water Quality Model Technical Report), monitoring of water in the Closure and Reclamation and Post-closure phases will be a continuation of the monitoring proposed for the Operations phase. Details of the proposed environmental monitoring are provided in Chapter 7, Environmental Monitoring and Appendix 7-A (Aquatic Effects Monitoring Program [AEMP]), including monitoring of water, sediment, aquatic biota (periphyton and benthic invertebrates), and fish.

Throughout the phases of the Project, the AEMP will be re-evaluated and recommendations made for adjustment, if necessary, during each reporting cycle to ensure that the program continues to achieve its objectives. This re-evaluation and adjustment of the AEMP will continue throughout the Closure phase and into Post-closure phase to ensure that the scope of the program reflects the environmental conditions existing at the time and expected to occur in the five-year period following each reporting period.

4.10.7 Erosion and Sediment Control

The Open Pit, Upper and Lower Waste stockpiles, and TSF will remain following closure. Stockpiles will be re-sloped to apply a growth medium prior to re-vegetation. Some of the waste rock and OVB will be used for reclamation activities across the site, particularly reclamation of the TSF.

Landform grading and placement of reclamation materials using large equipment, primarily bulldozers, are the key activities anticipated to require erosion and sediment control measures. Diversion and collection ditches to manage surface water runoff, sediment control ponds, stabilizing disturbed land surfaces, and establishing vegetation cover will minimize erosion.

Specific erosion and sediment control measures to be implemented for each work area for closure and reclamation activities will be presented on detailed design drawings prepared prior to the Closure phase.

---

[38] Exposed surfaces that have not yet received a reclamation prescription, particularly those adjacent to reclamation areas, should be temporarily revegetated using fast-growing native plant species that provide ground cover for erosion control as described in Section 4.2.2.3, Erosion and Sediment Control. If necessary, native plans can be supplemented with non-propagating agronomic grasses to provide short-term erosion control but avoid the introduction and establishment of non-native plants.

4.10.7.1 Monitoring

Monitoring locations and frequency in the Post-closure phase will be reduced compared to the Construction, Operations, and Closure phases, as the aim of closure activities is to minimize the need for post-closure monitoring and maintenance. The waste stockpiles will be re-sloped to resemble natural landforms, which will help reduce erosion potential. The collection ditches around the stockpiles will be decommissioned, and the surface of the stockpiles graded to connect surface drainages with those of the downstream terrain: runoff within these catchments will report to TSF C. Some erosion control monitoring is anticipated to be required in the Post-closure phase down-gradient of the TSF D dam, which will not be reclaimed as equivalent local ecosystems for geotechnical stability reasons. The Open Pit will be flooded at closure, and any riparian areas adjacent to the Pit Lake edges will be reclaimed using riparian treatments: those for grass-shrub ecosystems will be followed for any areas requiring erosion control. Monitoring locations will be established down-gradient of these areas. Similarly, for diversions and collection ditches, riparian revegetation prescriptions can be adapted for use in reclamation; establishment of willows using staking and wattles may be used to facilitate quicker establishment and limit erosion along watercourse banks. Monitoring of turbidity (a proxy for total suspended solids) in the downstream receiving environments (e.g., Davidson Creek) will be implemented at the same frequency as the Construction and Operations phases (weekly during spring freshet and monthly outside of freshet and in open water periods, as well as after each significant melt event or runoff-producing rainfall event) until monitoring indicates that the closure prescriptions become well established (as determined by a qualified professional).

Monitoring activity reports will be included to comply with reporting requirements of the *Mines Act* and *Environmental Management Act* permits.

4.10.7.2 Maintenance

Inspection of erosion control measures and best management practices will follow the same frequency as outlined for the Construction and Operations phases (weekly during spring freshet and monthly outside of freshet and in open water periods, as well as after each significant runoff-producing rainfall event) until inspection activities indicate that the closure prescriptions have become well established (as determined by a qualified professional). Effectiveness of erosion control measures and best management practices will be determined by a qualified professional, and maintenance will be carried out as necessary.

4.10.8 Site Security

4.10.8.1 Monitoring

The security gatehouse will be constructed at approximately KM 11.6 of the MAR at the new camp location. The security gatehouse will be constructed on the mine site portion of the MAR and operated commencing in Y-2 through Y+23. The checkpoint will be staffed by security personnel 24 hours/day, 7 days/week and only authorized personnel will be granted entry to the mine site.

The operations at the security gatehouse will be ramped down after closure, at a planned time the gatehouse may not be staffed full time although access controls will remain in place through Y+44.

During mine site inspections, any attempts or actual unauthorized access will be noted and measures reviewed to manage risks associated with unauthorized public access. A record of observations and incidents will be kept on site.

4.10.8.2 Maintenance

Site security structures (gates, fences, barricades) will be regularly inspected and maintained through post-closure.

4.10.9 Potable Water Monitoring

4.10.9.1 Monitoring

Monitoring of the groundwater quality for the domestic water supply will continue into the Post-closure phase at the frequency and with the parameters required by the *Drinking Water Protection Act* operating permit for the water system. Monitoring of the potable water supply will continue until the groundwater well and supply system is decommissioned.

4.10.10 Adaptive Management Framework

The RCP is a living document that will evolve over time in response to monitoring and research trial results and findings and and regulatory changes. Adaptive management is a tool that is used within all stages of the Project based on analysis using the best available information or during the life of the Project. The plan incorporates adaptive management as follows:

- **Plan**
  - Use the results of analysis or monitoring to inform the need to adjust future planned or current activities. This can apply to construction, operations, closure and decommissioning or post-closure activities. Adaptive management measures are expected to come out of several activities listed in the RCP including but not necessarily limited to:
    - Section 0 – Reclamation Research
    - Section 4.2.6 – Reclamation Monitoring
- **Do**

Once an activity has been identified and planned it will be carried out to determine what information can be gained and applied to updating the RCP.

The investigation will involve either a desktop study or monitoring results obtained from an activity or program. The results of the investigation then inform if adjustments are required to improve reclamation and closure initiatives or to avoid ineffective implementation of closure strategies.

Corrective actions, if needed, are then put in place.

  - Adaptive management measures are expected to come out of several activities listed in the RCP including but not necessarily limited to:
    - Section 0 – Reclamation Research
    - Section 4.2.6 – Reclamation Monitoring
    - Section 4.3 –Trace Metal Uptake in Soils and Vegetation and the Monitoring program as part of the Country Foods Monitoring Program
    - Section 4.2.7 – Implementation of Habitat Compensation works
- **Monitor**
  - Monitoring will occur based on the following sections outlined in the RCP:
    - Section 4.2.6 – Reclamation Monitoring
    - Section 4.3 –Trace Metal Uptake in Soils and Vegetation and the Monitoring program as part of the Country Foods Monitoring Program
  - Follow-up monitoring may also be required to verify the efficacy of additional mitigation measures.

- **Adjust**
    - A review of the effectiveness of management measures by the EM. Appropriate adjustments to the RCP will be made according to the research and monitoring findings from the Planning, Doing and Monitoring Sections outlined above. The RCP will also be adjusted at least at a minimum on 5-year intervals in alignment with the requirements in the following sections:
        - 4.12 – Reporting and Record Keeping – gathering feedback from Aboriginal groups and government agencies on the annual reclamation reports
        - 4.13 – RCP Plan Updates

Additionally, results from post-closure monitoring programs will be evaluated to assess the effectiveness of the programs to measure changes in environmental conditions on site that may require action. As data are collected and analyzed through each monitoring program, an adaptive management framework including triggers for different action levels of responses (none, low, medium, and high) will be developed to guide any required changes. In this manner, the knowledge and application of adaptive management becomes more refined with successive cycles of evaluation.

4.11 Reclamation Cost Estimate

In accordance with Section 10.1.3(i) of the Code and section 4.11 of the 2019 Joint Application Information Requirements, a reclamation cost estimate for the Blackwater *Mines Act*/*Environmental Management Act* Permits Application has been submitted to EMLI for review and establishment of bonding security. This estimate includes mitigation measures for the LGO stockpile, including water collection and treatment, as well as final reclamation of the LGO pad.

A separate cost estimate for an LGO stockpile contingency plan has also been submitted to EMLI. The LGO contingency plan is noted in Table 5.1-1 of the Application and consists of moving the stockpile at its maximum planned storage volume and placement into the open pit where it will be flooded. The contingency plan includes the continued treatment of LGO contact water in accordance with the mitigation measures proposed for the project until the LGO has been rehandled to the open pit. Despite provision of the cost estimate for this contingency, BW Gold plans to mill the low grade ore stockpile prior to closing the mine.

4.12 Reporting and Record Keeping

4.12.1 Annual Reclamation Report

The reclamation and closure planning for the mine site will be reported in the Annual Reclamation Report as a condition of the *Mines Act* permit and distributed to agencies and Aboriginal Groups as required under the permit. Information presented in the Annual Reclamation Report will be in accordance with the *Mines Act Permit Annual Reclamation Report – General Information and Format Requirements* (EMLI 2021). All records pertaining to reclamation and closure topics such as the reclamation-material balance, areas disturbed and reclaimed, reclamation success, reclamation research trial results, and other relevant data, will be maintained on site throughout the LoM and into post-closure.

4.12.2 Decision Statement Annual Reporting and Information Sharing

DS Conditions 2.11, 2.12 and 2.13 set out annual reporting requirements related to the implementation of conditions in the DS. Condition 2.14 sets out information sharing requirements related to the annual reports. Reporting will commence when BW Gold begins to implement the conditions set out in the DS. Requirements in DS Conditions 2.11 – 2.14 are presented below.

DS Condition 2.11 requires:

"The Proponent [BW Gold] shall, commencing in the reporting year during which the Proponent begins the implementation of the conditions set out in this Decision Statement, prepare an annual report that sets out:

- *2.11.1 the activities undertaken by the Proponent in the reporting year to comply with each of the conditions set out in this Decision Statement;*
- *2.11.2 how the Proponent complied with condition 2.1;*
  - *2.11.3 for conditions set out in this Decision Statement for which consultation is a requirement, how the Proponent considered any views and information that the Proponent received during or as a result of the consultation, including a rationale for how the views have, or have not, been integrated;*
  - *2.11.4 the information referred to in conditions 2.5 and 2.6 for each follow-up program;*
  - *2.11.5 the results of the follow-up program requirements identified in conditions 3.14, 3.15, 3.16, 4.5, 5.5, 6.11, 6.12, 6.13, 6.14, 8.18.6, 8.20.5, 8.21, and 8.22 if required;*
  - *2.11.6 any update made to any follow-up program in the reporting year;*
  - *2.11.7 any modified or additional mitigation measures implemented or proposed to be implemented by the Proponent, as determined under condition 2.9 and rationale for why mitigation measures were selected pursuant to condition 2.5.4; and*
  - *2.11.8 any change(s) to the Designated Project in the reporting year."*

DS Condition 2.12 requires: *"The Proponent [BW Gold} will provide the draft annual report to Indigenous groups, no later than June 30 following the reporting year to which the annual report applies. BW Gold will consult Indigenous groups on the content and findings in the draft annual report."*

DS Condition 2.13 requires: *"The Proponent [BW Gold], in consideration of any comments received from Indigenous groups pursuant to condition 2.12 shall revise and submit to the Agency [Impact Assessment Agency of Canada] and Indigenous groups a final annual report, including an executive summary in both official languages, no later than September 30 following the reporting year to which the annual report applies."*

DS Condition 2.14 requires: "The Proponent [BW Gold] shall publish on the Internet, or any medium which is publicly available, the annual reports and the executive summaries referred to in conditions 2.11 and 2.13, the offsetting plan(s) referred to in condition 3.11, the compensation plan referred to in condition 8.18 and, if required, condition 5.3, the whitebark pine management plan referred to in condition 8.20, the communication plans referred to in conditions 6.15 and 10.5, the reports related to accidents and malfunctions referred to in conditions 10.4.2 and 10.4.3, the schedules referred to in conditions 11.1 and 11.2, and any update(s) or revision(s) to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available for 25 years following the end of decommissioning of the Designated Project. The Proponent shall notify the Agency and Indigenous groups of the availability of these documents within 48 hours of their publication."

DS Condition 2.15 requires: "When the development of any plan is a requirement of a condition set out in this Decision Statement, the Proponent [BW Gold] shall submit the plan to the Agency and to Indigenous groups prior to construction, unless otherwise required through the condition."

4.12.3 Environmental Assessment Certificate Reporting

Condition 5 of the EAC sets out reporting requirements. BW Gold must submit a report to the attention of the EAO and Aboriginal Groups on the status of compliance with EAC #M19-01 at the following times:

- At least 30 days prior to the start of Construction;
- On or before March 31 in each year after the start of Construction;

- At least 30 days prior to the start of Operations;
- On or before March 31 in each year after the start of Operations;
- At least 30 days prior to the start of Closure;
- On or before March 31 in each year after the start of Closure until the end of Closure;
- At least 30 days prior to the start of Post-closure; and
- On or before March 31 in each year after the start of Post-closure until the end of Post-closure.
- BW Gold will submit reports to the EAO and Aboriginal Groups within the timelines specified in Condition 5.

4.13 Plan Updates

Part 10, Section 10.4.1 of the Code requires:

> *(1) After commencement of operations, mine plans, including programs for reclamation and closure, shall be updated, at a minimum, every 5 years.*
>
> *(2) Reclamation plans shall outline progressive reclamation activities for the 5 years following the date on which the plans are updated in accordance wit; Ch subsection (1).*

The RCP will continue to evolve during Construction and Operation phases of the mine with regards to new research findings, First Nation's guidance regulatory changes, and updated management practices and standards. The RCP will be updated every five years, or more frequently if required for major permit amendment applications. Table 4.13-1 lists some of the anticipated inputs that will inform updates and improvements to the RCP. At the time of plan updates, the closure cost estimate is re-examined and adjusted to reflect the existing and planned disturbance, activities, and liabilities on the site.

Table 4.13-1: External Inputs to be Considered in Future Updates to the Reclamation and Closure Plan

External Input	Review Frequency	Potential Reclamation Plan Updates
Whitebark Pine Research	Every five years in conjunction with RCP submission	Incorporate BMP or new findings into whitebark pine management and research
Climate Change Modelling	Every five years in conjunction with RCP submission	Revise ecosystem models and vegetation planting prescriptions and research to reflect climate change model results
Tweedsmuir Caribou Herd planning	Annual or as information is made available through FLNRORD/ECCC	Revise land use goals, reclamation, and mitigation measures based upon herd planning information and management practices
Traditional Knowledge	Annual through dedicated EMB meetings other meetings	Utilize new traditional knowledge to inform reclamation planning such as revegetation species selection and research
Provincial Species and Ecosystem Rankings and Guidance	Annually during construction; Every five years in conjunction with RCP submission	Identify potential changes to management measures related to species and ecosystem ranking by the BC CDC

External Input	Review Frequency	Potential Reclamation Plan Updates
Federal Species at Risk (SARA)	Annually during construction; Every five years in conjunction with RCP submission	Ensure project activities and potential effects are aligned with changes in species status and status report information
Reclamation Research	Every five years in conjunction with RCP submission	Update reclamation planning to reflect new research and improvements in reclamation practices
Regulatory Changes	Annual	Review regulatory changes that affect reclamation planning and practices and ensure conformity with required legislation and regulations

Condition 4 of the EAC sets out consultation requirements. BW Gold must comply with the following steps to update the Reclamation and Closure Plan:

Consult participating Indigenous nations and relevant government agencies regarding the content of a plan, program or other document, the Holder must, to the satisfaction of the EAO:

a. provide written notice to each such party that:
   i) includes a copy of the plan, program or other document;
   ii) invites the party to provide its views on the content of such plan, program or other document; and
   iii) indicates:
      i. if a timeframe for providing such views to the Holder is specified in the relevant condition of this Certificate, that the party may provide such views to the Holder within such time frame; or
      ii. if a timeframe for providing such views to the Holder is not specified in the relevant condition of this Certificate, specifies a reasonable period during which the party may submit such views to the Holder;
b. undertake a full and impartial consideration of any views and other information provided by a party in accordance with the timelines specified in a notice given pursuant to paragraph (a);
c. provide a written explanation to each such party that provided comments in accordance with a notice given pursuant to paragraph (a) as to:
      i. how the views and information provided by such party to the Holder have been considered and addressed in a revised version of the plan, program or other document; or
      ii. why such views and information have not been addressed in a revised version of the plan, program or other document;
d. maintain a record of consultation with each such party regarding the plan, program or other document; and
e. provide a copy of such consultation record to the EAO, the relevant party, or both, promptly upon the written request of the EAO or such party. The copy of such consultation record must be provided to the EAO, relevant party, or both, no later than 15 days after the Holder receives the request for a copy of the consultation record, unless otherwise authorized by the EAO.

4.14 References

Definitions of the acronyms and abbreviations used in this reference list can be found in the Acronyms and Abbreviations section.

Legislation

Authorizations Concerning Fish and Fish Habitat Protection Regulations, SOR/2019-286.

Canadian Environmental Protection Act, 1999, SC 1999, c. 33.

Contaminated Sites Regulation, BC Reg. 375/96.

Declaration on the Rights of Indigenous Peoples Act, SBC 2019, c. 44.

Environmental Assessment Act, SBC 2018, c. 51.

Environmental Management Act, SBC 2003, c. 53.

Fisheries Act, RSC 1985, c F-14.

Impact Assessment Act, SC 2019, c. 28.

Metal and Diamond Mining Effluent Regulations, SOR/2002-222.

Mines Act, RSC 1985, c. 293.

Persistence and Bioaccumulation Regulations, SOR/2000-107.

Species at Risk Act, SC 2002, c. 29.

United Nations Declaration on the Rights of Indigenous Peoples Act, SC 2021, c. 14.

Water Sustainability Act, SBC 2014, c. 15.

Wildlife Act, RSBC 1996, c. 488.

Secondary Sources

AMEC. 2013a. Blackwater Gold Project: Soils, Terrain, and Surficial Geology, 2013 Baseline Report. Appendix 5.1.3.2A. Prepared for New Gold Inc.

AMEC. 2013b. Blackwater Gold Project: 2011-2013 Vegetation Baseline Report. Appendix 5.1.3.3A. Prepared for New Gold Inc.

AMEC. 2013d. *Blackwater Gold Project – Water and Sediment Quality Baseline Report*. VE52277. Prepared for New Gold Inc. by AMEC Environment & Infrastructure: Vancouver, BC.

Arno, S F, E.D. Reinhardt, and J.H. Scott. 1993. Forest structure and landscape patterns in the subalpine lodgepole pine type: A procedure for quantifying past and present conditions. Forest Service general technical report. United States: N. p.

Ayres, B., B. Dobchuk, D. Christensen, M. O'Kane, and M. Fawcett. 2006. *Incorporation of Natural Slope Feature into the Design of Final Landforms for Waste Rock Stockpiles.* Paper presented at the 7th International Conference on Acid Rock Drainage (ICARD), March 26-30, 2006, St. Louis MO. R.I. Barnhisel (ed.) Published by the American Society of Mining and Reclamation (ASMR).

Avison Management Services Ltd. (Avision). 2018. 2018 Annual Report: Blackwater Project Reclamation. Vanderhoof, BC.

Baker, T.D., J. Straker, and M.G. Ryan. 2020. Development of a soil water balance-based model for predicting ecosystem occurrence on post-closure landforms. British Columbia Technical and Research Committee on Reclamation, BC Mine Reclamation Symposium. September 23, 2020. Accessible at https://trevor-baker.github.io/QEA/QEA_TRCR_final.pdf.

BC CDC. n.d. *BC Species and Ecosystems Explorer*. BC Ministry of Environment: Victoria, BC. http://a100.gov.bc.ca/pub/eswp/ (accessed December 2020).

BC EMLI. 2021. *Health, Safety and Reclamation Code of British Columbia.* British Columbia Ministry of Energy and Mines.

BC EMPR & ENV. 2019. *Joint Application Information Requirements for* Mines Act *and* Environmental Management Act *Permits.* Government of BC. September. Victoria, BC.

BC MOE. 2009. *An Introduction to Contaminated Sites in British Columbia (Fact Sheet 1 on Contaminated Sites).* Available online at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/fact-sheets/fs01.pdf. Accessed April 27, 2020.

BC MOE. 2014a. *Policy for Mitigating Impacts on Environmental Values (Environmental Mitigation Policy). Environmental Mitigation Policy – Working Document, May 13, 2014*.

BC MOE. 2014b. *Procedures for Mitigating Impacts on Environmental Values Procedures for Mitigating Impacts on Environmental Values (Environmental Mitigation Procedures) Version 1.0*.

BC MOE. 2016a. *Technical Guidance 10: Guidance for a Stage 1 Preliminary Site Investigation.* BC Ministry of Environment. Available online: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/technical-guidance/tg10.pdf. Accessed June 2021.

BC MOE. 2016b. *Technical Guidance 11 on Contaminated Sites: Guidance for a Stage 2 Preliminary Site Investigation and Detailed Site Investigation.* Available online: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/technical-guidance/tg11.pdf. Accessed June 2021.

BC FLNRORD. 2020. *Northern Mountain Caribou – Habitat Map.* Wildlife Conservation. https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/wildlife/wildlife-conservation/caribou/north-mountain-caribou (accessed December 2020).

BC MOF.1995. *Riparian Management Area Guidebook*. Government of British Columbia: Victoria, BC. Available at https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/silviculture/silvicultural-systems/silviculture-guidebooks/riparian-management-area-guidebook. Accessed May 2021.

BC MOFR and BC MOE. 2015. *Field manual for describing terrestrial ecosystems*. Second edition. Land Management Handbook 25. British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment: Victoria, BC.

Brockley, R.P. 2001. *Fertilization of lodgepole pine in western Canada.* In C. Bamsey (ed.). Enhanced Forest Management: Fertilization and Economics Conference, March 1-2, 2001, Edmonton, AB. pp. 44-55.

BW Gold. 2021. Caribou Mitigation and Monitoring Plan; Blackwater Gold Project. Prepared by ERM for Artemis Gold.

Carson, M.A. and M.J. Kirkby. 1972. Hillslope Form and Process. Cambridge University Press, Cambridge, UK, 475 p.

Carr, W.C. 1980. *A Handbook for Forest Roadside Erosion Control in British Columbia.* Land Management Handbook 4, January 1980. British Columbia Ministry of Forests: Victoria, BC.

Cox, R. and J. Cullington. 2009. *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia.* Wetland Stewardship Partnership: n.p. Available at https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-planning-strategies/wetlands-in-bc. Accessed May 2021

Delgado, J., D. García-Morrondo, J. Luis Cereijo-Arango, A. Muñoz-Ibáñez, E. Grande-García, B. Rodríguez-Cedrún, and R. Juncosa-Rivera. 2016. *Pit lake lime dosing: Assessment of the performance of the treatment based on a high-spatial resolution AUV survey*. Geophysical Research Abstracts Vol. 18.

DeLong, C., D. Tanner, and M.J. Jull. 1993. *A Field Guide for Site Identification and Interpretation for the Southwest Portion of the Prince George Forest Region.* British Columbia Ministry of Forests. Land Management Handbook Number 24.

EC. 2014. *Recovery Strategy for the Woodland Caribou, Southern Mountain population (*Rangifer tarandus caribou*) in Canada*. *Species at Risk Act* Recovery Strategy Series. Environment Canada: Ottawa, ON. viii + 103 pp.

EMLI. 2021. Mines Act *Permit Annual Reclamation Report – General Information and Format Requirements*. Available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/mineral-exploration-mining/documents/reclamation-and-closure/annual-reclamation-reports-supporting-files/2021_annual_reclamation_report_-_format_requirements.pdf

ERM. 2016a. *Memo: Blackwater Gold Project – Human Health – Northern Health Comment Responses #398, #400 and BC Centre for Disease Control Comment Responses #403, #404, #405, #406, #407, #409, #410, #416, #417.* Memo prepared by ERM Consultants Canada for New Gold. May 24, 2016.

ERM. 2016b. *Memo: Blackwater Gold Project EA Review Comment Responses – Response to health Canada Comment dated March 3, 2016, HC-49.* Memo prepared by ERM Consultants Canada for New Gold. June 29, 2016.ERM. 2017. *Memo: Blackwater Gold Project – Consolidated Current Use of Lands and Resources for Traditional Purposes (Current Aboriginal Use) Effects Assessment*. Memo prepared by ERM Consultants Canada for New Gold. December 8, 2017.

ERM. 2021. *Blackwater Gold Project: Surface Water Baseline Report*. Prepared for BW Gold. Vancouver, BC.

Government of BC. 2013. *BC Field Sampling Manual, Part A: Quality Control and Quality Assurance.* Available online: https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/bc_field_sampling_manual_part_a.pdf. Accessed June 2021.

Government of BC. 2020. BC Field Sampling Manual, Part D: Solids. Available online: https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/bc_field_sampling_manual_part_d.pdf. Accessed June 2021.

Government of Canada. 1991. *The Federal Policy on Wetland Conservation.* Environment Canada, Ottawa, ON.

Government of Canada. 2021. Species at Risk Act *Schedule 1.* https://laws.justice.gc.ca/eng/acts/S-15.3/page-17.html#h-435647 (accessed April 2021).

Jensen, N. 2002. *Canadian Milkvetch Plant Fact Sheet.* U.S. Department of Agriculture, Natural Resources Conservation Service. Available online: https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/ndpmcfs7521.pdf. Accessed July 2021.

KP. 2013. *New Gold Inc. Blackwater Gold Project Feasibility Open Pit Slope Design.* Prepared for New Gold Inc. by Knight Piésold Ltd., Vancouver, BC.

KP. 2021. *BW Gold Ltd. Blackwater Gold Project – Life of Mine Water Balance Model Report.* Prepared for BW Gold Ltd. by Knight Piésold Ltd., Vancouver, BC.

MacKenzie, W.H. and J.R. Moran. 2004. *Wetlands of British Columbia: A Guide to Identification*. B.C. Min. For., Res. Br., Victoria, B.C. Land Management. Handbook. 52.

Mackenzie, D., and A. Naeth. 2010. *The role of the forest soil propagule bank in assisted natural recovery after oil sands mining.* Restoration Ecology 18(4): 418–427.

MacKenzie, W.H. and C.R. Mahony. 2021. An ecological approach to climate change-informed tree species selection for reforestation. Forest Ecology and Management, 481, 118705

McCaughey, W.W., G.L. Scott, and K.L. Izlar. 2009. Whitebark pine planting guidelines. *Western Journal of Applied Forestry*, 24:163-166.

McCullough, C.D. 2008. Approaches to remediation of acid mine drainage water in pit lakes. *International Journal of Mining, Reclamation and Environment*, 22: 105-119.

Moody, R. and A. Clason. 2016. *Whitebark Pine 2016 Reporting*. Prepared for New Gold Inc. by Keefer Ecological Services Ltd. unp.

New Gold. 2015. *Blackwater Gold Project Environmental Assessment Application/Environmental Impact Statement*. Prepared by AMEC Environment & Infrastructure for New Gold Inc.: Vancouver, BC.

O'Neill, G., T. Wang, N. Ukrainetz, L. Charleson, L. McAuley, A. Yanchuk, and S. Zedel. 2017. *A Proposed Climate-based Seed Transfer System for British Columbia.* BC Ministry of Forests, lands and Natural Resources Operations, Tree Improvement Branch: Victoria, BC.

Palmer. 2016. *Blackwater Project, Offsetting Plan for* Fisheries Act *Section 35(2)b Authorization and Schedule 2 MMER Amendment.* Prepared for New Gold Inc. by Palmer Environmental Consulting Group Inc.

Palmer. 2021. *Blackwater Project Compensation Plan for MDMER Schedule 2 Amendment*. Prepared for BW Gold Ltd. by Palmer Environmental Consulting Group Inc. February 2021.

Pojar, J., K. Klinka, and D. Meidinger. 1985. *Biogeoclimatic ecosystem classification in BC.* Ministry of Forests. Victoria, BC.

Pojar, J., K. Klinka, and D.V. Meidinger. 1987. Biogeoclimatic ecosystem classification in British Columbia. *Forest Ecology and Management*, 22(1-2): 119–154.

Polster, D.F. 2009. *Natural Processes: The Application of Natural Systems for the Reclamation of Drastically Disturbed Sites.* BC Technical and Research Committee on Reclamation, BC Mine Reclamation Symposium. Cranbrook, BC. September 14-17, 2009.

Ronalds, I., and L. Grant. 2018. *Tweedsmuir Lichen Restoration Trial: Year 1 Report.* Prepared for L. Grant, Skeena Region, BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development. February 13, 2018.

Serediak, M. S., Prepas, E. E., Murphy, T. P., and Babin, J. 2002. Development, construction, and use of lime and alum application systems in Alberta, Canada. *Lake and Reservoir Management*, 18(1), 66–74. https://doi.org/10.1080/07438140209353930

Straker, J., O'Kane, M., Carey, S., Baker, T., Charest, D., & Shurniak, R. (2014). *Towards an ecohydrologic classification of reclaimed watersheds: methods for estimating soil water regime on reclaimed mine waste materials; and relationships between reclamation and surface water balances in Teck's reclaimed coal-mining watersheds.*

Straker, J., T. Baker, S.L. Barbour, M. O'Kane, S. Carey, and D. Charest. 2015. *Mine Reclamation and Surface Water Balances : An Ecohydrologic Classification System for Mine-Affected Watersheds.* British Columbia Mine Reclamation Symposium 2015. A.B. Fourie, M. Tibbett, L. Sawatsky and D. van Zyl (eds).

Wang T, A. Hamann, D. Spittlehouse, and C. Carroll. 2016. *Locally Downscaled and Spatially Customizable Climate Data for Historical and Future Periods for North America.* PLoS ONE 11(6): e0156720. https://doi.org/10.1371/journal.pone.0156720

Wielinga, B. 2009. *In Situ Bioremediation of Pit Lakes*. In D.N. Castendyk and L.E. Eary (Eds). Mine Pit Lakes: Characteristics, Predictive modelling, and Sustainability (volume 3, pp. 215 – 223). Littleton, Colorado: Society for Mining, Metallurgy, and Exploration, Inc.