

Pogo Reclamation and Closure Plan



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Prepared by



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Acronymns

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADNR	Alaska Department of Natural Resources
APDES	Alaska Pollutant Discharge Elimination System
ARD	Acid Rock Drainage
BMP	Best Management Practices
CIP	Carbon-in-Pulp
COE	Corps of Engineers
DMR	Discharge Monitoring Report
DSTF	Drystack Tailing Facility
EPA	Environmental protection Agency
GMU	Game Management Unit
LOM	Life of Mine
MOU	Memorandum of Understanding
Plan	Reclamation and Closure Plan
SC	Sumitomo Corporation
RTP	Recycle Tailings Pond
ROW	Right-of-Way
SCRE	Standard Reclamation Cost Model
SWPPP	Stormwater Pollution Prevention Plan
TBAP	Tanana Basin Area Plan
TVSF	Tanana State Forest
TWUA	Temporary Water Use Authorizations
USGS	United States Geological Survey

Units of Measure

°C	Celsius
°F	Fahrenheit
amsl	above mean sea level
ft	foot/feet
gpm	gallons per minute
g/t	gross tons
Ma	million annum
opt	ounce per ton
tpa	tons per annum
yd ³	cubic yards

1.0 INTRODUCTION

Pogo Mine is an underground gold mine and mill in central Alaska, located approximately 38 miles northeast of Delta Junction (**Figure 1.1**). Sumitomo Metal Mining Pogo LLC (Pogo) is the operator of the Pogo Mine.

This “Reclamation and Closure Plan” (Plan) updates document 7 of the original Pogo Project Documentation Series for Permitting Approval and is an integral part of the operating plan for the project. This Plan describes the post-mining land use and provides the basis for the reclamation and closure activities that will be implemented. Also incorporated in this Plan are field investigations to gather site-specific information to help guide final closure designs.

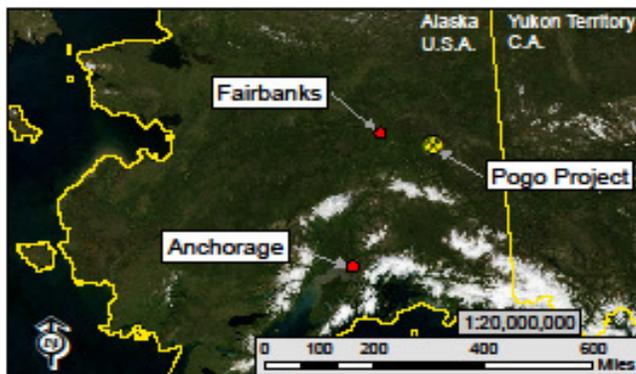
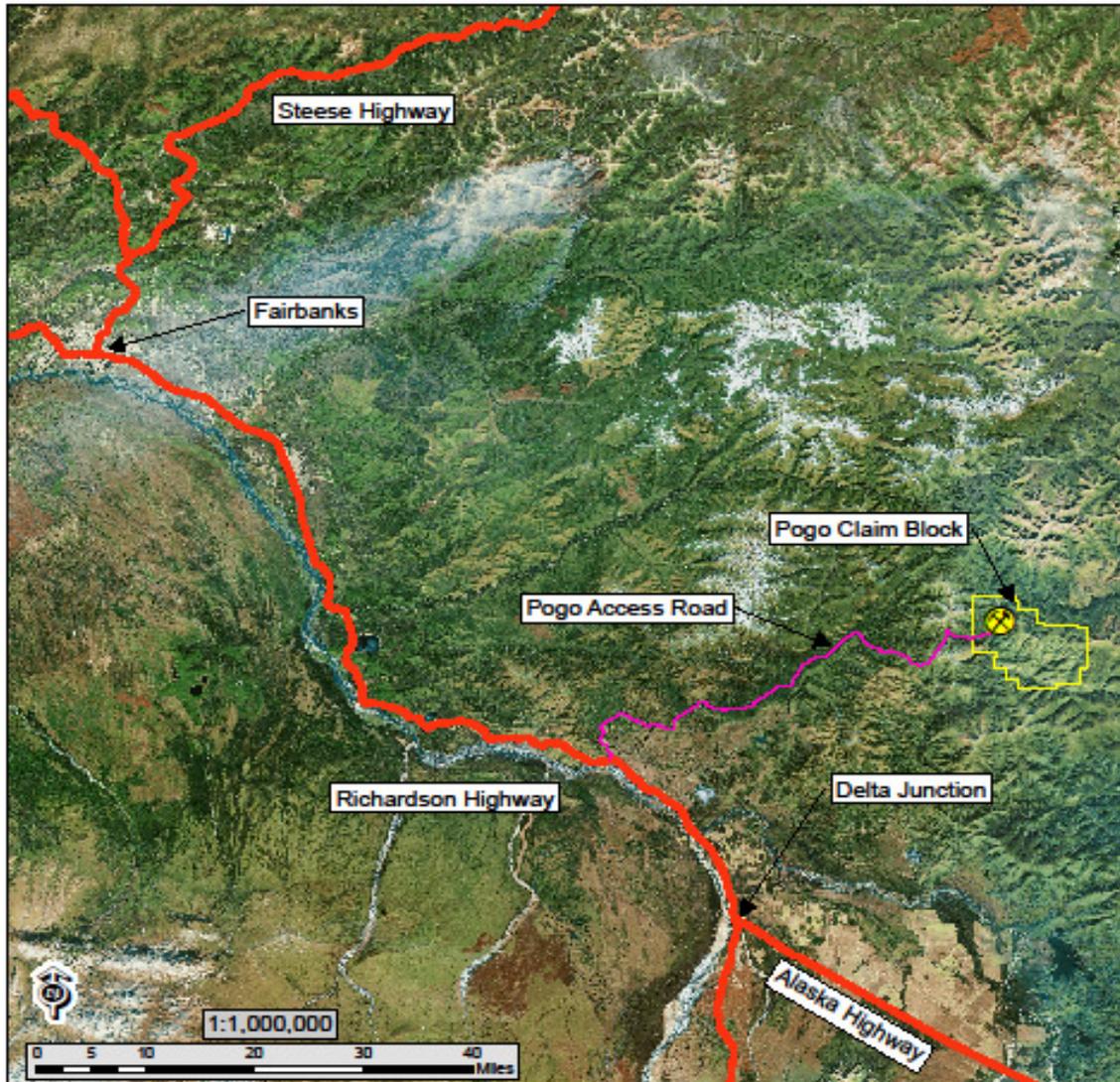
This February 2017 Plan was revised to reflect current knowledge of site conditions, closure plans, comments from state agencies and projected reclamation and closure costs.

1.1 Purpose of this Document

This Plan is a working document that will be used to guide operations in conformance with the appropriate regulations from the Alaska Department of Natural Resources (ADNR), the Alaska Department of Environmental Conservation (ADEC), the U.S. Environmental Protection Agency (EPA), and the U.S. Army Corps of Engineers (COE). As operations proceed, this Plan will be updated with new information to reflect current Best Management Practices (BMPs) and to reflect any changes to the design and operation of the facility.

The purpose of this Plan is to describe methods and procedures that will be used to ensure that operations are conducted in accordance with AS 27.19.020, which states:

“A mining operation shall be conducted in a manner that prevents unnecessary and undue degradation of land and water resources, and the mining operation shall be reclaimed as contemporaneously as practicable with the mining operation to leave the site in a stable condition.”



Pogo Project
Figure 1.1
General Location Map
Pogo Plan of Operation

POGO MINE
 MIN. ENVIRONMENTAL GROUP

Base Map: GINA BDL WMS
 Coordinate System: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
 Projection: Transverse Mercator
 False Easting: 1,640,416.67
 Central Meridian: -149.00
 Latitude of Origin: 64.00

Author: Pogo Environmental
 File Location: P:\Geology\Environmental\Maps

To achieve these directives, Pogo has defined the following objectives for the reclamation and closure components of this Plan.

The reclamation objective is to stabilize disturbed land surfaces against erosion and return the land to a post-mining land use of public recreation and wildlife habitat. This objective will be achieved by improving plant growth conditions and encouraging the succession of self-sustaining native and naturalized plant communities. Inactive areas that are not anticipated to be disturbed in the future will be reclaimed concurrent with mining.

The closure objective is to ensure that water quality is not unduly influenced after mining operations cease. Successful reclamation and revegetation will play an important role in reaching this closure objective. As part of this goal, materials that could potentially cause degradation to the lands and waters of the state of Alaska will be stabilized, removed, or mitigated.

The issues Pogo believes to be most important to successfully achieving these reclamation and closure objectives are:

- successful stabilization and erosion control on steep dipping slopes
- closure of the tailings drystack facility
- closure of the underground workings.

1.2 Organization of this Document

This document is organized into five sections. **Section 1** is the introduction and provides an overview of the project and ecological setting. **Section 2** provides an overview of the operating profile and the nature and extent of the expected disturbance at closure. **Section 3** describes general revegetation guidelines, while **Section 4** describes the specific reclamation and closure prescriptions that will be applied to various project components. **Section 5** presents the performance standards for monitoring the effectiveness of the reclamation practices and the reclamation and closure cost estimate.

The appendices to this report include general procedures to be followed during construction, revegetation, and demolition, as well as material site reclamation plans, proposed vegetation test trials, and a reclamation cost estimate. All units of measure in this report are U.S. standard.

1.3 Agency Involvement

Reclamation of the Pogo project site falls under the jurisdiction of the Alaska Department of Natural Resources, Division of Mining, Land and Water Management (ADNR-DOM), ADEC, and the COE.

The Alaska governor approved the State *Reclamation Act* on 6 June 1990. This act, administered by ADNR-DOM, establishes performance standards of “undue and unnecessary degradation” and return to “stable condition” for mining reclamation and extended reclamation requirements to state, federal, and private land subject to cooperative agreements between state and federal agencies. Under the act, reclamation bonding is mandatory for mines disturbing more than five acres.

The ADEC regulates closure activities for specific site facilities under the Department’s Solid Waste (18 AAC 60) and Water (18 AAC 70 and 18 AAC 72) regulations.

The COE regulates dredge and fill activities associated with wetlands under Section 404 of the *Clean Water Act* (33 U.S.C. 1344).

1.3.1 Reclamation Plan Review

Table 1.1 summarizes the project stages from exploration to closure, and the pertinent reclamation and closure activities for each stage. This Reclamation Plan has been developed during Project Stage VI – Operating Life-of-Mine.

1.3.2 Financial Assurance

Financial assurance requirements by the ADEC and ADNR-DOM ensure that performance criteria will be met during the reclamation process and that the owner or operator closes a project site according to state and federal regulations.

Pogo proposes to post financial assurance for the amount of the estimated reclamation and closure costs as presented in **Appendix F** for the millsite lease area, access road, and transmission line.

Table 1.1: Project Development Stages

Project Stage	Project Activity	Reclamation & Closure Activity
I	Grass Roots Surface Exploration	No surface disturbance.
II	Advanced Exploration	
	Stage 1 - Surface Exploration	As permitted by ADNR & COE.
	Stage 2 - Underground Exploration	As permitted by ADNR & COE.
III	Mine Environmental Assessment	Mine reclamation & closure plan developed.
	Mine Feasibility	Design for closure at the outset.
IV	Permitting for Mine Construction and Operations	Mine reclamation & closure plan approval by ADNR, ADEC, & COE.
V	Mine Construction	Disturbance minimized to reduce impacts.
VI	Operating Life of Mine	Concurrent reclamation where possible.
VII	Reclamation & Closure	Mine closure in accordance with mine reclamation & closure plan, permit requirements, & best management practices.

1.4 Ecological Setting

The following sections provide a brief overview of the physical and biological baseline environment at the Pogo project. A more detailed description of the environment is included in the Pogo Environmental Impact Statement (EPA 2003).

The Pogo Mine is located near the Goodpaster River in the Tanana Uplands, an area of rolling hills and mountains on the north side of the Alaska Range in Interior Alaska (**Figure 1.1**). The Goodpaster is a major north side tributary to the Tanana River in the Yukon drainage basin. Elevations range from approximately 1,300 ft above mean sea level (amsl) along the alluvial floodplain to over 4,000 ft amsl along the ridge tops. An east-west trending ridge dominates the project site, with creeks to the south of the ridge draining first into Central Creek and then into the Goodpaster, and creeks on the north side draining directly into the Goodpaster River.

Southeast-facing slopes have closed forests of aspen, birch, and white spruce. Open communities of dwarf black spruce and birch are found on the north-facing slopes. The west-facing slopes in the headwaters of the Liese basin have open stands of white spruce at lower elevations and alder at higher elevations. Exposed rubble and short-stature alpine vegetation characterize the surface of the ridges surrounding the basin. For the most part, vegetation is influenced by limited amounts of soil cover and discontinuous permafrost within much of the basin.

1.4.1 Climate

The climate in the Pogo project area is similar to other areas of interior Alaska. Wind speeds at higher elevations (>2,800 ft) are moderate to strong in winter and light to moderate in summer. The wind speeds at lower elevations are generally lighter. Winter temperatures range from -40°F to 32°F. Summer temperatures range from 41°F to 86°F. Temperature inversions are common in the winter, particularly in mountain valleys.

The predicted mean annual precipitation ranges from 12 inches to 19 inches with approximately 38% occurring as snowfall (Teck-Pogo Inc. 2002c).

1.4.2 Soils & Vegetation

Soils in the area vary from very poorly drained, deep organic soils (Histosols), to well-drained but only moderately developed mineral soils (Cryochrepts and Cryumbrepts), to well-drained highly developed mineral soils (Spodosols) (Three Parameters Plus 2000).

Soils in the floodplain of the Goodpaster River are well drained on the higher elevation terraces, and poorly to somewhat poorly drained in more active but vegetated and detritus lined, lower elevation channels. Terraces are typically vegetated with larger diameter, 14 inch plus at diameter at breast height (DBH), white spruce (*Picea glauca*), and support a sparse understory. Relic and seasonally active channels support a mixed forest typically dominated by white spruce, black spruce (*Picea mariana*), and paper birch (*Betula papyrifera*). The understory in these areas is denser, but highly variable due to the varying frequency of flooding and degree of saturation found in these channels.

Lowlands within the floodplain of the Goodpaster River and the adjacent lower elevation footslopes support poorly drained soils. These are very cold soils with organic mats of at least 8 inch. These soil types also extend well up the west-facing hillside above the area of the existing advanced exploration camp. Lowland and lower footslope soils often contain ice-rich permafrost within the upper 2 ft of the soil profile, and several of the soil pits in these areas filled with water shortly after the pit was dug. Permafrost is discontinuous in the project area, and its presence and depth is difficult to predict. Mineral soil horizons under these deep organic mats typically become very thixotropic upon exposure and thawing. *Histic Pergelic Cryaquepts* generally support open black spruce forests or scrub shrub vegetation types. These two vegetation types can also occur over cryohemists, however, the tussock sedge vegetation type, dominated by *Eriophorum vaginatum*, is more common.

Hillsides and upper mountain-slopes with a south to west aspect, or convex topography, can also support moderate- to well-drained mineral soils. Generally, these soils have a relatively thin organic mat (2 to 6 inches) overlying 6 to 24 inches of sandy loam material, which in turn overlies loose talus/colluvium or weathering rocks. In some areas, the loamy soil can

be sparse to non-existent and the organic mat resides directly on blocky talus/colluvium and/or frost-shattered weathered bedrock.

Soils on these landforms commonly support a closed black spruce forest type with relatively large diameter black spruce (12 inch + DBH) and a moderately sparse understory, or mixed forests with larger diameter spruce and paper birch. Where drainage is poor on these sites, such as in seeps or small depressions, mottles or organic stains are common in the sandy layer. The taxonomic classification of these soils is dependent on several variables, but most would fall into the *Typic Cryaquept* classification. Ice-rich permafrost is uncommon in these areas; however, the colder, wetter soils can become slightly thixotropic upon removal of the organic mat and exposure to warmer temperatures (Teck Resources Inc. 1998).

1.4.3 Wildlife

The project area comprises three types of shrub and forest habitats—lowland shrub needleleaf, riparian and lowland forest needleleaf, and upland forest needleleaf—that are dominated by varying proportions of white and black spruce (*Picea glauca* and *mariana*), quaking aspen and balsam poplar (*Populus tremuloides* and *balsamifera*), paper birch (*Betula papyrifera*), alder (*Alnus spp.*), and willows (*Salix spp.*). These habitat types support both resident birds (e.g., grouse, woodpeckers, chickadees) as well as a number of migratory species that occur only during the summer breeding season—principally songbirds (thrushes, warblers, sparrows, and flycatchers, many of which are neotropical migrants) and raptors. The three types present in the immediate vicinity of the underground project are among the lower diversity types in interior Alaska.

A few waterfowl and shorebirds occur in the wetlands of the Goodpaster River valley but in low densities; habitats suitable for breeding waterfowl are small and widely dispersed in this portion of the Goodpaster drainage. The project area supports a mammalian fauna typical of the boreal forest of the Yukon–Tanana Uplands of interior Alaska. Specific surveys to inventory the small mammals and furbearers have not been done in the project area, but species that are common elsewhere in interior Alaska include: red squirrels (*Tamiasciurus hudsonicus*), snowshoe hares (*Lepus americanus*), red foxes (*Vulpes vulpes*), and various shrews and arvicoline rodents (voles, mice, and lemmings). More information exists for big game species such as moose and bears due to their harvest by humans. The project area is located in the northwestern portion of Game Management Unit (GMU) 20D, which is considered less accessible to hunters than other subunits (Teck Resources Inc. 1998).

1.4.4 Surface Water

The surface water environment in the project area is generally good and overall water quality and physical characteristics are typical of many subarctic Alaska streams.

Surface water in the Pogo project area is clear and non-glacial, with slight to moderate organic staining observed during spring runoff. Water quality and physical characteristics are influenced by the source of the stream flow, which varies seasonally. During the open water season, which lasts from approximately late April through October, the source of stream flow is a combination of groundwater baseflow and precipitation runoff. Freezing conditions in the winter limit the source of stream flow to groundwater inputs.

The baseline hydrological conditions at the Pogo site have been investigated by analyzing on-site rainfall, snowpack, and stream discharge data as well as regional meteorological information. The short-term rainfall records on site have been correlated with long-term data at regional meteorological stations, and possible orographic (mountain) influences have been assessed. The runoff regime is characterized by spring snowmelt followed by runoff from summer rainfall events. Annual runoff depths have been quantified based on the monitoring results for the Goodpaster River and two tributary creeks, Sonora and Central Creek. Winter discharges often produce areas of aufeis, or glaciation, in the tributary creek valleys.

1.4.5 Groundwater Hydrology

The Pogo project consists of two main hydrogeologic areas: the upland area in the eastern portion of the site and the Goodpaster River valley to the west.

The groundwater table in the project area is a subdued replica of the topography with the water table at a higher elevation beneath the ridge than beneath the valley. Recharge of the groundwater system occurs predominantly in the upland areas. Regional discharge is to the Goodpaster River valley, with local groundwater discharge to Pogo Creek and Liese Creek. Groundwater flow in the sediments of the Goodpaster River is predominately horizontal and from the north to the south, parallel to the river.

The upland or Pogo Ridge area is underlain by low permeable bedrock consisting predominantly of igneous and metamorphosed sedimentary rocks. More pervious zones of broken rock may be present within the less fractured bedrock, but recent data gathered from the advanced exploration adit suggests that these zones are not extensive over large areas and as such are not significant pathways for groundwater flow. Permafrost has developed to a depth of up to 350 ft below ground surface on the north-facing slope of this ridge, while on the south-facing slope it is virtually absent. The water table beneath the ridge is deep and up to approximately 500 ft below the ground surface.

The Goodpaster River valley is underlain predominantly by highly permeable sands and gravels. These sediments are up to 100 ft thick in the center of the valley, with their thickness decreasing towards the valley flanks. The water table is located at approximately 2 to 8 ft below the ground surface. In the eastern portion of the valley, permafrost, which can be considered to be virtually impermeable, generally extends from the ground surface down to

the bottom of the sediments. Closer to the existing river channel, the permafrost gradually thins and is underlain by unfrozen sediments.

Pogo began a hydrogeological characterization in 2012 in order to rebuild the groundwater flow model. The original model was initially established in 2002 and was updated in 2009 (Brown 2009). The current model includes the East Deep zone. The final model was released by SRK in May 2014 (SRK 2014).

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1.5 Land Use

The Tanana Basin Area Plan Amendment (TBAP) for State Lands (ADNR 2009) designates the uses that will occur on state lands within the Tanana Basin and establishes guidelines that allow various uses to occur without conflicts. The TBAP goals for subsurface resources are:

- To make metallic and non-metallic minerals, coal, oil and gas, and geothermal resources available to contribute to the energy and mineral supplies and independence of the United States of America.
- To contribute to Alaska's economy by making subsurface resources available for development, which will provide stable job opportunities, stimulate growth of secondary and other primary industries, and establish a stable source of state revenues.
- When developing subsurface resources, to protect the integrity of the environment and affected cultures to the extent feasible and prudent.
- To aid in the development of infrastructure such as ports, roads, and railroads, and continue to provide geologic mapping and technical support for the mining industry.

According to the TBAP (ADNR 1991), the Pogo project area is in the Delta-Salcha Subregion (Management Unit 7). The Delta-Salcha Subregion is bordered by Eielson Air Force Base to the north, the Alaska Range to the south, federal lands to the west, and by the limit of the Tanana Basin to the east .

The land within the claim block and west of the claim block where the access route was constructed is classified into six subunits. Primary land use designations for these six subunits include: public recreation (six of the six subunits), wildlife habitat (four of the six subunits), and forestry (two of the six subunits). All state lands in these units are to be retained in public ownership.

The primary designated surface uses for the uplands within the claim block are public recreation and wildlife habitat. Prohibited surface uses are specified along a corridor of the lower Goodpaster River. For the lower portion of the river corridor, Subunit 7D1, all-season roads, timber harvest greater than 10,000 board ft except for special conditions, and permanent commercial facilities are prohibited surface uses. The upper portion of the river corridor, Subunit 7D2, is within the claim block and prohibited surface uses include timber harvesting within the 100-year floodplain.

Tanana Valley State Forest (TVSF) land, Units 9 and 10, is located along access corridors. Management Unit 9 includes most of the uplands between Shaw Creek and the Goodpaster River, while Management Unit 10 includes the bottomland along the Tanana River between Big Delta and Dot Lake as well as the uplands that surround Volkmar Lake.

Traditional resource use of the region has been for subsistence and recreation. Delta Region residents as well as owners of recreational properties in the Goodpaster area hunt moose, bear, rabbit, grouse, ptarmigan, buffalo, and dall sheep. Trappers in the area report the harvesting of furbearers such as lynx, marten, beaver, wolf, and fox. Recreational fishing in the region includes pike, grayling, trout, and silver and chum salmon. Several of these species are available year-round through winter ice fishing.

Numerous well-developed trails throughout the region are used by snowmobiles, skiers, and dog teams in the winter and spring months. Riverboats, canoes, river rafts, and kayaks are used by residents and visitors on many of the rivers in the region between mid-April and October. Primary among the recreational rivers in the regions are the Tanana, the Goodpaster, and the Clearwater.

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2.0 OPERATIONS PROFILE / APPLICANT INFORMATION

2.1 Surface and Mineral Lease Information

The mine is 38 air miles northeast of Delta Junction, Alaska and the property consists of 1,281 state mining claims covering an area approximately 41,880 acres (**Figure 1.1**). The Pogo claim block lies in Sections 13, 14, 22-27, and 34-36 within T5S, R14E, Sections 18, 19, and 29-34 within T5S, R15E, Sections 1-3, 10-15, and 36 within T6S, R14E, and Sections 3-11, 14-23, and 29-32 within T6S, R15E, Fairbanks Meridian. Information on mining claims and land status for Sumitomo Metal Mining Pogo is listed in the Pogo Mine Plan of Operations Appendix A.

2.2 Corporation Officer Completing Application

Name: Chris Kennedy
Title: General Manager
Telephone: (907) 895-2841
Date: January 2017

2.3 Designated Contact Person

Name: Keri DePalma
Title: Environmental Manager
Telephone: (907) 895-2879

2.4 Corporate Information

Business Name: Sumitomo Metal Mining Pogo LLC
Entity Address: 701 Fifth Avenue, Suite 2150
Seattle, Washington 98104
Local Address: PO Box 145
Delta Junction, Alaska 99737
Telephone: (907) 895-2713
President: Fumikazu Oshita
Treasurer: Hiromi Johnston
Secretary: Hiromi Johnston

Sumitomo Metal Mining Pogo LLC is an Alaska Limited Liability Company wholly owned by Sumitomo Metal Mining America, Inc.

2.5 Alaska Registered Agent

Name: DWT Alaska Corp
Address: 188 W Northern Lights, Suite 1100
Anchorage, Alaska 99503-3985

2.6 Applicant Statement of Responsibility

Pogo recognizes its responsibility in the use of state lands and accepts that responsibility in its commitment to reclaim the Pogo project site. Pogo will meet the requirements of its reclamation plan and return the site to a safe and stable condition consistent with the approved post-mining land use. Pogo will meet all required local, federal, and state laws and regulations regarding reclamation activities.

2.7 General Description of the Project

The mine consists of the six major elements shown on **Figure 2.2** and described below.

1525 Portal Area (1000)

- 120-person camp facilities
- Sewage treatment plant
- Water treatment plant
- Development rock stockpile
- Laydown areas for warehouse and supply
- Warehouses for mine supply
- Growth media stockpiles

Airport Area (2000)

- A 3,000-foot airstrip in the Goodpaster River valley just north of Liese Creek
- Site access roads connecting the plant site with the shop/camp facilities, construction camp area, airstrip, tailings site, borrow sites, and other facilities as needed
- Growth media stockpiles

Mill / Camp Complex (3000)

- Surface gold mill for recovery through gravity concentration, flotation, and Carbon-in-Pulp (CIP) process
- Tailings preparation facilities, including cyanide detoxification and filtration, to produce paste backfill for the underground mine workings and dewatered tailings material suitable for placement in a drystack facility on the surface
- Maintenance shops, office, warehouse complex
- 250-person camp with recreation and catering facility

Tailings Area (4000)

- Drystack tailings facility
- Recycle Tailings Pond (RTP) water storage facility
- Diversion Ditch
- Growth media stockpiles and connecting roads

Mine (5000)

- Underground cut-and-fill mine with adit access and conveyor for transfer of ore to a surface mill
- 1525 portal original exproation adit, ventilation, waste rock haulage, etc.
- 1875 portal primary access for workers, supplies, etc.
- 1690 portal conveyor access and ventilation
- 2150 portal intake ventilation, access for workers, supplies, etc.

All of Mine (6000)

- All utilities, piping and items that connect all of the respective area
- Items not included in other areas

2.8 Design Goals & Considerations

To protect the environment, all aspects of operations for the Pogo mine will be based on the following principles:

- perform concurrent reclamation and planning for closure
- comply with all relevant federal and state laws and regulations

- reduce, to the extent reasonable, the amount of water discharged, and comply with all federal and state laws and regulations if a discharge of water does occur
- reduce, to the extent reasonable, the overall surface footprint of the project
- reduce, to the extent reasonable, the project's effect on the Goodpaster River
- reduce, to the extent reasonable, the project's effect on wetlands
- reduce the risk of spills and comply with all federal and state laws regarding the handling of hazardous materials, including cyanide, fuel, and mill reagents
- collect and control rainfall runoff from the plant site, plant site roads, and the tailings drystack placement area

2.9 Nature & Extent of Land Disturbance at Closure

There are approximately 527 acres currently disturbed within the Millsite Lease area. Disturbances associated with mining operations are shown in **Table 2.1** and on **Figure 2.1**. Approximately 368 acres of disturbance are associated with the Pogo access road, material sites, and transmission line (approximately 159 acres for material sites, 208 acres for private portion of the access road, and 1 acre - power poles only).

Table 2.1 also provides an estimate of the areas that will require natural and enhanced recovery methods and soils to be reshaped and relocated for recontouring. The goal of the revegetation program is to stabilize soil erosion so that native species may re-colonize the area. This will be accomplished using the two methods described below.

- Natural recovery will be implemented in minimally disturbed areas; scarification and fertilization of the disturbed and surrounding area may be undertaken to encourage natural recovery.
- Enhanced recovery will be implemented in highly disturbed areas using a combination of one or more of the following: growth media, fertilizer, native grass seed, or native shrubbery to immediately establish a vegetative cover to reduce soil erosion and prevent sediment loss into rivers and streams.

Table 2.1: Mine Land Disturbance & Reclamation Methods

Pogo ID	Minesite Facility Name	2016 Acres	Cover layer below GM (ft)	GM thickness (inches)	Rip/scarify Yes/No	Seeding Yes/No	Cover volume (yd ³)	GM volume (yd ³)
1525 Portal Area								
	Buildings - Lower Camp Area	1.00	3	6	yes	yes	4,855	809
	Buildings - D-wing Area & incinerator	0.91	3	6	yes	yes	4,382	730
	Buildings - 1525 Portal Area	0.76	3	6	yes	yes	3,677	613
	Material Site 23	6.84	0	0	no	no	0	0
	1525 Portal Organic Stockpile	0.62	0	0	no	no	0	0
	1525 Portal Inorganic Stockpile	1.66	0	0	no	no	0	0
	1525 Portal GM-01 & GM-02	1.39	0	0	no	no	0	0
E01	1525 Portal Access Road #8	9.91	0	0	yes	no	0	0
E02	Non-Mineralized Rock Storage Area 1 & 2	2.85	0	0	no	no	0	0
E02	Mineralized Rock Storage Area 3	2.32	0	6	no	no	0	1,873
E03	Lower Camp Pond & Gravel Pond	6.97	0	0	no	no	0	0
E04	Construction Airstrip	1.37	0	0	yes	no	0	0
E05	Lower Camp Diversion Ditch	0.07	0	0	no	no	0	0
E06	Access from Goodpaster Bridge to Construction Camp	0.21	0	6	yes	no	0	171
E07	Burn Pit	0.42	0	0	no	no	0	0
N01	1525 Portal Area	5.61	0	6	yes	no	0	2,261
N02	Outfall 002 Path	0.55	0	0	no	no	0	0
N04	1525 Portal Laydown Area #1 & #2 and D-wing Area	11.99	0	0	yes	no	0	0
N05	Construction / Exploration Camp Pad	11.40	0	6	yes	no	0	4,598
N06	Access Road #6 from Goodpaster Bridge to Liese Bridge	12.22	0	6	yes	no	0	9,857
N08	Fuel Area	0.20	0	6	no	no	0	163
	Subtotal	79.28					12,913	21,077
Airport Area								
N03	Access Road #7	10.99	0	6	yes	no	0	8,863
N07	Main Airstrip	44.6	0	6	yes	no	0	26,992
N09	Borrow source at airstrip	1.82	0	0	no	no	0	0
N27	GM-05 through GM-08, GM-16 & GM-17	11.49	0	0	no	no	0	0
	Airstrip Clearance	0.7	0	0	no	no	0	0
N11	Airstrip Laydown 1-3, Non-Organic Stockpile	30.66	0	0	yes	no	0	0
N31	ORTW, Inlet Pond & Mixing Pond	18.31	0	6	yes	no	0	14,773
N34	Log Storage 1 - 8, Exploration Core Stockpile & Laydown Yard	4.11	0	0	yes	no	0	0
	Subtotal	122.73					0	50,628
Mill and Camp Area								
	Buildings - 1875 Portal Area	0.13	3	6	yes	yes	634	106
	Buildings - 1690 Portal Area	0.05	3	6	yes	yes	232	39
	Buildings - Main Camp Area	1.71	3	6	yes	yes	8,279	1,380
	Buildings - Mill Area	2.91	3	6	yes	yes	14,068	2,345
N10	1690 Portal 1 & 2 Area	4.89	0	6	yes	yes	0	3,946
N13	Access Road #1	9.19	0	6	yes	yes	0	7,417
N14	Mill Bench & Main Substation	19.54	0	6	yes	yes	0	15,758
N16	Main Camp / 1875 Portal Area	19.31	0	6	yes	yes	0	15,579
N25	Stormwater Pond	0.74	0	6	no	yes	0	593
N30	Ore Stockpile	1.38	0	0	yes	yes	0	0
	Subtotal	59.84					23,212	47,163
Tailings Area								
	Buildings - RTP Area	0.02	3	6	yes	yes	118	20
	Diversion Channel Area	13.85	0	6	no	yes	0	5,586
	Diversion Channel Access Road	1.24	0	0	yes	yes	0	0
N27	GM-11 through GM-15	6.57	0	0	no	no	0	0
N15	Road Mill to RTP	15.80	0	6	yes	yes	0	6,373
N15R	Access RTP to Drystack	23.20	0	0	yes	yes	0	0
N17	RTP	10.07	0	6	no	yes	0	8,125
N18	Drystack-1, -2 & -3	73.02	1.5	6	yes	yes	176,712	58,904
N20	RTP Access Road	2.27	0	6	yes	yes	0	1,829
	Drystack Perimeter Channel	5.98	0	0	no	yes	0	0
N23	Drystack Diversion Channel	4.33	0	0	no	yes	0	0
	Drystack Diversion Channel Access	30.25	0	0	yes	yes	0	0
	RTP Still Basin	0.49	0	6	no	yes	0	392
N32	Stilling Basin	1.84	0	6	no	yes	0	1,482
	Subtotal	188.92					176,829	82,711
Site-Wide Area								
	Buildings - Exploration Camp	0.05	3	6	yes	yes	227	38
	Buildings - sitewide	0.20	3	6	yes	yes	983	164
	Upper Exploration Camp Area	1.75	0	0	no	no	0	0
	Liese Creek Bridge	0.05	0	0	no	no	0	0
	Goodpaster Bridge	0.18	0	0	no	no	0	0
N21	Transmission Line	18.61	0	0	no	no	0	0
N27	GM-9 & GM-10	2.28	0	0	no	no	0	0
N28A	Material Site A	2.06	0	0	no	no	0	0
N36	Access to GM-19 & MS-1	0.11	0	0	no	no	0	0
N36	Access to GM-18 & MS-2	3.00	0	0	no	no	0	0
N37	Material Site 1 & 2	28.22	0	0	no	no	0	0
N38	GM-18 & GM-19	7.90	0	0	no	no	0	0
	Subtotal	64.40					1,211	202
2150 Portal								
	2150 Portal Yard & Material Site D	11.24	0	0	yes	yes	0	0
	Buildings - 2150 Portal Area	0.12	3	6	yes	yes	562	94
	Subtotal	11.36					562	94
	Total	526.53					214,728	201,875
Grand Total Required Material Quantities							214,728	201,875
Available Material Quantities								205,816
Available Less Required								3,941

2.9.1 Impacts to Vegetation

A description of the types of vegetation to be found on the project site is presented in **Table 2.2**.

The majority of the impacted vegetation is a mosaic of alluvial forest (lowlands) and open black spruce forest with tussock sedge wetlands.

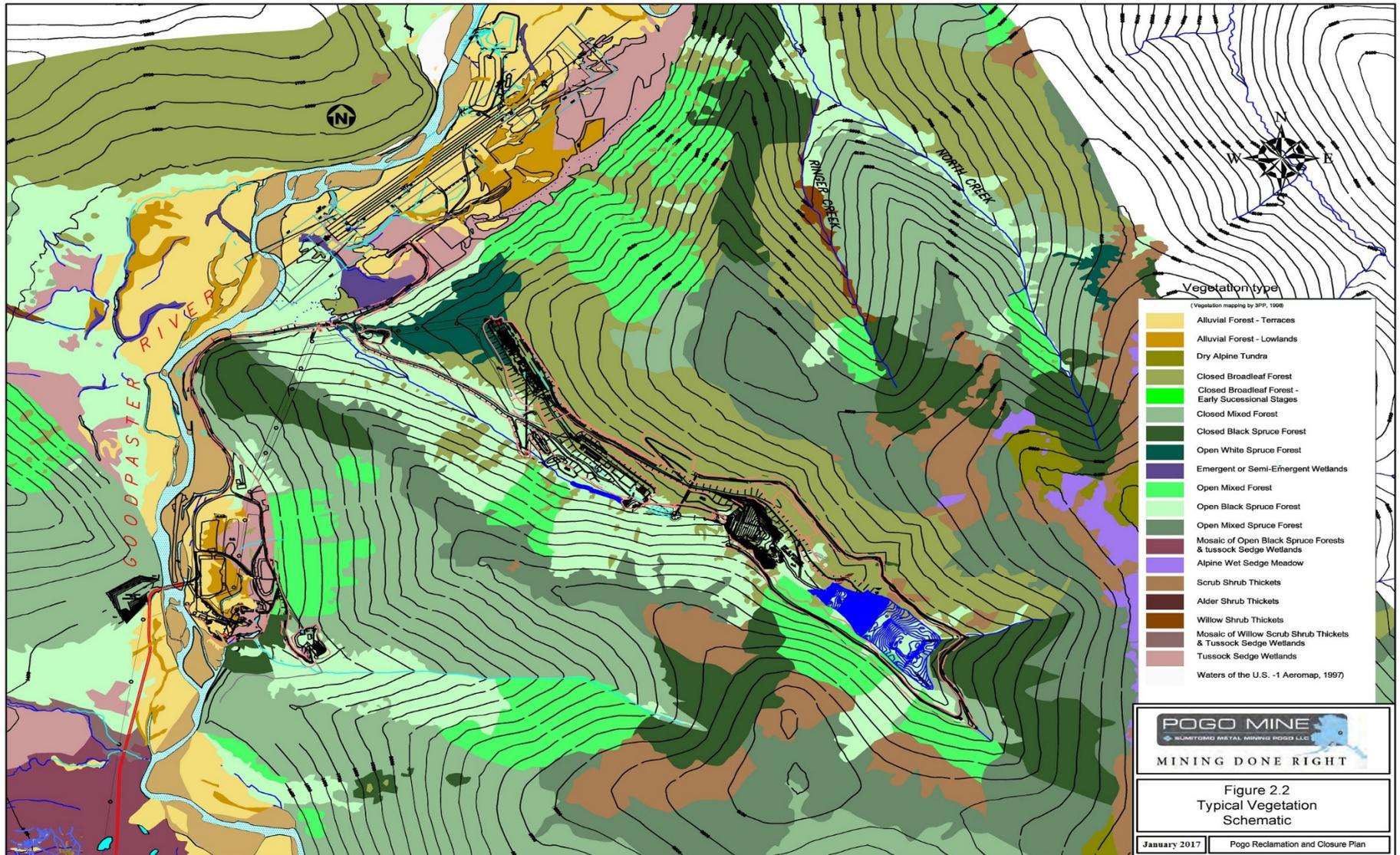
The typical vegetation within the project footprint is presented in **Figure 2.3**. The major vegetation types are: alluvial forest (terrace), open black spruce forest, closed broadleaf forest, and open black spruce forest (tussock sedge complex).

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Table 2.2: Vegetation Type Descriptions

Vegetation Type	Soil Description
Alder Shrub Thicket	Somewhat poorly-drained Pergelic Cryaquepts or moderately well-drained Pergelic Cryochrepts, depending on the degree of slope. Hydric or non-hydric.
Alluvial Forest – Emergent Complex	See Alluvial Forests – Lowlands
Alluvial Forest – Lowland	Loamy, mixed, non-acid Pergelic Cryaquepts. Hydric.
Alluvial Forest – Terraces	Moderately well-drained, coarse-silty, mixed, non-acid Aeric Cryaquepts; or Typic Cryofluvents. Hydric.
Alluvial Forest – Willow Shrub Thicket Complex	See Alluvial Forests – Lowlands
Closed Black Spruce Forest	Moderately well- to somewhat poorly-drained Pergelic Cryorthents or Cryochrepts, variable. Predominantly non-hydric.
Closed Broadleaf Forest	Well-drained, coarse-silty, mixed, non-acid Aeric Cryaquepts (occasionally well-drained Typic Cryochrepts). Non-hydric.
Closed Mixed Forest	Moderately well-drained, coarse-silty, mixed, non-acid Aeric cryaquepts (Typic Cryochrepts). Non-hydric.
Disturbed – Filled Areas	Mixed soils.
Dwarf Birch Shrub Thicket	Dysic Pergelic Sphagnofibrists or Histic Pergelic Cryaquepts. Both hydric.
Emergent Aquatic Areas	Dysic Pergelic Sphagnofibrists or Typic or Pergelic Cryofibrists. Hydric.
Gravel Bars	Probable waters of the U.S.
Open Black Spruce Forest	Loam, mixed, non-acid Histic Pergelic Cryaquepts. Hydric.
Open Black Spruce Forest – Tussock Sedge Complex	Loamy, mixed, non-acid to acid Histic Pergelic Cryaquepts or Histic Cryaquepts. Hydric.
Open Mixed Forest	Complex mosaic of forests & shrub thickets, high degree of variability (Pergelic Cryohemists to Typic or Pergelic Cryorthods). Hydric and non-hydric soils.
Open Mixed Spruce Forest	Range from moderately well-drained Pergelic Cryochrepts to somewhat poorly-drained Pergelic Cryaquepts, again depending on the degree of slope and topography. Hydric or non-hydric.
Open Water	Waters of the U.S.
Tussock Sedge	Loamy, mixed, acid Histic Pergelic Cryaquepts or Histic Cryaquepts. Hydric.
Willow Shrub Thicket	Somewhat poorly drained Pergelic Cryaquepts or Pergelic Cryofluvents. Hydric.

Figure 2.2: Typical Vegetation Schematic



3.0 REVEGETATION GUIDELINES

Pogo will use the following guidelines to successfully revegetate the Pogo project area (Helm 1990):

- establish the post-mining land use
- determine the final landform that will meet that use
- determine available plant species
- determine the plant growth media available
- determine the optimum combination of landform, vegetation, and plant growth media for various applications that will meet the stated objectives.

3.1 Post-Mining Land Use

According to the Tanana Area Basin Plan Amendment, the designated and traditional land use in the area is wildlife habitat and recreation (ADNR 2009).

Reclamation of the disturbed areas is expected to enhance wildlife habitat within five to fifteen years by stimulating the growth of early successional forest which provides: willow and shrub browse for moose and other game; young aspen stands for Ruffed Grouse habitat; and grass areas, which provide forage, diversity, and cover for voles and other species.

3.2 Final Landforms

With the exception of stable highwalls, the final post-mining landforms will be blended into the undisturbed landscape through the use of contouring and vegetation. Mine structures will be contoured with the objective of reducing infiltration, keeping the disturbed area to a minimum, and stabilizing the surface. To achieve these objectives, the primary design consideration for reclamation will be the overall slope angle as determined by stability and environmental considerations. The slope length of final landforms will be broken to reduce the water runoff velocity and consequent erosion if necessary.

Where required, highwall stabilization will include a combination of toe buttressing and benching. Examples of areas requiring stabilization include cuts at the mill bench, camp/shop bench, portal cuts, Material Sites A and D, and some rock cuts along the road and ditches.

Where possible, wetland areas will be established to increase the post-mining biodiversity of the project area. These wetland areas may include the material site areas and the recycle tailings pond.

3.3 Plant Species

The project revegetation program will build on previous work done in conjunction with advanced exploration. In 1998 and 1999, seed and fertilizer were applied to erodible areas on the winter road and an unstable slope cut into the hillside above the advanced exploration camp during previous placer operations. Anecdotal experience since construction of the mine demonstrates that the growth media stockpiles readily revegetate.

Further site-specific knowledge will be gathered from test plots of various seed, fertilizer, growth media depth, and shrubbery applications. These tests will be conducted sometime during operations. **Appendix B** provides information on previous revegetation efforts and **Appendix E** presents the list of grass, legume, and woody species that may be used.

3.4 Plant Growth Media

The amount of growth media stripped and stockpiled is more than adequate to reclaim the overall disturbance. Growth media will consist of a combination of organic material, topsoil, and overburden that will serve to enhance revegetation efforts. Approximately 205,816 loose cubic yards of growth media was salvaged during construction activities and stored in 19 growth media stockpiles. Assuming that a six-inch lift of growth media is applied over all the area that will require enhanced recovery, approximately 201,875 loose cubic yards of growth media is required. In addition, the overburden stockpiles have substantial plant growth, which indicates the material is a viable growth media cover. **Appendix B** provides details on the storage and use of growth media in revegetation procedures. The stockpiles will be protected from wind and water erosion using BMPs as described in **Appendix E**.

Table 3.1 summarizes the growth media volumes from storage locations around the site based on the 2015 aerial photographs, surveys, and/or truck counts. The storage locations are shown in **Figure 3.1**.

Relevant assumptions regarding growth media recovery and placement are listed below:

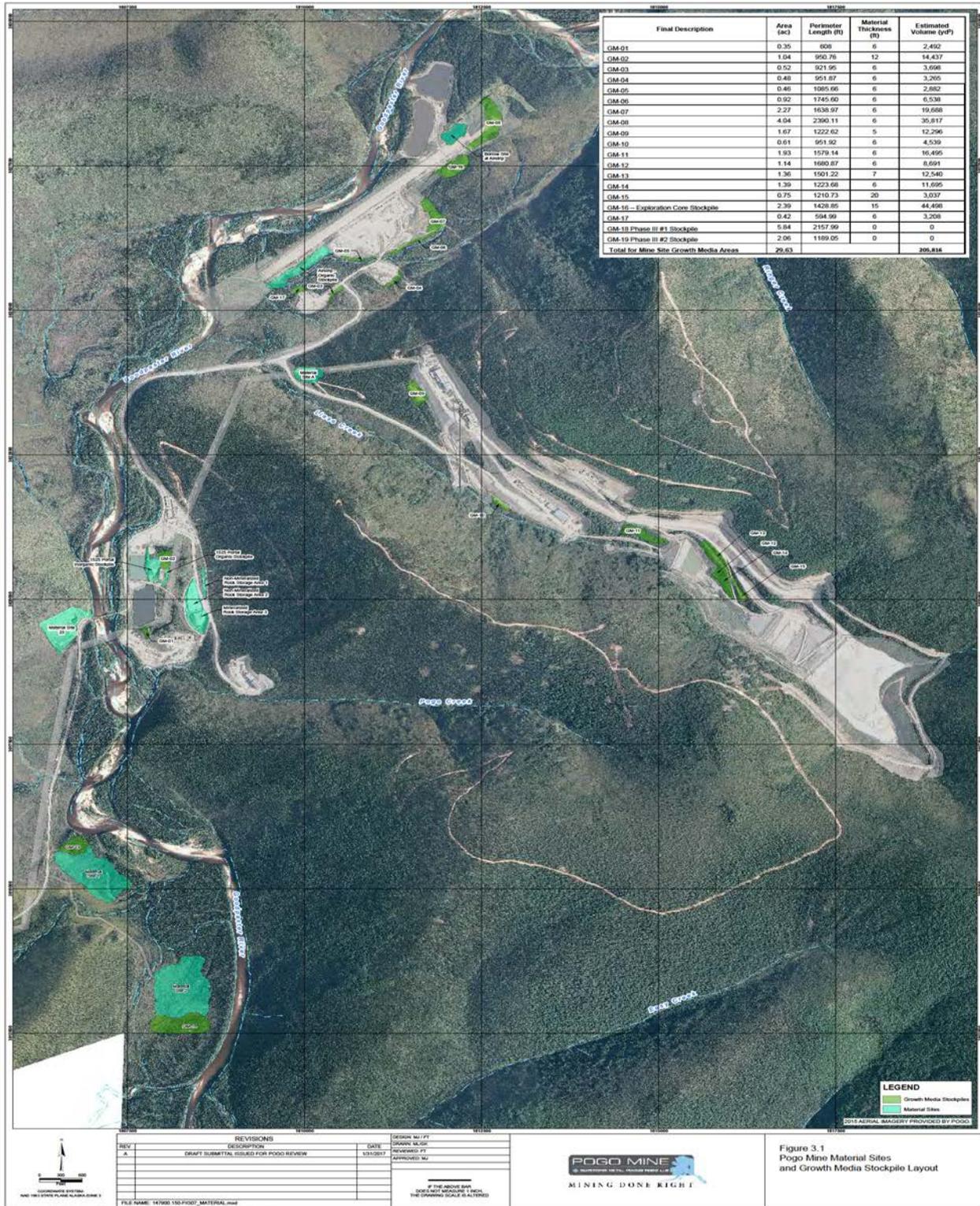
- As the drystack is constructed, growth media will continue to be salvaged
- The Goodpaster valley material site areas will be reclaimed as wetlands
- Mulched organic material has not been included in this balance, but could be available if required
- After mixing in the growth media stockpiles, the organic mat will contribute 50% of its original volume to the growth media available for reclamation

- If the contingency material site on the west side of the Goodpaster River is developed, growth media will be stockpiled in designated locations at the edge of the pits and would be available for reclamation of project facilities. These pits will only be opened as needed.

Table 3.1: Growth Media Stockpiles

Final Description	Area (acre)	Perimeter Length (feet)	Material Thickness (feet)	Estimated Volume (yd ³)
GM-01	0.35	608	6	2,492
GM-02	1.04	950.76	12	14,437
GM-03	0.52	921.95	6	3,698
GM-04	0.48	951.87	6	3,265
GM-05	0.46	1085.66	6	2,882
GM-06	0.92	1745.60	6	6,538
GM-07	2.27	1638.97	6	19,688
GM-08	4.04	2390.11	6	35,817
GM-09	1.67	1222.62	5	12,296
GM-10	0.61	951.92	6	4,539
GM-11	1.93	1579.14	6	16,495
GM-12	1.14	1680.87	6	8,691
GM-13	1.36	1501.22	7	12,540
GM-14	1.39	1223.68	6	11,695
GM-15	0.75	1210.73	20	3,037
GM-16 – Exploration Core Stockpile	2.39	1428.85	15	44,498
GM-17	0.42	594.99	6	3,208
GM-18 Phase III #1 Stockpile	5.84	2157.99	0	0
GM-19 Phase III #2 Stockpile	2.06	1189.05	0	0
Total for Mine Site Growth Media Areas	29.63			205,816

Figure 3.1: Pogo Mine Material Sites and Growth Media Stockpile Layout



3.5 Revegetation Standards

The overall objective of the revegetation program is to establish a vegetative cover on all disturbed lands (except for those determined by ADNR to be reclaimed in a different manner or those determined by ADNR to be exempt from the cover criteria) that will flourish without need for fertilization or reseeding after a 5-year period. The standard for measuring revegetation success will be the establishment of a diverse cover of at least 70% as determined using a method approved by ADNR. This cover should be achieved without the application of topsoil, seed, fertilizer, or any water in addition to natural precipitation for the last three growing seasons in the 5-year period. If a cover of 30% has not been achieved by the end of the third growing season, then Pogo will develop an action plan to address any potential problems that may be interfering with revegetation success.

The interim diversity objectives for the vegetative cover after a 5-year period will be such that no one graminoid will comprise more than 70% of the relative cover and no tree or shrub species will comprise more than 95% of the relative density value. These standards may be revised based on the revegetation test trials.

Revegetation progress for reclaimed lands and test plots will be reported annually to ADNR.

4.0 RECLAMATION AND CLOSURE PRESCRIPTIONS

This section describes the reclamation activities and schedule planned for various project components. To the extent practicable, reclamation efforts will be carried out concurrent with mining activities to minimize the activities required after mining operations cease.

General construction, revegetation, and demolition procedures are described in **Appendices A, B, and C**. These methods will be applied to the prescriptions outlined in this section.

Reclamation scheduling is divided into five phases based on the design, construction, operation, and closure activities of the mine:

Phase I: Reclamation of construction disturbance

Phase II: Reclamation concurrent with mining

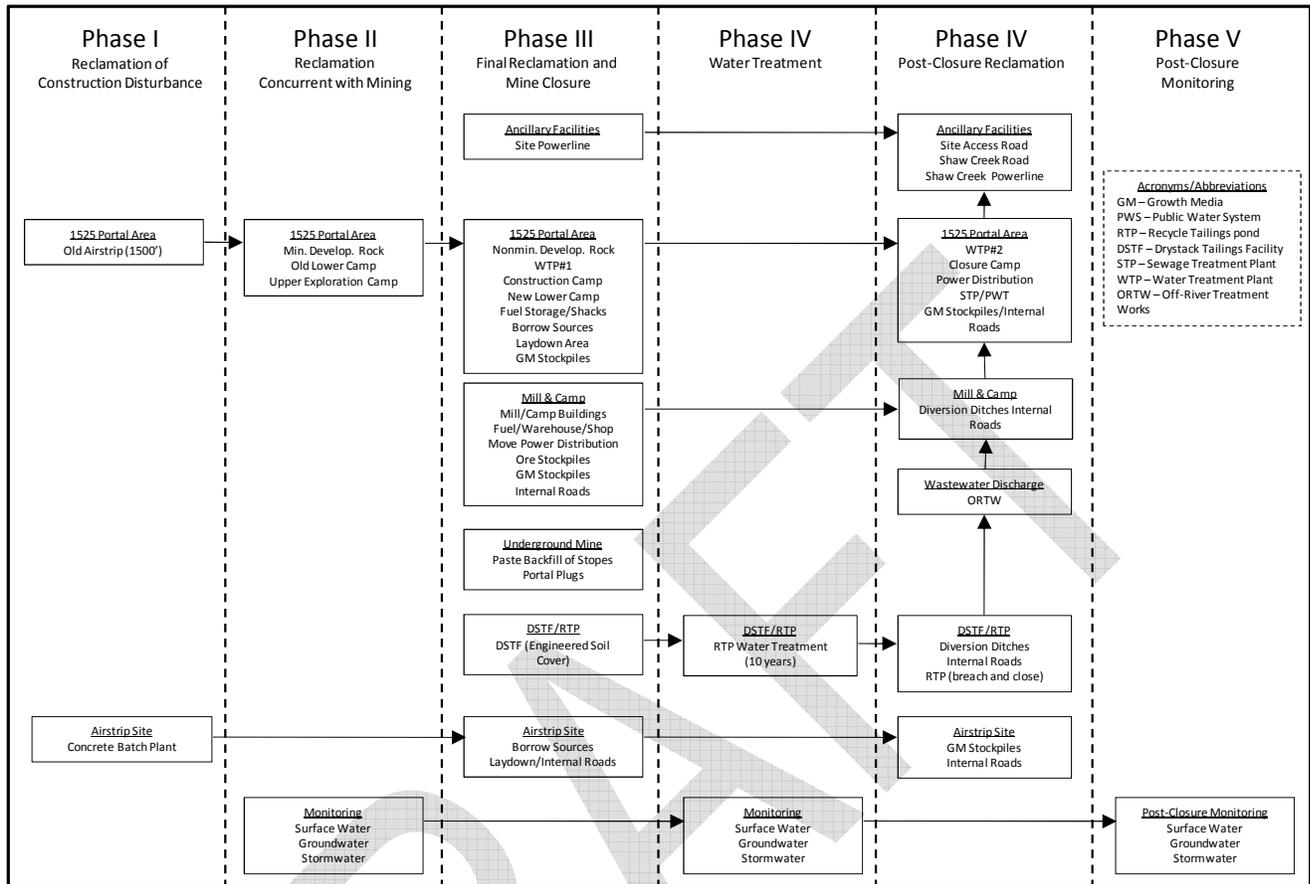
Phase III: Final reclamation and closure of the mine site

Phase IV: Water treatment and post-closure reclamation

Phase V: Post-closure monitoring

Table 4.1 shows the proposed reclamation sequence according to the phase, and each phase is described in more detail below.

Table 4.1: Reclamation Schedule



4.1 Phase I: Reclamation of Construction Disturbance

Any project disturbance from advanced exploration or construction that has not been reclaimed to date has been transferred to Phase II.

Phase I reclamation completed includes:

- 1525 Airstrip Facilities - The airstrip used during early exploration was regraded to remove berms and left in place. Floods and natural revegetation have reclaimed the site.

4.2 Phase II: Reclamation Concurrent with Mining

Phase II reclamation will be undertaken concurrently with mining activities. All of the stockpiled mineralized development rock will be reclaimed during this phase.

4.2.1 Upper Exploration Camp

The upper exploration camp will be removed using the general procedures outlined in **Appendix C**, and revegetated using the general procedures outlined in **Appendix B**. All other disturbances associated with this program (such as drill pads and drill holes) will be reclaimed in accordance with the advanced exploration reclamation plan.

4.2.2 Mineralized Development Rock Storage

Development rock from the 1525 and 1875 portals is hauled to a temporary stockpile outside each portal where it is classified as mineralized or non-mineralized for its disposal location within the drystack. Mineralized rock is entombed within the drystack.

Remaining mineralized rock stockpile material at the 1525 portal area will be moved to the drystack tailings facility. All liner materials will be placed in the drystack. Gravel materials underlying the liner of the mineralized rock stockpile will be used for surfacing site access roads or left in place and reclaimed by recontouring for drainage, tapering edges, and scarifying or ripping. Organic materials stockpiled will be placed on the area as needed to promote vegetation.

4.2.3 Non-Mineralized Development Rock Storage

Non-mineralized rock is used for site construction and maintenance activities. All liner materials associated with the non-mineralized rock storage will be buried in the drystack gravel materials underlying the liner will be used for surfacing site access roads or may also be left in place and reclaimed by recontouring for drainage, tapering edges, and scarifying or ripping. Organic materials stockpiled will be placed on the area as needed to promote revegetation. Establishment of a vegetative cover will be based on the results from the vegetation test trials outlined in **Appendix E**.

4.2.4 Material Sites

If not needed for ongoing facility maintenance or reclamation, the material sites developed in alluvial gravels during advanced exploration for project construction activities will be reclaimed as described in **Appendix D**. This plan incorporates the use of benches, islands, and the development of riparian and wetland habitat to enhance wildlife use of the area. Material sites that are required for reclamation will be stabilized using BMP's.

4.3 Phase III: Final Reclamation & Closure of the Mine Site

Phase III will consist of the major closure activities required to decommission the mine, remove the facilities from the property, and place the site in a stable condition. During Phase III, all facilities and structures not needed to support post-closure reclamation activities (Phase IV) will be removed following the general procedures outlined in **Appendix C**. A part

of lower camp will be used as a temporary closure camp to support Phase III and IV activities.

Monitoring of groundwater, stormwater, and surface water will continue through Phase V.

4.3.1 Fuel Storage & Hazardous Materials

All surplus fuel, hazardous materials, above-ground tanks, and piping will be removed following the general demolition procedures outlined in **Appendix C**.

A plan will be developed to comprehensively test for fuel contamination near the storage areas. If found, contaminated soil will be removed and treated in accordance with ADEC guidelines before the area is recontoured and revegetated.

4.3.2 Liese Creek Mill Facilities

All buildings, materials storage areas, fencing, and supplies will be removed from the Liese Creek mill area using general demolition procedures outlined in **Appendix C**. An existing substation will provide power for Phase IV operation of the water treatment plant and support facilities.

The storm pond liner will be removed, cut into pieces and buried in the drystack.

The highwall cut faces will be stabilized and left in place. Fill embankments will be reclaimed by pulling the outer crest of the fill over the pad to the highwall, grading to control surface water runoff towards Liese Creek, and blending with the local topography as much as possible. The recontoured surfaces will be ripped where compacted, covered with stockpiled growth media, and seeded and fertilized as needed.

Gravel pads and access roads will be recontoured for drainage, ripped or scarified, spread with growth media, and fertilized and seeded as necessary.

4.3.3 Liese Creek Camp, Office & Shop Facilities

All buildings, materials storage areas, fencing, and related facilities will be removed from the Liese Creek camp and shop area using general demolition procedures (**Appendix C**).

The highwall cut faces will be stabilized and left in place. Fill embankments will be reclaimed by pulling the outer crest of the fill over the pad to the highwall, grading to control surface water runoff towards Liese Creek, and blending with the local topography as much as possible. The recontoured surfaces will be ripped where compacted, covered with stockpiled growth media, and seeded and fertilized as needed.

Gravel pads and access roads will be will be recontoured for drainage, ripped or scarified, spread with growth media, and fertilized and seeded as necessary.

4.3.4 Underground Mine

In general, the closure plan and cost estimate for the mine involves removing salvageable¹ equipment, backfilling, installing cement plugs in all mine openings, and re-flooding as described in the Pogo Mine Underground Closure Study. (Tetra Tech 2014), The tentative closure procedures follow:

Pumps and mobile mining equipment will be removed from site. Chutes, conveyors, ventilation, piping, and electrical systems will be dismantled. Pipes supplying fuel and hazardous materials will be flushed before disposal. Components will be buried in designated areas within the underground workings of the mine during Phase III or the solid waste disposal facility (not yet constructed).

Mined-out stopes will be backfilled completely with cemented paste backfill. The relatively impervious nature of the paste backfill will seal mineralized areas of the wall rock and prevent oxidation and subsequent leaching. At mine closure, select areas of the connecting access declines will be also be backfilled to compartmentalize the hydrogeology and to reduce the potential for water flow through the mine.

After the 1525, 1690, and 2150 mine openings are sealed, the mine workings will be flooded through the 1875 portal to accelerate groundwater level recovery towards pre-operational levels. The 1875 portal will then be sealed and the remainder of the mine flooded through a surface borehole, which will be cemented at completion. The backfill, sealing, and flooding process is expected to be completed within two years.

To monitor potential effects of underground water into Goodpaster River, the groundwater monitoring wells installed down gradient from the underground workings MW99-213 and MW11-216 will be sampled throughout all phases of reclamation and closure.

4.3.5 Portals

Upon completion of mining, the 1525, 1690, and 1875 adits will be permanently stabilized and sealed using a combination of select paste backfill placement and concrete plugs to prevent access and drainage. The 2150 portal will be sealed to prevent access and maintain safety at the reclaimed site.

Adit plugs will be located in competent ground to resist the pressure head developed between natural groundwater and the plug elevation. The concrete used to construct the plug will be Type II Portland cement mixed with Type F fly ash to ensure low shrinkage and good sulfate resistance. A grout curtain will minimize seepage across the plugs.

¹ No salvage value is included in the reclamation and closure cost estimate.

Preliminary design of the plugs has been carried out according to Lang's "Permanent Sealing of Tunnels to Retain Tailings or Acid Rock Drainage" (1999). **Table 4.2** summarizes Lang's criteria for monolithic plugs.

Final plug plans will be stamped by a professional engineer and submitted to the State for review and approval. The plug plans will include a site investigation to assess geotechnical, geochemical, and hydrogeological characteristics at each site. The final plug designs will consider static and dynamic failure mode, seepage rates for each plug, and the feasibility of long-term monitoring. The final plug designs will also include proposed construction methodology and QA/QC plans as well as an estimate of construction cost.

Groundwater levels were estimated based on both piezometer data and by modeling the pre-development heads (Adrian Brown, "Inflow to the Pogo Mine" report, 25 January 2002). For the purpose of this analysis, the highest modeled pre-development water table elevation was used as the driving head for all plugs. The design plug lengths for the various adits are shown in **Table 4.3**. The portal locations and design for the concrete plugs for the 1525, 1690, and 1875 portals are shown in **Figures 4.1, 4.2, and 4.3**.

At the 1690 portal, the external conveyor structure will be dismantled and salvaged where possible. Unusable components will be buried in the mine. Concrete conveyor footings less than one-foot thick will be broken and buried in place as fill material.

The highwall cut faces will be stabilized and left in place. Fill embankments will be reclaimed by pulling the outer crest of the fill over the pad to the highwall, grading to control surface water runoff, and blending with the local topography as much as possible. The recontoured surfaces will be ripped where compacted, covered with stockpiled growth media, seeded, and fertilized as needed.

Gravel pads and access roads will be recontoured for drainage, ripped or scarified, covered with growth media, seeded, and fertilized as necessary.

Table 4.2: Summary of Recommended Design Criteria for Closure Plug

Failure Mode	Design Criteria
Hydraulic jacking of rock	Factor of Safety > 1.3 for normal conditions Factor of Safety > 1.1 for earthquake conditions
Shear failure along contact or through rock mass	Factor of Safety > 3 normal condition Factor of Safety > 1.5 earthquake condition
Deep beam flexure	When the plug length is less than the largest dimension of the opening. Design to allowable concrete tensile stress according the ACI Code
Excessive seepage	Maximum hydraulic gradient (<i>i</i>) dependant upon rock mass characteristics and if formation grouting is performed. Seepage limited to drips at plug and < 0.5 l/s downstream of plug (<i>i</i> =7-14 for fair to good rock mass conditions)
Long-term degradation of concrete	Concrete > 25 MPa compressive strength, mix to resist sulfate, acid, and alkali-silica reactivity

Note: Criteria are for plugs with no reinforcement that are created in one continuous pour.

Table 4.3: Plug Designs

Adit	Design Water Head (ft)	Design Plug Length for Factor of Safety >3 (ft)
1525 exploration adit	477	19
1875 haulage adit	30	4
1690 conveyor drift	327	17

Figure 4.1: Portal Closure Locations

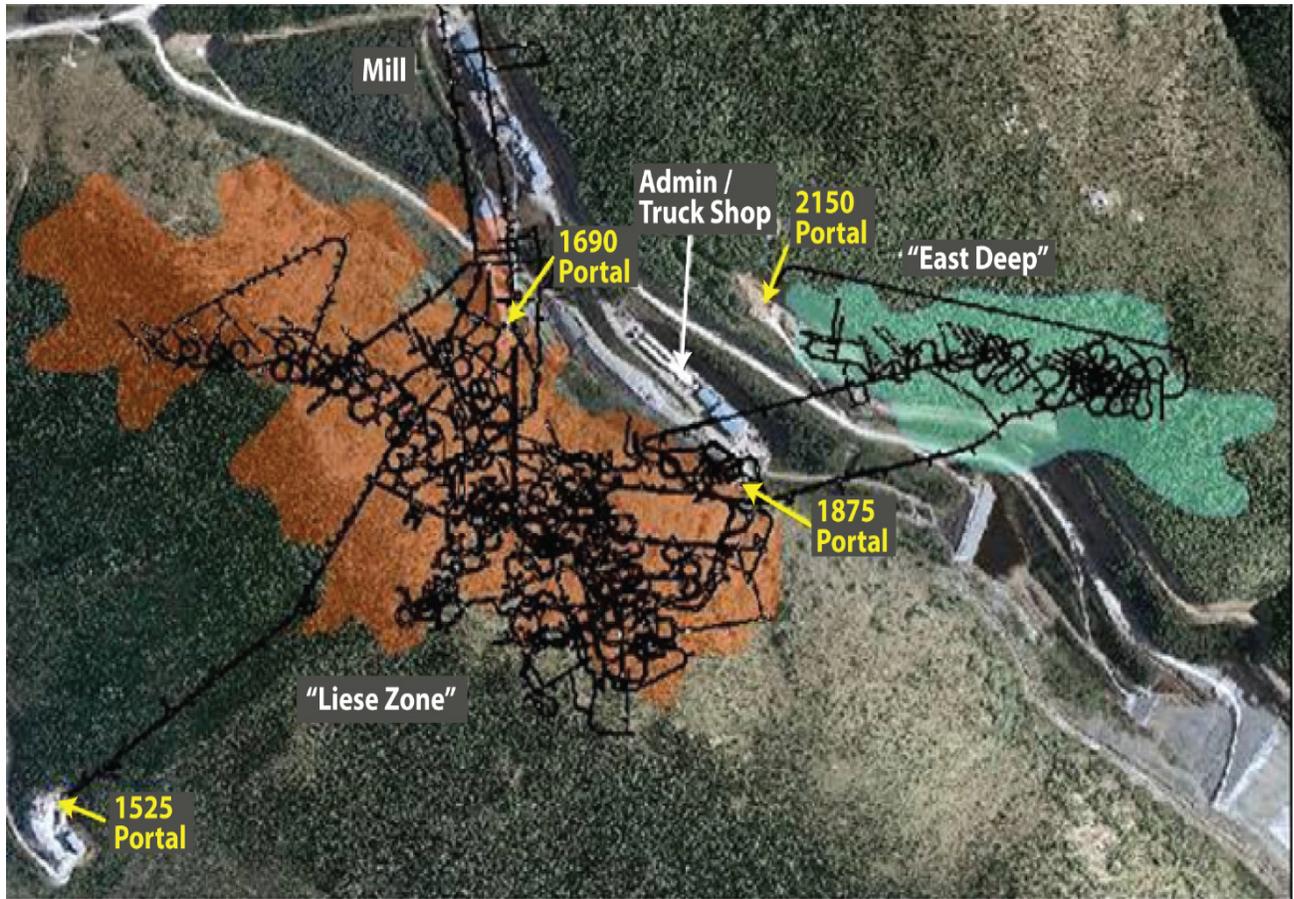
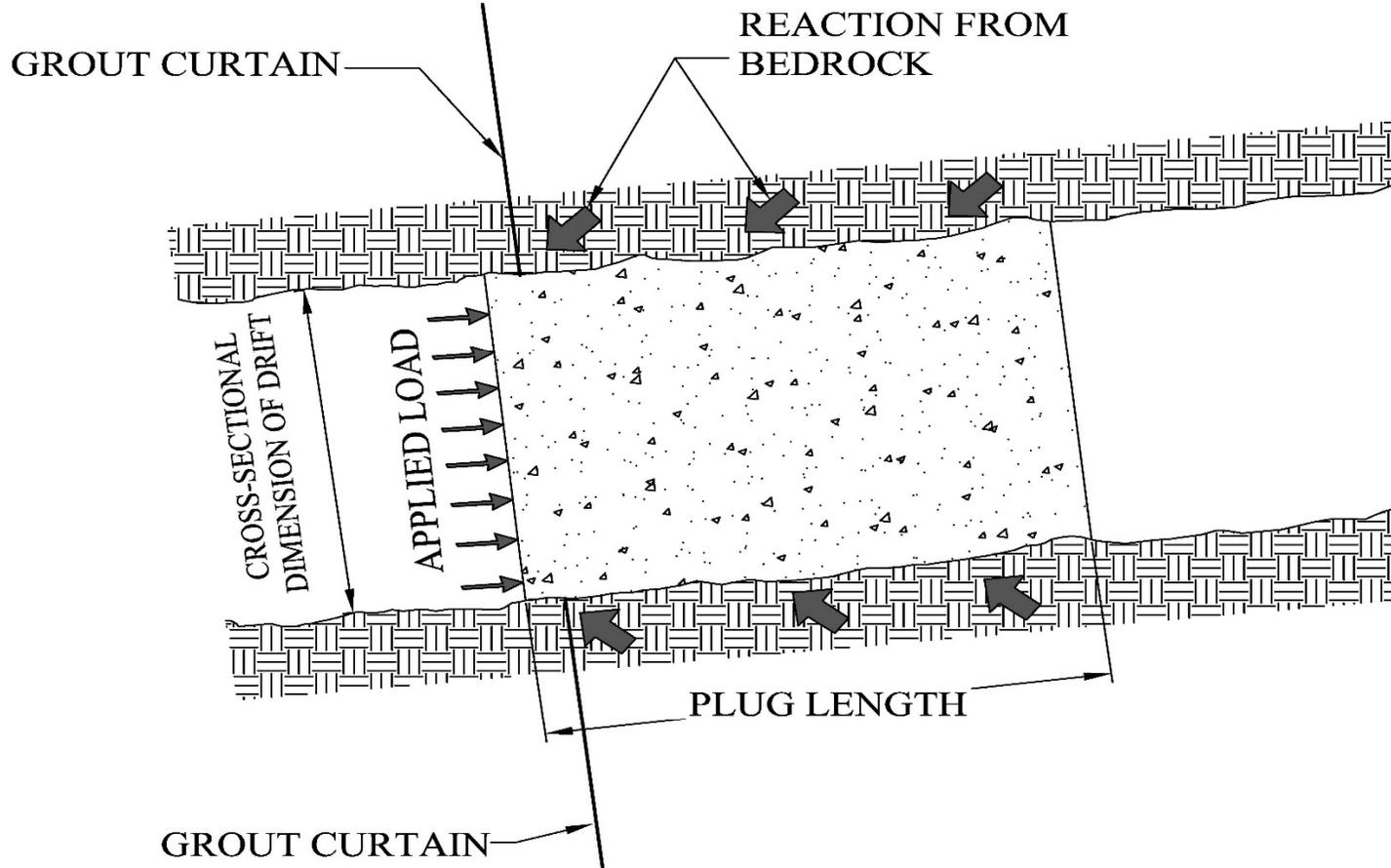


Figure 4.2: Portal Plug Longitudinal Section



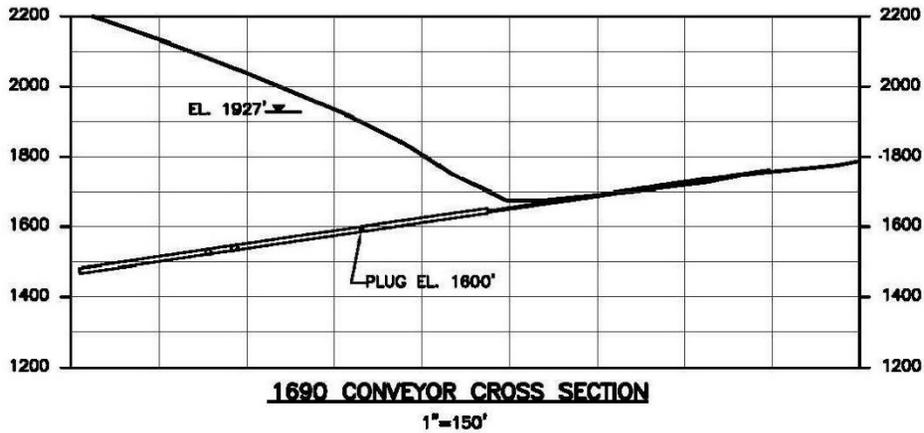
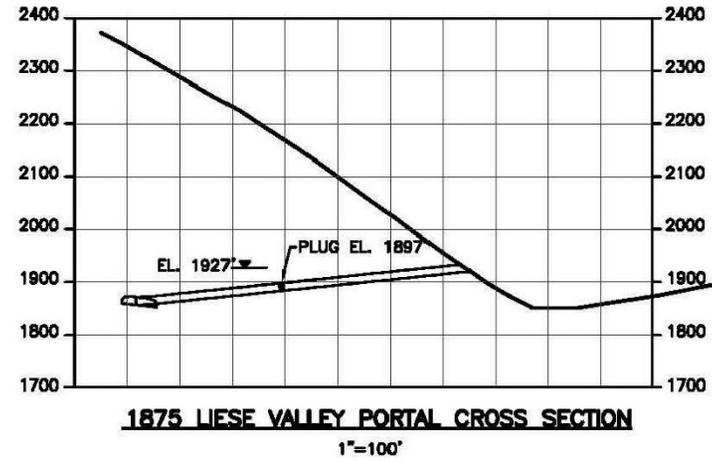
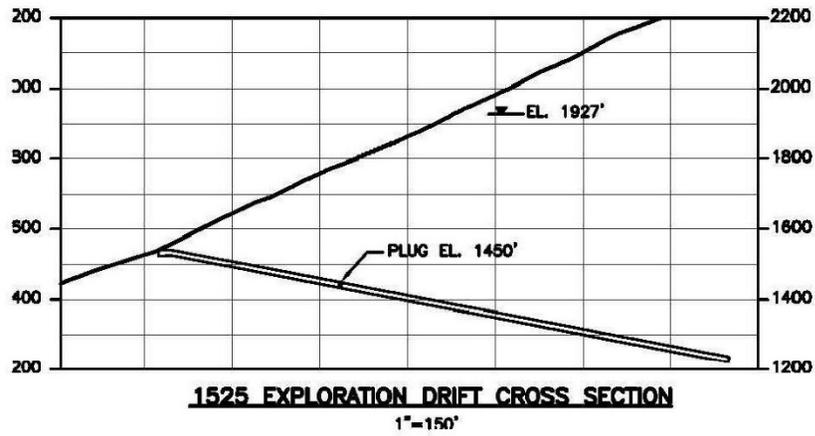
LOCATION:	DESIGN HEAD:	PLUG LENGTH:	GROUT CURTAIN REQUIRED:
1525 Portal	477 ft	19 ft	yes (l = 25)
1690 Portal	327 ft	17 ft	yes (l = 19)
1875 Portal	30 ft	4 ft	yes (l = 8)

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Figure 4.2
 Portal Plug
 Longitudinal Section

FEB 2017 Pogo Reclamation and Closure Plan

Figure 4.3: Location of Portal Plugs



POGO MINE
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Figure 4.3
 Location of Portal Plugs

FEB 2017 Pogo Reclamation and Closure Plan

4.3.6 Drystack Tailings Facility

Tailings that are not placed underground will be dewatered through pressure filtration and placed in the general placement area of the drystack tailings facility. The DSTF expansion and new diversion ditch construction was completed in 2013.

The drystack facility will have two zones: the shell area, which will provide structural stability and erosion control for the facility; and the general placement area, which will be used for random tailings placement and is not required to contribute strength. Non-mineralized development rock and compacted tailings are used to construct the shell with a benched overall slope of 3H:1V to provide long-term stability.

The long-term reclamation and closure goal for the drystack is to establish an alpine grass meadow. The closure concept includes creating a final configuration that limits erosion potential; diverts runoff water from upstream in the watershed around the drystack in permanent ditches; and provides an engineered cover that including an erosion resistant armor over the entire drystack with growth media to enhance revegetation.

Details of the drystack closure are presented in **Figure 4.4**. The engineered soil cover will consist of one-foot of non-mineralized development rock applied over the surface of the crowned drystack facility, followed by a six-inch sand and gravel layer to provide support for an additional six-inch of growth media.

A soil cover is proposed due to the relatively modest annual rainfall at the site, the low hydraulic conductivity of the drystack tailings material, and the lack of acid generating potential. It is not believed that additional measures to prevent infiltration, provide a capillary break, or to provide an oxygen barrier, are warranted.

Runoff control for the general placement area surface of the drystack facility will include crowning with a two percent slope to the closure perimeter ditches. The surface of the shell is being constructed with non-mineralized rock to prevent the erosion of drystack.

The closure perimeter ditches will be constructed as wide ditches with flat side slopes. This configuration has a significantly higher flow capacity than the maximum probable precipitation catchment potential. This design will allow for significant ice development and still maintain requisite freshet capacity. Riprap protection will be provided to prevent erosion on both sides of the ditch adjacent to the drystack face. The riprap requirements include graded filters to maintain soil particle stability.

During mine operations, a field trial program will be undertaken to evaluate the optimum cover depths. Performance will be evaluated over a three-year period. Variables to be assessed during the field tests include various depths of engineered soil cover material, topsoil, vegetation type, soil amendments, and surface topography. Experience from mines in similar climatic conditions will be used to augment the site-specific information obtained from the trials.

4.3.7 Material Sites

Remaining alluvial gravel material site areas will be reclaimed as described in **Appendix D**. This plan will incorporate the use of benches and islands, as well as develop riparian and wetland habitat to enhance wildlife use of the area.

Material Site C and Material Site D will be reclaimed at the end of Phase III when no longer needed for closure materials. The highwall cut faces will be stabilized and left in place. Fill embankments will be reclaimed by pulling the outer crest of the fill over the pad to the highwall, grading to control surface water runoff towards Liese Creek, and blending with the local topography as much as possible. The recontoured surfaces will be ripped where compacted, covered with stockpiled growth media, and seeded and fertilized as needed.

4.3.8 Internal Access Roads

Access and service roads not specifically required for post-closure and reclamation monitoring will be ripped or scarified, covered with growth media, and fertilized and seeded as necessary. Highwalls or cut-banks associated with sections of these roads will be stabilized as needed.

4.3.9 Water Management

Upon the cessation of milling, all sumps, ponds, and drains will be filled, contoured, seeded, or stabilized to meet the requirements of the designated post-mining land use. Monitoring wells not used for Phase IV and Phase V compliance monitoring will be plugged and abandoned according to **Appendix C**. Drinking water wells not needed to support the closure camp will be closed in a similar manner.

4.4 Phase IV: Water Treatment and Post-Closure Reclamation

Phase IV begins when site monitoring indicates that reclamation and revegetation has stabilized the drystack tailings facility sufficiently so that major additional earthworks will not be required. At this point, the vegetative cover on the drystack will begin taking hold, all of the underground mine openings will be sealed and the mine workings flooded, In addition, the mill and camp facilities in Liese Creek will be decommissioned and reclaimed. Water quality will be monitored in the surface water and groundwater in Liese Creek downstream

of the drystack facility to determine whether operation of the RTP and water treatment plant should continue.

The RTP and water treatment plant will remain in place during Phase IV as long as needed to treat the drystack runoff and seepage. When agency review of the site information indicates it is appropriate to do so, the remaining RTP water will be treated and discharged, and then the RTP dam will be breached and reclaimed. Any tailings that were transported to the RTP over the life of the project would be capped in place in the bottom of the RTP reservoir and protected from erosion. It is anticipated this Phase IV water treatment will last ten years.

4.4.1 Drystack Tailings Facility

When the water quality data indicates that the RTP can be breached and reclaimed, a determination will be made as to any contingency measures that might be appropriate to help maintain water quality standards. The selection will be based on the circumstances and the current technology at the time. Based on the four to six gpm of long-term seepage anticipated from the drystack, it is reasonable to expect that one or more of the contingency measures shown in **Table 4.4** will be both feasible and effective in protecting the environment. The goal would be to implement a system that would allow the RTP to be breached as soon as possible. For the purpose of estimating the reclamation costs, it has been assumed that the RTP and water treatment plant will remain in place and be in operation for ten years during Phase IV.

Table 4.4: Contingency Measures to Mitigate Potential Drystack Seepage

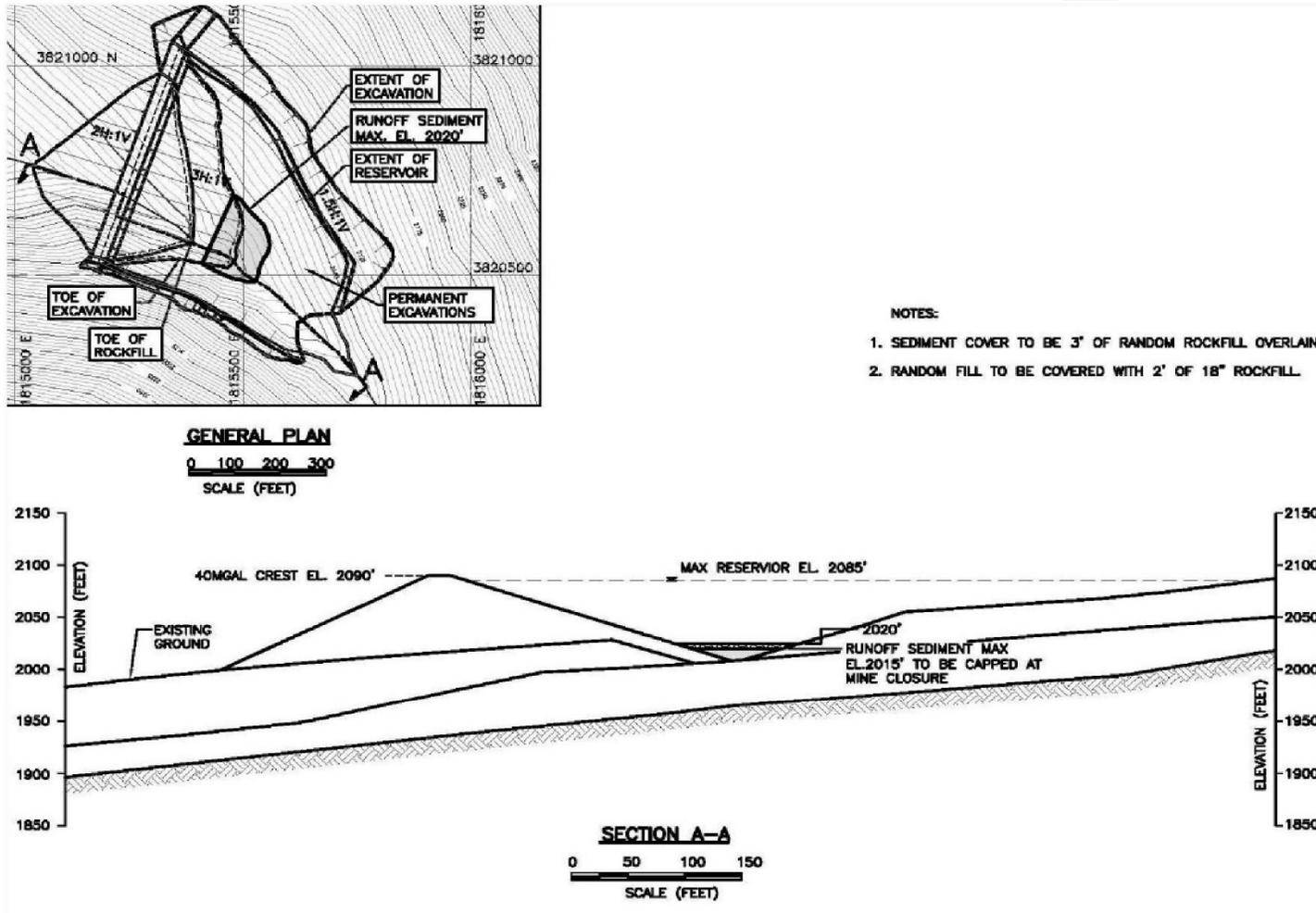
Contingency Approach	Activities
Passive Measures	None required
	Mixing with receiving water
	Natural attenuation
	Infiltration gallery
	Cut-off trench and grout curtain with aufeis (accumulated ice due to glaciation) retention of seepage in winter and release during spring freshet
Active Measures	Settling ponds with simple lime or chemical addition
	Seepage pumped from collection wells to aufeis retention system on Liese Creek hillside and release during freshet
	Seepage pumped from collection wells to active treatment system
	Cut-off trench and grout curtain with collection system and pumped to aufeis retention system on Liese Creek hillside and release during freshet
	Cut-off trench and grout curtain with collection system and pumped to active treatment system

4.4.2 RTP Closure & Sediment Capping

When appropriate, the RTP dam will be breached. Slopes will be trimmed to a maximum of 2:1 side slopes on the dam, and a 50 ft wide floodplain will be re-established. **Figure 4.5** shows the RTP dam in plan and section both at the end of the mine life and after reclamation. Disturbed areas will be recontoured for drainage and the channel re-establishment for Liese Creek. Foot slopes and the former impoundment area will be covered with growth media, seeded, and fertilized as necessary. Micro-wetlands sites will be established where possible. Steeper side slopes will be armored as necessary and shaped to blend with the natural talus slopes of the Liese Creek valley. Highwall cut faces will be stabilized and abandoned in place.

Any of RTP liner covering the section of the RTP dam removed during the Phase III reclamation will be disposed of in the drystack tailings facility. The portion of the RTP liner covering the section of the RTP dam that will remain after completion of the Phase III reclamation activities will be left in place. Leaving the liner in place poses no long-term stability or environmental issues. The pumps and piping will be removed as described in **Appendix C**.

Figure 4.5: RTP Dam at Closure



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Figure 4.5
 RTP Dam at Closure

Dec 2010 Pogo Reclamation and Closure Plan

During mine operations, some of the drystack tailing material will be eroded and deposited in the RTP as sediment. The Universal Soil Loss Equation was used to estimate that as much as 135 tons of sediment could be transported from the drystack during the mine life. This estimated rate is based on six tons per annum (tpa) initially, increasing to 20 tpa when the maximum drystack footprint is achieved. Assuming a safety factor of two, the estimate was rounded to 300 tons. This equates to approximately 0.1% of the RTP volume. The RTP sediment would be capped and protected from erosion by rock cover.

This rockfill should have a minimum thickness of three feet of random fill overlain by a minimum of two feet of material, with the majority being greater than 18 inches in size. The random fill and portions on the armoring material used to cap the sediments will come from excavating the breach through the RTP dam.

4.4.3 Site Transmission Lines

Electrical transmission lines from the project site and distribution to the mine, mill, and ancillary facilities will be dismantled when no longer necessary for closure operations. Poles will be cutoff at ground surface and removed. Electric cables, supports, insulators, transformers, and other equipment and materials will be removed and sold for salvage. Disturbance created during transmission line decommissioning will be stabilized and protected against erosion. Seeds and fertilizer will be applied where natural revegetation is not expected to rapidly reinvade.

4.4.4 Pogo Access Road

At the end of mine closure monitoring, the remaining camp facilities and equipment will be removed and the Pogo access road will be reclaimed. The road surface will be recontoured for drainage, ripped or scarified, covered with growth media, seeded, and fertilized as necessary. Culverts and bridges will be removed and drainage channels re-established.

Gravel pads and other cleared areas will be recontoured for drainage, ripped or scarified, covered with residual organics from initial construction, and fertilized and seeded as necessary following final equipment removal.

4.4.5 Pogo Transmission Line

Reclamation of the Pogo Transmission Line will also occur at the end of mine closure monitoring when the access road is reclaimed. All poles and ancillary facilities associated with the transmission line will be removed and pads and other cleared areas will be recontoured for drainage, ripped or scarified, covered with growth media, and fertilized and seeded as necessary following final equipment removal.

4.4.6 1525 Portal Area

Upon agency approval, the water treatment plant located at the 1525 portal will be removed along with the warehouse, shops, and fuel storage under the guidelines of **Appendix C**. The water treatment plant and closure camp will be dismantled and removed from site following the general procedures outlined in **Appendix C**.

The highwall cut faces will be stabilized and left in place. Fill embankments will be reclaimed by pulling the outer crest of the fill over the pad to the highwall, grading to control surface water runoff, and blending with the local topography as much as possible. The recontoured surfaces will be ripped where compacted, covered with stockpiled growth media, and seeded and fertilized as needed.

Gravel pads and access roads will be recontoured for drainage, ripped or scarified, spread with growth media, seeded, and fertilized as necessary.

4.4.7 Off-River Treatment Works

When discharge to the off-river treatment works is no longer necessary, the pump station, other surface facilities, and piping will be removed and the system reclaimed following the procedure in **Appendix D**. Agency input will be sought during closure to assess the merits of permanently connecting the ponds with the river.

4.4.8 Site Access Roads

The remaining site access roads will be ripped or scarified, covered with growth media, seeded, and fertilized as necessary. Culverts will be removed and drainage paths re-established.

4.4.9 Material Sites

Material Site A will be utilized for stormwater control throughout the project and will be reclaimed during Phase IV when the upstream reclamation of mill site, camp area, and local roads has stabilized. Material Site B will also be reclaimed during Phase IV.

4.5 Phase V: Post-Closure Monitoring

By Phase V, all surface disturbances will be stabilized and water quality will be acceptable. Post-closure monitoring of groundwater, stormwater, and surface water could continue for a 30-year period after completion of Phase IV reclamation (depending on compliance history). The monitoring events will take place on years 1, 2, 5, 10, 15, 20, and 30 after stopping active water treatment (unless modified by the agencies).

4.5.1 Control of Sedimentation

During the post-closure monitoring period, all diversion and erosion control structures will be monitored to ensure their effectiveness and long-term stability. Modifications and maintenance will be performed as needed to ensure the long-term success of closure.

4.5.2 Monitoring Wells & Well Closure

After the post-closure monitoring period, all groundwater monitoring wells will be de-commissioned using the procedures outlined in **Appendix C**. Access to the wells will be scarified, seeded, and fertilized.

4.6 Temporary Closure

“Temporary closure” means the cessation of the mining and process plant operations for a period of not more than three years. If conditions require temporary closure to extend beyond three years, final reclamation would begin, unless an extension is requested by the company and approved by ADNR and ADEC Temporary closure scenarios, which could require modifications to the Plan of Operation management plans, Reclamation and Closure Plan, or state or federal permits, would be coordinated with the appropriate federal and state agencies for approval.

Temporary closure may include planned or unplanned cessation of the mining and beneficiation processes. Planned temporary closures, which have specific conditions defining their beginning and end include, but are not limited to, the following:

- interruptions in the active beneficiation processes to provide planned periods of quiescence for metallurgical or operating reasons
- any other planned condition, which would interrupt the active beneficiation process including modification to process components or suppressed metal market conditions
- change in ownership requiring the temporary cessation of operations while operating permits are transferred to the new owner/operator.

Unplanned temporary closures may include, but are not limited to, the following:

- closure because of unforeseen weather events
- a failure in a major system component or a process failure, which causes the fluid management system, or a portion thereof, to shut down
- the cessation of operations because of litigation
- bankruptcy of the mine operator.

Pogo Mine would notify the appropriate agencies within three days of the first day of the temporary closure or of any unanticipated suspension or cessation of operations that is expected to last more than ninety days or more. No later than ten days after suspension of operations or temporary closure, Pogo Mine would submit an amended plan of operations that would state the nature and reason for the temporary closure, the anticipated duration of the temporary closure and any event that would reasonably be anticipated to result in either the resumption or abandonment of operations. Project operations must resume for not less than ninety consecutive days in order to terminate the temporary closure status. Pogo Mine would maintain the project area in a safe and secure condition during a temporary closure and not allow the project area to be degraded or eroded during, or as a result of, the temporary closure. All water collection and treatment, monitoring and reporting required by the reclamation plan would continue unless otherwise agreed to by the agencies.

While the mine operation is inactive, environmental monitoring programs would continue to be implemented. The need for implementation of interim reclamation activities or final reclamation on components of the mine would be addressed on the basis of environmental monitoring results and consultation with the appropriate agencies.

4.7 Final Reclamation

After Pogo Mine has completed operations at the mine site, or at any individual facility or mine unit (e.g., Mill, DSTF, etc.), final reclamation will be initiated. When a facility is no longer needed for mine operations or when it has reached its design capacity, then reclamation will be initiated as soon as practical. It is assumed that at the final stage of operations, a significant amount of site-specific reclamation experience and performance data will have been incorporated into periodic reclamation plan updates. The final reclamation plan will be submitted for approval 120-days prior to planned, final reclamation of the facility. Unlike the periodic updates, which make assumptions about the anticipated closure conditions (i.e., Basis of Cost Estimate); the final plan will be based on the actual conditions that exist at closure.

5.0 PERFORMANCE STANDARDS

Reclamation Performance Standards, 11 AAC 97, Mining Reclamation Regulations, are needed to assess the success of the reclamation program. The objective of the performance standards is to provide a stable condition that will “allow for the re-establishment of renewable resources on the site within a reasonable period of time by natural processes.”

Closure performance standards will be based on water quality criteria.

5.1 Objectives & Goals

Reclamation and closure performance objectives can be divided into three steps:

- Step 1 Establish stable soil conditions that can be expected to reduce waterborne soil erosion. The general procedures outlined in **Appendix B** will be used to accomplish this objective.
- Step 2 Establish a vegetative cover that will flourish without need for fertilization or re-seeding after a five-year period.
- Step 3 Conduct post-closure monitoring activities to demonstrate that water quality goals are met.

5.2 Monitoring & Reporting

Pogo personnel will monitor the progress of Step 1 objectives by monitoring the water quality in accordance with the “Storm Water Pollution Prevention Plan” established for the project and any other applicable permits.

An annual report will be prepared summarizing the disturbance for the year, the status of revegetation, the results of any test trials, an updated schedule, maps of new disturbance, and any proposed modifications to the procedures outlined in this plan.

5.3 Reclamation Cost Estimate & Financial Assurance

The ADNR and ADEC will coordinate their financial assurance authority through a Memorandum of Understanding (MOU) to require financial assurance for performance of reclamation and facility closure and post-closure monitoring activities at the Pogo Mine. Proof of financial assurance, which may take any form mutually agreed upon by the agencies and Pogo Mine, is referred to as a “bond” in this section. Unless otherwise agreed between the agencies and Pogo Mine, the bond amount would be calculated on the basis of the Reclamation Plan and use of the Standard Reclamation Cost Estimate (SRCE) Model Version 1.4.1 Build 16. The bond will address all costs that would be incurred by the agencies performing reclamation activities in the event of Operator **default (Appendix F)**.

SRCE cost estimates are provided for:

Life of Mine (LOM) reclamation/closure estimate that accounts for the full build out of facilities and final closure at the current end of LOM in approximately five years. Physical reclamation would be completed in approximately 10 years of water treatment activities prior to moving into the post-closure phase.

The SRCE cost estimates are based on third party implementation of reclamation plan, no recycle or salvage costs recovery, and on-site disposal of all equipment and facilities with the exception of hazardous waste, which would be shipped off-site to an appropriate hazardous waste disposal facility.

Financial assurance will be established by Pogo to provide for completion of the reclamation work described in this report. As summarized in **Appendix F**, reclamation and closure costs are estimated at \$71.91M for the Pogo Mine Site, the all-season road, transmission line, holding costs, and post-closure water treatment and monitoring. These estimates are based on an updated model described below.

The Pogo Mine Reclamation and Closure Plan was updated to reflect 2016 as-built conditions and current site knowledge. An updated closure cost estimate was also prepared. The SRCE model is more detailed than the approach used previously and projects a physical closure cost of \$52.29M for the mine site and \$4.81M for the access road and transmission line.

The Pogo SRCE included in **Appendix F** was developed to include all reclamation activities that were previously accounted for under the Mine and ROW reclamation cost estimates. A “Basis of the Reclamation Cost Estimate for the Pogo Mine” is also included in the **Appendix F**. This document summarizes the effected facilities and documents the SRCE model calculations including development of cost unit rates, closure construction quantities, haul distances/profiles, equipment fleets and crews productivities, as well as additional assumptions used to prepare the SRCE model. Supporting documentation including site drawings and vendor quotes are also included in **Appendix F**.

Equipment costs are based on 2016 monthly rental rates obtained from N.C. Machinery. Labor rates are based on State of Alaska Department of Labor, “Laborers’ & Mechanics’ Minimum Rates of Pay” Issue 33 effective September 2016². Fuel costs are based on \$3.23/gallon (2016 vendor quote). The estimate is in constant 2016 dollars, with adjustment for inflation or discounting at 2.66% (the five year average of Anchorage CPI between 2011 and 2016).

² Basis of Cost Estimation provided in Appendix F.

5.4 Release of Financial Assurance

It is proposed that the financial assurance be released in steps as each phase is completed and the reclamation objectives have been met. The Authorized Officer will inspect reclaimed areas on an annual basis to determine if the general procedures outlined in **Appendix B** have been performed adequately to meet the objectives.

5.5 Post-Closure Public Access & Safety

It is intended to restrict public access during the reclamation and post-closure monitoring phases of the project to protect the public. During reclamation, the portals will be capped and plugged to prevent access. Recontouring sideslopes during reclamation and removing access roads will also protect against public injury.

Public restrictions will be lifted by the agencies during Phase V whenever it is appropriate to do so.

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6.0 ACKNOWLEDGEMENTS

- A. It is understood that should the nature of the operation change, a modified or supplemental plan of operations and reclamation may be required.
- B. It is understood that approval of this Plan does not constitute:
 - 1. Certification of ownership to any person named herein; and
 - 2. Recognition of the validity of any mining claim herein.
- C. It is understood that a bond equivalent to the estimated cost of performing the agreed upon reclamation measures would be required before this Plan can be approved. Bonding and any bond reduction amounts would be set on a site-specific basis by ADNR in coordination with the cooperating agencies.
- D. It is understood that any information provided with this Plan or provided in the future, that is marked "Confidential" would be treated by the agency in accordance with that agency's laws, rules, and regulations.
- E. Sumitomo Metal Mining Pogo LLC would conduct an environmental closure audit to determine if any previously unknown environmental liabilities exist as a direct or indirect result of the Pogo Mine project.

Sumitomo Metal Mining Pogo LLC has reviewed and agrees to comply with all conditions in the Reclamation and Closure Plan. Sumitomo Metal Mining Pogo LL understands the bond would not be released until ADNR and ADEC give written approval of the reclamation work.

Sumitomo Metal Mining Pogo LLC

By: _____

Title: _____

Signature: _____

Date: _____

7.0 REFERENCES

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Appendix A
General Construction Procedures

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General Construction Procedures

Sumitomo Metal Mining Pogo LLC (Pogo) recognizes that the construction method employed has a direct impact on the success of the reclamation process. The primary objective of minimizing disturbed areas will be considered during all phases of construction, and all activities will be conducted in a manner that will prevent or minimize disturbance of natural drainage systems and fish and wildlife resources. General procedures and guidelines to be followed during construction activities are outlined in this appendix.

Facility Construction

Specific construction practices for facility types are presented below. These will be expanded as designs and specifications are developed.

Roads

All roads, whether proposed for exploration, construction, or production access, will be laid out on the overall site plan prior to flagging. An assessment will determine whether the road is necessary; whether it will provide temporary or permanent access; how surface runoff and erosion will be controlled; and what considerations are required for its final reclamation.

After a road is determined to be necessary, it will be flagged in the field. Consideration will be given to the following factors before the road is constructed:

- Minimize width needed for safe operations, berms, and drainage.
- Minimize cut and fill (follow natural contours where practicable or along ridge lines).
- Provide drainage and erosion control structures as needed (crowns, ditches, culverts, water bars, etc.).
- Salvage topsoil if feasible (i.e., when the safety of the operator is not compromised—seed to stabilize).
- Buy and plant trees or, if downed trees are available, build a brushberm (filter windrow) at the bottom of slopes to help limit erosion.
- Install culverts at intermittent streams.
- If possible, avoid areas that are wet and/or frozen. If this is unavoidable, leave vegetative mat in place and armor if necessary. Use geotextiles or rock to improve the sub-base and minimize rutting and erosion.
- Avoid steep grades when possible.
- Avoid areas where snow will drift if possible, as these areas are often unstable and difficult to revegetate.

Drill Pads

Drill pads will be constructed when needed for the safe operation of the drill and to contain drill fluids. The following general procedures will be followed:

- Use the minimum size drill pad required to accommodate the drilling rig and associated equipment.
- Level the pad the minimum amount necessary for safe operations (use the drill's self levelers).
- Segregate and move trees to the side of the site.
- Segregate and stockpile growth media at the site.
- Construct a mud pit or reserve pit on the drill pad, or use a portable tub.
- Contain all drilling fluids and produced water from the drilling operation and recirculate if possible.

Trenches

Trenches will be backfilled and reclaimed as soon as possible to minimize the danger to personnel and wildlife. Clearing of the trenches will include:

- Segregating and moving trees to the side of the site.
- Segregating and stockpiling growth media at the site.
- Benching sidewalls if the trench depth is greater than 4 ft.

If trenches are not reclaimed immediately, the following safety measures will be followed:

- Stabilize the sidewalls by reducing the angle.
- Implement erosion controls and prevent impoundment of water.
- Post signs if trenches are located near vehicle and/or foot traffic areas.

Laydown Areas

All proposed laydown areas will be flagged in the field prior to construction. Other techniques will include:

- Preserving the natural drainage of the area when feasible.
- Removing brush and trees and stockpile separately.
- Not grubbing topsoil from permafrost or poorly drained areas.
- Removing topsoil (if grubbed) to designated growth media stockpiles.

Highwalls

Highwalls will be cut into steep terrain to accommodate roads, facility pads, and the RTP. The following construction practices will ensure stability:

- Benching highwalls where feasible.
- Directing drainage away from top of highwall.
- Scaling the face to reduce the risk of falling debris.
- Using rock bolting or screens in some cases to enhance stability.

General Practices

General practices to be followed during construction activities are described below. These will be expanded as the project design proceeds.

Timber

Salvageable timber will be managed in a manner to prevent infestation by insects. The following general procedures will be followed:

- Salvageable trees will be cut from the stump using conventional methods (i.e., chain-saw, feller-buncher, or shear).
- Salvageable trees will not be pushed over with a dozer.
- Salvageable timber will be disposed of in a manner approved by the State of Alaska.

Surface Water Use

Surface water may be obtained during construction to aid in compaction of structures or the construction of an ice road. Surface water may only be used at designated locations that have an approved "Temporary Water Use Permit." The following general procedures will be used during water filling operations:

- Water will be taken at the deepest area of the stream.
- Water trucks will not enter any body of water before, during, or after filling the truck with water.

Any water intake structure in fish-bearing water—including a screened enclosure, well point, sump, or infiltration gallery—will be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. Water velocity at the screen/water interface may not exceed 0.5 fps when the pump is operating and must not cause fish impingement on the screened surfaces. Screens aligned parallel to the stream current will require the least maintenance and will be least likely to impinge on fish.

Appendix B
General Revegetation Procedures

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General Revegetation Procedures

General procedures will be followed during the reclamation process. These procedures will be field adjusted where appropriate, and modified as more efficient and/or environmentally effective procedures are developed on site or in similar zones in Alaska. These will be submitted to ADNR for approval.

These prescriptions and improvements are designed to promote successful mine reclamation by providing good soil conditions for plant growth, establishing vegetation to control erosion, and enhancing natural ecological processes.

Establish Good Soil Conditions

Good soil conditions will be established prior to seeding to ensure soil stability and the long-term success of revegetation efforts.

Soils Contouring & Grading

The primary goal of soils contouring and grading is the immediate stabilization of the surface. The secondary goal is to establish a stable surface for revegetation.

Disturbed areas will be graded and contoured to control erosion. Slopes will be modified to control the velocity and direction of runoff, trap and retain water on site, and retard the flow of water as it moves off the disturbed areas. Topography, slope angle, type of soil, and rainfall intensity will be considered when determining the design for contouring. Techniques to be used may include re-sloping, terracing, contour benches or furrows, bioengineering with natural plant materials, and the use of geotextile material.

Slopes flatter than 2H:1V may have dozer gouges prepared for erosion control where appropriate. These gouges are constructed by operating the dozer perpendicular to the crest of the slope. Steeper slopes will be treated on a case-by-case basis to ensure the safety of the operator. These slopes would include quarry highwalls, mill bench highwalls, camp / shop bench highwalls, and other rock cuts along roads and ditches.

Areas that are likely to develop rills and gullies will undergo surface manipulation such as ripping and chiseling along the contour, contour furrows, and pits and/or terraces. Water bars will be placed as needed.

Soil Tillage

During reclamation, soil may be compacted, decreasing the soil pore space. This limits water holding capacity and soil rooting volume, resulting in reduced root growth and seedling success. Soil tillage helps correct these adverse conditions and is particularly important during the critical first years of reclamation.

Areas that have been heavily traveled, such as roads, laydown areas, building pads, etc., will be ripped prior to scarification. If necessary, cross-ripping will be done in extremely compacted material.

Where appropriate, all compacted areas and areas likely to develop rills and gullies will be ripped to a minimum depth of 18 inches prior to growth media placement.

Ripping can have a greater impact on development of seedling roots than any other soil tillage treatment, as this technique will increase the soil volume available to roots and improve their ability to reach water and nutrients.

Growth Media

Growth media in designated areas, such as overburden and topsoil, will be stockpiled for future use. These stockpiles will be seeded to prevent erosion and to enhance their biological properties, such as buried seeds, plant roots, rhizomes, and microbes, that aid in nutrient absorption. These properties decrease with time in stored topsoil.

If available, growth media will be stripped from material sites, laydown areas, and the mill site area. Depending on geotechnical design criteria and water quality considerations, growth media will not be stripped from areas with underlying ice-rich permafrost and fine-grained, poorly drained soils.

Approximately the top 6 inches to 18 inches of growth media will be stripped and stockpiled as topsoil, with the depth dependent on local conditions. The portion of soil containing plant roots will be used as a guide to segregate topsoil from overburden. Growth media will be stockpiled at prescribed locations as shown in **Figure D.1** in **Appendix D**.

Generally, a 6" layer of growth media will be placed over disturbed areas, excluding rock cuts and slopes steeper than 2.5H:1V, that require additional growth media to support revegetation or efforts to promote natural re-invasion by native vegetation. The ongoing test trials (**Appendix E**) will help establish the areas requiring growth media. Stable highwalls will be left in place and will not require growth media.

A Growth Media Replacement Plan that includes depth of growth media placement over buried foundations and proposes a seed mix and fertilizer application rate will be submitted to ADNR for approval prior to Phase III reclamation activities.

Soil Amendments

Disturbed areas are expected to be nutrient-poor, and an initial application of fertilizer will likely be required. However, upland forests of the boreal forest are generally found to leach nutrients, and fertilization may have a negative impact on the establishment of native plant species.

Initial field trials indicate that a fertilization rate of 300 pounds per acre of 20N-20P-10K is adequate. Fertilizer application rates will be adjusted based on additional field trials, the reclamation objective, and field conditions such as growth media organic content, soil temperature, and moisture content. Fertilizer will be applied prior to, or during, seeding operations.

Growth media will be tested for the most important nutrients involved in plant production in the boreal forest: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) (Magoun et al., 2000). Fertilizer rates will be adjusted accordingly.

Fertilizer will not be used within 100 feet of the Goodpaster River, its tributaries, or whenever conditions may facilitate transport of fertilizer to the river.

Mulch

Mulch may be used to protect seeds and help retain soil moisture during the critical germination process. The benefits of using mulch produced from native tree and shrub twigs include: (1) provides nitrogen and nutrients as decomposition products, (2) supplies seeds, roots, and microorganisms needed to reestablish native vegetation, and (3) contributes woody debris for habitat enhancement. Mulch cover may not be appropriate for seed mixtures that require mineral soil and light for germination.

During the land clearing process, salvageable timber will be cut and decked. Other plant material may either be cut or chipped and incorporated as a soil amendment, or stockpiled for later use as mulch or woody debris applications.

Seeding

Seeding methods are described below to ensure optimum conditions are present for seed growth.

Seedbed Preparation

After or during placement of growth media, the seedbed area will be scarified. Scarifying improves rooting conditions in the soil surface by increasing the volume of large pores in the surface soil that allows for more water and air transport. Other advantages of preparing a rough surface include the ability to:

- trap moisture
- reduce wind shear
- minimize surface erosion
- increase infiltration
- create micro-habitats conducive to seed germination
- encourage native plant recolonization.

Seeding

The goal of the revegetation program is to stabilize soil erosion so that native species may recolonize the area. This will be accomplished using two methods:

- In minimally disturbed areas with existing duff or plant growth, scarification and fertilization of the disturbed and surrounding area may be undertaken to encourage natural recover.
- In highly disturbed areas, seeding will be conducted to immediately establish a grass cover to reduce soil erosion and prevent sediment loss into rivers and streams.

Test trials began in 1998 with revegetation of the winter road, and have continued with revegetation of portions of the advanced stage exploration project. These trials will continue throughout the life of the mine (**Appendix E**), or until an optimum program is established that meets the following objectives:

- identifies existing and introduced grass, legume, and woody species potentially suitable for temporary and/or permanent stabilization of stockpiles and recontoured areas
- investigates potential requirements for soil amendments such as fertilizer, organic material, etc.
- determines the optimum grass cultivars, singularly or in mixtures, for stockpiled soil from the site areas, overburden and development rock, and tailings.

To date, winter road test trials have indicated the seed mixture presented in **Table B.1** is effective at stabilizing disturbed areas.

Table B.1: Current Seed Mixtures

Objective	Grass Species	Notes
Winter Road	Annual rye grass	Use 50/50 mixture of 40 pounds/acre. Add annual rye grass (up to 10%) to perennial mixture for early season planting. Late season follow up with perennials next spring. Use fertilizer mixture of 20N-20P-10K at 250 pounds/acre
Temporary – quick	Red fescue (Arctared) erosion control	Reapply fertilizer at 250 pounds/acre after grass cover is established (2 to 3 years)
Advanced Exploration	Annual rye grass	
Interim Reclamation	Red fescue (Arctared) stockpiles, erosion control devices, cut and fill areas where erosion is likely	Has proven to be effective on trial areas at MS7 and Mile 33

The timing of seeding considers the germination of the seed and its establishment. The preferred seeding time is in the spring, immediately following snowmelt and runoff when the soil surface is moist and temperatures are warming. However, fall seeding will be

practiced when necessary. If seed is applied during the winter, the snow surface will be roughed to provide microsites for trapping the seed. Proposed seeding date cutoffs are presented in **Table B.2**.

Seed and fertilizer will be broadcast by hydroseeder, depending on the size and accessibility of areas to be treated. Alternatively, helicopter-seeding currently planned for reclamation of the main access road and transmission line disturbances may be used to revegetate the whole site.

Table B.2: Seed Timing

	Germinate & Establish Seedlings for Overwintering	Lie Dormant until Spring Breakup
Uplands	Spring breakup through July 30	October 15 through spring breakup
River Valley	Spring breakup through July 15	October 1 through spring breakup

Woody Debris

Preliminary research indicates that woody debris may play an important role in forest ecosystems (Magoun et al, 1999). The function of woody detritus in forests may include the following:

- reducing erosion
- enhancing soil development
- storing carbon, nutrients, and water
- providing a seedbed for plants
- supplying an important habitat for microorganisms, invertebrates, and vertebrates.

Small-scale natural disturbances such as wind throw, snow breakage, localized mortality from insects and disease, and activity by herbivores may be imitated. Woody debris from cleared areas will be utilized in this way to enhance the overall reclamation program.

Appendix C
Demolition Procedures

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General Demolition Procedures

Demolition will include:

- removal of all hazardous materials
- removal of all equipment and buildings
- removal of above-ground power and telephone lines
- burial of concrete foundations and footers
- removal of piping to just below grade
- approved on-site disposal of inert construction and demolition debris.

Hazardous Materials

All controlled and hazardous chemicals, fuels, and regulated materials will be removed from the site for recycling and/or disposal in an approved manner. Decommissioning will include pumping to remove any remaining hazardous materials in pipes, tanks, and other potential storage units. Tanks will be cleaned and purged following all applicable and relevant regulations.

Fuel tanks and steel infrastructures such as walkways will be disposed of in designated areas of the underground mine workings. Uncontaminated gravel will be used to surface site roads. Contaminated gravels will be treated in a manner approved by ADEC. The synthetic liners will be removed to the solid waste disposal facility.

Equipment & Buildings

All equipment will be removed from buildings and salvaged. Modular buildings will be shipped off site. Non-mobile buildings constructed on site will be dismantled. Reusable components will be shipped off site. Other portions will be burned or incinerated, as approved, or removed to the drystack tailings facility during Phase III and the solid waste disposal facility (not yet constructed) or designated area within the underground workings of the mine during Phase III.

All fencing will be dismantled and disposed of. the solid waste disposal facility (not yet constructed) or designated area within the underground workings of the mine during Phase III.

Above-Ground Power & Telephone Lines

When electrical power requirements are no longer necessary, associated facilities such as conductors and insulators will be removed from the site for salvage or disposal. Wooden poles will be cut off at ground surface and removed from site. All above-grade lines will be removed, while any underground conduit below grade will remain in place.

Concrete Foundations & Footers

A dozer will be used to break concrete slabs less than 1 ft thick prior to burial. Foundations thicker than one foot will be buried in place with a minimum twelve inches of cover. Elevated slabs, walls, and footings will be broken to grade level and buried as fill material.

Piping

All piping, including HDPE, PVC, and carbon steel, will be cut off at a minimum twelve inches below grade, and ends will be capped. Buried pipes will be kept to a minimum, but will mainly consist of water and sewage transfer pipes between the mill and camp benches. Buried water lines will be flushed before in situ disposal. Buried lines (other than water lines) will be blown free of liquids using compressed air to remove any residual fuel, antifreeze or hazardous chemicals unless otherwise approved by ADNR.

Surface piping will be flushed, if necessary, and removed to the drystack tailings facility (Phase III), solid waste disposal facility (not yet constructed) or the designated area within the underground workings of the mine during Phase III.

Inert Construction & Demolition Debris

Inert construction and demolition debris will be burned or incinerated, as approved, or placed in the drystack tailings facility (Phase III), solid waste disposal facility (not yet constructed) or within the underground workings of the mine during Phase III.

Septic & Leach Fields

Surface components of the sewage treatment systems will be removed to the solid waste disposal facility (not yet constructed). The remaining below-ground portions will be abandoned in accordance with ADEC regulations.

Injection & Supply Wells

Injection, water supply, and monitoring wells will be abandoned by removing all projecting casing and piping, and plugging from the surface to the water table with concrete or bentonite. Concrete will not be used as a surface plug because of its susceptibility to frost jacking in ice-rich soils.

Appendix D
Reclamation of Material Sites in Goodpaster
Alluvial Gravels

RECLAMATION OF MATERIAL SITES IN GOODPASTER ALLUVIAL GRAVELS

Pond material sites MS-D and MS-H will be developed in support of the Pogo project. All other material sites will be used as contingencies in the event that additional material is required or some of the material sites do not prove viable.

Estimated extraction volumes are 190,000 cubic yards(yd³) from site MS-H and 70,000 yd³ from MS-D, for a total 260,000 yd³ of sand and gravel. This total is based on an estimated construction volume of 144,000 yd³ plus an allowance for wastage/contingency, unusable native soil, and future maintenance requirements. The other material sites have not been included in this total because of their contingency status, although acreages and reclamation plans are included in this report.

In general, sand and gravel will be used for concrete aggregate, road surfacing, construction laydown areas, structural backfill, and in the RTP dam.

General

Gravel mining during the construction will be conducted as follows:

1. The perimeter of the borrow pits will be surveyed, and the trees and brush removed from within the perimeter. Tree and brush removal will only be done if and when the particular borrow pit is required. Trees with diameter at breast height (DBH) greater than 9 inches will be decked and used for construction or support activities. Trees with DBH of 9 inches or less will be cut into short sections or chipped for use during reclamation. Growth media will be removed to the nearest designated growth media stockpiles in the airstrip facility area or the 1525 portal area. Brush will be either stockpiled or chipped and incorporated into the growth media.
2. Gravel will be excavated below the water table with either a backhoe or a dragline. The depth of the material sites will vary from 15 to 25 ft depending on the equipment available, the permafrost encountered, and the material found at depth. The sideslopes of the material sites are proposed to be approximately 1.75H:1V to ensure stability and to avoid wildlife entrapment.
3. A cleared buffer zone of 25 ft will be maintained between undisturbed vegetation and the material site limits. This will ensure minimal tree collapse into the material site due to bank thawing and erosion.
4. If gravel requirements and scheduling dictate that gravel is needed from areas where seasonal frost is present, blasting may be necessary. Some irregular areas around the perimeter will not be blasted, and once thawed during the summer, these areas will be reshaped to provide flat slope shoreline and shallow pond areas.
5. When explosives are necessary for gravel extraction during the winter months, Pogo will use appropriate charge sizes and setbacks from the river to prevent injury

to fish. These parameters will be based on ADF&G's 1991 publication Blasting Standards for the Protection of Fish. Precautionary measures will also be taken to minimize nitrogen contamination of the gravels and surrounding area.

6. For the definition of the material site layouts for this permit application it is assumed that gravel extraction will be terminated where permafrost is encountered. As the frost comes out of the gravel, the gravel may be removed, but the general concepts of "upland areas" and "shallow bars" will be maintained.
7. Generally, "upland areas" and "shallow bars" will comprise approximately 20% of the material site areas.
8. Where possible, gravel will be excavated in a manner that maximizes shoreline irregularity.

Final Reclamation

The objective of final reclamation will be to establish wetland habitat with suitable features for waterfowl and shorebirds. This will include the following procedures:

1. Material site slopes and banks will be contoured immediately following completion of each sectional part or the entire operation, as appropriate. No gravel stockpiles will be left at the completion of operations.
2. Shoreline length and diversity will be maximized to the extent practicable.
3. Topsoil will be applied to disturbed areas where erosion is possible.
4. Native emergent plants may be transplanted in shallow areas as appropriate to improve habitat value for waterfowl. In addition, shrubs and other indigenous plant materials may be used to create pockets that should assist natural colonization and increase habitat values.
5. Perimeter vegetation within 100 ft of the material site perimeter will be fertilized so as to enhance vigor and seed production.
6. Because seeding with grass cultivars is likely to inhibit natural colonization, it will be limited to areas where rapid cover development is needed for erosion control.
7. Fertilizer and seed will be broadcast by hand or mechanically, depending on the size and accessibility of areas to be treated. Application rates will depend on the results of the test plots described in **Appendix E**. Fertilizer will not be used within 100 ft of the Goodpaster River or its tributaries.

Clearing activities at the material sites are expected to generate more growth media than will be required for use during material site reclamation. This material will be stored in the designated growth media stockpiles to be used during project reclamation.

Appendix E
Proposed Vegetation Test Trial Program

RECLAMATION OF MATERIAL SITES IN GOODPASTER

Vegetation test trials will be performed throughout the life of the project to ensure that the revegetation goal — namely, stabilizing disturbances so native species may eventually re-colonize the area — is achieved.

Purpose

The purpose of vegetation test trials at the Pogo project is to establish the optimum methods and procedures for revegetating the project site after mining ceases. Test trials will commence in the first year of construction and continue until selected procedures are field-tested for a minimum of three years. Processes will focus on: (1) encouraging the natural recovery of local plant communities, and (2) applying seed and shrub cuttings to heavily disturbed areas.

Natural Recovery

In areas where surface disturbance and the erosion potential from water and wind are low, treatment will be utilized to stimulate natural recovery. **Table E.1** summarizes the treatment to be applied to these areas (which will not be seeded). Undisturbed vegetation surrounding the disturbed areas may also be fertilized with the objective of enhancing the vigor and promoting additional flowering and seeding of existing flora.

Table E.1: Natural Recovery Treatments

Surface Disturbance	Erosion Potential	Fertilizer	Examples
Minimal, 75% of plants remain rooted	Low	None	Powerlines and winter roads
Minimal, 50%-75% of plants remain rooted	Low	Based on literature and previous site applications	Construction access for heavy equipment

Enhanced Recovery

Fertilizer and/or seed will be applied to help establish a protective plant cover over disturbed areas in the following conditions:

- to provide erosion control of disturbed areas likely to erode before natural recovery can provide protection
- to establish grassed areas needed to protect the physical stability of conveyances, roads, or material stockpiles on a temporary basis
- to promote the successful reestablishment of post-mining land uses
- for aesthetic reasons.

Table E.2 summarizes the general vegetation types and landform-shaping techniques that will be applied to the various areas of the project site after mining is completed.

Table E.2: Summary of Enhanced Recovery Methods

Disturbed Area	Proposed Long-Term Vegetation Type	Landform Shaping Needs
Tailings Site	Alpine grass meadows/talus	Upper meadow flats and scree slopes with drainage
Liese Creek Mill, Camp & Shop Areas	Closed broadleaf forest, early successional	Gentle slopes
RTP Site	Uplands, willow thickets	Depressions to hold snow
Airstrip Facility	Alluvial forest - willow shrub thicket	Flat, generally with drainage

Disturbed Site Evaluation

Each disturbed area will be investigated to determine soil site limitations that may affect growth; to define grass species that will survive under those particular site conditions and meet the overall reclamation goals; and to choose woody species that can be transplanted or encouraged.

Soil & Site Limitations

The quality and quantity of the growth media will affect the success of revegetation as well as the aspect and elevation of the site. Test plots will consider the physical, chemical, and biological properties of the growth media and will be sited to mimic the aspect, elevation, and other conditions.

Specifically, the grass or woody species selected for the test plots will be based on:

- growth media texture (i.e., coarse, well-drained vs. finer, poorly drained soils)
- growth media pH
- expected nutrient levels
- control of squirrel tail barley, which competes vigorously with woody regeneration.

Woody Species

Some mammalian species, such as moose, snowshoe hare, beaver, and yellow-cheeked vole, depend on early successional vegetation for food. In addition, it provides thermal cover for moose and wildlife habitat for small mammals including marten and lynx. **Table**

E.3 summarizes the woody plant species and methods to be used during the vegetation trials. Test trial results will be compared against natural recolonization to determine if large-scale woody species planting is possible or needed. Scarification and maintaining bare soil for natural regeneration of birch and white spruce will be considered as variables in the woody plant revegetation trials.

Table E.3: Selected Woody Plant Vegetation Trials

Soil Conditions	Method	Species
Medium to high moisture	Transplant root ball	Alder (<i>Alnus Sinuata</i>)
High pH south-facing	Transplant root ball	White spruce (<i>Picea glauca</i>)
High pH	Transplant root ball	Paper Birch (<i>Betula papyrifera</i>)
Medium to high moisture, low acid tolerance	Unrooted cuttings	Balsam Poplar (<i>Populus Balsimifera</i>)
High moisture - along ponds, depressions, seeps	Unrooted cuttings	Willow feltleaf (<i>Salix alaxensis</i>)
High pH	Fresh catkins with fresh seeds	

Grasses

The native grass seed mix (**Table E.4**) will be based on meeting the following objectives:

- grass and legume cultivars that will grow on tailings, development rock, and disturbed soil
- a ratio of grass and legume species within the seed mix that will improve the diversity of the resultant community
- a seeding rate that will allow establishment of local species and outplanted browse without jeopardizing the cover needed to stabilize the soils
- success of species previously used at Pogo.

All selected species have high winter hardiness and are long-term survivors, with the exception of the annuals.

Table E.4: Selected Grasses & Legumes (University of Alaska Fairbanks Cooperative Extension Service, 1991)

Species	Soil/Site Group	Acidity Tolerance
Alpine blue grass (Gruening) <i>Poa alpina</i>	1,2,3	Fair acidity tolerance, low fertilizer requirement. Moderate drought resistance, poor flood tolerance. Bunch root system tufted, usually found on rocky or stony places in higher elevation areas.
Alpine milkvetch <i>Astragalus alpinus</i>		Legume, perennial, non-climbing.
Annual rye grass <i>Lolium multiflorum</i>	1,2,4	Good acidity tolerance, low fertilizer requirement. Fair 1,2,4 drought resistance, fair flood tolerance. Bunch root system, annual.
Bluejoint reedgrass (Sourdough)	1-5	Very good acidity tolerance, moderate fertilizer requirement. Good drought resistance. Good flood tolerance. Bunch root system.
Kentucky bluegrass (Nugget) <i>Poa pratensis</i>	1,2,4	Fair acidity tolerance, high fertilizer requirement. Fair drought resistance. Good flood tolerance. Sod root system. Will tiller (produce new shoots in response to grazing or mowing).
Glaucous bluegrass (Tundra) <i>Poa glauca</i>	1,2,3	Fair acidity tolerance, moderate fertilizer requirement. Good drought tolerance. Poor flood tolerance. Bunch root system.
Polar grass (Alyeska and Kenai) <i>Arctagrostis latifolia</i>	1,2,4,5	Very good acidity tolerance, moderate fertilizer 1,2,4,5 requirements. Poor drought resistance. Good flood tolerance. Bunch root system.
Red fescue (Arctared) <i>Festuca Rubra</i>	4	Good acidity tolerance (pH 5 to 7), moderate fertilizer 1-4 requirements. Poor drought resistance. Good flood tolerance. Bunch root system.
Norcoast Hairgrass		
Norcoast Hairgrass		
Egan American Sloughgrass		
Wainwright Slender Weatgrass		

Vegetation Test Trials

Vegetation test trial plots will be used to establish optimum soil amendments to meet the revegetation goal of stabilizing soil erosion so that native species may recolonize the area.

Alpine Grass Meadows/Talus

These test plots will evaluate the potential for the tailings drystack area to support an alpine grass meadow with talus slopes. Varying soil cover arrangements and soil amendments will be used. The test plots will be located on a site with similar slope and aspect as the tailings drystack area.

The surface of the tailings drystack is expected to be moderately well to well drained. Selected grasses will include: Alpine bluegrass (Gruening), Annual rye, Bluejoint reedgrass (Sourdough), Kentucky bluegrass (Nugget), Polar grass (Alyeska and Kenai), Red fescue (Arctared), and Smooth brome (Manchar).

The face of the tailings drystack is expected to be well drained and rocky with sparse vegetation, and may be shaped to mimic a scree slope, depending on the final closure plan. Similar grass species will be used.

Closed Broadleaf Forest, Early Successional

These test plots will evaluate the potential for the Liese Creek mill, camp, and shop areas to support an early successional closed broadleaf forest by enhancing natural plant invasion. Test plots will be located on previously disturbed areas with similar aspect and elevation. A combination of fertilizer and surface preparation will be used to encourage natural invasion of native shrubs and trees.

Willow/Alder Thickets

Test plots to evaluate the establishment of willow and alder thickets in the recycle tailings pond will be established on construction-disturbed land near the area. Depressions to hold snow will be created and Feltleaf willow and Bebb willow cuttings with Thinleaf alder sprouts will be established.

Alluvial Forest – Willow Shrub Thicket Complex

Test plots will evaluate the potential for the airstrip facility and off-river treatment works areas to support lowland and terrace alluvial forest with inclusions of willow shrub thickets. Test plots will be located in previously disturbed areas with similar aspect, soil conditions, and elevations and will be used to evaluate the effectiveness of fertilizer, surface preparation, and cuttings to encourage the invasion of woody species.

Material Sites

Test plots on representative disturbance will be established in the material site areas to evaluate erosion control and the establishment of wetlands. Grass species may include; Bluejoint reedgrass (Sourdough), Polar grass (Alyeska and Kenai), and Meadow foxtail and woody plant species may include Feltleaf willow, Thinleaf alder, and Beb willow.

Soil Amendments

Fertilizer will be applied at varying application rates and nutrient concentrations. Previous reclamation at Pogo indicates that a ratio of 20N-20P-10K is adequate in most areas. Final fertilizer application rates will be based on testing results (**Appendix B**).

Monitoring

Trial plots will be monitored to assess the success at meeting revegetation objectives and if those objectives are not met to determine better conditions to meet those objectives. Monitoring of plant parameter data will include percentage cover, and vigor using surface stabilization transects.

Test Plot Design

Test plots may be constructed using plastic garden edging or other barriers and adequate separation distances from existing communities to reduce confounding factors. Typical plot size will be based on available area but will be standard for these types of trials and extrapolation requirements. Each plot will be assigned a unique identifier and the average slope, orientation, elevation, slope length, plot area, and seed mix recorded, if applicable.

Transects will be located to obtain representative data from each test trial. Moisture conditions, slope, and surface materials will be as uniform as possible. After determining how many transects lines are need for each test trial, two permanently marked end points, 2 to 10 ft long, will be placed for each transect. A measuring tape, marked in tenths, will be stretched between the two end points and plant/soil observations will be made adjacent to the line at regular intervals.

Meteorological Monitoring

Meteorological data will be collected at the existing stations. Hourly averages of air temperature, relative humidity, and wind speed and direction, as well as precipitation and evaporation data, will be available.

Plant Growth

Plant growth will be monitored throughout the growing season by measuring heights and/or ground coverage dimensions of plants along the established transect lines within each plot. The methods used to measure plant dimensions may vary for different species and will be field adjusted.

Plant height will be measured from the soil surface by the stem to the maximum naturally standing height of the stalk. Canopy cover and soil characteristics will be determined using conventional methods. A summary of the data will be included in the annual report.

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Appendix F
Reclamation Cost Estimate & Financial
Assurance Model