Pogo Reclamation and Closure Plan

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November 2011

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1.0 INTRODUCTION

Pogo Mine is an underground gold mine and mill in central Alaska, located approximately 38 miles northeast of Delta Junction (see Figure 1.1). The mine is a joint venture between Sumitomo Metal Mining Pogo LLC (Pogo) and the subsidiary company of Sumitomo Corporation of Tokyo, Japan. Pogo, a wholly-owned subsidiary of Sumitomo Metal Mining America, Inc., itself a wholly-owned subsidiary of Sumitomo Metal Mining Co., Ltd. of Tokyo, Japan, is the operator of this project.

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 October 2008 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.”*

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 steeply dipping slopes;
- closure of the tailings drystack facility; and
- 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.

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. standards.

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), the Alaska Department of Environmental Conservation (ADEC), and the U.S. Army Corps of Engineers (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 discharge to 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.

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 costs as presented in **Table 5.1** for the millsite lease and mine and **Table 5.2** for the 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 & 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 Project History

The Pogo deposit was discovered by “grassroots” exploration of an area with promising geology but minimal mining history. In 1981, WGM Inc. discovered gold, arsenic, and tungsten anomalies in stream samples taken from Pogo and Liese Creeks in the course of a regional mineral potential evaluation. Claims were staked over these areas in 1991, becoming part of the Stone Boy Joint Venture. The Joint Venture consisted of several claims groups, covering a large area of the Chena, Salcha, and Goodpaster River basins. Exploration work in this area was carried out by WGM and financed by Sumitomo Metal Mining Co., Ltd. (SMM) and other companies that later withdrew. Teck Corporation (now known as Teck Resources Ltd.) signed a letter of intent in June 1997 to acquire a 40% interest in the Pogo Claims from SMM, and assumed operatorship in the spring of 1998.

Exploration work on the Pogo Claims from 1991 to 1994 consisted of grid-based soil sampling, prospecting, and geophysics. Three diamond drill holes were undertaken in

1994, targeting a large gold-in-soil anomaly and a magnetic linear in Liese Creek. Encouraging results led to 13 additional drill holes in the Liese Creek area in 1995, and the discovery of the “Liese Zone,” which consists of one or more low-sulfide quartz veins with high-grade gold. Highlights included 22.7 ft of 1.8 ounce per ton (opt) gold in drill hole 95-09. Drilling in 1996 (22 holes) focused on defining whether the zone consisted of several steeply dipping quartz veins, or a single, nearly flat-lying vein. The latter interpretation proved to be correct. Drilling in 1997 (41 holes) further enlarged the deposit area, refined interpretations of the orientation of the main Liese Zone (now designated L1 vein), and added a new “lower” vein (L2 vein) in a near-parallel orientation below the L1 vein.

In 1997, Teck and Sumitomo purchased the Faith Claims on Pogo Creek from Jack Stewart, a placer miner who had sporadically worked the state claims since staking them in the mid-1980s. In the winter and early spring of 1998, Teck constructed a 46-mile winter ice road and mobilized a fleet of underground mining equipment and supplies. A 48-man ATCO trailer camp was constructed along with laydown and fuel storage areas in the vicinity of Jack Stewart’s previous surface disturbance.

In 1998, 1999, and 2000, activities included in-fill and step-out drilling of the L1 and L2 veins, condemnation drilling at sites proposed for future mine facilities, and exploration drilling and surface sampling at several other gold anomalies on the Pogo claims. During this period, more than 175,000 ft of drilling in 201 drill holes were completed, bringing the project surface drilling total to more than 254,000 ft in 286 drill holes. In 2001, the surface exploration program consisted of detailed soil and rock sampling, as well as geologic mapping in several other gold prospects on the Pogo claims. More than 4,000 surface samples were collected, bringing the total number of soil and rock samples collected to date to more than 16,000.

As of March 2001, the 254,000 ft of surface drilling had resulted in a geologic resource of 9 million tons averaging 0.57 troy ounces per ton (opt) of gold and containing 5.6 million ounces of gold at a 0.1 opt cutoff.

Beginning in March 1999, more than 6,000 ft of underground adit was driven to access the L1 vein and to provide a platform for underground definition drilling. The L1 vein was intersected in April 2000, and more than 5,000 tons of L1 vein, representing 450 ft of drift, crosscuts, and a raise, were excavated. By July, more than 42,000 ft of underground drilling, representing 135 drill holes, had been completed in conjunction with detailed underground geological mapping and geochemical sampling. In October 2000, 50 tons of L1 vein material were shipped to Lakefield Research and used for pilot-scale metallurgical test work. The test work confirmed that the design gold recovery rates were possible using a combination of gravity concentration, flotation, and cyanide leach.

In 2002, a surface drilling program of approximately 35,000 ft was completed with emphasis toward condemnation of the facility area and definition drilling on the northwestern edge of the deposit.

Construction of the Pogo Mine began in January 2004, with the first gold poured in February 2006. In 2007 the upper camp was expanded to add 50-beds, which brings the main camp to 250 total bed capacity.

Teck sold its 40% interest to SMM and SC in July 2009, and Pogo became the operator of Pogo. Currently, Pogo owns 85% interest, and SC owns 15%.

In 2009, the 74-bed new lower camp was constructed at the lower laydown area, and the old lower camp was demolished in 2010. The new core shack was constructed on the site of old lower camp. The access road to the 1525 Portal area was widened by 15 ft at 700-ft section to improve the safety condition.

1.5 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.

1.5.1 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).

1.5.2 Geology and Ore Resources

The gold resource within the Pogo Upland Mining Lease includes sub-parallel quartz veins hosted in a sequence of amphibolite-grade, paragneiss and orthogneiss of probable Proterozoic to mid-Paleozoic age. Mid-Cretaceous, granitic, plutons and dikes intrude the gneisses, which in turn are generally cut by the veins. A post-vein, diorite pluton has been age dated at 94 Ma age, constraining the minimum age of the deposit.

The gneissic rock sequence is interpreted as part of the Lake George subterrane of the Yukon-Tanana terrane, which extends from Fairbanks into the Yukon Territory. Typical lithologies include intercalated biotite-quartz-feldspar gneiss, hornblende-rich gneiss, chlorite-sillimanite gneiss, calc-silicate gneiss, quartz-rich gneiss, and granitic orthogneiss. Well developed and regionally extensive foliation and folding within the gneiss largely pre-dates the ore vein structures.

The granitoid intrusive rocks are considered the source of the gold-bearing fluids that contributed to the gold endowment at Pogo. In particular, the Goodpaster batholith to the north of the deposit is thought to be the general source of the dikes and gold veins observed in the mine. Similar granitoids have a causative relationship to a number of “plutonic-related” gold deposits in the region, including the Fort Knox deposit near

Fairbanks (McCoy et al., 1997). Intrusive rocks within the mine area include granite, quartz monzonite, quartz diorite, diorite and basalt. Most intrusive rocks are likely of Late Cretaceous age as suggested by samples that yield a range of ages from 107 Ma to 92 Ma, using U-Pb and Ar40/Ar39 age-dating techniques. Some of the dikes appear to utilize the same structures as the ore veins.

Several fault sets, exhibiting a range of orientations, are documented within the mine area. Drill data and underground exposures reveal widespread faults with steep northeast to east orientations. The Liese Creek and Graphite faults are two northwest striking faults present in the mine area which have significant contributions to overall inflows of water from surface. Low angle faults, though not well expressed on the surface, are also well documented underground, particularly where they bound Liese-type quartz veins. The Liese-type veins are low-angle sub-parallel veins currently comprising the majority of the Geologic Resource.

Mine Reserves, as of end-of-year 2009, lay entirely within three of these ‘Liese’ veins: L1, L2, and L3 (see **Figure 5.1**). As of year-end 2009, Proven and Probable Reserves stood at 6 million metric tonnes of 14.7g/t material for 2.8 million ounces. The Geologic Resource, outside the Reserve, stood at 4.5 million metric tonnes of 11.42g/t material for 1.66 million ounces, including 2.9 million metric tonnes of Inferred Resource at a grade of 8.72g/t.

Fluid inclusions from the Liese veins indicate unmixing of a dense, carbonic, moderately saline fluid, with most gold deposition occurring at temperatures of 250 to 380°C when the carbonic phase boiled. Methane is occasionally observed in the fluid, indicating fairly reduced conditions, and hence bisulfide complexing of the gold. Isochores for the fluids indicate depositional pressures of approximately 2kbar, or 7km lithostatic.

As mineralizing fluids boiled sulfide complexes destabilized, causing Au, Bi, As, and Te to come out of solution. These elements are correlated in sampling, with the best correlation being between Au and Bi at 0.89. Visual inspection of drill core from the L1 and L2 veins indicates that arsenopyrite, pyrite, pyrrhotite, loellingite, chalcopyrite, bismuthinite, native bismuth, and native gold are present in most vein intercepts. Galena, sphalerite, molybdenite, and tetradymite have also been noted but they are not common. Maldonite and a variety of Bi-Pb-Ag tellurides have been noted in polished sections. Native gold accounts for 95.5% of the total gold with 2.1% as maldonite, and

2.4% in solid solution with loellingite, arsenopyrite, and pyrite. Sulfides generally average less than 3% for a given Liese vein intercept.

1.5.3 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 inch to 6 inch) overlying 6 inch to 24 inch 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).

1.5.4 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 exploration 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. A pair of Trumpeter Swans nested several kilometers downstream from the lower exploration camp in summer 1998. 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. Most notably are 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).

1.5.5 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 exploration 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.

1.5.6 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.

1.6 Land Use

The Tanana Basin Area Plan (TBAP) for State Lands (ADNR, 1991) 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 (see **Figure 1.2**).

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 feet 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.

2.0 OPERATIONS PROFILE

The Pogo Mine is operated by:

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Delta Junction, Alaska 99737

(907) 895-2713

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 1.2). 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.

2.1 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.

2.2 General Description of the Project

The mine consists of the six major elements shown on **Figure 2.1** 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 detoxificatioin 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
- 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

All of Mine (6000)

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

2.3 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.

2.4 Nature & Extent of Land Disturbance at Closure

The permitted mine footprint is approximately 426 acres with 386 acres currently disturbed. Disturbances associated with mining operations are shown in Table 2.1 and on **Figure 2.2**. An additional 440 acres of disturbance are associated with the Pogo access road (214 acres for public portion of the road, 221 acres for private portion of the road, and 5 acres for communication site access) and 651 acres with the Pogo transmission line. Reclamation of the all-season route and transmission line are described in the "Right-of-Way Application" (Teck-Pogo Inc., 2002b).

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: Land Disturbance & Reclamation Methods

Area	Description	(acres)	Est. Volume GM placement (yd^3)	Est. Area Seeding (acres)	Est. Area Natural Recovery (yd^2)	Est. Area Rip/ Scarify (yd^3)	Est. Volume Reshaping (yd^3)	Est. Volume Relocation (yd^3)
1525 Portal Area								
E01	1525 Portal access road	8.1	6,550	0.9	7.2			58,320
E02	Rock storage pad	7.4	5,970	0.8	6.6			11,950
E03	Low er camp pond	7.8	630		7.8		1,260	
E04	Construction Airstrip	2			2			
E05	Low er camp diversion ditch	0.1			0.1			110
E06	Road Goodpaster bridge to Construction Camp	0.2	530		0.2		1,060	1,060
E07	Burn Pit	0.5		0.1	0.5			1,640
N01	1525 Portal	4.4	2,600	0.5	3.9			28,180
N02	Outfall 002 path	0.5			0.5			
N04	1525 Laydow n areas	14.1		1.6	12.5	45,350		
N05	Construction/Exploration Camp pad	11.5	9,280	1.3	10.2	37,110		
N06	#6 Road Goodpaster bridge to Liese bridge	10.2	8,190	1.1	9	21,910		19,010
N08	Fuel berms	0.4	290		0.3			870
Airport Area								
N03	Access road #7	6.5	5,240	0.7	5.8	2,760		46,530
N07	Main Airstrip	44.8	37,050	5	39.8	144,630		6,220
N09	Borrow source at airstrip	0.5	40		0.5			90
N11	Airstrip laydow n	36.8	320	5.3	31.4	117,360		1,270
N31	ORTW	16.1	1,300	0.4	15.7		2,600	5,500
N34	Log Storage							
Mill & Camp Area								
N10	1690 Portal	3.3	2,340	3.3				40,240
N13	Access Road #1	4.4	3,580	4.4				25,090
N14	Mill bench	14.2	11,380	14.2				267,640
N16	Main Camp/1875 Portal	19.5	15,400	19.5				293,590
N16F	Main Camp/1875 Portal fuel berms	0.3						
N25	Storm pond	1.6	1,276.70					
N30	Ore stockpile	1.3		0.3				910
Tailings Area				1,280	1.6			
N15	Road #3 to Mill to RTP	7.9	1,020	1.3		4,080		
N15R	Road #3 to RTP to drystack	11.4						
N17	RTP	9.3	6,340	7.9				44,370
N18	Drystack	60.1	9,160	11.4				64,120
N20	Access road to RTP seepage w ells	2.5	6,950	9.3				
N23	Diversion ditches (flume)	25.8	24,250	60.1				48,510
N32	Stilling Basin	2.9	3,970	2.5				9,040
All of Mine			4,890	25.8				110,980
N21	Transmission line	17.7	4,630	2.9				16,200
N27	Grow th Media	21.2						
N28A	Material sites A	1.9		17.7				
N28B	Material site B	3.3		21.2				
N28D	Material site D	5.8	3,130	1.9				630
N36	Road - Phase III Access	3.2	530	3.3				1,070
N37	Material Site - Phase III	28.2	940	5.8				1,880
N38	Grow th Media Pile - Phase III	7.9	.		3.2			
Total		**425.6**	**177,777**	**1,511**	**159**	**373,200**	**4,920**	**1,105,020**

2.4.1 Impact to Wetlands

The project impact to wetlands and various vegetation types is shown in **Figures 2.3 and 2.4**. Jurisdictional wetland mapping (3PP, 1998) is divided into "uplands and wetlands," "wetlands in uplands," and "uplands in wetlands" at 10%, 25%, and 40%, respectively. **Table 2.2** presents the total impacts to wetlands as determined from 2010 as-built drawings.

These figures indicate that approximately 37% of total project surface disturbance is on wetlands. Microclimates to support wetlands will be incorporated into the reclamation landform-shaping program where possible, including the RTP reservoir and mined-out gravel material site areas.

2.4.2 Impacts to Vegetation

A description of the types of vegetation to be found on the project site is presented in **Table 2.3**.

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

The type of vegetation within the project footprint is presented in **Table 2.4** and **Figure 2.4**. In order of decreasing impacts, the major vegetation types are: alluvial forest (terrace), open black spruce forest, closed broadleaf forest, and open black spruce forest (tussock sedge complex).

Table 2.2: Project Impact to Wetlands

Area	Description	Disturbed (acres)	Wetlands Disturbed (Acres)	Wetlands Restored (Acres)	Wetlands Created (Acres)
1525 Portal Area					
E01	1525 Portal access road	8.1	3.4	3.4	0
E02	Rock storage pad	7.4	1.3	3.3	0
E03	Lower camp pond	7.8	0.5	0	7.8
E04	Construction Airstrip	2	0	0	0
E05	Lower camp diversion ditch	0.1	0	0	0
E06	Access road Goodpaster bridge to Construction Camp	0.2	0	0.2	0
E07	Burn Pit	0.5	0	0	0
N01	1525 Portal	4.4	1.7	1.7	0
N02	Outfall 002 path	0.5	0	0	0
N04	1525 Laydown areas	14.1	4.9	4.2	0
N05	Construction/Exploration Camp pad	11.5	1.3	1.3	0
N06	#6 Road Access road Goodpaster bridge to Liese bridge	10.2	3.4	3.4	0
N08	Fuel berms	0.4	0	0	0
	Subtotal	67.2	16.5	17.5	7.8
Airport Area					
N03	Access road #7	6.5	3.6	3.4	0
N07	Main Airstrip	44.8	12.6	0	12.6
N09	Borrow source at airstrip	0.5	0	0	0
N11	Airstrip laydown	36.8	6.3	6.3	0
N31	ORTW	16.1	0.2	0	16.1
N34	Log Storage				
	Subtotal	104.7	22.7	9.7	28.7
Mill & Camp Area					
N10	1690 Portal	3.3	3.1	0.3	0
N13	Access Road #1	4.4	4.4	0	0
N14	Mill bench	14.2	0.6	0	0
N16	Main Camp/1875 Portal	19.5	24.8	0.4	0
N16F	Main Camp/1875 Portal fuel berms	0.3	0	0	0
N25	Storm pond	1.6	1.6	0	0
N30	Ore stockpile	1.3	1.1	0	0
	Subtotal	44.6	35.6	0.7	0
Tailings Treatment Area					
N15	Road #3 to Mill to RTP	7.9	0.6	0.6	0
N15R	Road #3 to RTP to drystack	11.4	0	0	0
N17	RTP	9.3	5.2	0.9	0.4
N18	Drystack	60.1	20.3	0	0
N20	Access road to RTP seepage wells	2.5	1.7	0.7	0
N23	Diversion ditches (flume)	25.8	4.1	0	0
N32	Stilling Basin	2.9	2.5	0.1	0
	Subtotal	119.9	34.4	2.3	0.4
All of Mine					
N21	Transmission line	17.7	8.9	0	0
N27	Growth Media	21.2	9	9	0
N28A	Material sites A	1.9	0	0	0
N28B	Material site B	3.3	0	0	0
N28D	Material site D	5.8	0	0	0
N28	Material sites	0	0	0	0
N36	Road - Phase III Access	3.2	3	3	0
N37	Material Site - Phase III	28.2	25.1	0	25.1
N38	Growth Media Pile - Phase III	7.9	3.4	3.4	0
	Subtotal	89.2	49.4	15.4	25.1
Total		**425.6**	**158.6**	**45.6**	**62.0**

Table 2.3: 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.

Table 2.4: Project Impact to Vegetation

Vegetation Description	Disturbed Area (acres)
Alder Shrub Thicket	0.3
Alluvial Forest – Emergent Complex	0.5
Alluvial Forest – Lowland	21.6
Alluvial Forest – Willow Shrub Thicket Complex	0.1
Alluvial Forest – Terrace	105.8
Closed Black Spruce Forrest	1.8
Closed Broadleaf Forest	103.6
Closed Mixed Forest	5.2
Disturbed – Filled Areas	26.3
Dwarf Birch Shrub Thicket	2.7
Emergent Aquatic Areas	5.4
Gravel Bars	5.5
Open Black Spruce Forest	57.9
Open Black Spruce Forest – Tussock Sedge Complex	45.1
Open Mixed Forest	17.4
Open Mixed Spruce Forest	12.4
Open Water	1.9
Tussock Sedge	6.3
Willow Shrub Thicket	5.7
TOTAL	**425.5**

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; and
- 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, the designated and traditional land use in the area is wildlife habitat and recreation (ADNR, 1991).

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, B, 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 erodable 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 248,600 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 142,100 loose cubic yards of growth media is required. In addition the overburden stockpiles have substantial plant growth, which indicates the growth media 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 December 2010 site As-built drawing. 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 Balance

Layer	Area	Description	Pile #	Length	Area (footprint)	Acres	Average height	estimated vol. (cy)	requirements (cy)
1525 Portal Area									
N27	1000	north of burn pit	17	1447	80754	1.9	10	24156	
N27	1000	south end of pond	18	608	15248	0.4	3	1481	
N27	1000	north end of laydown area	16	656	15636	0.4	3	1508	
							Sub-Total	27,144	26,575
Airport Area									
N27	2000	southeast end of airstrip	5	1810	42352	1.0	6	6912	
N27	2000	northeast of second laydown by powerline	4	1086	19869	0.5	6	2882	
N27	2000	north end of laydown areas	1	1925	153662	3.5	6	31495	
N27	2000	northeast of first laydown	6	1035	22420	0.5	3	2135	
N27	2000	north end of airstrip	3	2390	175900	4.0	15	76471	
N27	2000	first road to left going to airstrip	7	793	27689	0.6	6	5010	
N27	2000	south end of airstrip, east side	8	1414	44404	1.0	6	7896	
N27	2000	first road to left going to airstrip	7	1243	101476	2.3	6	20808	
N27	2000	has substantial growth on it (possible GM pile)	2	1321	96796	2.2			
							Sub-Total	153,611	37,046
Camp Area									
N27	3000	below mill bench off of ore pad	9	2500	95922	2.2	6	17897	
N27	3000	below camp bench	10	993	39005	0.9	3	3992	
N27	3000			1184	27061	0.6	3	2601	
							Sub-Total	24,491	18,561
Drystack and RTP Area									
N27	4000	next to road to diversion ditch, off of #3 road	12	1127	35598	0.8	6	6323	
N27	4000	below road to toe of drystack	13	1458	83363	1.9	6	16496	
N27	4000	next to shell of drystack	15	471	8597	0.2	6	1197	
N27	4000	below road to toe of drystack	19	1681	49578	1.1	3	4938	
N27	4000	above road to toe of drystack	14	642	17252	0.4	6	2892	
N27	4000	below RTP road	11	1579	84088	1.9	4	11496	
							Sub-Total	43,342	59,924
							Total	248,588	142,106

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 DNR to be reclaimed in a different manner or those determined by DNR 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 DNR. 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 DNR.

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.

4.1 Phase I: Reclamation of Construction Disturbance

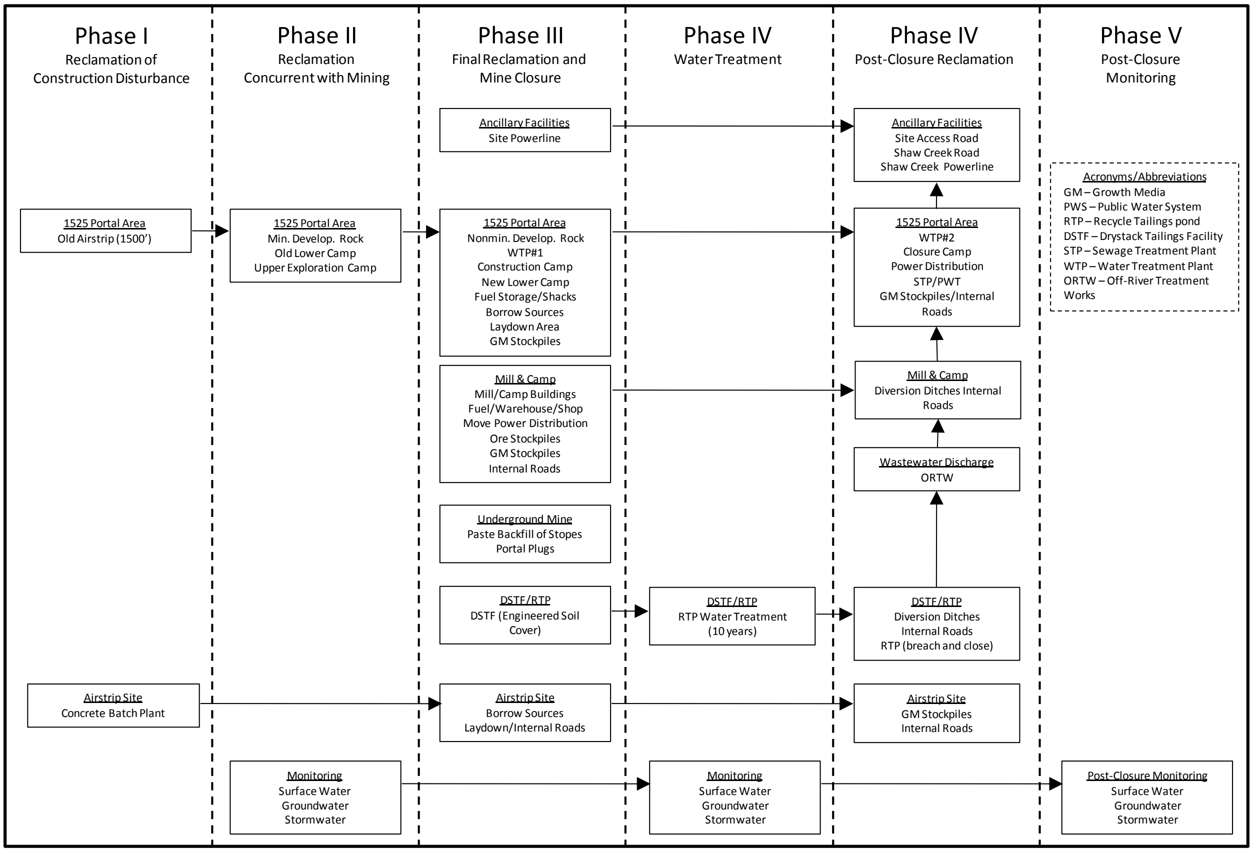
Any project disturbance from advanced exploration or construction that has not been reclaimed to date has been transferred to Phase II.

Phase I reclamation completed includes:

4.1.1 1525 Airstrip Facilities

The existing airstrip was regraded to remove berms and left in place. Floods and natural revegetation have reclaimed the site.

Table 4.1: Reclamation Schedule



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.

4.2.5 Temporary Shutdown

During temporary closures of less than three years (i.e., either planned or unplanned cessation of mining and processing operations), all environmental programs, permit requirements, and BMPs will continue unless specifically authorized to do otherwise by the applicable agency. Should unforeseen circumstances force the premature shutdown of project facilities for more than three years, final reclamation and closure measures will be implemented unless an extension is specifically authorized by the applicable regulatory agencies.

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 may be moved to the 1525 portal area to provide power for Phase IV operation of the water treatment plant and support facilities. This option is expensive and will be reviewed during the next five-year update.

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, respread 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, respread 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 for the mine involves removing salvagable equipment, backfilling, installing cement plugs in all mine openings, and re-flooding. More detailed procedures for underground mine closure, including design of cement plugs, assessment of the need for backfillng and accelerated re-flooding of underground workings, will be developed as a stand-alone technical report by end of 2013. The tentative procedures follow:

Pumps and mobile mining equipment will be removed from site. Chutes, conveyors, ventilation, piping, and electrical systems will be dismantled so that reusable equipment may be removed from site. Pipes supplying fuel and hazardous materials will be flushed before disposal. Unsalvageable components will be buried in the mine.

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 and 1690 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.

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.

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 location and design for the concrete plugs 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, respread 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.

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*) 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*=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

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. There is a plan to expand the current facility by constructing a new diversion ditch. When the detailed design for the expansion is completed, the mine reclamation and closure cost will be updated.

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 will be 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 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.

Two groundwater monitoring wells (one shallow and one deep well) will be installed near the downstream toe of the drystack in 2011. These wells, together with monitoring of the surface water flow between the drystack and the RTP, will provide the information required for further closure planning.

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, respread 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, spread 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 mine openings will be sealed and the mine re-flooded, and 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 seepage projected 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 spread with growth media and 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 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 reclamation 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.

During mine operations, some of the drystack tailing material will be eroded and deposited in the RTP. 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 present. Assuming a safety factor of two, the estimate was rounded to 300 tons. This equates to approximately 0.1% of the RTP volume. The 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 inch 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.

The volumes of materials that will require handling for closure of the RTP dam are summarized in **Table 4.5**.

Table 4.5: Volumes of Material Requiring Handling for Closure of the RTP Dam

Item	Units	Material for Proposed Construction	Material Removed at Closure	Comments
RTP Dam including base filter material	yd^3	128,900	85,400	A portion of the removed material will be used to cap the run-off sediments and the remainder will be taken to the dry stack facility.
Liner System	yd^3	16,200	14,100	A portion of the removed material

Base and Cover Materials				will be used to cap the run-off sediments and the remainder will be taken to the dry stack facility.
Material for capping run-off sediments	yd^3	NA	5,000	Capping material will be obtained from RTP Dam filter and rockfill materials.
HDPE	yd^2	9,700	8,500	Removed to solid waste disposal facility.
Geosynthetic Clay Liner	yd^2	9,700	8,500	Removed to solid waste disposal facility.

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

Reclamation of the Pogo access road is described in the “Right-of-Way Application” (Teck-Pogo Inc., 2002) and the August 15, 2003 Section 404 Permit Application. The cost estimate for reclamation and closure of the access road is summarized in Section 5 of this document.

4.4.5 Pogo Transmission Line

Reclamation of the Pogo Transmission Line is described in the “Right-of-Way Application” (Teck-Pogo Inc., 2002) and the August 15, 2003 Section 404 Permit Application. The cost estimate for reclamation and closure of the transmission line is summarized in Section 5 of this document.

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, respread 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.

4.4.7 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, spread with growth media, and fertilized and seeded 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 will continue for a 30-year period after post-closure reclamation. The monitoring events will take place on years 1, 2, 5, 10, 15, 20, and 30 after stopping active water treatment.

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.

4.5.3 Winter Road Demobilization

At the end of mine closure monitoring, the remaining camp facilities and equipment will be removed over the Goodpaster winter road utilized during exploration and construction activities.

Gravel pads and other cleared areas will be recontoured for drainage, ripped or scarified, spread with growth media, and fertilized and seeded as necessary before final equipment removal.

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

Financial assurance will be established by Pogo to provide for completion of the reclamation work described in this report. As summarized in Table 5.1 and 5.2, reclamation and closure costs are estimated at $44.43 million for the Pogo Mine Site and $4.81 million for the all-season road and transmission line. These estimates are based on an updated model described below.

The Pogo Mine Reclamation and Closure Plan was updated to reflect 2010 as-built conditions and current site knowledge. An updated closure cost estimate was also prepared. The new model is more detailed than the approach used in 2005 and projects a closure cost of $44.43M for the mine site and $4.81M for the access road and transmission line.

AMEC produced the first reclamation and closure cost estimate in 2002 and 2003 as part of the original project documentation. AMEC updated the unit cost inputs in the original model and incorporated some final design information. The reclamation prescriptions and the overall methodology of the 2005 estimate remained as described in the Pogo Reclamation and Closure Plan October 2003 and the Pogo Right-of-Way Application June 2002.

In 2008, Pogo developed an in-house cost estimate and submitted it to ADNR for review. The cost model was amended to reflect agency's comments. An agreement was reached with ADNR in September 2010 as an "interim approval pending final revision to the Plan of Operations and supporting documents and completion of the public review process." The 2010 model uses first principle engineering estimates and current site knowledge. The reclamation prescriptions such as the type and thickness of cover material to be placed on the drystack, or the location of the wetlands to be restored, have not changed from either the original project documentation or the 2005 plan.

However, the basis of cost estimation is completely different and more detailed in the 2010 model. For example, the 2010 earthworks costs are based on direct equipment and manpower productivity and costs per task, rather than the more general unit cost estimates used in the 2005 model. In another example, the 2010 model assumes mill and building closure costs using more typical shear and grapple productivities, while the 2005 approach estimated building closure costs by reversing construction and installation costs, which were clearly too high. Other than ensuring that all of the individual tasks identified in the 2005 estimate were carried forward into the new model, there is no appropriate way to directly compare the two estimates.

The 2010 model is considerably more detailed and added many additional tasks that were not included in the previous model. The 2010 model incorporates material quantities, haul distances, and haul profiles based on as-built conditions. It uses equipment productivity based on published sources and shows the detailed build up of manpower and supervision required. Assumptions are documented in the model.

Material quantities are based on 2010 as-built drawings. Growth media volumes and locations are based on actual stockpiles. Material balances for reshaping and haulage profiles are based on actual locations. Maps, volumes, and haul routes are shown in the model. Building demolition costs are based on building size, construction, and contents.

Equipment costs are based on published 2009 State of Alaska Mine Reclamation Equipment Rates. Labor rates are based on State of Alaska Department of Labor, "Laborers' & Mechanics' Minimum Rates of Pay" issued in September 2009. Fuel costs are based on $3.23/gallon (actual purchasing price at Pogo in 2009). The estimate is in constant 2010 dollars, with adjustment for inflation or discounting at 2.66% (the three year average of Anchorage CPI between 2007 and 2009).

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.

Table 5.1: Pogo Millsite Lease and Mine Site Reclamation and Closure Cost Estimate

SUMMARY OF ESTIMATED RECLAMATION AND CLOSURE COSTS-POGO MINE SITE

		1 year holding cost	Phase I	Phase II	Phase III	Phase IV Water Treatment	Phase IV Reclamation	Phase V	Total
Direct Cost		$ 1,952,300	$ -	$ 770,900	$ 7,953,500	$ 5,205,600	$ 2,990,200	$ 104,800	$ 18,977,300
Site Management Cost			$ -	$ 26,500	$ 2,668,800	$ 5,433,728	$ 1,902,100	$ -	$ 10,031,128
Subtotal Direct Cost		**$ 1,952,300**	**$ -**	**$ 797,400**	**$ 10,622,300**	**$ 10,639,328**	**$ 4,892,300**	**$ 104,800**	**$ 29,008,428**
Indirect Costs	**% of Subtotal**								
Mobilization/Demobilization	**5.0%**	$ -	$ -	$ 39,870	$ 531,115	$ -	$ 244,615	$ 5,240	$ 820,840
Subtotal		$ 1,952,300	$ -	$ 837,270	$ 11,153,415	$ 10,639,328	$ 5,136,915	$ 110,040	$ 29,829,268
Contractor Overhead and Profit	**15.0%**	$ 292,845	$ -	$ 125,591	$ 1,673,012	$ 1,595,899	$ 770,537	$ 16,506	$ 4,474,390
Subtotal		$ 2,245,145	$ -	$ 962,861	$ 12,826,427	$ 12,235,227	$ 5,907,452	$ 126,546	$ 34,303,658
Performance Bond	**3.0%**	$ 67,354	$ -	$ 28,886	$ 384,793	$ 367,057	$ 177,224	$ 3,796	$ 1,029,110
Insurance	**1.5%**	$ 33,677	$ -	$ 14,443	$ 192,396	$ 183,528	$ 88,612	$ 1,898	$ 514,555
Subtotal		$ 2,346,177	$ -	$ 1,006,189	$ 13,403,616	$ 12,785,812	$ 6,173,288	$ 132,241	$ 35,847,322
Contract Administration	**4.0%**	$ 93,847	$ -	$ 40,248	$ 536,145	$ 511,432	$ 246,932	$ 5,290	$ 1,433,893
Engineering Re-Design	**3.0%**	$ -	$ -	$ 30,186	$ 402,108	$ -	$ 185,199	$ 3,967	$ 621,460
Contingency	**15.0%**	$ 351,926	$ -	$ 150,928	$ 2,010,542	$ 1,917,872	$ 925,993	$ 19,836	$ 5,377,098
Total Indirects		$ 839,650	$ -	$ 430,151	$ 5,730,112	$ 4,575,789	$ 2,639,111	$ 56,533	$ 14,271,346
Total Direct + Indirect		$ 2,791,950	$ -	$ 1,227,551	$ 16,352,412	$ 15,215,116	$ 7,531,411	$ 161,333	$ 43,279,773
Infration Proofing	**2.66%**	74,192	-	32,620	434,542	404,320	200,137	4,287	$ 1,150,099
Total Closure Cost		**$ 2,866,142**	**$ -**	**$ 1,260,171**	**$ 16,786,955**	**$ 15,619,437**	**$ 7,731,548**	**$ 165,621**	**$ 44,429,873**
								Rounded	$ 44,430,000

Table 5.2: Pogo Access Road and Transmission Line Reclamation Cost Estimate

Pogo Access Road and Transmission Line - Estimated Closure Cost							
		Phase I	Phase II	Phase III	Phase IV	Phase V	Total
Direct Cost		$ -	$ 13,666	$ -	$ 2,478,500	$ -	$ 2,492,167
Site Management Cost		$ -	$ 128	$ -	$ 582,645		$ 582,773
Subtotal Direct Cost		**$ -**	**$ 13,794**	**$ -**	**$ 3,061,145**	**$ -**	**$ 3,074,940**
Indirect Costs	**% of Subtotal**						
Mobilization/Demobilization	**6.5%**	$ -	$ 897	$ -	$ 198,974	$ -	$ 199,871
Subtotal		$ -	$ 14,691	$ -	$ 3,260,119	$ -	$ 3,274,811
Contractor Overhead and Profit	**15.0%**	$ -	$ 2,204	$ -	$ 489,018	$ -	$ 491,222
Subtotal		$ -	$ 16,895	$ -	$ 3,749,137	$ -	$ 3,766,032
Performance Bond	**3.0%**	$ -	$ 507	$ -	$ 112,474	$ -	$ 112,981
Insurance	**1.5%**	$ -	$ 253	$ -	$ 56,237	$ -	$ 56,490
Subtotal		$ -	$ 17,655	$ -	$ 3,917,849	$ -	$ 3,935,504
Contract Administration	**4.0%**	$ -	$ 706	$ -	$ 156,714	$ -	$ 157,420
Engineering Re-Design	**4.0%**	$ -	$ 706	$ -	$ 156,714	$ -	$ 157,420
Contingency	**10.0%**	$ -	$ 1,766	$ -	$ 391,785	$ -	$ 393,550
1 year holding cost			$ 41,000				$ 41,000
Total Indirects		**$ -**	**$ 48,038**	**$ -**	**$ 1,561,916**	**$ -**	**$ 1,609,955**
Total directs and indirects		$ -	$ 61,833	$ -	$ 4,623,061	$ -	$ 4,684,894
Inflation Proofing	2.66%	$ -	$ 1,645	$ -	$ 122,973	$ -	$ 124,618
Total Closure Cost		**$ -**	**$ 63,478**	**$ -**	**$ 4,746,035**	**$ -**	**$ 4,809,513**
						Rounded	**$ 4,810,000**

6.0 REFERENCES

Alaska Department of Natural Resources, 1991. *Tanana Basin Area Plan for State Lands*.

Alaska Department of Fish and Game, 1991. *Blasting Standards for the Protecting of Fish*.

Brown, Adrian, 2002. *Inflow to the Pogo Mine, Alaska*.

Helm, Dot J., 1990. *Considerations in Mined Land Reclamation*. Alaska Miner.

Magoun, A. J. and Dean, F.C., 1999. *Floodplain forests along the Tanana River, Interior Alaska -Terrestrial Ecosystem Dynamics and Management Considerations*. Alaska Boreal Forest Council Miscellaneous Publication No. 3. Final Draft.

Teck-Pogo Inc., 2002a. *Plan of Operations*. Document 3 of the Pogo project Documentation Series for Permitting Approval.

Teck-Pogo Inc., 2002b. *Right-of-Way Application*. Document 6 of the Pogo project Documentation Series for Permitting Approval.

Teck-Pogo Inc., 2002c. *Water Management Plan*. Document 4 of the Pogo project Documentation Series for Permitting Approval.

Teck Resources Inc., 1998. *Pogo project Advanced Exploration Program Stage II Environmental Assessment*.

Teck Resources Inc., 2001. *Environmental Baseline Document – A compilation of information that describes the existing environment in the vicinity of the Pogo project*.

Three Parameters Plus, 2000. *Preliminary Jurisdictional Wetland Determination*, Pogo project, Interior Alaska.

U.S. EPA, Region 10, 2003. Final Environmental Impact Statement, Pogo Gold Mine Project

University of Alaska Fairbanks Cooperative Extension Service, 1991. *A Revegetative Guide for Conservation Use in Alaska*.

Teck Resources Inc., 2006. *Pogo Mine 2006 Annual Monitoring Summary*.

Teck Resources Inc., 2007. *Pogo Mine 2007 Annual Activity and Monitoring Summary*.

Appendix A

General Construction Procedures

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., chainsaw, 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

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 2:1 (H:V) 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" 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" to 18" 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 (see **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 (see **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.

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

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 removed from site. Uncontaminated gravel will be used to surface site roads. Contaminated gravels will be treated in a manner approved by ADEC. The 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) during Phase IV.

All fencing will be dismantled and removed from site.

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. 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) and solid waste disposal facility (Phase IV, not yet constructed).

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) or solid waste disposal facility (Phase IV, not yet constructed).

Septic & Leach Fields

Surface components of the sewage treatment systems will be removed to the solid waste disposal facility (Phase IV, 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 from site MS-H and 70,000 cubic yards from MS-D, for a total 260,000 cubic yards of sand and gravel. This total is based on an estimated construction volume of 144,000 cubic yards 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" will be decked and used for construction or support activities. Trees with DBH of 9" 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 recolonize 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 *(Alnus Sinuata)*
High pH south-facing	Transplant root ball	White spruce *(Picea glauca)*
High pH	Transplant root ball	Paper Birch *(Betula papyrifera)*
Medium to high moisture, low acid tolerance	Unrooted cuttings	Balsam Poplar *(Populus Balsimifera)*
High moisture - along ponds, depressions, seeps	Unrooted cuttings	Willow feltleaf *(Salix alaxensis)*
High pH	Fresh catkins with fresh seeds	

Grasses

The native grass seed mix (see 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 (after University of Alaska Fairbanks Cooperative Extension Service, 1991)

Species	Soil/Site Group	Acidity Tolerance
Alpine blue grass (Gruening) *Poa alpina*	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 Astragalus alpinus		Legume, perennial, non-climbing.
Annual rye grass Lolium multiflorum	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) Poa pratensis	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).

Species	Soil/Site Group	Acidity Tolerance
Glaucous bluegrass (Tundra) *Poa glauca*	1,2,3	Fair acidity tolerance, moderate fertilizer requirement. Good drought tolerance. Poor flood tolerance. Bunch root system.
Polar grass (Alyeska and Kenai) Arctagrostis latifolia	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) Festuca Rubra	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 (see **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.

Appendix F

FIGURES

Figure 1.1: General Location Map
Figure 1.2: Land Status Map
Figure 2.1: Overall Site Plan
Figure 2.2: Mine Site As-built
Figure 2.3: Project Wetlands Impact
Figure 2.4: Project Vegetation Impact
Figure 3.1: Growth Media Sites
Figure 4.1: Closure Plug Locations
Figure 4.2: Parallel Plug Longitudinal Section
Figure 4.3: Location of Adit Plugs
Figure 4.4: Tailings Drystack Schematic Closure Configurations
Figure 4.5: RTP Dam at Closure

Appendix G

Reclamation Cost Estimate & Financial Assurance Model