Rock Creek Mine
Reclamation and Closure Plan

FINAL

Prepared for:

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ATTACHMENTS

FIGURES

ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
AGC	Alaska Gold Company
amsl	above mean sea level
APDES	Alaska Pollutant Discharge Elimination System
AS	Alaska Statutes
ATV	all terrain vehicle
BSNC	Bering Straits Native Corporation

CFR	Code of Federal Regulations
CGP	Construction General Permit
CIL	carbon-in-leach
cm	Centimeters
CN	Cyanide
COA	Certificate of Approval
Corps	U.S. Army Corps of Engineers
CRSA	Coastal Resource Services Area
CWA	Clean Water Act
DC	diversion channel
EPA	Environmental Protection Agency
GCL	geosynthetic clay liner
ha	Hectares
hp	horsepower
IWF	injection well field
km	Kilometers
LCRS	leak collection recovery system
m	Meters
mm	Millimeters
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
PLS	pure live seed
PMP	Probable Maximum Precipitation
RCRA	Resource Conservation and Recovery Act
RPA	Reclamation Plan Approval
RWP	recycle water pond
SCAS	State Spatial Climate Analysis Service
SCS	Soil Conservation Service
SHPO	State Historic Preservation Office
SNC	Sitnasuak Native Corporation
SWPPP	storm water pollution prevention plan
TCLP	toxic characteristic leachate procedures
TCP	Temporary Closure Plan
TSF	tailings storage facility
UIC	Underground Injection Control
USGS	United States Geologic Survey
WMP	Waste Management Permit
WTP	water treatment plant

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1.0 INTRODUCTION

The Alaska Gold Company (AGC) has prepared this Reclamation and Closure Plan to address reclamation, closure, and post-closure activities for the Rock Creek Mine located north of Nome, Alaska. This plan outlines the closure objectives, technical approach, and long-term performance monitoring to demonstrate compliance with all regulatory and landowner obligations. This document represents an update to the 2006 Reclamation Plan developed by AGC at the start of mining operations at the Rock Creek Mine site, although the 2006 plan also addressed reclamation at the Big Hurrah project area. Upon receipt of agency approval, this plan will supersede the 2006 plan only as it pertains to the Rock Creek Mine site; the Big Hurrah project remains undeveloped and is not addressed in this revision.[1]

This Reclamation and Closure Plan has been prepared to meet Alaska Department of Natural Resources (ADNR) mine reclamation and closure requirements pursuant to Alaska Statutes (AS) Chapter 27.19 (AS 27.19) and the Alaska Administrative Code (11 AAC 97) as applicable to private land, and to provide internal guidance in keeping with the AGC Environmental Policy. AGC submits this plan to:

- ADNR in accordance with AS 27.19.010, 11 AAC 97.100, and Reclamation Plan Approval (RPA) F20069578; and
- Alaska Department of Environmental Conservation (ADEC), Division of Water, in accordance with Waste Management Permit (WMP) 2003-DB0051.

This closure plan specifically provides for closure of the Rock Creek Mine in two phases. The first phase involves covering the tailings in the tailings storage facility (TSF) and breaching the tailings dam after as much ponded water as possible is treated and discharged or injected. The first phase will be performed prior to 2012 break-up and will be performed by AGC regardless of the ownership status of the property. Concurrent with preparation of this closure plan, AGC has been in discussions with Sitnasuak Native Corporation (SNC) and Bering Straits Native Corporation (BSNC) regarding potential acquisition of the entire Rock Creek Mine site. Currently, SNC owns a portion of the surface land at the site, while BSNC owns a portion of the mineral rights. If the acquisition is completed, BSNC and SNC are expected to work towards re-opening the mine under a new mine plan. Phase 2 of this closure plan would only be conducted if the acquisition does not occur. However, the complete closure plan provides the basis for the full site closure cost estimate that has been submitted to the State.

[1] Miscellaneous Land Use Permit No. 9424 for hardrock exploration activities at the Big Hurrah Project remains in effect until 12/31/2012. NovaGold will continue to work separately with ADNR to address any additional requirements that may be applicable to the Big Hurrah Project.

1.1 PURPOSE

AGC is committed to meet its obligations under state regulations and leaseholder agreements with respect to the Rock Creek Mine. This Reclamation and Closure Plan is designed to return land disturbed by mining-related activities at the Rock Creek Mine to a near natural condition and ensure the site does not pose any long-term risk to the people or surrounding environment. The plan has been reviewed and approved by BSNC and SNC, and is consistent with their long term plans for the site. This plan describes the overall reclamation objectives, general technical approach and procedures, and implementation schedule. To comply with AGC's social and environmental responsibility policies, AGC plans to:

- Complete major closure activities by the end of 2012;
- Minimize long-term care and maintenance needs by demolishing and/or reclaiming nearly all structures; and
- Eliminate the need for long-term water treatment.

1.2 RECLAMATION SUMMARY AND SCHEDULE

Closure activities focus on three major areas of the Rock Creek Mine site—the Main Pit, TSF, and mill/water treatment plant (WTP) area—that are related to each other, requiring a coordinated implementation schedule. These facilities and structures have cumulatively disturbed approximately 170 hectares (ha) throughout the Rock Creek Mine site. A limited portion of the disturbed area has already been reclaimed as part of post construction stormwater management activities. At closure, virtually the entire site, except for selected roads, will be reclaimed and revegetated.

AGC expects most plan components to be completed as expeditiously as possible over a 12-month period based on a starting time of fall 2011. Closure and reclamation activities will accomplish the following:

- Obtain all necessary permits and approvals prior to initiating reclamation tasks.

Phase I

- Remove water from the TSF;
- Install a temporary cover over the tailings; and
- Breach the TSF dam.

Phase II

- Remove paste tailings from the TSF to the Main Pit;
- Backfill Main Pit to eliminate potential for surface water accumulation;
- Dismantle mill facilities and support buildings;
- Remove all equipment and supplies from the site;
- Recontour all reclamation areas with stockpiled topsoil and revegetate with native vegetation hydroseed mixes, except for the slightly disturbed area east of the existing ore stockpile (aka the hummock area) which has naturally revegetated;
- Regrade and revegetate all access roads, except limited road segments that will be used during post-closure maintenance and monitoring;[2] and
- Implement post-closure monitoring procedures.

1.3 PROJECT LOCATION AND LAND STATUS

The Rock Creek Mine is located on the Seward Peninsula along the west coast of Alaska, north of Norton Sound and approximately 10 kilometers (km) north of Nome in the Snake River watershed. The site is located within Sections 14, 15, 22, 23, 24, 25, and 26, Township 10 South, Range 34 West, Kateel River Meridian, within the Cape Nome Mining District (United States Geologic Survey [USGS] Quad Map Nome C-1).

The Rock Creek Mine occurs partly on patented mining claims owned 100% by AGC, a wholly owned subsidiary of NovaGold Resources Inc., and partly on land controlled by the Sitnasuak Native Corporation (SNC). The Bering Straits Native Corporation (BSNC) also owns local mineral rights.

The Rock Creek Mine is road accessible via the local Glacier Creek Road and the state maintained Teller-Nome Highway, an all-weather paved and gravel road.

The City of Nome (population 4,000) is situated on the Bering Sea coast and serves as the logistical and administrative center for this portion of western Alaska. Nome has daily commercial jet service from Anchorage and large container barge service from June through October. Nome is not connected to the interior Alaskan road system.

The mining operation does not involve the use of any state or federal lands. The nearest area to the Rock Creek Mine that is closed to mineral entry is the Bering Land Bridge National Preserve, which is more than 96.5 km northeast at its closest point.

[2] At some point after plan approval, SNC may request that certain roads be retained to support future uses at the site. Retention of roads on private lands is consistent with applicable regulations. If requested, AGC will notify the State of Alaska as an amendment to this plan.

1.4 Operator Information

1.4.1 Corporate Officer Completing Application

Name:	Ron Rimelman
Title:	Vice President, Environment, Health, Safety, and Sustainability
Phone:	(303) 884-1823
Email:	ron.rimelman@novagold.net

1.4.2 Corporate Officer and Designated Contact

Name:	Ron Rimelman
Title:	Vice President, Environment, Health, Safety, and Sustainability
Phone:	(303) 884-1823
Email:	ron.rimelman@novagold.net

1.4.3 Corporate Information

Business Name:	Alaska Gold Company
Address:	P.O. Box 640 Nome, AK 99762
Phone:	(907) 443-5272
President & CEO:	Rick Van Nieuwenhuyse

Parent Company:	NovaGold Resources, Inc.
Address:	200 Granville St. Suite 2300, Vancouver, BC V6C 1S4
Phone:	(604) 669-6227
President & CEO:	Rick Van Nieuwenhuyse

1.4.4 Additional Land Owner Information

Business Name:	Bering Straits Native Corporation
Address:	100 Front Street, Suite 300
	P.O. Box 1008, Nome AK 99762-1008
Phone:	(907) 443-5252

Business Name:	Sitnasuak Native Corporation
Address:	400 Bering Avenue
	P.O. Box 905, Nome AK 99762 - 0905
Phone:	(907) 443-2632

1.4.5 Individuals to Receive Notices

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1.5 EXISTING RECLAMATION PLANS

AGC developed a reclamation plan in 2006 during the initial development phase of the Rock Creek Project. The 2006 plan detailed reclamation and closure of the Rock Creek Mine and Big Hurrah project assuming both locations were mined to their originally planned extent. As noted above, AGC has not developed the Big Hurrah project and only a small portion of the Rock Creek ore body has been mined and processed. Since 2008, AGC has operated the Rock Creek Mine according to the terms of an approved Temporary Closure Plan (TCP) dated April 26, 2010. Prior to initiating final closure and reclamation, RPA F20069578 requires AGC to submit final closure plans to ADNR for review and approval.

1.6 REGULATORY BASIS

This Reclamation and Closure Plan is prepared to meet ADNR reclamation requirements pursuant to AS 27.19 and 11 AAC 97 as applicable to private land, and to provide internal guidance in keeping with the AGC Environmental Policy.

Reclamation plan requirements apply to areas disturbed by the proposed mining operations, including any mining disturbance occurring on previously mined areas. The Rock Creek Mine is located on private lands. As such, it must comply with the reclamation standards set out in the Alaska mining laws and regulations, and meet criteria that include:

- AS 27.19, Reclamation Section, 27.19.050 Reclamation Standard: 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.

Definitions:

- Unnecessary and undue degradation is defined to mean: Surface disturbance greater than would normally result when an activity is being accomplished by a prudent operator in usual, customary, and proficient operations of similar character and considering site specific conditions. It also includes: The failure to initiate and complete reasonable reclamation under the reclamation standard (above) or an approved reclamation plan under AS 27.19.030 (a).
- Stable condition is defined to mean: The rehabilitation, where feasible, of the physical environment of the site to a condition that allows for the re-establishment of renewable resources on the site within a reasonable period of time by natural processes.

Project reclamation plans are subject to land reclamation standards under 11 AAC 97.200:

- A miner shall reclaim areas disturbed by a mining operation so that any surface that will not have a stream flowing over it is left in a stable condition.
    - Stable condition for the purposes of the Alaska State Statute definition listed above and for the purposes of 11 AAC 97.200 means a condition that can reasonably be expected to return waterborne soil erosion to pre-mining levels within one year after the reclamation is completed, and that can be reasonably expected to achieve revegetation, where feasible, within 5 years without the need of fertilizers or reseeding.
    - If not feasible due to low natural fertility of the mined site soils, or if the site lacks a natural seed source, the department (ADNR) recommends the miner fertilize and re-seed or replant the site with native vegetation to protect against soil erosion – but this is not required by statute.
    - Rehabilitation to allow for the reestablishment of renewable resources is not required if that reestablishment would be incompatible with the post-mining land use intended by the private land owner, but the miner should inform ADNR of the intended post-mining land use.
    - If topsoil disturbed is not promptly redistributed it should be segregated, protected from erosion and from contamination, and preserved in a condition suitable for later use.
    - If the natural composition, texture or porosity of the surface materials is not conducive to natural revegetation a miner should take measures to promote revegetation including redistribution of topsoil. If topsoil is not available then a miner shall apply fines or other suitable growing medium – but do not apply to surfaces likely to be exposed to annual flooding, unless the action is authorized in an approved reclamation plan and will not result in an unlawful point, or non-point-source discharge of pollutants.

  - Re-contouring shall be done in a manner conducive to natural revegetation or with the landowners' intended post-mining land use by backfilling, contouring and/or grading – miner need not restore original contours.
  - Shall re-stabilize the site to a condition that will retain sufficient moisture for natural revegetation or for the landowners' intended post-mining land use.
  - Pit walls, subsidence features, or quarry walls exempt if the steepness makes them impracticable to accomplish. Miner shall leave wall in a condition that it will not collapse nor allow loose rock that presents a safety hazard to fall from it.
- If a mining operation diverts a stream channel to the extent that the stream channel is no longer stable, a miner shall re-establish that stream channel in a stable location. A miner may not place a settling basin in the way of a re-established channel unless the fines will be removed and protected from erosion.
- Regulations regarding the removal of buildings and infrastructure are applicable only to state lands.
- Acid Rock Drainage – A miner shall reclaim a mined area that has the potential to generate acid rock drainage in a manner that prevents the generation of, or prevents the offsite discharge of, acid rock drainage.
- Material Sites – Continuous and intermittent use of material sites shall be reclaimed as contemporaneously as practicable with mining. Cell by cell development with contemporaneous reclamation is encouraged. However, if site conditions require that the entire material site be mined continuously, layer by layer, a miner shall reclaim the site as soon as possible after mining is completed. Reclamation may be postponed at the discretion of the Commissioner (ADNR), and with additional reclamation plan and bonding requirements, if reclamation is impracticable and/or to allow for future intermittent mining of the material site. If the primary use of the extracted materials is to assist another mining operation, the miner must include the reclamation plan for the material site as part of the reclamation plan for the primary mine.
- River Gravel Extraction – Re-establish a stable bed and bank profile as contemporaneously as possible in a manner that will not alter river currents or change erosion and deposition patterns downstream.
- Stockpiles, located at mining sites, are to be located where they will not erode into a water body.
- Reclamation Plan Submittal – A reclamation plan must be submitted 45 days before the proposed start of the mine. The Commissioner will approve or disprove within 30 days after determination of completeness.
- Alternate Post-Mine Planning Use – The Commissioner may not propose an alternate post-mining land use if the land is on privately owned lands and the state or federal government owns only the reserved minerals. If the state owns both the land estate and the mineral estate, the commissioner will not approve an alternate post-mining land use that is inconsistent with state statutes. The landowner may

propose an alternate post-mining land use, but must include a description of the proposed alternate use in the reclamation plan.

- Posting – Must keep a copy of the approved reclamation plan on site until completion of the mining operation.

In addition, this reclamation plan is also subject to the general and project-specific stipulations contained in RPA No. F20069578.

2.0 PROJECT DESCRIPTION

The Rock Creek Mine is located approximately 10 km north of Nome in the Snake River drainage (Figure 1) on private lands owned by SNC (surface rights), BSNC (sub-surface rights), and AGC (Figure 2). Development activities at the Rock Creek Mine began in 2006 and were originally intended to include an open-pit mine, with two non-acid-generating development rock stockpiles, a gold recovery plant, and a paste TSF. After a brief period of operation in fall 2008, AGC ceased mining and milling operations at the Rock Creek Mine and entered temporary closure in November 2008. Only one development rock stockpile was constructed, with only a small portion of the Main Pit excavated compared to the originally planned development. The current stockpile contains approximately 237,000 m^3 of ore and development rock. Support facilities include the mill/gold recovery plant, maintenance shop, administration and mine dry buildings, warehouse, WTP, reagent storage locations, recycle water pond (RWP), and fuel storage locations.

2.1 HISTORIC MINING

Limited mining began in the Nome area in 1865, while a gold strike on Anvil Creek in 1898 started the Nome Gold Rush, bringing tens of thousands of miners to the region. The discovery led to the construction of the Nome-Anvil railroad in 1900, which paralleled a portion of what is now the Glacier Creek Road. Claims were extensively staked along the Glacier Creek Road, with known mining activity in the proximity of Glacier Creek, Rock Creek, and Lindblom Creek. Historical artifacts of this turn-of-the-century mining activity still exist at the Rock Creek Mine site, although a Cultural Resource Survey, reviewed by the State Historic Preservation Office (SHPO), concluded that none of the artifacts would be affected by activities at the Rock Creek Mine.

Continuous intermittent mining has existed along the Glacier Creek Highway, the Nome-Council Highway, and the Seward Peninsula over the last 100 years. Currently, there are four active placer-mining operations along Glacier Creek Road, and one active placer miner operation along the Nome-Council Highway. Independent and corporate miners show interest in continuing mining throughout these areas.

2.1.1 Prior Land Use

The Snake River Valley, which is accessed by the Glacier Creek Road and a sled dog/snow-machine/all terrain vehicle (ATV) trail, has a long-standing prior use as a subsistence hunting area. The area is particularly important for moose, but is also utilized for bear, caribou, and bird hunting. Musk oxen are also present in the area and may be hunted although this is not a popular sport or subsistence activity at this time. Reindeer herding occurs on the Seward Peninsula and the herd at times grazes within the Snake River Valley. Fishing and berries are additional subsistence resources utilized by the local population.

Bird watching is a growing tourist activity in Nome. The Glacier Creek Road provides access to birding areas along the Snake River Valley. Additional recreational activities within the area include dog-mushing, snow-machining, and cross-country travel opportunities for ATVs.

There are approximately 10 to 15 recreational/hunting cabins located along the Glacier Creek Road. There is one year-round resident located at the confluence of the Snake River and Glacier Creek. There are remains of historic cabin sites within the Rock Creek Mine and Mill complex footprint, but no active cabin sites presently exist on the property.

The majority of the lands within the Rock Creek Mine footprint are private lands owned by AGC; public use of those lands is discouraged for liability reasons. The peripheral lands that are owned by BSNC and SNC are open for shareholder use for recreational and subsistence purposes. Public access to the Rock Creek Mine site is controlled due to the hazards inherent to surface mining operations.

2.2 Environmental Setting

The Rock Creek Mine site is bounded on the north and east by Mount Brynteson, to the west by the Snake River, and on the south by Glacier Creek. Elevation varies from 30 meters (m) above mean sea level (amsl) to 200 m amsl. The property is located within the Bering Straits Coastal Resource Services Area (CRSA) north of Norton Sound.[3]

The Rock Creek Mine site lies within the Snake River catchments. The Snake River, which flows about 18 km south from the Rock Creek confluence to Norton Sound near Nome, has a 220 km^2 catchment area. The Rock Creek Mine site is situated on the eastern side of the Snake River valley. Three creeks, all tributary to Snake River, are in the immediate vicinity of the mine site: Lindblom Creek to the north; Rock Creek in the middle; and Glacier Creek to the south.

The climate and physiography create typical high latitude vegetation. Tundra, consisting of low lying shrubs and grasses, cover a majority of the region. Higher regions have areas of bedrock outcrop. Discontinuous permafrost has been documented in the mine area.

2.2.1 Climate

Prior to mine development, regional climate data were evaluated to estimate an extended monthly precipitation and temperature dataset for the Rock Creek Mine site. Precipitation frequency analysis was completed on the precipitation dataset to estimate average, and wet and dry values for various return periods.

The regional data utilized for this task were as follows:

[3] The Alaska Coastal Management Program (ACMP) sunset on July 1, 2011 per AS 44.66.030. The program has not yet been reauthorized as of the adoption of this Plan.

- Daily precipitation and temperature data from the Nome Airport weather station from 1907 through 2003 (National Climatic Data Center); and
- Daily precipitation data for 2005 from an onsite meteorological station.

Temperature

The annual average temperature at the site, based on data collected as part of baseline data collection, was near freezing (0.6° C). The maximum and minimum hourly temperatures recorded during the time period were 29.5° C and -33.3° C, respectively. The site temperatures at lower elevations are expected to be similar to Nome, as the site is fairly close to Norton Sound.

Precipitation

Sources for precipitation data at the Rock Creek Mine site include the Oregon State Spatial Climate Analysis Service (SCAS), U.S. Weather Bureau Precipitation Atlases, and the Western Regional Climate Center. Based on the data available, the annual total precipitation at the Rock Creek Mine site is 478.0 millimeters (mm).

The average annual total precipitation at Nome, based on data from the SCAS, U.S. Weather Bureau Precipitation Atlases, and the Western Regional Climate Center data, is 391.5 mm. The extreme wet and dry years, calculated based on the 57 years of available monthly data collected in Nome, are 683 mm and 188 mm of precipitation, respectively.

Precipitation occurs throughout the year with the wettest months (on average) occurring in July, August (wettest), and September. The least amount of precipitation, falling as snow, occurs in March, April, and May (driest). The moderating influence of the open water of Norton Sound is effective from early June to about the middle of November. Overcast conditions are common during July and August. Temperatures generally remain well below freezing from the middle of November to the latter part of April. Snow begins to fall in September, but usually does not accumulate on the ground until the first part of November. The snow cover decreases rapidly in April and May, and normally disappears by the middle of June. Severe wind storms are common.

The precipitation record indicates wet periods from 1920 to 1925 (average of about 550 mm/year) and 1942 to 1952 (average of about 500 mm/year) and a dry period from 1960 to 1980 (average of about 320 mm/year). Average Nome Airport precipitation from 1985 through 2005 was 441 mm. Future precipitation levels may be affected by global climate change.

2.2.2 Geologic Setting

Glacial, alluvial and tectonic processes shaped the eastern wall of the Snake River Valley, upon which the Rock Creek Mine site lies. The hydrogeology of the Rock Creek basin is controlled by the surficial and bedrock geology, the topographic setting as well as the climate and hydrology. Steep slopes of local bedrock dominate the higher elevations. The surface topography quickly shallows over the 4 km creek path, which ends on the alluvial plain of the Snake River.

Within the Rock Creek drainage the dominant bedrock is a well foliated, “wavy” banded, quartz-muscovite schist containing varying proportions of carbonate graphite/carbon and chlorite. Outcrops and near surface bedrock are highly weathered and fractured. Regionally, shales, siltstones, marls, and limestone, shallow water continental shelf setting deposits, discontinuously overlie the schist.

Overburden materials include silts formed as a weathering profile overlying the schist, as well as glacial, alluvial, and colluvial materials. Sands and gravels have been observed at some locations on the lower slopes. The bottom of the Rock Creek valley is infilled with sand and gravel. West of the Rock Creek Mine site, the Snake River valley has been infilled, primarily with alluvium. The remnants of abandoned and infilled channels are apparent on the valley floor. Silt infill, as well as channel and bar sands are found. Sand and gravel deposits are co-depositional and overlie the Snake River alluvium as fans from Lindblom Creek, Rock Creek, and Glacier Creek.

The Boulder Creek Fault strikes northwest directly above the pit area, the Rock Creek Fault underlies the creek bed which runs through the pit and Sophies Gulch Fault, a low angle normal fault, can be seen in the surface topography at the southeast corner of the pit. Three other high angle strike slip faults, all of which strike north, are the Anvil Fault, Brynteson Fault, and Upper Albion Creek Fault.

2.2.3 Permafrost

The Rock Creek Mine site is located near a regional boundary between continuous and discontinuous permafrost, with permafrost depths approaching approximately 100 m in the Nome area. The surface zone of the permafrost horizon termed the “active layer” repeatedly thaws and freezes on an annual basis as the seasonal air temperatures change. This zone generally consists of approximately 2 to 3 m at the Rock Creek Mine site. A series of thermistors are used to monitor the depth of permafrost across the site.

2.2.4 Groundwater Hydrology

The estimated annual infiltration in the Rock Creek basin is approximately 200 mm, based on rainfall, estimated evapotranspiration, and limited runoff measurements. The presence of permafrost over the catchment locally reduces groundwater recharge.

In general, groundwater recharge in sub-arctic, discontinuous permafrost regions initiates as surface infiltration from snowmelt and rainfall, and from uphill streams and surface water features which are perched on the permafrost above the water table. The infiltrated water may be transmitted downslope as interflow (or very shallow groundwater) or percolate through gaps or holes in the permafrost to the groundwater table.

There is a significant quantity of groundwater moving downstream in the alluvium within the Rock Creek valley. The permeability of this alluvium was probably enhanced by dredging operations. Groundwater within this alluvium includes direct precipitation, interflow from upper slopes and groundwater discharged from depth.

Recharge of groundwater in the Snake River alluvium occurs as direct precipitation, as discharge of deep groundwater into the alluvium, and as stream recharge of alluvial fans. The sand and gravel fans (Rock Creek, Lindblom Creek, and Glacier Creek) transmit considerable water as a result of higher hydraulic conductivity and gradients than the underlying Snake River alluvium. As a result, groundwater discharge is expected into the alluvium, as well as into channels and ponds surrounding the fans.

Drilling with an air rotary rig results in significant water returns, to full depth, in many of the drillholes. This indicates at least moderate bedrock permeability over a significant portion of the site.

2.2.5 Surface Water Hydrology

The Rock Creek catchment has an elevation gain of 400 m from the valley floor, which lies at 30 m amsl. The catchment area for Rock Creek is approximately 5.2 km^2.

Lindblom Creek has a smaller catchment than Rock Creek while Glacier Creek is larger, encompassing the entire east and south side of Mount Brynteson. All of these creeks are tributary to the Snake River.

The local discharge of deeper groundwater into Rock Creek is apparent from the presence of winter base flow, flow from open drill holes, and from the chemistry of Rock Creek water. Another source of Rock Creek flow is a significant quantity of water that transmits down the slope as interflow, with visible discharge from the banks of Rock Creek. This flow path results in a significant retention of storm water, probably reducing the peaks from rainfall events. Some of this retention is within the tundra grasses and some is within the overburden and near surface fractured rock.

2.2.6 Ecology

According to the U.S. Department of Agriculture Forest Service classification system, the Rock Creek Mine site is located within the Seward Peninsula Tundra – Meadow ecological sub region. The terrain is fairly hilly with broad and narrow valleys. Forested areas and trees are generally non-existent, although closed willow thickets exist in wetland areas.

On hill slopes and ridges, soils are formed in gravelly regolith material over weathered bedrock. Soils in the vicinity include Histic Pergelic Cryaquepts with loamy or gravelly textures. They tend to be poorly drained with a shallow permafrost table at a depth of 13 to 76 centimeters (cm). Soils formed in moderately deep loamy sediment are underlain by very gravelly and stony material and support tundra vegetation.

Vegetation in the area consists mostly of tundra mat, sedges, shrubs, mosses, lichens, willows, and in some places, cottonwoods. The Seward Peninsula is home to more than 170 species of birds, and small mammals including Arctic foxes, Alaskan hares, land otters, lynxes, and ground squirrels.

Prior to mining, approximately 276 ha of wetlands occurred within the project area. The type and distribution of wetlands within the project area reflect surrounding areas, most of which is undisturbed and in a natural state. Open sedge/shrub tundra wetland is the dominant vegetation community covering approximately 40% of the project area and comprising approximately 70% of all wetlands at the site. Other wetland communities, in descending order of abundance, include closed willow thicket wetlands, shrub/sedge tundra communities, and close-flooded willow thicket wetlands which lie along the perimeter of Rock Creek and its riverine habitat.

3.0 ENVIRONMENTAL PERMITS

3.1 WASTE MANAGEMENT PERMIT

AGC's WMP No. 2003-DB0051, issued on August 9, 2006, addresses a wide range of activities at the Rock Creek Mine site, including solid waste management, and water treatment and disposal. The WMP acts as a comprehensive regulatory document by incorporating requirements from other plans and permits under its authority. While many of the activities regulated by the WMP are applicable to a mining facility in full operation, it contains provisions that govern the Rock Creek Mine under temporary closure as well. The TCP does not supersede the WMP, but does modify some of its requirements to reflect operations under care and maintenance. The Rock Creek Mine has operated under the TCP since November 2008, with the most recent revision in April 2010.

3.1.1 Regulatory Background

The WMP is administered by ADEC's Wastewater Discharge Program in the Division of Water under the provisions of AS 46.03, 18 AAC 15, 18 AAC 60, 18 AAC 70, and 18 AAC 72, and other laws and regulations. AGC initiated the formal permitting process by filing a Solid Waste Permit application in May 2006. The permit expired on August 8, 2011, but has been administratively continued by ADEC. The final WMP incorporates several plan documents and other permits by reference and codifies their requirements, including:

- Plan of Operations;
- Reclamation and Closure Plan;
- WMP; and
- Monitoring Plan.

The WMP contains one significant waiver from 18 AAC 60.225, which requires that ponded water be removed from waste disposal facilities within seven days. The WMP waived this requirement for the TSF. The waiver does not apply to inert solid waste landfills (e.g., development rock stockpiles).

3.1.2 Scope of Permitted Activities

At the Rock Creek Mine, the permit addresses waste disposal in the TSF, inert solid waste landfill facilities, underground injection of treated mine dewatering wastewater, and the groundwater and surface water monitoring systems. In addition, the permit covers hazardous chemical storage and containment, as well as reclamation and closure activities.

3.1.3 Tailings Disposal

The WMP establishes a numeric limit for placement of paste tailings in the TSF of 9,000,000 dry metric tons over the life of the project, with no more than 7,000 dry metric tons placed in the TSF each day, on average. Tailings must be subjected to a cyanide destruction process prior to their disposal in the TSF. As of the date of this Reclamation and Closure Plan, approximately 105,000 metric tons of paste tailings have been placed in the TSF, with none placed since entering temporary closure in 2008.

3.1.4 Wastewater Treatment and Disposal

The WMP, as originally issued, limits water disposal at the Rock Creek Mine site to the injection of treated water to the well field from pit dewatering activities (e.g., interception wells, sumps) and precipitation that drains to the open pit. Authorization to inject wastewater is contingent upon the construction and operation of an ADEC-approved WTP. ADEC has approved the current configuration and operation of the existing WTP.

Disposal of process water and water contained in the TSF is prohibited in the WMP. However, the TCP modified this prohibition to allow injection of treated TSF water while the facility is in temporary care and maintenance status. ADEC approved the treatment and disposal of TSF water via injection as long as new tailings were not placed into the TSF. The WMP also establishes numeric limitations for treated wastewater prior to injection to ensure compliance with Alaska's water quality standards. These limits are identical to the limits contained in federal Underground Injection Control (UIC) Permit AK-5X27-001-A administered by the Environmental Protection Agency (EPA). During 2010 an average of 323 gpm was injected to between 18 and 23 active wells at any given time. In addition, as discussed in Section 3.8, ADEC has issued an Alaska Pollutant Discharge Elimination System (APDES) permit for the Rock Creek site that authorizes the discharge of treated wastewater to Rock Creek during periods of open water (typically May to December).

3.1.5 Groundwater Monitoring Wells

The WMP requires AGC to operate and maintain downgradient monitoring wells below the injection well field (IWF) to ensure that treated wastewater injection does not contribute to an exceedance of Alaska water quality standards or show a statistically significant increase over applicable water quality standards when accounting for natural conditions. This requirement also applies to downgradient monitoring wells below the TSF to ensure that seepage from the TSF, if any, is not adversely affecting groundwater quality. If an exceedance is observed, AGC must initiate a corrective action plan to identify and, as appropriate, address the cause. The Rock Creek Mine 2010 Annual Report, submitted to ADEC and ADNR in March 2011, presents the results of recent groundwater monitoring at the site.

AGC's groundwater monitoring program was developed to determine whether TSF seepage, if any, contributes to significant increases in key parameter concentrations or exceedances of applicable water quality standards in downgradient groundwater. Determining the influence of TSF seepage is complicated by the fact that the groundwater concentrations of some parameters are naturally elevated due to the geochemical composition of the surrounding area. The TCP attempts to address this situation by incorporating specific action levels for key parameters that account for natural conditions. When action levels are exceeded, AGC implements a corrective action plan to determine the cause of the exceedance and whether any additional corrective measures are needed.

Because action levels were routinely exceeded for certain parameters known to be naturally present in high concentrations, such as manganese and arsenic, and the TSF had not received tailings since 2008, AGC conducted additional monitoring to support a more detailed statistical analysis of groundwater conditions. The analysis, submitted to ADEC on April 27, 2010, has been used to demonstrate that elevated concentrations observed in the monitoring wells have been the result of background conditions and/or have not caused any adverse impacts on groundwater quality.

Similar monitoring is conducted at groundwater monitoring wells downgradient of the injection well field. As with the TSF wells, the data have consistently shown that effluent injected to the well field has not adversely affected groundwater chemistry since injection began in May 2009.

3.1.6 Monitoring Program

In addition to specific monitoring requirements for treated wastewater, the WMP incorporates the May 2006 Monitoring Plan, which requires periodic sampling and analysis of groundwater and surface water as well as visual monitoring of critical system components. Records of all monitoring activities (e.g., inspection sheets, logs, laboratory analyses) must be retained and summarized for use in compliance reporting. At AGC's request, ADEC approved modifications to the monitoring program during spring 2010, which reduced the required frequency of monitoring for groundwater and surface water at the site. The Rock Creek Mine 2010 Annual Report presents the results of all recent water monitoring at the site.

3.1.7 Reporting

AGC is required to submit quarterly monitoring reports to ADEC summarizing all of the inspection and monitoring activities occurring during the reporting period. The 4th quarter report also serves as the annual report, which summarizes activities for the entire calendar year. Reports for the 1st, 2nd, and 3rd quarters must be submitted no later than 60 days after the last day of the quarter, while the 4th quarter/annual report must be submitted by March 31st of the following year.

3.1.8 Performance Audit

The WMP requires a comprehensive environmental performance audit every five years, beginning in 2010, to determine if facility management and regulatory controls are functioning as intended. The scope of the audit and selection of the independent third-party auditor are mutually agreed upon by ADEC, ADNR and AGC, although in the event an agreement cannot be reached, ADEC and ADNR retain final decision authority. The 2010 audit was postponed while the reclamation cost estimate was being revised to reflect temporary closure status.

3.2 TEMPORARY CLOSURE PLAN

WMP section 1.11 defines temporary closure as a suspension of mining or milling operations for more than 90 days but less than three years, although temporary closure may be extended by written authorization from ADEC. AGC entered temporary closure on November 24, 2008, when milling operations were suspended. Upon entering temporary closure, AGC submitted a TCP to ADEC and ADNR for approval. ADEC approved the final TCP on February 20, 2009. Subsequent modifications were made on June 26, 2009 and April 26, 2010. The TCP is an extension of the WMP in that the same prohibitions, limitations, and requirements apply during care and maintenance unless specifically modified by the approved TCP.

In addition to notifying ADEC and as required by the reclamation plan described below, AGC must notify ADNR as to the nature and reason for temporary closure, the anticipated duration, actions to be taken to maintain compliance with existing permits and plans, and reasonably foreseeable future actions that might result in restart or permanent closure. Following notification, ADNR directed AGC to address the following issues in the TCP:

- Describe water storage in and disposal from the TSF;
- Provide and update water balance;
- Document TSF and RWP chemistry; and
- Update status and schedule for WTP completion.

The final TCP addressed these concerns by proposing to treat and dispose of TSF water via the WTP and IWF, and analyzing water chemistry from TSF seepage water to determine the need to continue pumping this water back to the TSF.

In addition to the prohibitions, limitations, and requirements contained in the WMP, the TCP requires AGC to record the total pumped water volume from the TSF seepage collection system, the TSF pond elevation, and the total precipitation each day.

3.3 Reclamation Plan

ADNR (Division of Mining, Land and Water) issued RPA No. F20069578 for the Rock Creek Mine and Big Hurrah site to AGC on August 9, 2006. It expired on August 8, 2011, but was administratively extended through December 11, 2011. The RPA was issued in accordance with Alaska Statutes 27.19 (Reclamation) and 38.05 (Alaska Lands Act), and Alaska Administrative Code Title 11, Chapter 97 (Mining Reclamation). Upon approval, this Reclamation and Closure Plan will supersede the previously approved plan for the Rock Creek Mine site only; RPA No. F20069578 will remain in effect for the Big Hurrah Project until AGC submits and receives approval for a revised Reclamation and Closure Plan applicable to that location.

3.4 Land Application Permit

Out of concern that water expressed at the toe of the TSF dam was seepage from the TSF itself, the TCP initially required AGC to collect all seepage water and pump it back to the TSF. This inflow, at an average of approximately 380 gpm, contributes significantly to the TSF water volume. Efforts to accurately characterize water collected in the TSF seepage collection system showed, however, that this water is composed of both seepage and natural groundwater flows unrelated to the TSF. AGC sought an alternative method of disposal rather than pumping back to the TSF, and thus reduce TSF inflows and accelerate dewatering operations. Accordingly, AGC commissioned a feasibility study to determine whether sump water could be land applied to upland areas rather than pumping it back to the TSF. The September 2, 2009 *Results of Feasibility Study for the Land Application of Wastewater at the Rock Creek Project* evaluated the land application process and demonstrated there would be no adverse effects to groundwater in the area.

3.4.1 Scope of Permitted Activities

Land Application Permit No. 2010-DB0011, issued August 6, 2010, authorizes AGC to dispose of water in the TSF rather than sump water as originally requested. Water may be land applied to a 4-ha area immediately upslope from the TSF at a rate not to exceed 300 gpm and only during periods when rainfall and ambient temperatures will not result in surface runoff or snow accumulation.

3.4.2 Monitoring and Reporting

Daily visual monitoring of the land application area is required to determine any adverse impacts to vegetation or accumulation of surface runoff. Groundwater monitoring requirements are identical to the WMP requirements to monitor groundwater wells below the TSF seepage collection system.

Exceedances of Alaska water quality standards must be reported within 24 hours. Periodic reporting requirements (quarterly and annual) are identical to the WMP, and may be incorporated into one consolidated report.

3.4.3 Final Closure and Reclamation

The Land Application Permit does not place any restriction on land disposal of TSF water once final closure activities have been initiated, although land application must be suspended if new tailings are placed in the TSF. The same limits and monitoring and reporting requirements apply during the reclamation process or until AGC ceases land application.

3.5 CONSTRUCTION GENERAL PERMIT FOR STORM WATER DISCHARGES

AGC is currently permitted to discharge storm water associated with construction activities at the Rock Creek Mine site under ADEC Construction General Permit (CGP) No. AKR10BT00. The CGP requires a facility to develop a storm water pollution prevention plan (SWPPP) that implements a series of structural and non-structural BMPs to minimize the potential for storm water to impact nearby surface waters. AGC obtained initial coverage for construction-related storm water discharges from the Rock Creek Mine site in 2005, including preparing a SWPPP in August 2006 based on the existing Plan of Operations. After the Rock Creek Mine site was placed into temporary closure status, AGC prepared a revised SWPPP in 2009 to address activities occurring under care and maintenance at the Rock Creek Mine site only. Additional revisions to the SWPPP were made in 2010 and 2011 to reflect ongoing activities at the Rock Creek Mine site.

Coverage under the CGP is required until major land disturbing activities have ceased and disturbed areas have achieved final stabilization. From 2008 to 2010, AGC significantly upgraded many of the Rock Creek Mine site's structural controls to effectively manage storm water and reduce solids loadings to Rock and Lindblom creeks. Additional land stabilization activities are being completed during 2011, after which time AGC will have achieved full stabilization of all disturbed areas covered by the CGP.

3.5.1 Regulatory Background

The CGP is administered by ADEC's Wastewater Discharge Program in the Division of Water under the provisions of 18 AAC 83 and Title 40, Part 122.26 (National Pollutant Discharge Elimination System [NPDES]) of the Code of Federal Regulations (CFR). Prior to October 31, 2009, storm water discharge programs in Alaska were administered by EPA and followed the federal CGP. After October 31, 2009, ADEC received authorization to administer the NPDES program in Alaska, including storm water general permits, although EPA retains oversight authority on all NPDES/APDES permits. ADEC reissued the CGP under the APDES program on January 31, 2010 for all Alaska CGP permittees, including the Rock Creek Mine. Permits originally obtained under the federal permit were automatically transferred to the APDES program and did not require reapplication. At that time, the Alaska CGP effectively mirrored the federal CGP and did not contain any noteworthy differences.

The previous CGP expired on June 30, 2011. ADEC reissued the CGP on July 1, 2011. Coverage under the reissued CGP for active projects initiated prior to June 30, 2011, including the Rock Creek Mine, is automatically extended through November 27, 2011. If AGC wishes to continue coverage under the CGP after that date, a new Notice of Intent (NOI) will be submitted.

Storm water discharges from the Rock Creek Mine site into Rock Creek and Lindblom Creek; there are no storm water discharges to Glacier Creek. The Rock Creek Mine site SWPPP includes discharge, upstream, and downstream monitoring at locations in the Rock Creek and Lindblom Creek drainages. There are no effluent limitations in the CGP that apply to these locations. However, the CGP requires compliance with Alaska's water quality standards. The governing water quality standard for storm water discharges is the State's turbidity standard, which requires that storm water discharges not cause downstream turbidity levels to be more than five Nephelometric Turbidity Units (NTUs) above background levels.

3.5.2 2011 EPA Information Request

Because of past concerns related to storm water management at, and discharges from, the Rock Creek Mine site, EPA exercised its authority under CWA Section 308 to issue an information request to AGC on February 25, 2011 directing AGC to:

- Develop a storm water sampling plan to measure turbidity upstream and downstream of construction activities in all surface waters including, but not limited to, Rock Creek, Glacier Creek, and Lindblom Creek. Samples must also be collected from the identified discharge points;
- Initiate sampling upon completion of the sampling plan, continuing to at least June 30, 2011; and
- Submit a monthly report summarizing all monitoring data to EPA and ADEC no later than the 15th day of the month following sampling.

In June and July 2011 AGC submitted its monitoring report to EPA and ADEC describing the results of May and June 2011 storm water monitoring. The results show consistently lower turbidity levels than preceding years and that storm water controls are working effectively.

3.6 UNDERGROUND INJECTION CONTROL PERMIT

AGC is authorized to inject treated TSF water into the upper shallow bedrock aquifer near the mine under an EPA-administered Class V UIC permit. Class V wells are used to inject non-hazardous fluids underground into or above known or potential drinking water sources. AGC filed an application to authorize up to 15 Class V wells on August 5, 2007. EPA adopted the UIC permit effective January 15, 2008, although underground injection was not authorized to proceed until well integrity was sufficiently demonstrated and the proper completion reports filed with the agency. Thereafter, AGC requested a minor modification to the UIC permit to authorize the installation of an additional 15 injection wells. EPA concurred with the minor modification in August 2009. Presently, AGC is authorized to construct and operate up to 30 injection wells under terms of its UIC permit.

Many of the requirements contained in the UIC permit, including installation and monitoring provisions, are identical to the WMP. Injected water limits, for example, are the same limits that apply to WTP effluent prior to injection under the WMP. Reporting requirements that are the same in each permit have been consolidated to avoid duplication.

3.6.1 Regulatory Background

EPA has direct implementation responsibility in Alaska for the regulation of Class V injection wells through the UIC program (40 CFR 145), which is authorized by Part C of the Safe Drinking Water Act (SDWA). Class V injection wells are used for the disposal of fluids into aquifers that could serve as current or future underground sources of drinking water as defined at 40 CFR 144.3.

3.6.2 Compliance Requirements

AGC was not permitted to initiate underground injection to a well until its mechanical integrity had been demonstrated and proper completion reports filed. Treated water injected may not exceed maximum effluent concentrations contained in the permit (UIC Permit Table 1). Injection water monitoring requirements are the same as WTP effluent monitoring contained in the WMP; sample results from the WTP effluent satisfy the requirements for both permits. EPA must be notified of any permit non-compliance within 24 hours by phone or email, followed by written notice within seven working days. Quarterly and annual reports summarizing compliance activities for the period are submitted in conjunction with WMP reports.

3.7 U.S. Army Corps of Engineers/Section 404 Permit

The Rock Creek Mine site covers an area of approximately 526 ha across the Rock Creek, Lindblom Creek, Glacier Creek, and Snake River drainages. Prior to mining, wetlands comprised slightly more than 50% of the total project area (276 ha). To date, approximately 98 ha of wetlands have been impacted due to mine construction activities.

The U.S. Army Corps of Engineers (Corps) issued a Section 404 permit (POA-2006-742-M) to AGC on March 13, 2007, expiring on February 29, 2012. ADEC issued a Certificate of Reasonable Assurance for the proposed project on August 18, 2006, which expired on August 17, 2011. Re-application for both the permit and certification must be received at least 30 days prior to expiration. AGC will apply for a permit amendment to reflect the revised closure plan. AGC will also apply to ADEC for reissuance of the certification; AGC has been coordinating with ADEC on the status of this plan and the certification.

3.7.1 Regulatory Background

Construction projects that may result in the discharge of dredge material to or placement of fill material in a Water of the U.S. must obtain discharge authorization under Section 404 of the Clean Water Act (CWA). The Rock Creek Mine site consists of excavation and fill activities within jurisdictional wetlands, thus requiring permit coverage from the Corps.

3.7.2 Scope of Permitted Activities

The Section 404 permit authorizes the discharge of fill materials at the Rock Creek Mine site for the following activities, which have disturbed a total of 98 ha to date:

- North stockpile;
- Organic overburden stockpiles;
- Storm water diversion channels;
- Class V injection wells;
- TSF;
- Access road and on-site roads; and
- Plant site construction.

3.7.3 Compliance Requirements

In addition to requiring specific reclamation and mitigation activities when the Rock Creek Mine site undergoes permanent closure, the Section 404 permit includes several special conditions that must be implemented during the permit term:

- Evaluate all temporary and standing water sources that will be created by the project for toxicity in levels that are harmful to fish, birds, and wildlife. Testing and monitoring shall be conducted over at least a 10 year period;
- Replace the Lindblom Creek culvert on Glacier Creek Road with a culvert sufficiently sized to accommodate the increased flows resulting from the diversion of Albion Creek and portions of Rock Creek;
- Install bird diverter devices on either side of the Glacier Creek Bridge to reduce the potential for bird collisions with power lines and poles; and
- In collaboration with the Corps, develop a plan to offset loss of wetlands and bird habitats.

3.7.4 Closure and Reclamation

The Corps permit was issued on the assumption that reclamation at the Rock Creek Mine would occur following full development of the site. Thus, AGC is required to remove all organic stockpiles for re-application on the TSF and development rock stockpiles.

Wetlands under the organic stockpiles (25 ha) would be reclaimed. Likewise, long-term plans would have allowed the Main Pit to fill and form a lake as compensatory wetlands. Because the Main Pit would be backfilled under the proposed closure, thus eliminating lake formation, AGC proposed an alternative mitigation plan that effectively alters the amount of reclaimed wetlands achieved at closure. The Corps accepted this proposal as a modification to AGC's 404 permit (*Final Compensatory Wetland Mitigation Plan, Rock Creek Project, Department of the Army Permit: POA-2006-742-M, March 10, 2010).* This modification, however, does not allow for additional wetland disturbances beyond what was initially permitted. The inert solid waste monofill (Section 5.3) proposed for demolition debris generated during closure will require permanent fill placement on approximately 2 acres of jurisdictional wetlands. AGC will obtain all necessary permit modifications from the Corps and ADEC prior to constructing the monofill.

3.8 APDES Permit

On June 24, 2011 ADEC issued APDES Permit No. AK0053627 authorizing the discharge of treated water from the TSF, RWP, and Main Pit while operating under temporary closure and final reclamation. The effective date of the permit was August 1, 2011, when AGC began discharging. Treated wastewater is transported from the WTP to Rock Creek near the diversion channel #3 (DC #3) outlet between May and December of each year.

The APDES permit expires on July 31, 2016; permit renewal requires an application to be submitted 180 days prior to the expiration date. The APDES permit includes discharge limits comparable to the WMP and UIC permits, which are generally based on Alaska's water quality standards. As such, the treated water quality is projected to meet the effluent limits in the permit.

3.9 Certificate of Approval to Operate a Dam

AGC operates the TSF dam (NID ID#AK00309) as permitted by a temporary Certificate of Approval (COA) to Operate a Dam, issued by ADNR under the authority of AS 46.17 and 11 AAC 93. The COA was issued on December 31, 2009, and expires on November 24, 2011. New tailings may not be placed in the TSF without applying for a new COA. Under COA Special Condition No. 1, AGC must strive to dewater the TSF at an average monthly rate of 400 gpm until the water surface elevation reaches 140 feet. Below 140 feet, the dewatering rate may be adjusted as necessary to maintain applicable water quality requirements or injection well field integrity or conduct other maintenance requirements, but dewatering must continue in general towards the goal of reaching and maintaining the minimum volume of water practicable.

The COA, or any other applicable permit for the Rock Creek Mine, does not impose requirements for dewatering the Main Pit or maintaining a certain water level within the Main Pit.

3.9.1 Compliance Requirements

In addition to operating the TSF dam as specified in the *Rock Creek Project Tailings Storage Facility Operations and Maintenance Manual*, AGC must continue to maintain the surface water elevation at 42.7 m or below by dewatering the TSF pond as necessary. The COA requires weekly monitoring reports between May 1 and October 1, with monthly reports submitted at all other times of the year.

3.9.2 Closure and Reclamation

The current COA is not valid for final closure and reclamation. In order to close and reclaim the TSF, AGC will submit an application for a COA to Remove or Abandon a Dam in accordance with 11 AAC 93.172. Consistent with discussions with ADNR staff, AGC expects an application to be submitted for state review and approval in November 2011.

3.10 AIR QUALITY CONTROL MINOR PERMIT

AGC received authorization to discharge air emissions on December 22, 2006, under Air Quality Control Minor Permit No. AQ0978MSS01. The permit was subsequently revised on July 23, 2007, and there is no expiration date. The permit addresses allowable emissions from processing operations, emergency generators, heating, and other emission sources associated with the mine (87 total sources). Compliance under the permit includes an annual estimate of assessable emissions and semi-annual operating reports. No compliance issues have arisen under the air quality permit.

3.11 TEMPORARY WATER USE PERMITS

Temporary water use permits are issued by ADNR under the authority of AS 46.15. These permits address site activities including mine dewatering, mill processing, and the diversion of Rock Creek. The initial permits, valid for a 5-year term, became effective on August 8, 2006. ADNR reissued these permits for an additional 5-year term in summer 2011. Other than meeting the stated conditions, the permits do not require any periodic compliance demonstration such as reports or sampling. No specific requirements are listed for closure and reclamation.

4.0 FACILITIES AND STRUCTURES

Existing buildings, facilities, and structures at the Rock Creek Mine site encompass several primary areas (Figure 3). For closure, the site is organized into 9 separate planning areas (Figure 4). Volumes and areas presented below are estimates based on available data.

Table 1. Site Components

AREA	LOCATION
1	Plant Site and Development Rock/Ore Stockpile
2	Main Pit and Walsh Pit
3	TSF and Diversion Channel #3
4	Injection Well Field and Diversion Channel #2
5	Explosives Storage Area and West Pit
6S	Diversion Channel #1 – South
6N	Diversion Channel #1 – North
7	Roads and Causeway
8	Organic Stockpile #1

4.1 PLANT SITE AND DEVELOPMENT ROCK/ORE STOCKPILE (AREA 1)

Area 1 encompasses several smaller component areas, which will be decommissioned and reclaimed beginning in spring 2012.

4.1.1 Administrative and Maintenance

Administrative and security functions at the Rock Creek Mine are managed from 9 portable trailers located near Glacier Creek Road in the northwest section of the mine site. The area also includes a truck shop (30.5 m x 10 m) with two mobile equipment repair bays, offices, a warehouse, and central laydown area, as well as diesel fuel storage for equipment and backup generators. Operations under temporary closure have led AGC to consolidate activities into fewer operating areas, although all structures remain in place.

4.1.2 Development Rock and Ore Stockpile

The development rock and ore stockpile is located near the main plant site and DC #2. To date, approximately 600,000 metric tons have been placed in the stockpile.

4.1.3 Mill and Processing Buildings

The mill and ore processing area consists of a ball mill, crusher assemblies, process refining building, assay laboratory, carbon-in-leaching (CIL) building, cyanide destruction tanks, reagent storage area, and electrical substation. These facilities have generally not been actively used since the Rock Creek Mine entered temporary closure in

2008, although reagents and other process materials remain on site. A complete inventory of all hazardous materials will be conducted prior to initiating closure activities.

4.1.4 Water Treatment Plant

The Rock Creek Mine WTP was commissioned on February 15, 2009 and is designed to remove metals from wastewater prior to disposal in the injection well field. Treatment is achieved through chemical precipitation, oxidation, microfiltration, and pH adjustment. Oxidation is achieved with sodium hypochlorite. Water is then sent to the plate clarifiers for primary removal of coagulated arsenic and antimony prior to membrane filtration. This process consistently removes approximately 90% of all coagulated arsenic and antimony prior to membrane filtration stage. Water from the plate clarifiers is sent to a reaction tank where it is chemically treated in preparation for membrane filtration.

After secondary chemical addition, the water enters the membrane filter skid assembly. This treatment skid consists of a small buffering feed tank, feed pump, membrane filter modules, a reverse filtration supply tank and reverse filtration pump. An air compressor is also located near the filter skid to supply compressed air to the membranes during the reverse filtration cycle. The membranes have a fixed pore size that only allows smaller particles through, retaining the larger particles on the outside of the filter. The larger coagulated arsenic and antimony particles and other possible contaminants cannot pass through the filter.

Treated water is either pumped to the injected well field for disposal in one of 30 active injection wells or discharged through the APDES-permitted outfall to Rock Creek.

4.1.5 Recycle Water Pond

The RWP is a synthetically lined retention pond initially designed to capture runoff from the plant site and for management of WTP sludge prior to removal to the thickener. AGC has begun implementing new stormwater BMPs to redirect runoff away from the RWP to a separate containment structure, with completion anticipated by the end of 2011. These modifications will restrict the RWP's use to sludge management and groundwater infiltration capture. There are a total of three liners underlying the RWP. Over time, leaks were detected in the primary liner from small punctures. Rather than remove and reinstall the primary liner, AGC installed a secondary liner as an overlayment, with a leak collection recovery system (LCRS) placed in between. An additional synthetic underliner was installed below the primary and secondary liners. The interstitial water volume (between the primary and secondary liners) from the LCRS is continuously pumped back to the RWP. Monitoring data show that water from the RWP is not adversely impacting groundwater quality.

4.2 DEVELOPMENT PITS (AREA 2)

Area 2 is comprised of the Main Pit and smaller Walsh Pit, located immediately east of the larger Main Pit. In Phase II, these pits will serve as inert solid waste landfills for all remaining ore and development rock, excess fill material, and excess topsoil from other areas at the Rock Creek Mine site. The Main Pit will also be used to manage paste tailings that will be excavated from the TSF.

4.2.1 Main Pit

The Main Pit is located to the east of the main plant site and downgradient from DC #1. During active mining in the pit, groundwater and precipitation were intended to be dewatered through a series of dewatering wells. While in temporary closure, however, water has been allowed to accumulate in the pit and has not been actively dewatered. The Main Pit floor is approximately at the groundwater table, with little appreciable groundwater infiltration into the pit. Water accumulating in the pit, therefore, drains slowly to groundwater over the year. The Main Pit's maximum free water capacity is approximately 141,000 m^3.

4.2.2 Walsh Pit

The Walsh Pit is a smaller excavated area immediately east of the Main Pit, covering approximately 11,808 m^2. Only small volumes of development rock have been excavated.

4.3 TAILINGS STORAGE FACILITY AND DIVERSION CHANNEL #3 (AREA 3)

Area 3 comprises the TSF, TSF dam, DC #3, inert solid waste landfill, and several smaller facilities. Following closure and reclamation, all facilities will be reclaimed. Under Phase I of the closure plan, a temporary cover will be installed over the tailings. Once the cover has been installed and the TSF dewatered to the maximum extent possible, the dam will be breached, and a temporary diversion channel constructed to direct runoff through the breach towards Rock Creek. Under Phase II, tailings will be removed to the Main Pit, and the TSF area will be regraded and revegetated.

4.3.1 TSF Dam

In fall 2009, AGC buttressed the TSF to eliminate any potential slope stability concerns. AGC also developed a *Dam Geotechnical Analysis and Investigation* work plan for 2009 and 2010. The work plan addressed the installation and monitoring of inclinometers, piezometers, thermistors, and surface settlement monuments to verify the embankment is stable following buttress construction in 2009. The TSF's stability under current conditions was demonstrated in a report submitted to ADNR on October 30, 2010. AGC continues to collect TSF dam performance data to monitor stability and enhance the hydrologic understanding of the TSF and surrounding area.

To date, approximately 105,000 metric tons of paste tailings have been placed in the TSF, with an estimated volume of 85,000 m^3. Since entering temporary closure, precipitation has accumulated behind the TSF dam, necessitating either land application or treatment and disposal to the injection well field.

4.3.2 Main and South Sumps

During 2009, AGC constructed a seepage collection system at the TSF dam's downstream toe consisting of flexible drain pipe backfilled with drain rock. Water collected by the drainage system is conveyed by gravity to one of two collection sumps (Main and South). The sumps are lined with a geosynthetic clay liner (GCL), filled with drain rock and capped with GCL. South Sump water is pumped to the Main Sump through a 7.62-cm insulated, heat-traced high-density polyethylene (HDPE) pipeline by a 7.5-horsepower (hp) submersible pump. Main Sump water is pumped by a 30-hp electric pump over the top of the TSF and into the TSF pond. During TSF buttress construction, AGC recognized that a small portion of the seepage collection system was not performing as designed. AGC repaired the underperforming section, extending approximately 152 m, by excavating the entire section and installing new drain pipe and drain rock; the repaired section now performs as designed.

4.3.3 Diversion Channel #3

DC #3 conveys storm water runoff from the Glacier Creek and Rock Creek watersheds around the TSF into Rock Creek.

In summer and fall 2009, AGC identified enhancements to DC #3, primarily to allow for improved water management in the TSF area. However, they were also designed to limit erosion and sediment loadings. These improvements included hydroseeding of the upper portion of DC #3 and lining and armoring the entire lower portion. Construction was initiated in October 2009 and the enhancements were completed in January 2010.

4.3.4 Organic Stockpiles and Sediment Ponds

Three organic stockpiles are maintained at Rock Creek. The total volume of organic material available for use during reclamation is approximately 1,200,000 m^3. A final land survey is being conducted to update final volumes.

4.3.5 Inert Solid Waste Landfill

AGC operates a small inert solid waste landfill located in the upslope area east of the TSF. This landfill is permitted under the WMP and has been used to dispose of small volumes of office materials, construction debris, used parts, and discarded equipment. A separate inert monofill for demolition debris will be constructed during closure activities (Section 5.3).

4.4 INJECTION WELL FIELD AND DIVERSION CHANNEL #2 (AREA 4)

4.4.1 Injection Well Field

The Rock Creek Mine IWF is developed and operated as authorized by UIC Permit No. AK-5X27-001-A, issued by EPA Region 10. The IWF is also regulated by ADEC WMP No. 2003-DB0051, which incorporates many of the same conditions as the UIC permit.

For the temporary closure period, the IWF was developed to dewater the TSF and reduce the water elevation behind the TSF dam to an acceptable level. AGC has operated the IWF since May 2009 when injection was initiated with the original 15 wells at an operating capacity of approximately 220-250 gpm. The initial capacity, however, was insufficient to fully dewater the TSF. In fall 2009, AGC developed additional injection wells by drilling 20 boreholes in an area above the existing IWF. Of these 20 boreholes, 15 were deemed acceptable and incorporated into the UIC and WMP permits. Referred to as the upper IWF, the new wells have increased Rock Creek's injection capacity to 500 gpm when combined with the lower IWF. In total, 30 injection wells are active and available for disposal of treated water from the WTP.

Both the lower and upper IWFs are serviced by pipeline from the WTP. During IWF construction the pipeline was insulated and heat-traced, while 18 wells were enclosed within small sheds to improve winter access.

4.4.2 Diversion Channel #2

DC #2 conveys storm water runoff from the Rock Creek and Lindblom Creek watersheds around organic stockpile #1 into Lindblom Creek. DC #2 includes two inline sedimentation ponds near the channel's outlet to settle out any sedimentation prior to discharge into Lindblom Creek. Rock rundowns into Lindblom Creek stabilize the discharging flow and promote filtration of any additional silt. Modifications to DC #2 were initiated in October 2009 and completed in January 2010 with final stabilization of disturbed areas. In addition, AGC completed lining of the lower settling pond to eliminate any seepage that may have been causing sloughing on the slope adjacent to the outlet.

4.5 EXPLOSIVE MAGAZINES AND WEST PIT (AREA 5)

4.5.1 Explosive Magazine Pads

Nine gravel storage pads for explosive magazines are located west of Rock Creek and the Main Pit. Each pad contains CONEX containers and has been bermed to prevent runon flow.

4.5.2 *West Pit*

The West Pit is a small development pit located east of the Main Pit on the opposite embankment of Rock Creek. This pit does not accumulate any appreciable amount of storm water runoff. Final dimensions are being determined by the ongoing land survey. The West Pit is also being used as a final disposal site for solids removed from the CIL tanks.

4.6 DIVERSION CHANNEL #1 (AREA 6)

DC #1 conveys storm water runoff from the upper portions of the Glacier, Rock, and Lindblom creek watersheds around the active mine site into Lindblom Creek. DC #1 includes an inline sedimentation basin near the channel's outlet to settle out any sedimentation prior to discharge into Lindblom Creek. Rock rundowns into Lindblom Creek stabilize the discharging flow and promote filtration of any additional silt. Modifications to DC #1 were initiated in October 2009 and completed in December 2009 with final stabilization of disturbed areas.

Following an upset of the DC #1 channel in May 2010, AGC initiated permanent repairs to the channel, which resulted in separating the original channel into multiple sections. Rock and Albion creeks were specifically restored to their original channels.

4.7 ROADS AND CAUSEWAYS (AREA 7)

Over the course of the Rock Creek project, approximately 15 km of access roads and causeways have been constructed at the Rock Creek Mine site. The ongoing land survey will update the cumulative distance of all roads and causeways that will be reclaimed at closure.

4.8 ORGANIC STOCKPILE #1 (AREA 8)

Organic stockpile #1 is located north of the main plant site and is the largest of Rock Creek's three organic stockpiles with approximately 460,000 m^3 of stored material.

5.0 CLOSURE AND RECLAMATION METHODS

This section summarizes the Reclamation and Closure Plan for the Rock Creek Mine from its current condition (Figure 5). It includes the major closure and reclamation goals; strategies and activities; reclamation schedule; engineering and hydrologic designs and dimensions; and important material grading and soil cover quantities. Material quantity estimates are preliminary and based upon existing topographic data that included more than one survey grid causing minor elevation inconsistencies. A more accurate survey is ongoing to confirm initial quantity estimates. References to specific equipment use and salvage expectations should be considered conceptual based on current knowledge. A final plan for these activities will be developed in conjunction with the contractor(s) selected to perform the closure activities. Salvage opportunities will largely depend on the specific economic conditions at the time of potential sale. Also, grading plans should be considered preliminary to facilitate approximate material quantities. These plans will be finalized immediately prior to and during final execution of the reclamation activities. As noted throughout this plan, AGC will ensure that all reclamation and grading is done to provide free drainage and prevent surface accumulation/ponding of water. All ground surfaces, except the specific roads needed for care and maintenance, will receive a minimum of 30 cm soil cover and be revegetated. The Main Pit area will receive a minimum 60 cm soil cover and also be revegetated.

5.1 CLOSURE AND RECLAMATION GOALS AND STRATEGIES

This Reclamation and Closure Plan is developed to achieve:

- Physical and chemical stabilization of mine waste and other mine-related surface disturbances;
- Compliance with applicable water quality standards and permit requirements;
- Compliance with ADNR regulations governing mine closure and landowner agreements;
- Protection of public safety;
- Post-mining land use consistent with subsistence hunting, berry gathering, wildlife habitat, reindeer fawning, and recreation; and
- No/low-maintenance closure for the post-closure period.

Strategies and methods used to develop this Reclamation and Closure Plan include:

- Initiate standard closure practices and design engineering suitable for the local sub-arctic environment;
- Modify standard closure practices and designs according to site-specific conditions and analyses;
- Integrate the closure designs for each component into one practical site-wide reclamation plan;
- Use on-site reclamation materials (e.g., stockpiled soil, rip rap), equipment, and facilities to the extent practical allowing additional sustainability;

- Consolidate and cover tailings, waste rock, and excess fill in the existing pits;
- Re-grade slopes to be stable and blend with the surrounding topography;
- Revegetate disturbed areas to promote establishment of a self-sustaining vegetation community consistent with vegetation communities in the area;
- Convey storm water and run-on in engineered channels and structures that are designed to safely pass the Probable Maximum Precipitation (PMP) event; and
- Monitor groundwater and surface water throughout the approved post-closure monitoring period.

5.2 RECLAMATION PLAN OVERVIEW AND SCHEDULE

A facility-by-facility summary of the Reclamation and Closure Plan is provided in subsequent sections and includes closure plan details, backfilling and grading cross-sections, material quantities and volumes, and storm water design details. Since the various facilities, such as the Main Pit and development rock and ore stockpile, have different reclamation sequences, site-wide reclamation should be achieved over a 12-month period, although some facilities will be reclaimed more rapidly than others.

Closure plan arrangements and designs associated with Section 5 are shown on the following figures:

- Figure 1 Project Location Map
- Figure 2 Land Ownership
- Figure 3 Existing Facilities
- Figure 4 Closure Planning Areas
- Figure 5 Proposed Closure Conditions by Area
- Figure 6 Area 1 Plant Site Proposed Closure Conditions
- Figure 7 Area 1 Monofill
- Figure 8 Area 2 Main Rock Creek and Walsh Pits Proposed Closure Conditions
- Figure 9 Area 2 Main Rock Creek and Walsh Pits Proposed Sections and Detail
- Figure 10 Area 3 TSF Proposed Phase I Closure Conditions
- Figure 11 Area 3 TSF Proposed Phase II Closure Conditions
- Figure 11 Area 3 TSF Temporary Diversion Channel Proposed Profile
- Figure 12 Area 3 TSF Dam Breach Proposed Sections and Detail
- Figure 13 Area 4 Injection Well Field Proposed Closure Conditions
- Figure 14 Area 5 Explosives Storage and West Pit Proposed Closure Conditions
- Figure 15 Area 5 West Pit Tailings Disposal Bed
- Figure 16 Area 5 West Pit Tailings Disposal Bed Sections and Detail
- Figure 17 Area 6 Diversion Channel #1 South Proposed Closure Conditions
- Figure 18 Area 6 Diversion Channel #1 North Proposed Closure Conditions
- Figure 19 Area 7 Causeway Proposed Closure Conditions
- Figure 20 Area 7 Causeway Proposed Sections and Detail
- Figure 21 Area 7 Causeway and Ponds Proposed Closure Conditions
- Figure 22 Area 7 Roads Proposed Closure Conditions

5.2.1 General Overview

To achieve the Reclamation and Closure Plan goals noted above, AGC plans to:

Phase I

- Dewater, treat, and discharge solution from the TSF;
- Install a temporary cover over the tailings in the TSF;
- Breach the TSF embankment and grade the TSF area to promote positive drainage through the breach to Rock Creek;

Phase II

- Remove all facilities;
- Backfill the Main Pit (with paste tailings from the TSF, development/ore rock, excess fill, and topsoil); grade to promote positive drainage to Rock Creek;
- Remove man-made storm water diversions;
- Re-establish original drainages; and
- Grade the area to near pre-mining topography, cover all disturbances with salvaged topsoil, and seed the area with an approved seed mixture.

5.2.2 Soil Cover and Revegetation

The final site grading and any required backsloping will be completed to generally represent the pre-mining land form. Several pieces of equipment will be used to attain the goal. Typical equipment used in a cut and fill process include: dozers, graders, loaders, and trucks. Following attainment of the final land forms, the stockpiled topsoil will be loaded and hauled to the graded areas. The placed soil will be spread at a minimum nominal thickness of 30 cm using graders or dozers. A thicker minimum soil cover of 60 cm is proposed to cover the Main Pit. The additional Main Pit soil cover acts as an allowance against any settling that may occur after pit closure and provides a more substantial growth medium over the barren rock layer that will be placed underneath. Following final soil spreading, the seed bed will be prepared prior to seeding.

The proposed seed mixture (Table 2) was developed in consultation with the Alaskan Plant Center, ADNR, and the landowners. Reseeding will most likely be done by broadcast seeding or drill seeding. Fertilizer is not proposed on this site as the soil organic content is adequate to allow germination and nutrients. Fertilizer would also accelerate weed growth and remove needed moisture for the new growth. Monitoring for noxious weeds will be included in the annual revegetation inspection and controlled as necessary. An interim revegetation standard of 30% vegetation cover over the disturbed areas within three years will be used. A final standard of 70% vegetation cover is proposed for final bond release.

In general, the primary emphasis of reclamation activities will focus on promoting rapid, natural recovery of indigenous vegetation.

Table 2. Proposed Seed Mixture for the Rock Creek Mine Reclamation

Life Form	Common Name	*Latin name*	Seeds/pound	Pounds PLS/acre [1]
Grasses				
	Glaucous Bluegrass	*Poa glauca*	2,177,000	Final grass seed mix will be developed in consultation with the Alaskan Plant Center and based on plant material availability. Seed mixtures will be approved by ADNR prior to implementation.
	Bering Hairgrass	*Deschampsia brevifolia*		
	Bluejoint	*Calamagrostis canadensis*	3,837,472	
	Red fescue	*Festuca rubra*	454,087	
	Tufted Hairgrass	*Deschampsia beringensis*	1,200,000	
	Polargrass	*Arctagrostis latifolia*	1,800,000	
Forbs [2]				
	Fireweed	*Epilobium angustifolium*	6,500,000	Final forb seed mix will be developed in consultation with the Alaskan Plant Center and based on plant material availability. Seed mixtures will be approved by ADNR prior to implementation.

[1] Final seeding rates will be determined following seed mixture approval.
[2] If certain forbs are unavailable, other species listed will be increased to achieve a forb component of approximately 17 PLS/ft^2.
PLS = pure live seed

5.2.3 *Proposed Closure Schedule*

The target completion date for the closure and reclamation of the Rock Creek Mine is November 2012. A tentative closure schedule of critical milestones is presented in Table 3 below.

As discussed in Section 1, the schedule for dewatering and process solution treatment is a critical factor in determining the final closure schedule for the TSF. AGC anticipates that treatment of water from the TSF will continue through fall 2011, depending on seasonal precipitation. By late fall/early winter 2011 dewatering is expected to be completed.

When the TSF has been dewatered, Phase I closure activities will be initiated in December 2011. This will include placement of the temporary cover over the tailings and construction of the drainage controls to further prevent water from contacting the tailings. After the tailings are covered, the TSF breach will be constructed during the first quarter of 2012. Prior to break-up in 2012, the TSF will be re-graded to drain through the breach and discharge through the DC#3 channel to Rock Creek. Storm water management practices, including use of best management practices (BMPs), will be implemented to limit erosion and associated sediment loadings during break-up. This is the extent of the Phase I activities.

If the mine is not acquired by BSNC and SNC, NovaGold will initiate the Phase II closure activities during early summer 2012. Under Phase II the TSF cover will be removed and the tailings will be hauled to the Main Pit for final disposal. Stockpiled development rock and ore will be placed in the Main Pit on top of the tailings. Additional fill volumes from the causeway removal and excess topsoil will be placed in the Main Pit in summer/fall 2012 to achieve final grade. Topsoil will be placed on reclaimed areas beginning in summer 2012, with final seeding completed by fall 2012.

Under Phase II, the main plant site demolition is scheduled to begin in summer 2012 and includes all site facilities not needed for water treatment or the support of reclamation activities. The associated demolition debris will be placed in the inert solid waste monofill, which will be constructed in early summer 2012 and remain active until major closure activities have ended. The main plant area will be regraded and revegetated during summer and fall 2012. All other disturbances (diversion channels, roads, causeway) will be reclaimed during summer and fall 2012.

Table 3. Tentative Rock Creek Mine Closure Schedule

Dewatering Schedule	**October 2010 – November 2011**
TSF	*October 2010 – December 31, 2011*
Submit Plan to State	**March 2011 – November 2011**
Prepare and submit initial plan	*March 1, 2011 – April 18, 2011*
Receive comments from State	*May 13, 2011*
Submit final plan including cost estimate	*October 24, 2011*
Final state approval	*November 15, 2011*
Phase I	**November 15, 2011-July 1, 2012 (projected)**
Complete engineering design drawings and specifications	*November 1, 2011-December 1, 2011*
Complete Phase I activities	*December 1, 2011-July 1, 2012*
Phase II*	**June 1, 2012-November 15, 2012 (projected)**
Complete engineering design drawings and specifications	*June 1, 2012-July 1, 2012*
*Complete Phase II activities**	*July 1, 2012-November 15, 2012*

*Only to be performed by NovaGold if acquisition not completed.

5.3 AREA 1 – PLANT SITE, DEVELOPMENT ROCK/ORE STOCKPILE, AND MONOFILL

All closure activities conducted in Area 1 are part of Phase II of the closure plan. Area 1 encompasses the main plant site, process buildings, WTP, ore crushing facility and conveyors, and development rock and ore stockpile (Figure 6). The main plant site will be decommissioned, decontaminated, and demolished or salvaged beginning in early summer 2012. The initial focus will be on buildings and equipment that are not necessary to support ongoing reclamation activities or water treatment. Items prioritized for removal include the laboratory building, CIL circuit and building, mill and mill building, ore dump and crusher systems, process refining building, stockpile assembly, and the initial plant floor clean-up. Salvaged items may include the CONEX storage trailers, ball mill, crusher systems, CIL circuit, and stockpile assembly. Metallic debris will be separated and stockpiled for sale as scrap. Inert demolition debris will be disposed of in the monofill in accordance with the WMP. Stockpiled ore and development rock (approximately 237,000 m^3) will be hauled to the Main Pit for disposal.

Additional demolition activities address facilities and equipment that will be used throughout the reclamation process and thus will be decommissioned, decontaminated, and demolished only when the activities they support have been completed in fall 2012. These items include the RWP, reagent building, thickener tank, truck shop, warehouse, fuel depot, and electrical building. The WTP could be salvaged.

Soil and fill materials within Area 1 will be visually inspected for spills and the type and extent of contamination, if any, will be determined. If necessary, remedial measures will be developed. Material that cannot be treated in-situ will be excavated and disposed of in the Nome solid waste landfill or other facilities certified to accept petroleum-contaminated and other specific types of wastes.

The Area 1 reclamation site area is approximately 161,000 m^2. This includes the main plant site, administration buildings, processing plant, and development rock and ore stockpile (Figure 6). The area will be re-contoured to blend into the surrounding topography and promote natural drainage patterns. Re-contouring this area will consist mainly of using available grader equipment. The area continues to drain positively except for the RWP, which will be backfilled with development rock. A minimum 30 cm of soil cover will be redistributed across all disturbed areas. Erosion and sediment controls will be designed and constructed to minimize erosion and the area will be seeded with a seed mixture composed of native species that are adapted to site condition. The estimated cut/fill grading and soil volumes necessary to reclaim Area 1 are as follows:

AREA 1	Cut (m^3)	Fill (m^3)
Ore/development rock stockpile	237,000	6,400
Grading	7,500	15,500
Topsoil	0	52,500
RWP	0	12,600
Demolition debris	0	20,000

5.3.1 Inert Solid Waste Monofill

AGC will construct a new inert solid waste monofill to permanently dispose of inert debris generated during demolition. This monofill is designed to a capacity of 20,000 m^3. The area selected for the monofill lies entirely within AGC patented claims immediately north of the main plant area (Figure 7). Its close proximity to the main plant area, where most debris will be generated, will minimize hauling costs while sufficient topsoil cover can readily be obtained from the adjacent organic stockpile. A temporary access road (approximately 150 m long) will be constructed using development rock to reach the site. The proposed monofill site lies outside of known permafrost areas based on the survey conducted for the Rock Creek Mine site (*Geotechnical Field Investigation, Permafrost Delineation. Smith Williams Consultants, Inc., March 2006).*

To ensure a stable working surface and minimize unnecessary disturbances, no topsoil will be removed from the area. A 1.0-m thick pad will be constructed from development rock over the entire monofill footprint (6,410 m^2) sufficient to support articulated trucks that will be used to place debris. Debris will be placed in the monofill to a height of no more than 7.0 meters and occupy a footprint of approximately 4,414 m^2 assuming side slopes are maintained at 2H:1V. A final topsoil cover will be placed over the monofill at a minimum depth of 0.6 m, although the slopes will be thicker to achieve the desired 3H:1V grade (Figure 7).

5.3.2 Water Treatment Plant

The WTP will continue normal (continuous) operation until contained water sources (TSF sumps and pond, RWP, and Main Pit) have been reclaimed and no longer require treatment. The WTP is expected to operate at a 400–450 gpm average during the initial phases of the closure and reclamation period and decrease over time. Once contained water sources have been sufficiently dewatered, the WTP will be retained and operated on an as-needed basis to treat runoff water and/or rinse solutions generated during closure activities such as tank decommissioning. All rinse water will be routed to the RWP or an approved holding tank where it will be tested prior to treatment in the WTP for eventual discharge. Batch testing in this manner will ensure that the WTP is capable of treating all influent sources to a level consistent with APDES, WMP, and UIC permit requirements. Any contained or captured wastewaters that cannot be treated in the WTP will be disposed of properly at an offsite location.

From spring 2012 through the anticipated end of major site reclamation activities in fall 2012, treated water disposal will consist primarily of surface water discharge to Rock Creek. AGC installed a 500-m discharge pipeline down Brynteson Gulch from the WTP to Rock Creek, terminating near the Glacier Creek Road culvert, and began discharging treated water to Rock Creek on August 1, 2011. The IWF will remain available as an alternative disposal method if needed during this period. When reclamation reaches a stage at which sources of potential contamination have generally been eliminated and water treatment is no longer required, operation of the WTP and RWP will not be needed and any runoff will be considered as stormwater only with discharges covered under an appropriate APDES general permit.

Potentially salvaged items could include the WTP tanks, pumps and piping package, and reagents. The building will be torn down, cut up with excavator shears, and removed to the monofill. Stem walls will be knocked down and buried in place along with the concrete slab. Development rock will be used as infill or cover material as necessary to promote natural contouring and drainage patterns that will not contribute to ponding. The entire area will be covered with a minimum of 30 cm of soil cover. The buried concrete will be covered with growth media and seeded consistent with the entire site.

5.3.3 Buildings and Equipment

The majority of the buildings and equipment at the plant site, including the administration building, will be decommissioned, demolished, and removed in summer 2012 (Table 4). If agreements can be met, AGC will investigate any opportunities to donate buildings or CONEX containers to local organizations.

The buildings and equipment in Area 1 include:

Table 4. Area 1 Buildings and Facilities

Facility	Length (m)	Width (m)	Height (m)	Concrete (m^3)
Mill Building	39.6	21.3	22.9	340
Electrical Building	10.4	21.3	6.1	85
Refinery	30.5	12.2	10.7	142
Reagent	18.3	33.5	10.7	204
Pumphouse	6.1	3.0	3.0	28
Truck Shop	19.8	39.6	15.2	297
WTP	30.5	15.2	10.7	170
Administration Building	21.3	13.7	3.0	99
Electrical Substation	12.2	13.7	n/a	45
Assay Lab	21.3	15.2	3.0	96

Equipment, tanks, pipelines, and other facilities in contact with acid, hydrocarbon, organic, and cyanide solutions will be decontaminated with neutralizing solutions (e.g., lime solution, surfactants, oxidants, and chlorine). Rinse solutions will be captured and managed in the RWP. Concrete foundations and other non-reactive, non-combustive, non-corrosive, and non-hazardous, inert demolition waste and near-surface and shallow pipes will be broken up and placed in the monofill. Clean pipes that are located at depth will have the ends plugged with concrete and left in place.

Limited office supplies and furniture will be taken from the administration building to the truck shop where a temporary office will be established and remain operational until the end of mine closure. The truck shop and warehouse, WTP, reagent building, fuel depot, and electrical building will be the only facilities remaining in Area 1 until final demolition in fall 2012.

All concrete slabs and foundations will be buried in place. Development rock will be used as infill or cover material as necessary to promote natural contouring and drainage patterns that will not contribute to ponding. The entire area will be covered with a minimum of 30 cm of soil cover and reclaimed as described in Section 5.2.

All power corridors and access roads will be reclaimed by ripping, adding soil cover (if necessary) and seeding as described in Section 5.2.

Crushing System

The crushing system, including crusher and conveyors, could be salvaged and would be removed off site by either the purchaser or AGC. The concrete conveyor supports will be removed by excavator and hauled to the monofill. The reclaim tunnel under the fine ore stockpile will be excavated and specifically salvaged, sold as scrap or hauled to the monofill for disposal. The tunnel area will then be filled. The entire disturbance area will be graded positively and reclaimed as described in Section 5.2.

Administration and Security Buildings

The administration and security buildings could be salvaged of all saleable materials (desks, chairs, file cabinets, computers, white boards, etc.). Following removal of all salvaged items, the buildings will be knocked down and cut up into manageable size and hauled to the monofill for disposal. Any remaining foundations will be buried in place. The entire disturbance area will be graded positively and reclaimed as described in Section 5.2.

Fuel Depot

The fuel depot will be used during reclamation by the contractor. Following project completion, any remaining fuel will be shipped off-site. The tanks and distribution system will be rinsed and removed off-site for salvage. The secondary containment liner beneath the depot will be inspected, cut up, and disposed in the monofill. The site will be inspected and tested to ensure no hydrocarbon soil impacts exist above regulatory limits. Any impacted soils will be removed and disposed in an approved disposal site. The entire disturbance area will be graded positively and reclaimed as described in Section 5.2.

Reagent Building

The reagent building and several CONEX containers contain reagents and chemicals that will be removed and salvaged or disposed in approved locations during fall 2012. A preliminary inventory is presented in Table 5. All tanks used to store and mix reagents will be emptied, rinsed, and salvaged or hauled to the monofill for disposal. Rinse solution will be discharged to the RWP. Once all chemicals and reagents have been removed the building will be demolished. Demolition will be similar to the WTP, with all materials removed to the monofill for disposal. The area will be graded, covered with soil, and seeded as described in Section 5.2.

Table 5. Chemical Reagent Inventory

Reagent	Description	1-year Quantity (tons estimated on-site) [1]
MIBC	Alcohol for froth stabilization	50 liquid
Xanthate	Collector for gold sulfide mineral	190 liquid
Flocculant	Used to enhance water/solid separation	50 dry
Lime	PH conditioner	625 dry
Activated Carbon	Gold collection media	25 dry
HCl	Acid used to wash calcium from carbon	50 liquid
NaOH	pH modifier for carbon stripping circuit	75 dry
NaCN	Gold leach chemical	500 dry
Ferric Sulfate	Cyanide destruct chemical	750 dry
Ferric Chloride	Water treatment chemical	50 dry
Ammonium Nitrate [2]	Used as blasting agent	75 dry in CONEX

[1] An updated on-site inventory is scheduled for spring 2012. This table will be updated at that time.
[2] Managed as discussed in Section 5.7.

Truck Shop

The truck shop will be used throughout reclamation by AGC and contractors. All unneeded contents and inventory will initially be removed and some may be shipped off-site as salvage. Office space in the truck shop will also be used by AGC, the contractor, and their agents to assist the project. At project completion, any remaining lubricants will be removed off-site by the contractor. The building will be demolished and hauled to the Nome solid waste landfill along with all remaining office equipment that is not salvaged. Stem walls will be knocked down and buried in place along with the concrete slab. Development rock will be used as infill or cover material as necessary to promote natural contouring and drainage patterns that will not contribute to ponding. The entire area will be covered with a minimum of 30 cm of soil cover. The buried concrete will be covered with growth media and seeded consistent with the entire site.

Refinery and Mill Buildings

The refining and mill buildings will have all equipment and reagents removed during summer 2012. Reagents will be removed from the mill and refinery and managed to ensure compliance with all applicable plan and regulatory requirements. Lubricants from the mill, refinery, and other miscellaneous equipment will be drained and removed off-site to an approved disposal facility. All tanks will be rinsed as required to allow demolition and disposal in the monofill. Rinse solutions will be collected in the RWP. Salvage materials could include all pumps, screens, mills, compressors, motor control centers, cyclones, etc. Following equipment removal, initial plant clean-up will occur. All clean-up debris and any spilled process materials will be characterized using the toxic characteristic leachate procedure (TCLP) and managed as results indicate. Materials passing TCLP will be hauled to the Nome solid waste landfill. Those materials that exceed TCLP thresholds will be packaged and shipped to an approved disposal site. The building shells will then be knocked down and cut up with excavator shears into manageable pieces to be hauled to the monofill or the Nome solid waste landfill. Stem walls will be knocked down and buried in place along with the concrete slab. Development rock will be used as infill or cover material as necessary to promote natural contouring and drainage patterns that will not contribute to ponding. The entire area will be covered with a minimum of 30 cm of soil cover. The buried concrete will be covered with growth media and seeded consistent with the entire site.

Assay Lab

The assay lab will be removed in summer 2012. The equipment (HVAC, testing machines, furnaces, etc.) will be salvaged, sold as scrap or hauled to the monofill for disposal. All chemicals will be packaged and disposed in the same manner as the reagent, mill, and refinery building inventories. The building shell will be knocked down and cut up with excavator shears into manageable pieces to be hauled to the monofill. Concrete slabs will be buried in place. Development rock will be used as infill or cover material as necessary to promote natural contouring and drainage patterns that will not contribute to ponding. The entire area will be covered with a minimum of 30 cm of soil cover. The buried concrete will be covered with growth media and seeded consistent with the entire site.

CIL and CN Destruct Buildings

The CIL tanks and cyanide (CN) destruct system include several large tanks sitting on concrete containment. Six CIL tanks previously contained approximately 85,000 gallons of residual CIL tailings and solution each. During summer 2011, AGC initiated the process of removing the CIL tailings from the tanks. Under a plan approved by ADEC, the liquid portion is being treated to remove cyanide as Prussian Blue solids. After cyanide removal and antimony pretreatment, the remaining solution is being combined with flow from the TSF to the WTP for further treatment. Treated water is either injected or discharged to Rock Creek according to permit limitations. AGC developed a plan to manage the CIL solids in a lined area within the West Pit. ADEC approved this plan on

July 7, 2011 (Attachment 3). Similarly, ADEC approved AGC's plan to also dispose of Prussian Blue in the lined area of the West Pit. All tailings and Prussian Blue are expected to be placed in the lined area by the end of October 2011.

The emptied tanks will undergo a final rinse with the rinse solution tested for WAD cyanide. Assuming WAD cyanide levels do not pose a concern, the rinse solutions would be managed in the RWP. If WAD cyanide presents an unexpected discharge concern, the rinse water would require an alternative management scenario (e.g., blending or further treatment) or off-site management. The rinsed tanks could be salvaged or, if no buyer is found, will be cut up into manageable sized pieces and disposed in the monofill. The CN destruction circuit tanks will be managed similar to the CIL circuit. Any remaining sludge or residue that cannot be treated to acceptable disposal levels will be packaged and shipped to a RCRA disposal facility.

The system containment areas consist of concrete. The concrete will be inspected and sampled to ensure no contamination exists above regulatory disposal limits. Once the concrete is clean, it will be rubblized and buried in place. The area surrounding these facilities and beneath the concrete will be inspected and tested for soil impacts. Should impacts exist that cannot be treated on-site, the impacted materials will be packaged similar to other sludge and removed to a RCRA disposal facility. Following final clean-up (if necessary), the disturbance will be covered with soil and seeded with the prescribed seed mixture as described in Section 5.2.

5.3.4 Recycle Water Pond

The RWP will remain active until just prior to the WTP being decommissioned. The RWP currently receives sludge from the WTP, storm water runoff from the plant site, and groundwater pumped from between the liners. Stormwater runoff from the plant site is in the process of being diverted to a separate containment structure. AGC is also working on pumping all water collected from between the RWP liners and the groundwater pumping wells directly to the WTP for treatment and disposal. These projects will be completed by the end of 2011.

Excess water in the RWP will be pretreated at the thickener, as needed. During spring 2012, AGC will submit a request for an amendment to this closure plan for final closure of the RWP. This is expected to include treating excess water in the pond and disposal of sludge generated from the WTP as well as existing solids in the RWP. AGC is considering a method to fixate the sludge and pond solids with cement or other material, and managing them in the RWP with the liner folded inward to cover the solids. The RWP would then be filled with inert soil and rock, graded to drain, and covered with a layer of topsoil to a minimum depth of 30 cm. The area will be seeded with the prescribed seed mixture as described in Section 5.2.

5.3.5 Development Rock and Ore Stockpile

The development rock and ore stockpile is located northeast of the crusher area. The combined material volume in this stockpile is estimated at 237,000 m^3, which will be used as backfill material in the Main Pit. A portion of the development rock stockpile will be used in constructing the monofill pad and temporary access road. Smaller volumes may be used as infill around the site to achieve the desired final grading.

The stockpile areas removed of materials will be covered with a minimum 30 cm of soil. Erosion and sediment controls will be designed and constructed to minimize erosion, and the disturbance will be covered with soil and seeded with the prescribed seed mixture as described in Section 5.2.

5.3.6 Storage Trailers

CONEX storage containers will be removed from the site and may be salvaged, although some trailers may be retained to provide storage for any other salvageable mine components that accumulate during reclamation. At least one CONEX container will be kept onsite until the end of mine closure to store all office furniture and supplies that remain until the truck shop and warehouse are demolished. The final CONEX container will have all contents removed and could be salvaged locally.

5.4 AREA 2 – MAIN PIT AND WALSH PIT

Under Phase II, the Main Pit will be the focal point for most mine closure activities since it is the designated final disposal location for tailings, ore and development rock, excess fill generated during reclamation grading, and excess topsoil. Backfilling operations can only begin when the Main Pit has been sufficiently dewatered. If necessary, standing water in the Main Pit will be pumped to the WTP. Treated water will either be injected or discharged to Rock Creek. The maximum estimated storage elevation is 90.4 meters, with a corresponding estimated water storage capacity of 141,000 m^3. Based on 2009-2011 pit water volume data, an estimated 7,600 m^3 of accumulated stormwater could require treatment. Assuming an average summertime treatment and discharge rate of 400–450 gpm, the stored water could be removed in approximately 5 days.

The Main Pit will be partially backfilled to approximately 90 m amsl on the west side and to approximately 120 m amsl on the east side of the pit (figures 8 and 9). Excavated tailings will be placed in the Main Pit during summer 2012, followed by development rock and ore, and excess fill material from the TSF grading. Additional fill volumes from the causeway removal will be placed in the Main Pit to achieve final grade. Overall, there will be adequate fill to ensure complete pit backfill. Excess fill will be placed within the pit limits and contoured to approximate surrounding topography. Any water that accumulates in the pit prior to final cover placement will be treated in the WTP and either injected or discharged.

The Walsh Pit, located east of the Main Pit, is approximately one-fourth the size of the Main Pit. Depending on the actual volume of tailings, development rock and excess fill generated during reclamation, the Walsh Pit will either be backfilled with development rock and excess fill, topsoiled and revegetated, or backfilled with topsoil and revegetated.

Both pits will ultimately be graded to prevent ponding of incident precipitation and surface runoff. A minimum 60 cm of soil cover will be distributed on the backfilled pits. Erosion and sediment controls will be designed and constructed to minimize erosion and the area will be seeded with a seed mixture composed of native species that are adapted to the site conditions.

The Area 2 disturbance is approximately 97,000 m^2 (Main Pit = 85,000 m^2; Walsh Pit = 12,000 m^2). The estimated type and volume of pit backfill material, as well as the soil cover volumes for Area 2 are as follows:

AREA 2	Cut (m^3)	Fill (m^3)
Tailings backfill	0	85,000
Development rock and ore	0	230,600
Topsoil	0	58,200
TSF breach excess fill	0	266,300
Causeway breach excess fill	0	79,600
Riprap quarry	10,000	0

The estimated volume of stockpiled ore and development rock is approximately 237,000 m^3. Ample quantities of development rock and excess fill should be available to backfill the pits as well as the sumps at the toe of the TSF.

Construction of the pit backfill would occur with loaders and haul trucks. As described above, development rock would be hauled with haul trucks and loaders. Tailings will be loaded into haul trucks using a loader. Following final fill deposition and grading, reclamation of the disturbance would be performed as described in Section 5.2.

Based on existing geochemistry analyses conducted during the development phase of the Rock Creek Mine, AGC does not expect backfilling the Main Pit with ore and development rock and the small volume of paste tailings to have any adverse post-closure impact to groundwater in the vicinity. A detailed discussion of water quality associated with a backfilled Main Pit is presented in Attachment 2.

5.5 AREA 3 – TSF, ORGANIC STOCKPILES AND DIVERSION CHANNEL #3

Closure and reclamation of the TSF will be conducted in two phases as discussed in sections 1 and 5.1. Phase I will consist of dewatering the TSF, installing a temporary cover over the tailings, breaching the TSF dam, and grading the area to drain through the breach to Rock Creek (Figure 10). Under Phase II, tailings will be removed to the Main Pit for final disposal and disturbed areas will be covered with topsoil and revegetated (Figure 11).

AGC will continue to dewater the TSF to the extent practicable through fall/winter 2012. The water volume stored in the TSF is dependent on the amount of precipitation that falls in the watershed and the rate at which water is removed, treated and disposed. In June 2011, the TSF water elevation rose to a maximum elevation of approximately 43.5 m amsl, which corresponds to a water volume of approximately 845 million gallons. Assuming a treatment and disposal rate of 400–450 gpm, approximately 5 to 6 months will be needed to dewater the TSF to facilitate tailings removal.

Phase I

AGC's objective under Phase I is twofold:

- Isolate the tailings in the TSF and install temporary structures that will eliminate contact between the tailings and surface water runoff; and
- Breach the TSF dam by spring 2012 such that snow melt and precipitation will no longer accumulate behind the dam.

During late fall 2011, AGC will initiate construction of a temporary diversion channel along the upgradient edge of the tailings footprint (Figure 11). Construction will begin when the TSF pond elevation has receded sufficiently and the ground has frozen to provide a stable working surface. This channel will divert stormwater away from the tailings and collect runoff from the temporary cover, and ultimately direct it through the TSF breach to Rock Creek. Some grading of the channel may be necessary to achieve the minimum 0.5 percent grade that will allow positive drainage. In areas with steeper grades, erosion control structures such as check dams or riprap may be installed. The need for additional controls and grading will be determined as the channel is constructed.

When the TSF pond has been sufficiently dewatered and the tailings have frozen to provide a stable working surface, AGC will install an impermeable hypalon liner (minimum 30 mil) over the entire tailings area to prevent contact with meteoric water (Figure 10). The cover will extend 3 meters up the interior face of the dam and extend into the temporary diversion channel bordering the upgradient edge of the tailings. The existing geomembrane liner on the upstream dam embankment will be left in place. Excess snow and ice will be removed before the cover is installed. In general, AGC does not intend to grade the tailings, but some minor grading may be necessary to ensure the cover drains positively and does not accumulate standing water. The hypalon cover will be placed in latitudinal segments with a 3-m overlap from the top down to prevent water seeping into the tailings. Sand bags will be placed according to the manufacturer's recommended intervals to hold the cover in place.

The TSF will be breached only when the temporary diversion channel has been constructed and the tailings cover is in place. The breach will be approximately 30 meters wide with side slopes graded to 3:1. The breach channel will be 10 meters wide and armored with riprap to prevent scour and limit the erosion potential during high flows. The maximum water depth is 2 meters through the channel (Figure 12). Stormwater routed through the breach will discharge to the lower portion of DC #3, which will be retained and modified to serve as a sediment collection pond following closure. Additional stormwater controls (e.g., check dams, silt fences, straw baffles) will be implemented as needed in the TSF area. Input parameters and a summary of results for the HEC-HMS models used to design the breach are provided in Attachment 1.

The TSF foundation drains will continue to be routed to the sumps while tailings remain uncovered. Sump water will be pumped directly to the WTP through a new feed line installed alongside the APDES outfall in Brynteson Gulch. When the TSF has been breached, the sumps will be backfilled. Foundation drains will be either severed and allowed to drain or removed through excavation.

Phase II

Activities under Phase II will focus on removing the tailings from the TSF, grading the TSF area, and applying a minimum 30 cm topsoil cover and seed mixture. Other structures in Area 3 (e.g., DC #3, organic stockpiles) will also be decommissioned and reclaimed during Phase II.

The approximate tailings volume of 85,000 m^3 will be removed from the TSF in late summer/early fall 2012 and hauled to the Main Pit for final disposal. The hypalon cover will be cut up and hauled to the monofill for disposal. The temporary stormwater channel will be graded to drain towards the TSF breach.

Tailings will be loaded into haul trucks using a loader. Depending on the consistency of the tailings, controls such as truck bed baffles will be implemented to minimize the potential for spillage en route to the Main Pit. Individual load volumes will also be managed accordingly.

The HDPE pipe systems and the HDPE liner on the interior face of the TSF dam will be cut up and hauled to the monofill for disposal. The upper portion of DC#3, defined as the segment upstream of the TSF breach intercept, will be graded using sidecast material or excess fill. All HDPE pipes will be demolished and removed from the existing diversion channel and hauled to the monofill for disposal. HDPE liners will be perforated and buried in place. Final grading will promote positive draining and surface/sub-surface stability. A minimum 30 cm of soil cover will be distributed in the area. Erosion and sediment controls will be designed and constructed to minimize erosion and the area will be seeded with a seed mixture composed of native species that are adapted to site conditions. The lower portion of the DC #3 will be retained and reconfigured to serve as a sedimentation basin for runoff from the TSF area (Figure 11). The thickener tank and associated facilities are likely to be required as part of the water treatment system. As such, decommissioning, decontamination, and demolition of the thickener and associated pumps will be completed after water treatment is no longer required (fall 2012). Pumps could be salvaged and the thickener tank will be cleaned, sampled for contamination, cut up, and disposed of in the monofill. All material stored in organic stockpiles #2 and #3 is expected to be used during site-wide reclamation activities. Loaders and haul trucks will move the cover soil to required areas. The area will be reclaimed, with wetland areas reclaimed in place. Following stockpile removal, wetland areas will be contoured to reflect the surrounding topography and drainage patterns, and covered with a minimum of 30 cm of topsoil. The area will be seeded with a native vegetation to promote soil stability. Wetland flora and fauna are expected to gradually return to the area as natural surface and groundwater flow patterns are re-established over successive years.

The combined reclaimed area of Area 3 is approximately 969,000 m^2. The estimated grading and soil cover volumes for Area 3 are as follows:

AREA 3	Cut (m^3)	Fill (m^3)
Tailings	85,100	0
TSF grading	349,400	324,200
DC #3 grading	189,700	0
Channel riprap	0	3,600
Topsoil	0	291,700

5.6 AREA 4 – IWF AND DIVERSION CHANNEL #2

Closure of Area 4 will occur under Phase II. The IWF is made up of the lower IWF, located north of organic stockpile #1 (Area 8), and the upper IWF, located northeast of the main plant area (Area 1). The combined site covers an area of approximately 397,000 m^2 consisting of 30 active injection wells. Demolition and removal of the IWF and all associated materials is scheduled for fall 2012, assuming active year-round water management is no longer required.

The area surrounding each well head will be excavated, and each well casing will be cut approximately 0.61 m below the existing soil surface. Wells will be filled with bentonite cement as a secure plug. The disturbed area will be graded as necessary to promote positive drainage and seeded with the prescribed seed mixture (Section 5.2). A total of 18 well sites contain well houses and ancillary piping that will also be decommissioned and demolished (Figure 13). Construction and demolition debris will be placed in the monofill.

DC#2 measures approximately 823 m and runs slightly northward conforming to the hillside topography until it reaches a settling pond prior to joining Lindblom Creek. Accurate grading volumes for DC#2 have not been completed at this time due to questions related to the preliminary topographic information. The channel will be removed during summer 2012 and contoured to blend with the surrounding topography. HDPE liners will be perforated and buried in place. Channel contouring will be accomplished with a 4-yard excavator by pulling sidecast material into the channel. Final grading will promote positive draining and surface/sub-surface stability. The entire graded area will be covered with a minimum 30 cm of topsoil. Erosion and sediment controls will be designed and constructed to minimize erosion and the area will be seeded with a seed mixture composed of native species that are adapted to site conditions as described in Section 5.2. Any construction debris identified will be removed and hauled to the monofill for disposal.

The area between DC#1 and DC#2 was previously disturbed during mine construction. Since then, significant soil stabilization and revegetation has occurred on the disturbed areas. Based on discussions with SNC and BSNC, this area will be left in its current condition.

The initial, combined Area 4 disturbance is approximately 434,000 m^2. As noted above, some areas have been allowed to stabilize and naturally revegetate. Upon completion of the final land survey, the revegetated areas will be subtracted from the total area shown here. The estimated grading and soil cover volumes used for planning purposes for Area 4 are as follows:

AREA 4	Cut (m^3)	Fill (m^3)
Upper IWF grading	18,800	25,500
Upper IWF topsoil	0	113,400
Lower IWF grading	1,900	5,400
Lower IWF topsoil	0	3,600
DC #2 grading	20,000	20,000

5.7 AREA 5 – EXPLOSIVES STORAGE AND WEST PIT

Closure of Area 5 will occur under Phase II. The explosives storage area is located east of the upper IWF and northwest of the Main Pit, and consists of nine separate magazine pads. All explosives currently stored in the magazines will be removed from the site prior to reclamation of the area. Likewise, CONEX trailers will be removed from the site. Any remaining construction debris will be hauled to the monofill for disposal. An excavator will contour the pads with stockpiled material from berms, and the area will be topped with a soil cover to a minimum depth of 30 cm (Figure 14). Erosion and sediment controls will be designed and constructed to minimize rilling, and the area will be seeded with the prescribed seed mixture composed of native species that are adapted to site conditions as described in Section 5.2.

As discussed in Section 5.3.2, by the end of October 2011, the residual CIL tailings will have been placed in the West Pit for permanent disposal after processing through a belt filter press. The filter cake will be placed on a liner underlain with 10 cm of gravel and drainage rock to prevent water infiltration (figures 15 and 16). Pressed Prussian Blue solids will have been placed in a separate cell in the lined bed. Upon completion, additional liner will be placed over the filter cake and welded in place. Loose fill material will cover the entire structure to minimize rupture potential, and the area will be topped with a soil cover to a minimum depth of 30 cm. AGC estimates approximately 520 m^3 of CIL tailings and 40 m^3 of Prussian Blue solids will be produced and disposed of in the West Pit. Erosion and sediment controls have been designed and constructed to minimize rilling, and the area will be seeded with the prescribed seed mixture composed of native species that are adapted to site conditions as described in Section 5.2.

The Area 5 disturbance is approximately 223,000 m^2. The estimated grading and soil cover volumes for Area 5 are as follows:

AREA 5	Cut (m^3)	Fill (m^3)
Grading	16,500	48,300
Topsoil	0	103,400
CIL disposal	0	500

5.8 AREA 6S – DIVERSION CHANNEL #1 SOUTH

Closure of Area 6S will occur under Phase II. The closure of DC#1 is scheduled in two parts to accommodate the seasonal characteristics of the surface water flow from Albion and Rock creeks. DC#1 South is approximately 1,220 m in length and extends along the northeastern portion of the mine site above the Main Pit. HDPE liners will be perforated and buried in place. Once the Main Pit is completely backfilled, the channel will be removed and contoured to blend with the surrounding topography. Channel contouring will be accomplished by pulling sidecast material into the channel. Final grading will promote positive draining and surface/sub-surface stability (Figure 17). The entire graded area will be covered with a minimum 30 cm of topsoil and seeded with the prescribed seed mixture as described in Section 5.2. The DC#1 South disturbance is approximately 68,000 m^2. The estimated grading and soil volumes for DC#1 South are as follows:

AREA 6S	Cut (m^3)	Fill (m^3)
Grading	30,000	30,000
Topsoil	0	20,900

5.9 AREA 6N – DIVERSION CHANNEL #1 NORTH AND DC #1 CENTRAL

Closure of Area 6N will occur under Phase II. DC #1 North is approximately 1,524 m long and extends along an east-west trajectory upgradient of the mine site from Albion Creek to Lindblom Creek. DC #1 Central runs approximately 152 m between Albion and Rock creeks. Both portions of the channel will be decommissioned during the Main Pit closure stage. HDPE liners will be perforated and buried in place. The two channel sections will be backfilled with sidecast material and re-graded similar to DC#1 South. The existing outfall to Lindblom Creek will remain in place. The Rock Creek and Albion Creek stream beds shall be maintained in their existing drainage and channel geometry. Following the final grading of the Main Pit, grading of the channel sections will be completed (Figure 18). The disturbed area will be covered with a minimum 30 cm of topsoil and seeded with the prescribed seed mixture as described in Section 5.2. The Area 6N total disturbance is approximately 83,000 m^2. The estimated grading and soil volume for Area 6N is as follows:

AREA 6N	Cut (m^3)	Fill (m^3)
Grading	62,200	62,200
Topsoil	0	25,300

5.10 AREA 7 – ROADS, PONDS AND CAUSEWAY

Closure of Area 7 will occur under Phase II. The Rock Creek causeway extends approximately 914 m southwest from the plant site to the Main Pit access road. Reclamation will consist of breaching the causeway and removing the culverts that currently convey Rock Creek flow underneath the road (Figure 19). The proposed slope of the causeway cut is 3.3:1. A loader being fed by a dozer above could be used to load a truck fleet of six trucks. If the fleet cycles 20 times per shift, the material could be moved in 16 to 18 days. The culverts will be cut up and sold as scrap. A drainage channel will be constructed to reconnect the existing upstream and downstream Rock Creek channel through the breached area and armored as necessary to prevent erosion. The remaining causeway will be sufficiently excavated to allow for stable slopes. Construction debris and any excess material will be placed in the monofill for disposal. Following final grading of the breach and remaining causeway, a minimum 30 cm of soil cover will be placed and seeding completed with the prescribed seed mixture as described in Section 5.2.

The estimated grading and soil volumes for the causeway breach are as follows:

AREA 7	Cut (m^3)	Fill (m^3)
Causeway grading	79,600	0
Topsoil	0	7,800

Rainfall runoff modeling was conducted for the post-closure Rock Creek drainage to design the causeway breach and the Rock Creek channel invert. The SCS Curve Number approach was used to determine initial abstractions and excess precipitation, and the SCS unit hydrograph method was used to derive the peak flow and hydrograph resulting from excess rainfall. The causeway breach was designed to easily convey the flood that will result from a 24-hour PMP storm event (269.2 mm) and match the existing Rock Creek channel geometry. The channel and breach were designed to convey the design flow using Manning's Equation, considering channel shape, flow depth, width, velocity, and discharge (figures 20 and 21). Attachment 1 includes the hydrology and model design outputs.

The existing sediment ponds in the Rock Creek channel above the causeway will remain in place until reclamation objectives are met. At that time, the ponds will be removed and the channel will be restored to pre-mining conditions.

Under current plans, nearly all access roads will be reclaimed by final closure, although scheduling of specific segments varies depending on their location. Road segments that will be reclaimed (Figure 22) include:

- Main Road – two segments (643 m);
- DC Road – (994 m);
- Pit Road 1 – one segment (36 m);
- Pit Road 2 (358 m);
- TSF 1 Road (1,179 m);
- TSF 2 Road (231 m); and
- Power corridor and access (200 m).

A small spur road (98 m) from the Glacier Creek Road near the TSF will be constructed and maintained to allow for post-closure site access and monitoring. All roadways will be regraded and reseeded, except for the small spur road, by fall 2012.

Road cuts will be filled with spoils created during their construction. An excavator will pull the spoils back into the cut. Topsoil on the fill is not anticipated as the road cut was typically pushed into the soil and the final material cast into the cut will be the soil. Roads that were built above grade will have the sides sloped to less than 4:1 (Figure 23). The road beds will be longitudinally ripped to an 18-inch depth, spaced 3 feet apart, to promote precipitation infiltration. The entire disturbance will be covered with a minimum 30 cm of topsoil and seeded with the prescribed seed mixture.

During discussions with SNC, they have indicated the potential desire to leave certain site roads to support future land use at the site. If such roads are identified, AGC will submit an amendment to this plan to the State for approval. Retaining roads on private lands is consistent with all regulatory requirements.

5.11 AREAS 8 – ORGANIC STOCKPILE #1

Closure of Area 8 will occur under Phase II. Like organic stockpiles # 2 and #3, all material stored in organic stockpile #1 is expected to be used during site-wide reclamation activities. Loaders and haul trucks will move the cover soil to required areas. Under Phase II, the area will be reclaimed, with wetland areas restored in place (Figure 24). A soil balance is presented in Table 7.

5.12 CUT AND FILL BALANCE MATERIAL AND SOIL

5.12.1 Material Balance

Table 6 describes the cut and fill required to achieve the desired final topography and to promote positive surface drainage. The areas are broken out with descriptions of the reclaim areas. Notations describe if the area's material balance is in deficit (fill) or excess (cut). Based on current understanding of the geometry of DC #1, DC #2, and DC #3, an excess cut of approximately 55,100 m^3 will be generated stemming primarily from grading the TSF area. A final land survey will be completed prior to the start of reclamation activities and estimated quantities will be adjusted accordingly.

Table 6. Projected Cut and Fill Balance

Area	Site/Element/Source	Cut (m^3)	Fill (m^3)	Net (m^3)	Cut/fill	Note
Plant Site and Stockpile (Area 1)	Ore/development rock stockpile	237,000	6,400	230,600	Cut	To Area 2
	Grading	7,500	15,500	8,000	Fill	
	Demolition debris	20,000	20,000	0	Cut	
	RWP	0	12,600	12,600	Fill	
Main and Walsh Pits (Area 2)	Tailings backfill	0	85,100	85,100	Fill	From Area 3
	Causeway breach	0	79,600	79,600	Fill	From Area 7
	Ore/development backfill	0	230,600	230,600	Fill	From Area 1
	TSF breach excess fill	0	25,200	25,200	Fill	From Area 3
	Riprap excavation	10,000	0	10,000	Fill	Waste material left in place
TSF and DC #3 (Area 3)	Tailings	85,100	0	85,100	Cut	To Area 2
	TSF grading	349,400	324,200	25,200	Cut	Used as fill for Main Pit
	Channel riprap	0	3,600	3,600	Fill	
	DC #3 grading	189,700	189,700	0	Cut	Channel backfilled with sidecast material
IWF (Area 4)	Upper IWF grading	18,800	25,500	6,700	Fill	Windrow areas will not be graded/revegetated; update volumes upon final survey
	Lower IWF grading	1,900	5,400	3,500	Fill	
	DC #2 grading	20,000	20,000	0	Cut	Channel backfilled with sidecast material
Explosives Storage Area (Area 5)	Grading	18,200	48,300	30,100	Fill	
	Filter cake and bedding	0	500	500	Fill	
DC #1 (Area 6)	North channel backfill	62,200	62,200	0	Fill	Channel backfilled with sidecast material
	South channel backfill	30,000	30,000	0	Cut	
Roads and Causeways (Area 7)	Grading	79,500	0	79,500	Cut	
	Total	**1,129,300**	**1,184,400**	**55,100**	**Fill**	**Additional fill demand supplied by excess topsoil (Table 7)**

5.12.2 Soil Balance

The soil salvaged during the project has organic matter that will aid in nutrient availability to assist germination of plants. Table 7 below describes the quantities of soil per area that are required to reach the minimum goal of 30 cm (60 cm over the pit areas). The soil will be picked up by loaders and hauled to the respective areas (closest to the piles). The excess of soil calculated may stem from either the estimation of organic stockpile #2, or that the area of the TSF is not accurate as a result of poor topography. As stated earlier, a survey is scheduled for fall 2011 that will clarify unknown quantities and elevations. The survey of the soil and disturbance areas will provide a more accurate soil balance. AGC and the contractor will salvage additional soil during the recontouring of areas and recover any additional soil should the opportunity present itself.

Table 7. Preliminary Soil Balance

Location	Topsoil Depth (m)	Volume (m^3)
Plant Site (Area 1)	0.3	52,500
Main and Walsh Pits (Area 2)	0.6	51,300
TSF and DC #3 (Area 3)	0.3	291,700
IWF (Area 4)	0.3	117,000
Explosives Storage Area (Area 5)	0.3	103,400
DC #1 North (Area 6N)	0.3	20,900
DC #1 South (Area 6S)	0.3	25,300
Causeway and Roads (Area 7)	0.3	7,800
Total required soil		**669,900**
Topsoil #1		459,000
Topsoil #2		179,000
Topsoil #3		595,000
Total soil available from stockpiles		**1,233,000**

6.0 POST-CLOSURE MONITORING

The overriding goal of the Rock Creek Mine Reclamation and Closure Plan is to restore the mine site to a near-natural condition and thereby eliminate the long term of adversely affecting water quality as a result of previous mine-related activities. AGC is taking an aggressive approach that will restore and/or stabilize all disturbed areas, and remove or permanently confine any materials that contain constituents of concern.

Current water quality monitoring requirements are governed by WMP No. 2003-DB0051 and the TCP as approved by the ADEC on April 26, 2010. These requirements will continue to apply until the major closure activities described in this final reclamation and closure plan are completed. The monitoring requirements for the post-closure period focus on surface and ground water monitoring activities that will verify the successful completion of reclamation activities. Systems that are decommissioned and removed during active closure (e.g., water treatment plant, seepage collection system) are not included in the post-closure monitoring plan.

This monitoring plan incorporates elements of, but supersedes, the TCP (April 26, 2010) and the Rock Creek Mine Monitoring Plan—Plan of Operations, Volume 7 (May 2006). This plan shall remain in effect for the duration of the post-closure monitoring period, except as modified by AGC and approved by ADEC. The post closure monitoring period extends to 30 years following the completion of major closure activities, although AGC reserves the right to request termination of some or all post closure monitoring requirements upon submittal to ADEC of information documenting the return to natural conditions for the Rock Creek Mine site.

6.1 WATER QUALITY MONITORING

Water quality monitoring during the post closure period will focus on representative surface and ground water locations to demonstrate that areas previously supporting mine-related activities have chemically stabilized following closure and pose no long term risk to water quality.

6.1.1 Sample Locations

The sample locations shown in Table 8 and figures 25 and 26 have been selected as representative water quality monitoring stations. New monitoring well MW11-18 was specifically installed in fall 2011 to provide closure monitoring data immediately downgradient of the Main Pit area (Figure 25). It was drilled to a depth of 120 feet.

Table 8. Water Quality Sampling Locations

Water Type	System	Sample ID	Description	Rationale
Surface	Rock Creek	DC-3	Rock Creek at the DC-3 outfall, upstream of Glacier Creek Road	Collection point is downstream of previously disturbed areas; sample used to demonstrate stability of reclaimed areas.
	Snake River	SABC	Snake River at Balto Creek	Collection point is upstream of any potential influence from the mine; sample provides basis for comparison with downstream sample.
		SRTB	Snake River at Teller Bridge	Collection point is downstream of the mine site; sample used to demonstrate overall site stability and document influence, if any, from mine area.
Ground	TSF	MW06-09A	Groundwater monitoring well located downgradient from the TSF	Collection point is downgradient from the TSF; all paste tailings will be removed prior to the end major closure activities; sample used to verify no residual influence on groundwater quality.
	IWF	MW07-11; MW08-15	Groundwater monitoring wells located downgradient from the lower IWF, west of Glacier Creek Road	Collection point is downgradient from the lower IWF. Treated water injection will cease prior to the end of major closure activities; sample used to verify no residual influence on groundwater quality.
	RWP	MW08-14A/B	Groundwater monitoring wells located downgradient from RWP	Collection point is downgradient from the RWP; RWP will be decommissioned and backfilled prior to the end of major closure activities; sample used to verify no residual influence on groundwater quality.
	Main Pit/IWF	MW09-17	Groundwater monitoring well located downgradient of Main and West pits	Collection point downgradient of pit areas; sample used to verify no residual influence on groundwater quality.
	Main Pit	MW11-18	Groundwater monitoring well located immediately downgradient of Main Pit	New collection point used to monitor the backfilled pit area; sample used to verify no residual influence on groundwater quality.

6.1.2 Sample Collection Schedule

Samples for surface and ground water locations will be collected according to the schedule shown in Table 9. As discussed above, the post-closure monitoring plan will commence immediately following the completion of major closure activities. Annual samples will be collected during July of each designated year, or during a reasonably similar period of open water. All samples, both surface and ground, should be collected within the same time period to facilitate comparative analysis, if necessary. As noted above, AGC may request early relief from post-closure monitoring requirements after year 5 if samples collected in years 1, 2, and 5 demonstrate the monitored system has chemically stabilized. Any modification to the sample collection schedule in Table 9 must be approved in writing by ADEC prior to implementation.

Table 9. Sample Collection Schedule

Water Type	System	Sample ID	Frequency	Collection Time	Collection Years
Surface	Rock Creek	DC-3	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
	Snake River	SABC	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
		SRTB	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
Ground	TSF	MW06-09A/B	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
	IWF	MW07-11; MW08-15	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
	RWP	MW-08-14A/B	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
	Main Pit/IWF	MW9-17	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30
	Main Pit	MW11-18	Annual	July	Years 1, 2, 5, 10, 15, 20, & 30

6.1.3 Surface Water Parameters

Surface waters shall be analyzed for parameters shown in Table 10. Sample results will be analyzed as described in Section 6.1.5.

Table 10. Surface Water Analytical Parameters

Parameter	State	Sample Type	Limit	Method Detection Limit	Units	Test Method
Aluminum	Total	Grab	87	6.20	µg/L	200.8
Antimony	Total	Grab	6	0.31	µg/L	200.8
Arsenic	Total	Grab	10	2.5	µg/L	200.8
Barium	Total	Grab	2	0.94	mg/L	200.8
Beryllium	Total	Grab	4	0.13	µg/L	200.8
Cadmium	Dissolved	Grab	[a]	0.15	µg/L	200.8
Calcium	Total	Grab	NA	0.062	mg/L	200.7
Chromium	Total Recoverable	Grab	100	0.62	µg/L	6010B/200.8
Cobalt	Total	Grab	50	1.2	µg/L	200.8
Copper	Dissolved	Grab	[a]	0.31	µg/L	200.8
Iron	Dissolved	Grab	1	0.0124	mg/L	200.7
Lead	Dissolved	Grab	[a]	0.062	µg/L	200.8
Magnesium	Total	Grab	NA	0.062	mg/L	200.7
Manganese	Total	Grab	50	0.31	µg/L	200.8
Mercury	Total	Grab	50	0.5	ng/L	1631 E
Molybdenum	Total	Grab	10	3.1	µg/L	6010B/200.8
Nickel	Dissolved	Grab	[a]	0.62	µg/L	6010B/200.8
Potassium	Total	Grab	NA	0.15	mg/L	200.8
Selenium	Total	Grab	5	1.5	µg/L	200.8
Silver	Total	Grab	[a]	0.31	µg/L	200.8
Sodium	Total	Grab	NA	0.15	mg/L	200.8

Parameter	State	Sample Type	Limit	Method Detection Limit	Units	Test Method
Thallium	Total	Grab	1.7	0.31	µg/L	200.8
Vanadium	Total	Grab	100	6.2	µg/L	200.8
Zinc	Dissolved	Grab	[a]	2.5	µg/L	200.8
pH	NA	Field [b]	6.5 to 8.5	NA9	s.u.	150.1
Conductivity	NA	Field [b]	NA	NA	µS/cm	120.1
Temperature	NA	Field [b]	NA	probe	°C	
Alkalinity	as CaCO3	Grab	20	3.10	mg/L	SM20 2320B
Chloride	Total	Grab	230	0.0310	mg/L	300.0
Cyanide	Total	Grab	NA	1.5	µg/L	SM 4500-CN CE
Cyanide	Weak acid dissociable	Grab	5.2	1.5	µg/L	SM 4500-CN I
Fluoride	Total	Grab	1	0.0310	mg/L	300.0
Hardness	Total	Calculated	NA	NA	mg/L	130.2
Nitrate + Nitrite	as N	Grab	10	0.0310	mg/L	300.0
Phosphorus	Total	Grab	NA	0.0620	mg/L	300.0
Sulfate	Total	Grab	250	0.0310	mg/L	300.0
Dissolved solids	Total	Grab	500	3.10	mg/L	160.1
Suspended Solids	Total	Grab	NA	0.150	mg/L	160.2

[a] Hardness dependent limit

[b] Field samples analyzed using direct probe or within 15 minutes of sample collection.

<u>*Hardness Calculation*</u>

Permanent water hardness for each sample shall be calculated according to the following equation:

$$H = [2.5 \times Ca^{2+}] + [4.1 \times Mg^{2+}]$$

where:

H = permanent water hardness, as $CaCO_3$, in mg/L
Ca^{2+} = calcium, in mg/L
Mg^{2+} = magnesium, in mg/L

The calculated hardness shall be used determining the applicable limit for hardness-dependent criteria shown in Table 11. Hardness-dependent criteria shall be calculated according to the *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances—Appendix A (December 2008).*

6.1.4 Groundwater Parameters

Groundwater shall be analyzed for parameters shown in Table 11. Sample results will be analyzed as described in Section 6.1.5.

Table 11. Groundwater Analytical Parameters

Parameter	State	Sample Type	Limit	Method Detection Limit	Units	Test Method
Antimony	Total	Grab	6	0.31	µg/L	200.8
Arsenic	Total	Grab	10	2.5	µg/L	200.8
Cadmium	Dissolved	Grab	[a]	0.15	µg/L	200.8
Calcium	Total	Grab	NA	0.062	mg/L	200.7
Chromium	Total Recoverable	Grab	100	0.62	µg/L	6010B/200.8
Copper	Dissolved	Grab	[a]	0.31	µg/L	200.8
Iron	Dissolved	Grab	1	0.0124	mg/L	200.7
Lead	Dissolved	Grab	[a]	0.062	µg/L	200.8
Magnesium	Total	Grab	NA	0.062	mg/L	200.7
Manganese	Total	Grab	50	0.31	µg/L	200.8
Mercury	Total	Grab	50	0.5	ng/L	1631 E
Nickel	Dissolved	Grab	[a]	0.62	µg/L	6010B/200.8
Potassium	Total	Grab	NA	0.15	mg/L	200.8
Sodium	Total	Grab	NA	0.15	mg/L	200.8
Zinc	Dissolved	Grab	[a]	2.5	µg/L	200.8
pH	NA	Field [b]	6.5 to 8.5	NA9	s.u	150.1
Conductivity	NA	Field [b]	NA	NA	µS/cm	120.1
Temperature	NA	Field [b]	NA	probe	°C	
Alkalinity	as CaCO3	Grab	20	3.10	mg/L	SM20 2320B
Chloride	Total	Grab	230	0.0310	mg/L	300.0
Cyanide	Weak acid dissociable	Grab	5.2	1.5	µg/L	SM 4500-CN I
Hardness	Total	Calculated	NA	NA	mg/L	130.2
Nitrate + Nitrite	as N	Grab	10	0.0310	mg/L	300.0
Sulfate	Total	Grab	250	0.0310	mg/L	300.0
Dissolved solids	Total	Grab	500	3.10	mg/L	160.1
Suspended Solids	Total	Grab	NA	0.150	mg/L	160.2

[a] Hardness dependent limit

[b] Field samples analyzed using direct probe or within 15 minutes of sample collection.

Hardness Calculation

Permanent water hardness for each sample shall be calculated according to the following equation:

$$H = [2.5 \times Ca^{2+}] + [4.1 \times Mg^{2+}]$$

where:

H = permanent water hardness, as $CaCO_3$, in mg/L
Ca^{2+} = calcium, in mg/L
Mg^{2+} = magnesium, in mg/L

The calculated hardness shall be used in determining the applicable limit for hardness-dependent criteria shown in Table 11. Hardness-dependent criteria shall be calculated according to the *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances—Appendix A (December 2008).*

6.1.5 Analysis and Corrective Action

All sample results will be compared to the applicable limit, if any, and recorded in the Rock Creek Mine Environmental Management System (EMS).

An exceedance of any applicable limit will be verbally reported to ADEC within 24 hours of receipt of laboratory results. Written confirmation of the exceedance will be submitted within 30 days. In addition, the following corrective actions will be implemented.

Quality assurance procedures shall be reviewed to determine whether the sample collection plan was correctly implemented. All steps of the monitoring process (collection, shipping, analysis, transcription) shall be reviewed to determine if sample contamination or data entry error could be the cause of the exceedance. Results shall be summarized and provided to ADEC. If no conclusive explanation is determined, additional actions shall be implemented as described below.

Corrective Action

Arsenic, iron, manganese, and other metals are found naturally in the surface and ground water around the Rock Creek Mine site at levels above the limits in Tables 3 and 4, which are based on Alaska's water quality standards. AGC shall compare any observed exceedances to available background data from the site to determine whether the exceedances are representative of natural conditions with the area. All such comparisons will be provided to ADEC with the written confirmation of the exceedance(s).

If ADEC does not concur that the exceedance(s) are consistent with the natural background conditions at the site, AGC shall initiate an accelerated monitoring program to isolate the source of exceedance. An accelerated monitoring program shall be determined specifically for each instance and may include more frequent sampling, additional sample collection points, or analysis of duplicate samples at an alternative laboratory.

Within 60 days of submittal of the exceedance confirmation report, AGC shall submit the results of the accelerated monitoring to ADEC along with a draft corrective action plan to implement any measures necessary to address the exceedance(s) and protect human health and the environment. AGC shall implement the final corrective action plan after review and approval by ADEC. All reports shall also be provided to Sitnasuak Native Corporation and Bering Straits Native Corporation.

Sample Collection

All samples will be collected in bottles, with appropriate preservatives, provided by the analytical laboratory. Field parameters (pH/temperature/conductivity) will be measured in the field when weather conditions allow, and in protected mine facilities during inclement weather.

Sampling procedures to preserve the integrity of the water quality samples will include:

- Collection of representative and undisturbed water from flowing portions of the stream (surface water samples);
- Collection of representative water from monitoring wells following sufficient purging of standing water (groundwater samples);
- Using new disposable sample collection equipment for each sample (i.e. gloves, tubing, and 0.45 micron filter for the peristaltic pump); and
- Collection and documentation of field parameters at each location.

After collection, the samples will be returned directly to the environmental offices and placed in a refrigerator or preserved with ice. If filtration is required, this will be performed in the field or at the environmental offices before refrigeration or preservation. The samples will then remain in a refrigerator or on ice until they are shipped, in coolers packed with ice or “blue ice”, to the laboratory for analysis.

Standard methods will be followed for shipping the collected samples, including preservation in coolers with ice or “blue ice”, completing a chain of custody, and attaching seals to each cooler to detect any potential tampering. Samples will be expeditiously transported from the field to Nome for commercial air transport to the analytical laboratory to meet the shortest holding times for analyses. Sample preservation, handling, transport, and custody control will be performed according to the Surface Water Monitoring Quality Assurance Plan (HMH Consulting 2005) and the Groundwater Sampling and Analysis Quality Assurance Plan (Water Management Consultants 2005).

6.2 REVEGETATION MONITORING METHODS

Annual monitoring of multiple key indicators of site “stability” is proposed. These key indicators include multiple vegetation, surface erosion, sedimentation, and slope stability parameters. Annual monitoring will include:

- Estimation of soil stability for all reclaimed areas using the qualitative descriptors and ranking system;
- Inspection of slope movement, cut slope and rock face failures, and other indications of deep-set slope instability. Indications of slope failure may include, but are not limited to, surficial fractures that progressively widen and elongate, and/or surface cracks that are located above prominent, recently observed surface bulges;
- Inspection of all surface drainage channels and impoundments for indication of instability or reduced capacity to safely pass the design storm event or retain transported sediments;
- Documentation of the location, dimensions and connectivity of significant erosion, slope failures and channel scour and sedimentation features;
- Revisiting significant erosion, slope failures, and channel scour and sedimentation features documented in previous years to determine if new accretion, erosion or movement has occurred since last observed; and
- Documentation of the presence, abundance, frequency, and importance of:
    - plant species observed in the reclaimed area (and potentially the reference area);
    - plant species recognized as indicators of more mature vegetation communities; and
    - volunteer plant species (species that were not in the reclamation seed mixture).

Beginning in the first growing season after reclamation operations have been completed, monitoring of reclaimed areas would be performed. Monitoring would be performed annually for a minimum of five consecutive years, continuing until successful reclamation is demonstrated. The primary criterion for success will be 70% revegetation cover.

6.3 REPORTING

The results of analytical data and visual revegetation monitoring shall be reported to ADEC no later than 60 days following the calendar quarter subsequent to the collection of reportable data. Reports shall include all necessary data to determine data validity, data variations and trends, and any exceedance of the limits contained in this plan. All records created during the collection and analysis of reportable data shall be retained and made available to ADEC for three years. All reports shall be submitted to Sitnasuak Native Corporation and Bering Straits Native Corporation concurrent with submittal to ADEC.

6.4 SAMPLING DATA TRENDS

Antimony, arsenic, iron, and manganese are the constituents most likely to be present at elevated levels in water samples collected in and around the Rock Creek Mine. This is largely due to the naturally high mineralization present in the Snake River Valley. Water quality sampling data collected from various surface water locations and groundwater monitoring wells since 2010 have continually demonstrated that the Rock Creek Mine has not adversely impacted water quality near the mine site during operations and temporary closure. The potential for any long-term adverse impact will be further reduced following closure, when potential constituent sources (e.g., surface tailings, groundwater injection, surface water discharge) are eliminated.

The following sections summarize water quality monitoring data collected at the Rock Creek Mine from prior to mine construction through summer 2011. Data is only presented for the key constituents likely to be observed in notable quantities in the vicinity of the Rock Creek Mine or likely to result from mining activities (i.e., antimony, arsenic, iron, and manganese). Additional summaries of water quality, particularly as it relates to acid rock drainage potential, are discussed in Attachment 2, which addressed the predicted long-term behavior of the backfilled Main Pit. A more detailed discussion, with a full analysis of all water sampling data, is included in Rock Creek Mine annual reports submitted to ADEC and ADNR, and can be reviewed at dnr.alaska.gov/mlw/mining/largemine/rockcreek/.

6.4.1 Surface Water

Potential adverse impacts to surface water quality from the Rock Creek Mine are primarily monitored via samples collected at three locations (Figure 25):

- SABC—Snake River upstream of any potential influence from the Rock Creek Mine
- SRTB—Snake River downstream from all mining activities at the Rock Creek Mine
- DC3-A—Rock Creek downstream from the TSF and Main Pit

Samples collected from SRTB and DC3-A are compared to WQS and natural background conditions to determine what influence, if any, mining activities have on surface water quality. Samples collected from SABC serve as a reference point that, in theory, represents receiving water quality that has not been impacted by any mining activities. The geochemistry of the Snake River Valley, and the Rock Creek drainage in particular, demonstrate a high degree of natural mineralization that results in elevated background concentrations for certain key constituents, namely arsenic.

Water quality data from the DC3-A sample point have consistently demonstrated that mining activities have not adversely impacted surface water quality. Sample results for antimony, iron, and manganese are all well below the WQS, with observed values falling within a moderately variable range over time (charts 1-3). Likewise, results for arsenic show some variability over time, ranging from 57 to 107 µg/L, with all observed values greater than the WQS of 10 µg/L (Chart 4). These values, however, are consistent with the observed baseline water quality for arsenic, which was shown to range from 29 to 273 μg/L in pre-mining samples collected from 2004 to 2007 (Chart 5). Background samples were collected from Rock Creek at a location approximately 50 meters upstream from the current DC3-A location. All arsenic values observed at DC3-A are within one standard deviation (34 μg/L) of the mean of the baseline data (84 μg/L). AGC notes that all arsenic values observed since mine operations began are well within this baseline range and have not shown any discernible effect to surface water quality.

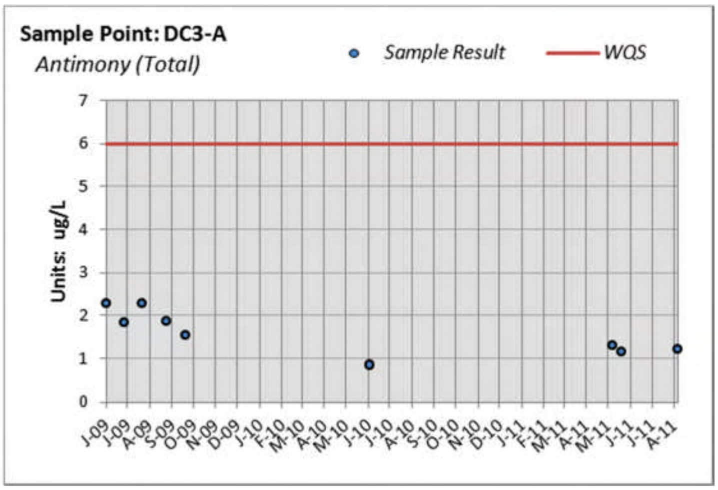


Chart 1

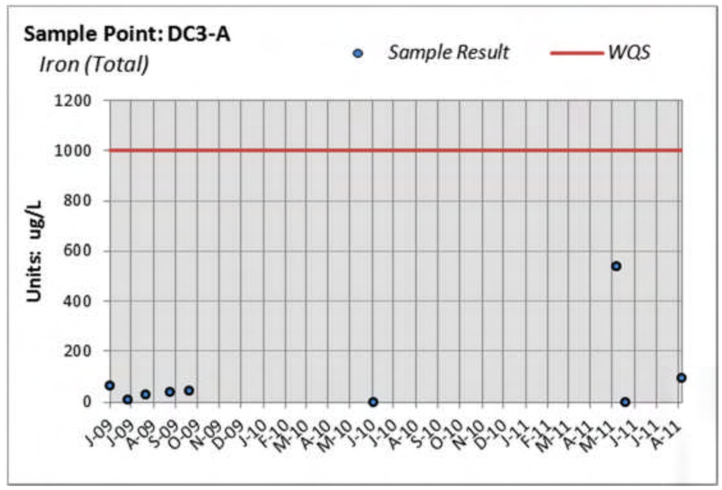


Chart 2

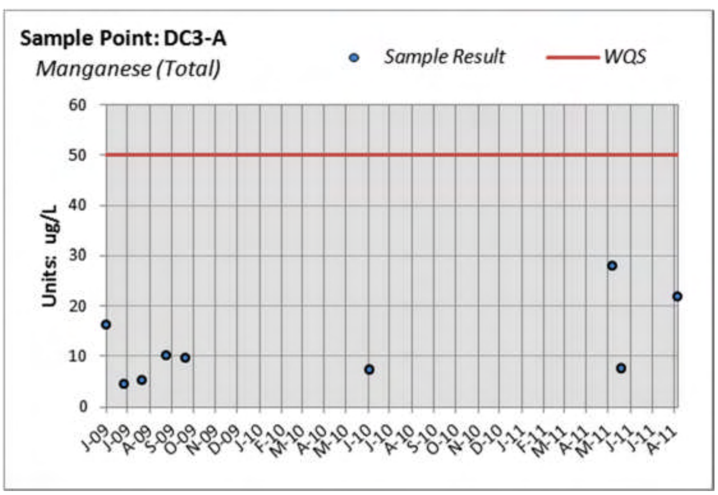


Chart 3

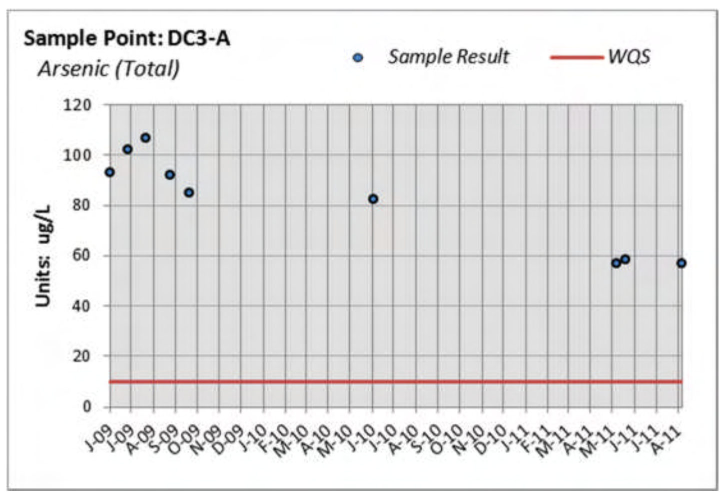


Chart 4

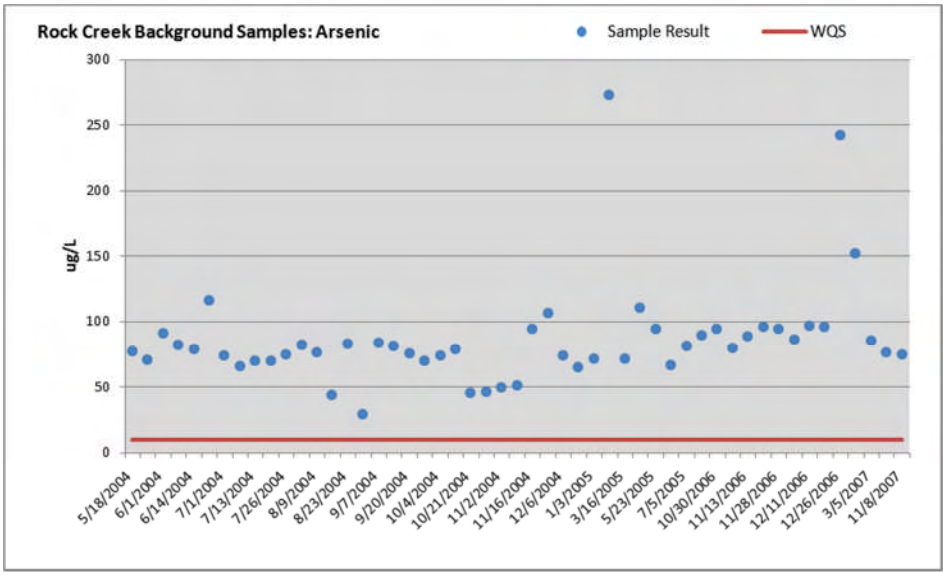
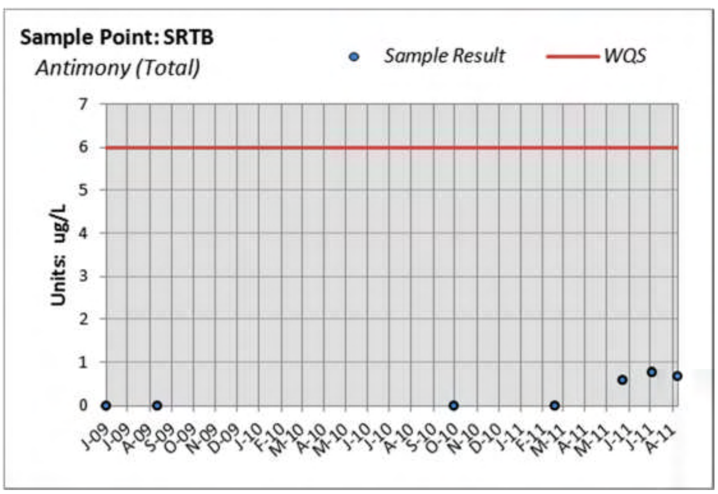


Chart 5

All surface water samples collected from the SRTB location downstream from the Rock Creek Mine have shown levels for antimony, arsenic, iron and manganese all well below their respective WQS (charts 6-9).



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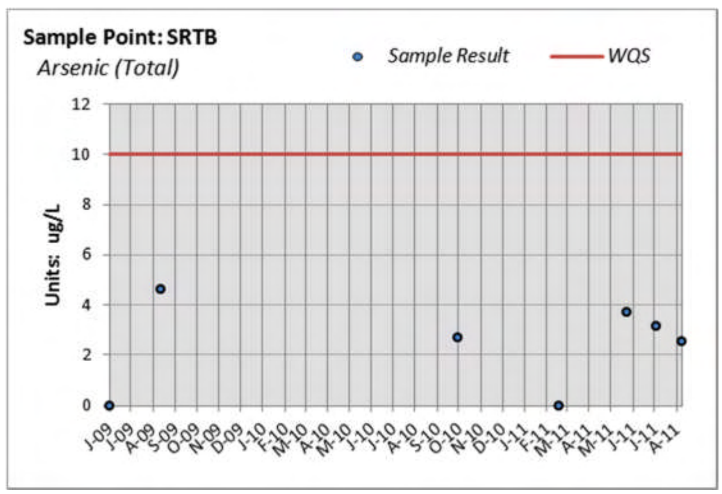

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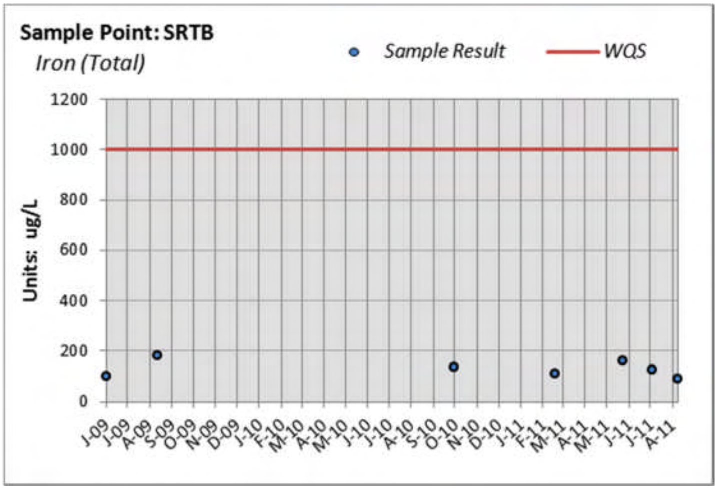

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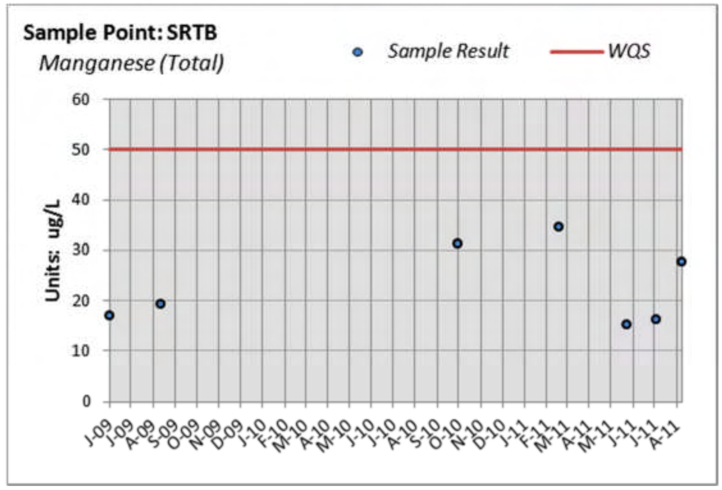


Chart 9

6.4.2 *TSF Monitoring Wells*

Potential impacts from TSF seepage to groundwater are monitored at monitoring wells MW06-09A and MW06-09B, located downgradient from the TSF embankment. Samples are compared to WQS and the natural background condition to determine what adverse impact, if any, is related to TSF seepage. When exceedances or statistically significant increases are observed, AGC is required to implement a corrective action plan.

AGC notes that weak acid dissociable (WAD) cyanide has never been detected at a level in excess of the WQS (0.0052 µg/L) in either of the TSF monitoring wells. Most sample results report WAD cyanide at undetectable levels, with the highest observed quantity reported as 0.0035 µg/L (January 22, 2009) in well MW06-09A. The most recent detected value was reported on August 27, 2010 (0.0015 µg/L) in well MW06-09A.

Data for MW06-9A show that, with the exception of arsenic, constituent concentrations for antimony, iron, and manganese are generally below the WQS and do not show any significant increase over background levels (charts 10-12). Arsenic concentrations, while above the WQS, are largely stable over time and do not show any influence from the TSF (Chart 13). Data for MW06-09B, collected at a shallower subsurface location than MW06-9A, show higher concentrations for all four key constituents, although values for antimony remain below WQS (charts 14-17).

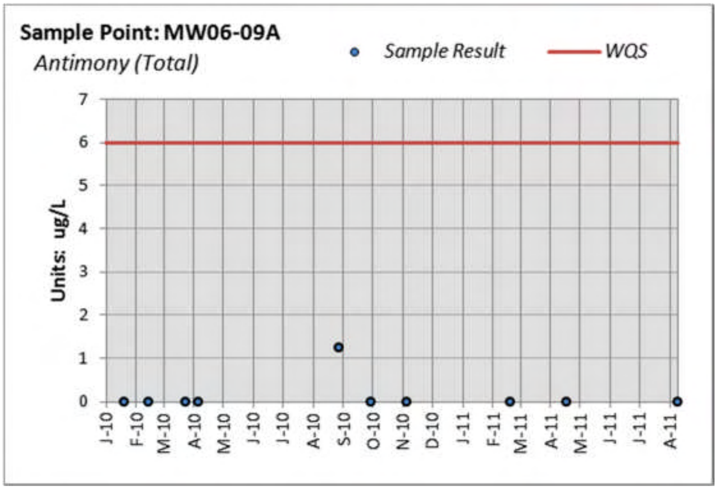


Chart 10

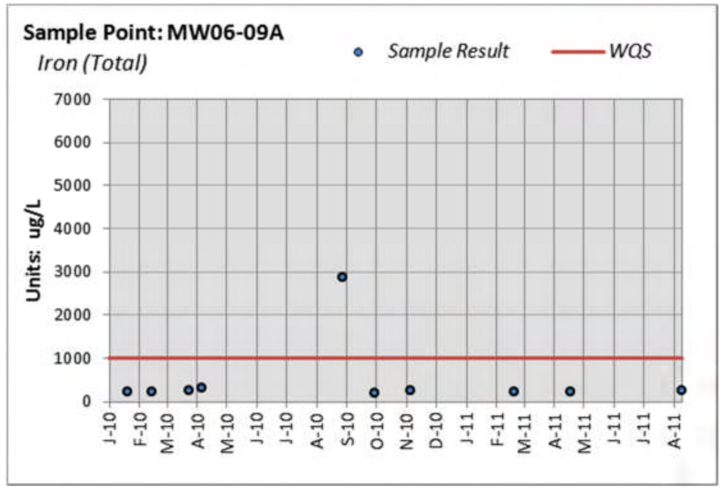


Chart 11

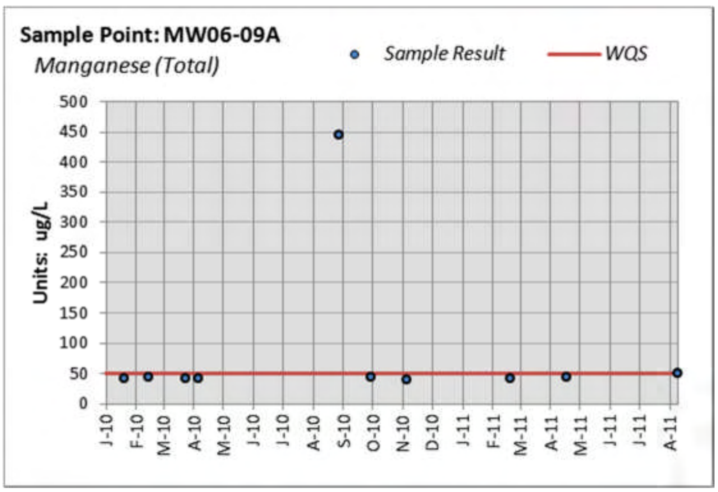


Chart 12

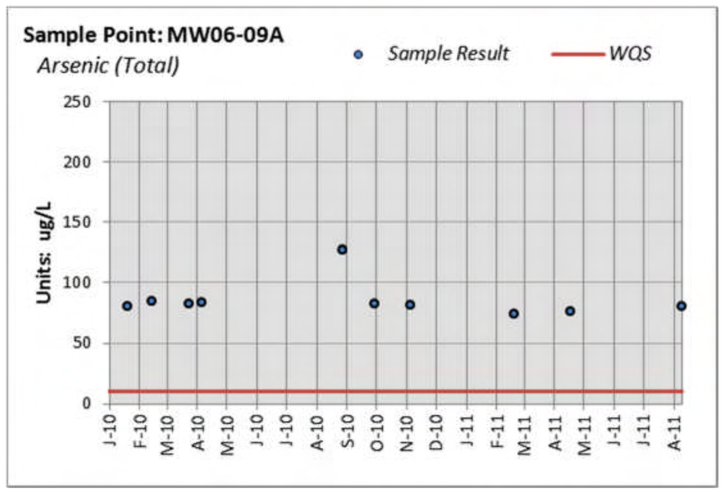


Chart 13

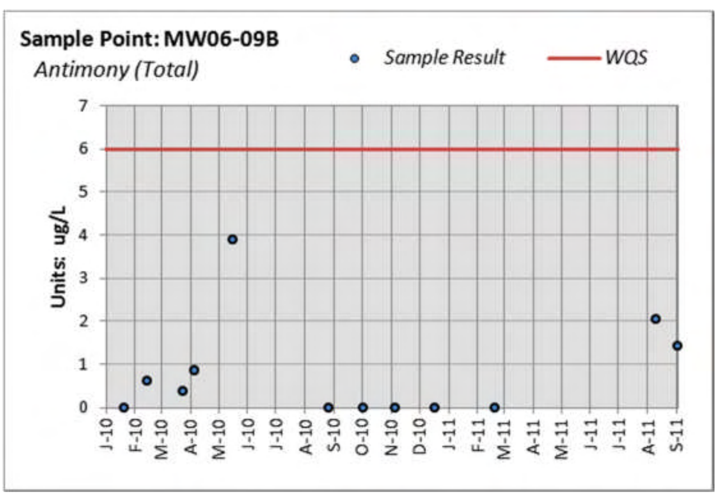


Chart 14

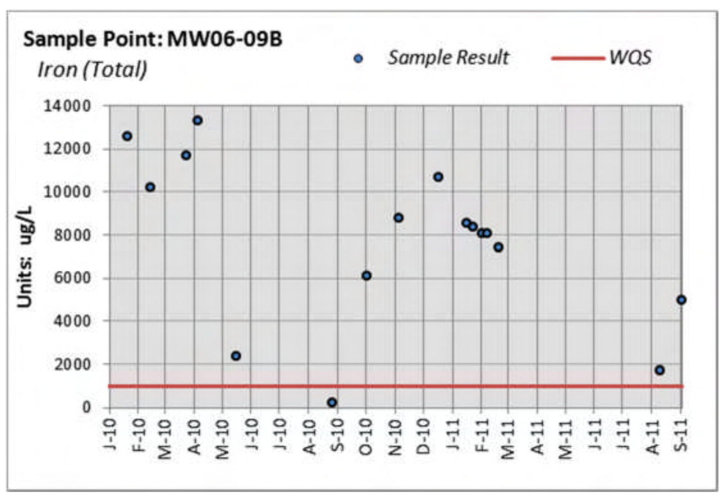


Chart 15

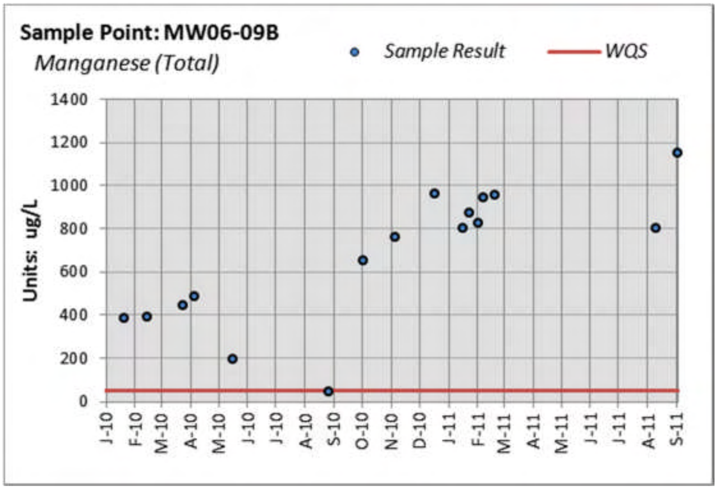


Chart 16

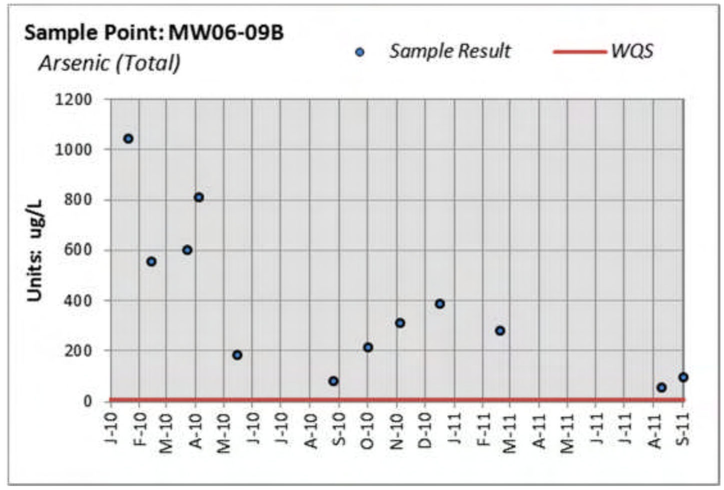


Chart 17

In response to observed exceedances, AGC implemented a corrective and investigative action plan in 2009, which consisted of accelerated monitoring and further statistical analysis. This plan was designed to more accurately determine the extent to which observed exceedances in the TSF monitoring wells were the result of natural background conditions rather than any influence from the TSF, and whether there have been any adverse impacts to groundwater. AGC notes that the TSF received only a small volume of tailings during the limited operating period in 2008, with no tailings placed in the TSF since 2008.

Tetra Tech, Inc., under contract to AGC, conducted a detailed statistical analysis of baseline conditions for each well. Tetra Tech's study reviewed data for each well individually to account for the potential differences in geochemistry and hydrology at each location. The resulting analysis demonstrated the strong influence of background groundwater concentrations on the observed exceedances in each well (Tetra Tech, 2010). In fact, nearly all sample results from the TSF wells, when considered against the more accurate natural conditions for each well, are within normal ranges for the Snake River Valley.

AGC submitted the detailed results of the Tetra Tech study to ADEC on April 27, 2010. This submittal proposed specific trigger levels for each well based on the higher of the water quality standard or the well-specific background level. AGC continues to report exceedances of water quality standards or upper tolerance limits (UTLs) as required under WMP section 1.2.10; however, AGC only performs further corrective action beyond monitoring when these well-specific background levels have been exceeded.

Arsenic

Exceedances of water quality standards for total arsenic are consistently observed in TSF monitoring wells and are generally below natural background levels established for these wells with the exception of the MW06-9A sample collected on August 27, 2010. The total arsenic level for MW06-9A (101 µg/L) was slightly above the established background level (93 µg/L). AGC re-sampled this well on September 30, 2010 to verify the accuracy of this single anomalous result. The re-sample result showed total arsenic (82.3 µg/L) was within natural background levels established for this well and within observed ranges for the Snake River valley.

Iron

Total iron levels in TSF monitoring wells vary in individual wells and show evidence of seasonal fluctuations when reviewing historic data. MW06-09A showed an anomalously high total iron (2860 µg/L) value in August 2010. As a result, AGC re-sampled the well on September 30, 2010 in order to verify the accuracy of the data. Re-sample results showed total iron levels (199 µg/L) were below water quality standards and within the expected range based on background data. Sample results for MW06-09B are observed over a greater range, but are generally consistent with the fluctuation and seasonal variability observed at other locations around the mine site.

Manganese

Total manganese values above WQS and established background levels were observed in the August 2010 sample MW06-09A (463 µg/L) and numerous times from November 2010 through 2011 for MW06-9B. Each well was re-sampled as a result of the exceedances. Re-sample results for MW06-09A (43.2 µg/L) showed total manganese levels were below WQS and expected ranges observed for these wells.

Re-sample results for total manganese in MW06-09B have remained high and well above historically observed levels for this well. AGC contracted HydroGeo, Inc. to conduct a geochemical and hydrologic investigation of MW06-09B, MW06-09A, and the Main Sump, which has elevated manganese levels, and has been considered up-gradient of these wells. HydroGeo, Inc. did not find any relationship between elevated manganese in the Main Sump and monitoring wells MW06-9A/B. Specifically, water level data show that groundwater appears to move from the wells towards the Main Sump rather than in the other direction. AGC submitted the HydroGeo technical memo to ADEC on February 16, 2011.

6.4.3 IWF Monitoring Wells

Monitoring wells MW07-11 and MW08-15A are located downgradient of the lower IWF, east of Glacier Creek Road. These wells are used to monitor potential influence resulting from the injection of treated wastewater from the Rock Creek Mine. Data for well MW07-11 consistently show concentrations for antimony, iron, and manganese below WQS (charts 18-20). Arsenic levels are above the WQS, but show little variance over time (Chart 21).

Data for MW08-15A show antimony below WQS (Chart 22) while arsenic is elevated but relatively stable over time (Chart 23). Iron and manganese concentrations show greater variability, ranging between levels above and below the WQS (charts 24-25).

Arsenic

Total arsenic is consistently above WQS for both IWF monitoring wells, but is within ranges observed for water quality around the mine site. The intent of these wells is to measure possible water quality influences from the injection of treated waste water. There have been no exceedances of permit limits/water quality standards for arsenic in the WTP effluent. Arsenic is routinely reported as “non-detect” in treated effluent.

Iron

Exceedances of water quality standards for total iron have been observed in well MW08-15A. There are no established background values for total iron in IWF wells. Previous data for these wells do not show any adverse or increasing trends; elevated iron levels are attributed to natural background variations and seasonal fluctuations that are observed around the mine site. The intent of these wells is to measure possible influences on groundwater chemistry from the injection of treated waste water. Since 2010, there has been only one exceedance of total iron permit limits/water quality standards in the WTP effluent (2630 μg/L on March 11, 2010).

Manganese

Monitoring well MW08-15A shows several exceedances of water quality standards for total manganese since 2010. Although some values are above water quality standards, total manganese is within natural background values observed at other wells around the mine site. The intent of these wells is to measure possible water quality influences for the injection of treated waste water. There have only been a few, sporadic exceedances of permit limits/water quality standards for manganese in the WTP effluent, and there were no exceedances for manganese in the WTP effluent from May 25 to December 23, 2010.

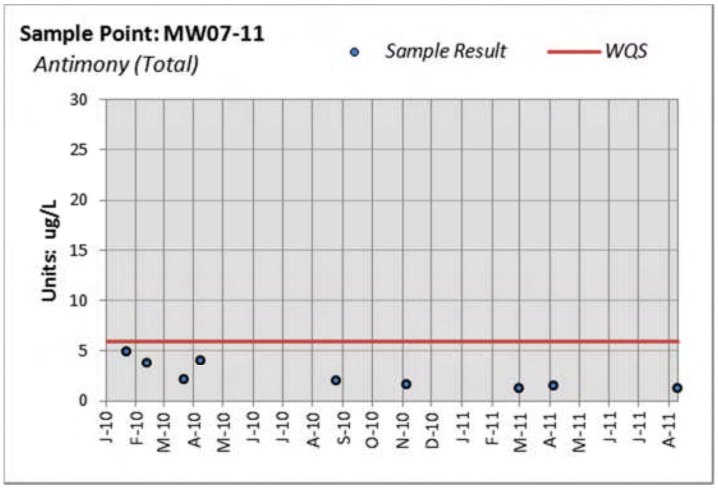


Chart 18

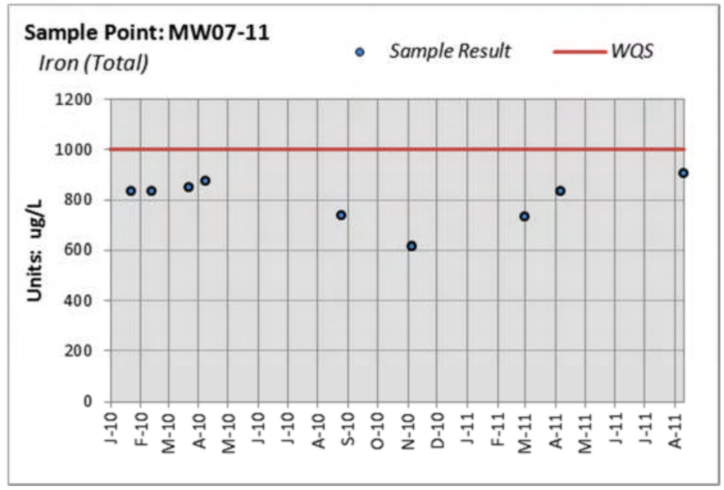


Chart 19

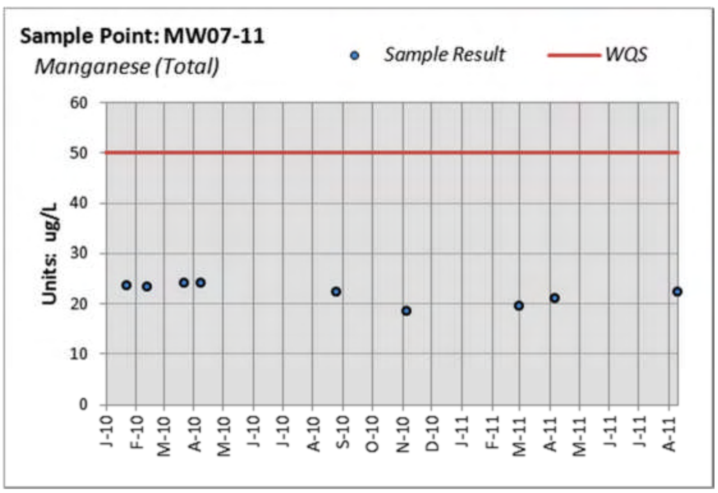


Chart 20

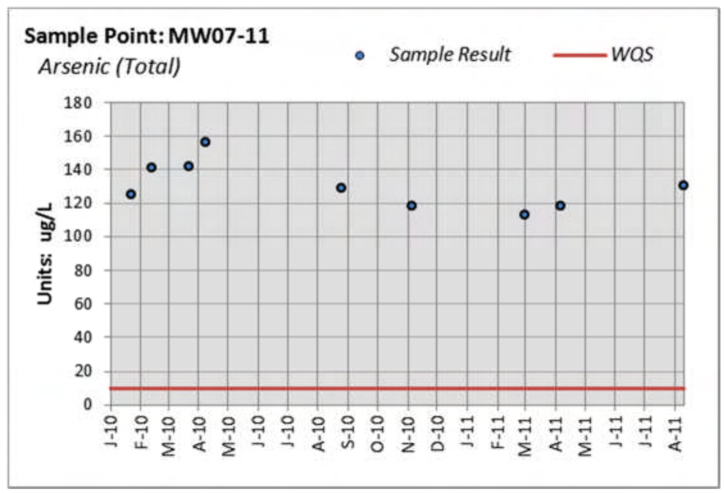


Chart 21

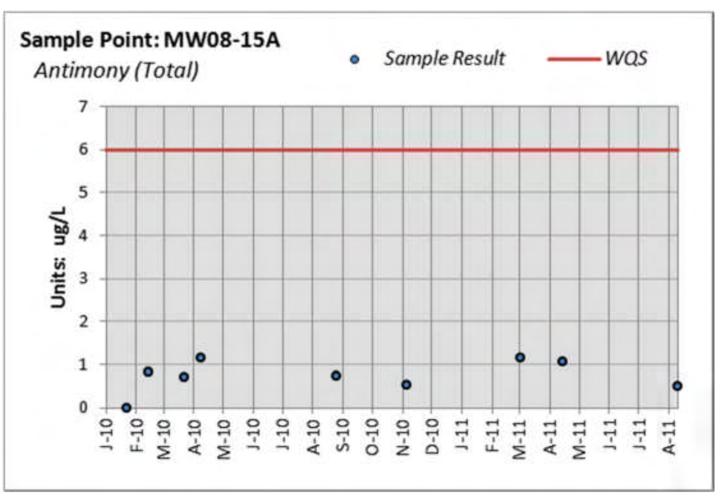


Chart 22

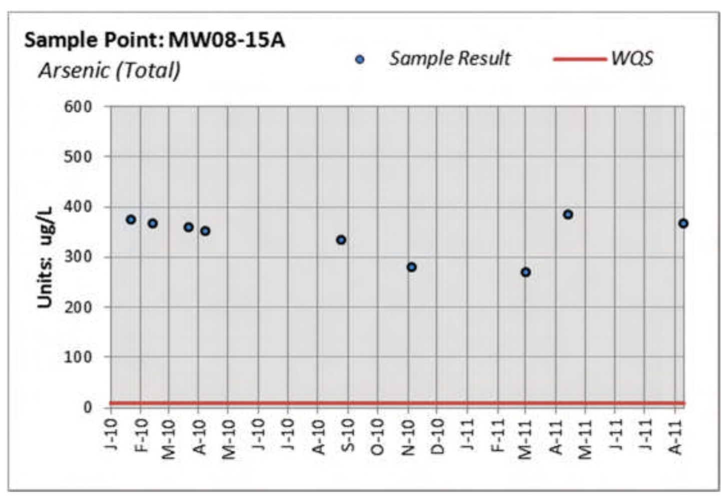


Chart 23

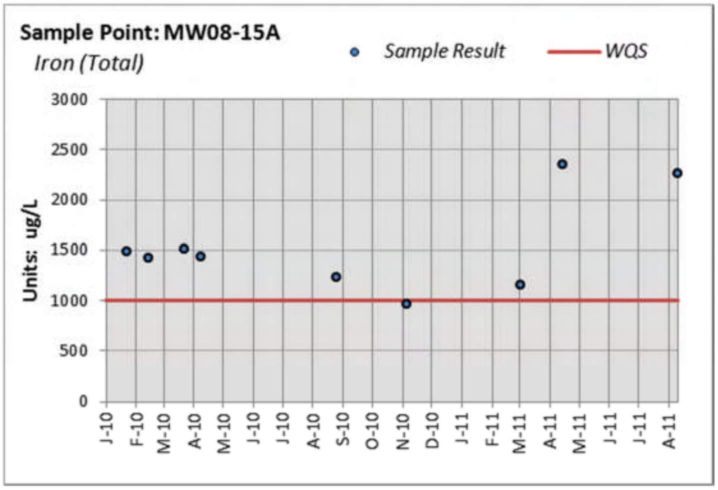


Chart 24

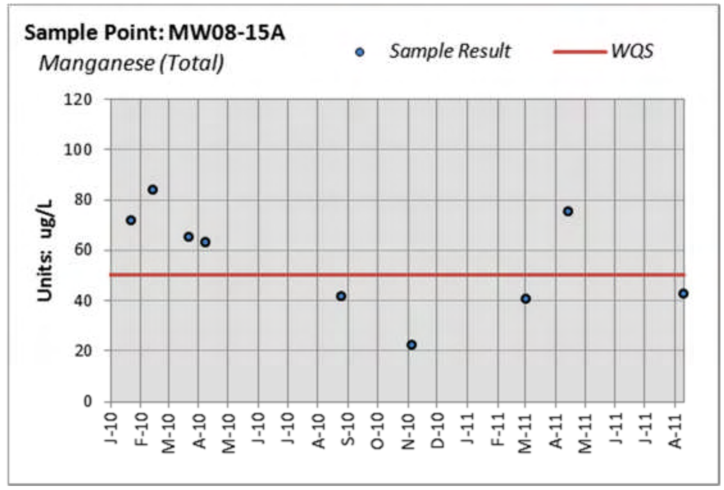


Chart 25

6.4.4 RWP Monitoring Wells

Monitoring wells MW08-14A and MW08-14B are located immediately downgradient of the RWP and are used to detect leaks from the RWP and RWP underliner. Well MW08-14B is in a shallow subservice location and is not routinely sampled due to insufficient water levels. Data for MW08-14A consistently show antimony and manganese levels below WQS and relatively stable over time (charts 26-27). Arsenic and iron levels are above the WQS, but show little variance over time (charts 28-29). Any effect from underliner leaks will cease, however, when the RWP is decommissioned. As indicated in Section 5.3.4, the specific closure and reclamation plan for the RWP is being developed and will be submitted to the state for approval. AGC does, however, expect to remove all water from the RWP and chemically stabilize all remaining sludges/solids prior to final closure.

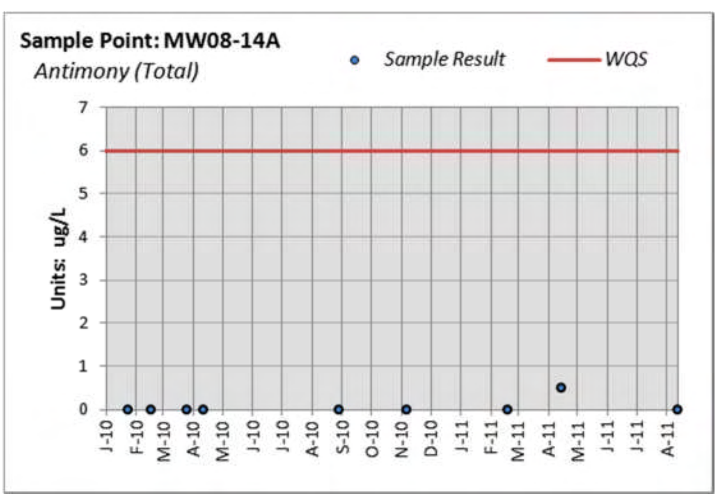


Chart 26

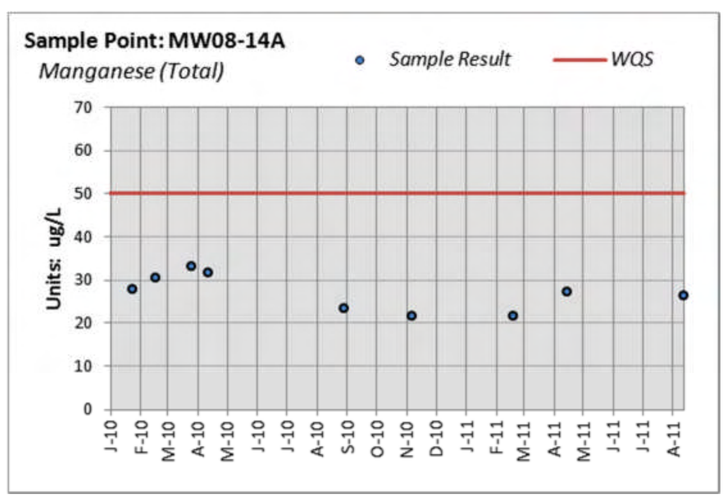


Chart 27

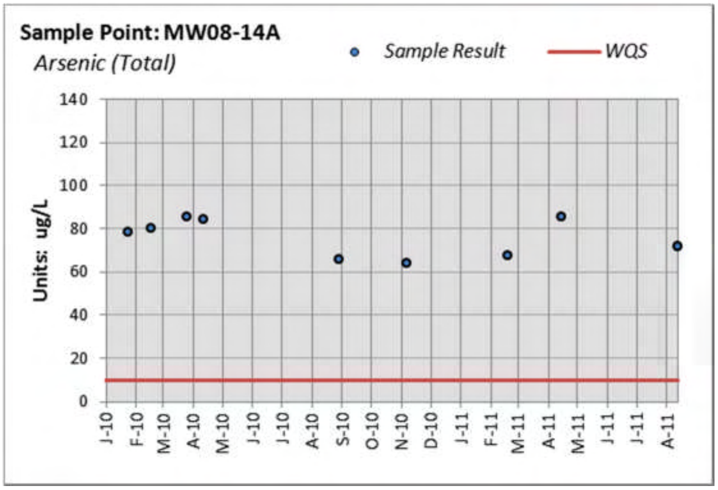


Chart 28

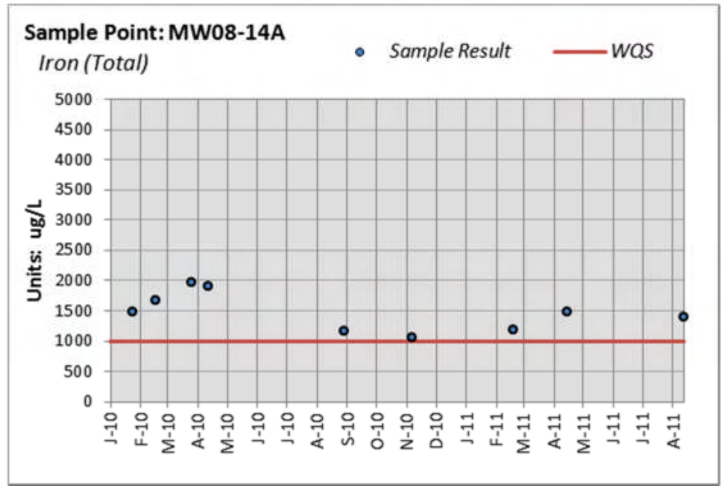


Chart 29

TETRA TECH
350 Indiana Street, Suite 500
Golden, CO 80401
Tel (303) 217-5700 Fax (303) 217-5705
www.tetratech.com

Technical Memorandum - Revised

To:	Luis Quirindongo; Tim Havey	From:	Tim Reeves
Company:	Alaska Gold Company, Inc.	Date:	June 15, 2011
Re:	Site Hydrology for Closure Revised	Project #:	Rock Creek Closure
CC:			

Rainfall-runoff modeling was conducted for the post-closure Rock Creek Drainage delineation and the post-closure drainage associated with the Tailings Storage Facility (TSF). The analysis was conducted to calculate the magnitude and timing of the peak discharge resulting from rainfall-runoff produced by design storms. For both drainage basins, the SCS Curve Number approach was used to determine initial abstractions and excess precipitation, and the SCS unit hydrograph method was used to derive the peak flow and hydrograph resulting from excess rainfall. All modeling was conducted using the SCS Type I rainfall distribution. Input parameters for the HEC-HMS models are provided in Table 1 for the Rock Creek Drainage and Table 2 for the Tailings Facility Drainage. A Summary of HEC-HMS results for several design storms and for each drainage basin are provided in Attachment 1*: HEC-HMS Results.*

Table 1. HEC-HMS input parameters for the Rock Creek drainage

Basin Area	Hydraulic Length (L)	Average Basin Slope (S)	Time of Concentration (Tc)	Lag Time (tp)	SCS Curve Number
m^2	m	m/m	minutes	minutes	
3,020,344	2,645	0.207	15.4	9.3	68

Analysis assumed a baseflow of 0.042 m^3/second and a recession coefficient of 0.9
m = meters

Table 2. HEC-HMS input parameters for the Tailings Storage Facility drainage

Basin Area	Hydraulic Length (L)	Average Basin Slope (S)	Time of Concentration (Tc)	Lag Time (tp)	SCS Curve Number
m^2	m	m/m	minutes	minutes	
988,858	2,339	0.102	18.4	11.0	80

m = meters

For all designs and evaluations, flow depths, widths, and velocities were evaluated statically, using Manning's equation in an Excel Workbook.

Estimated discharges at the base of the Rock Creek drainage were calculated for the 24-hour Probable Maximum Precipitation (PMP) storm event (10.6 inches). This design storm resulted in a peak discharge at the causeway breach of 89.2 cubic meters per second (m^3/s). The peak discharge was used to evaluate the excavation size through the existing road causeway near the base of the creek. It was assumed that this excavation would be a trapezoidal cut with a 30 meter base and 3:1 side slopes. With this design, the discharge that would result from the 24-hour PMP event through the causeway breach would have a flow depth of 1.00 meters (m). Detailed results for these analyses and other smaller design storms are provided in Attachment 2: *Rock Creek Designs.*

The runoff from the 2-year 24-hour event was also used to size a drainage channel invert for Rock Creek to replace the current culverts that convey flow through the breach in the causeway. Table 3 shows channel dimensions for dimensions for the Rock Creek channel invert for the 2-year, 24-hour storm event.

Estimated discharges at the breach of the Tailings Storage Facility were calculated for the Probable Maximum Precipitation (PMP) 24-hour storm event (10.6 inches). The resulting peak flow was 34.48 cubic meters per second (m^3/s) through the breach. This peak flow was used to evaluate the size the breach in the TSF dam and to size the channel invert draining through the breach and through the existing #3 Diversion to Rock Creek. It was assumed that the breach would be a trapezoidal cut with a 7.0 percent slope. Table 4 shows the flood dimensions for the breach and Table 5 shows channel dimensions for the lower channel invert at its narrowest width for the 24-hour PMP storm event. Detailed results and recommended rip-rap size for these are provided in Attachment 3: *Tailings Storage Facility.*

A water surface profile analysis was also conducted to evaluate the conveyance of the Probable Maximum Flood (PMF) through the dam breach, the design conveyance channel and the #3 Diversion Channel. A summary table of results are provided in Table 6. This analysis indicates that the current breach and channel design adequately convey the peak flow from the PMF.

The estimated runoff discharge was also estimated for the drainage area at the inside base of the dam in order to evaluate runoff velocities draining along the dam base to the breach and to estimate rip rap size to be used for armoring. While this analysis was done to size the armoring, it is assumed that a formally designed conveyance channel is required along this base. The analysis was conducted by assuming that one-half of the discharge volume for the TSF area (17.24 m^3/s) would drain to each side of the breach and drain toward the breach at a slope of 1.5 percent. Table 7 shows the flood dimensions of this drainage.

Table 3. Rock Creek Channel Dimensions and Data		
Flow depth (d)	0.241	m
Free Board	0.25	m
Channel Depth with free board (D)	0.49	m
Channel bottom width (b)	0.45	m
Side Slopes (z)	2	m/m
Top Width of Flow	1.41	m
Top Width with free board	2.41	m
Hydraulic Radius [R]	0.15	m
Velocity	0.70	m/sec
Flow X-Sectional Area	0.2	m^2
X-Sectional Area w/ free board	0.7	m^2
Discharge	0.156	m^3/sec

Table 4. TSF Breach PMF Flood Evaluation		
Flow depth (d)	0.4	m
Free Board	0	m
Channel Depth with free board (D)	0.4	m
Channel bottom width (b)	30	m
Side Slopes (z)	3	m/m
Top Width of Flow	32.4	m
Top Width with free board	32.4	m
Hydraulic Radius [R]	0.4	m
Velocity	2.8	m/sec
Flow X-Sectional Area	12.4	m^2
X-Sectional Area w/ free board	12.4	m^2
Discharge	34.48	m^3/sec
Recommended Rip Rap Size	0.30	m

Table 5. TSF Lower Channel Dimensions and Data		
Flow depth (d)	1.6	m
Free Board	2.4	m
Channel Depth with free board (D)	4.0	m
Channel bottom width (b)	5.0	m
Side Slopes (z)	3	m/m
Top Width of Flow	14.4	m
Top Width with free board	29.0	m
Hydraulic Radius [R]	1.0	m
Velocity	2.3	m/sec
Flow X-Sectional Area	15.2	m^2
X-Sectional Area w/ free board	68.0	m^2
Discharge	33.37	m^3/sec
Recommended Rip Rap Size	0.20	m

Table 6. Results of Hec-Ras Analysis for Tailings Facility Breach and Design Channel										
River	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
Statiion	(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
524.38	33.34	36.77	37.34	37.34	37.6	0.023973	2.29	15.68	31.99	0.99
475	33.34	31.17	31.99	32.43	33.48	0.118887	5.41	6.17	10.16	2.21
425	33.34	30.77	32.82	32.04	32.92	0.003041	1.43	23.32	17.88	0.4
375	33.34	30.37	32.72	31.64	32.79	0.001656	1.14	29.2	19.86	0.3
350	33.34	30.26	32.63	31.52	32.69	0.001599	1.13	29.58	19.99	0.3
325	33.34	30.01	32.55	31.83	32.65	0.002205	1.44	26.32	23.5	0.39
315	33.34	30.04	32.54	31.84	32.64	0.002296	1.45	26.51	25.03	0.39
275	33.34	30.15	32.31	31.88	32.49	0.005945	1.87	20.41	29.34	0.55
225	33.34	29.96	31.62	31.62	32.13	0.017214	3.15	10.59	10.62	1.01
175	33.34	27.55	30.67	29.52	30.76	0.001702	1.41	26.61	19.41	0.34
125	33.34	26.98	30.67	28.56	30.7	0.000418	0.82	43.38	25.68	0.18
75	33.34	26.89	30.67	28.08	30.68	0.000164	0.55	62.66	32.14	0.11
0	33.34	28.52	30.04	30.04	30.52	0.016957	3.07	10.87	11.38	1

Table 7. Inner Dam Base Analysis		
Flow depth (d)	1.5	m
Free Board	0.0	m
Channel Depth with free board (D)	1.5	m
Channel bottom width (b)	0.3	m
Side Slopes (z)	3	m/m
Top Width of Flow	9.2	m
Top Width with free board	9.2	m
Hydraulic Radius [R]	0.7	m
Velocity	2.5	m/sec
Flow X-Sectional Area	7.0	m^2
X-Sectional Area w/ free board	7.0	m^2
Discharge	17.24	m^3/sec
Recommended Rip Rap Size	0.25	m

Attachment 1

HEC-HMS Results

Project: Rock Creek
Simulation Run: RC-2yr Subbasin: Rock Creek

Start of Run:	01Aug2010, 12:00	Basin Model:	Rock Creek Drainage
End of Run:	03Aug2010, 12:00	Meteorologic Model:	2-year
Compute Time:	18Feb2011, 15:32:20	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Discharge :	0.157 (M3/S)	Date/Time of Peak Discharge :	02Aug2010, 06:52
Total Precipitation :	115.062 (1000 M3)	Total Direct Runoff :	4.550 (1000 M3)
Total Loss :	110.512 (1000 M3)	Total Baseflow :	6.887 (1000 M3)
Total Excess :	4.550 (1000 M3)	Discharge :	11.437 (1000 M3)

Project: Rock Creek

Simulation Run: RC-10YR Subbasin: Rock Creek

Start of Run:	01Aug2010, 12:00	Basin Model:	Rock Creek Drainage
End of Run:	03Aug2010, 12:00	Meteorologic Model:	10-year
Compute Time:	18Feb2011, 15:32:20	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Discharge :	1.253 (M3/S)	Date/Time of Peak Discharge :	01Aug2010, 22:07
Total Precipitation :	176.428 (1000 M3)	Total Direct Runoff :	23.354 (1000 M3)
Total Loss :	153.075 (1000 M3)	Total Baseflow :	6.887 (1000 M3)
Total Excess :	23.354 (1000 M3)	Discharge :	30.241 (1000 M3)

Project: Rock Creek

Simulation Run: RC-50YR Subbasin: Rock Creek

Start of Run:	01Aug2010, 12:00	Basin Model:	Rock Creek Drainage
End of Run:	03Aug2010, 12:00	Meteorologic Model:	50-year
Compute Time:	18Feb2011, 15:32:20	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Discharge :	7.080 (M3/S)	Date/Time of Peak Discharge :	01Aug2010, 22:04
Total Precipitation :	249.301 (1000 M3)	Total Direct Runoff :	58.292 (1000 M3)
Total Loss :	191.009 (1000 M3)	Total Baseflow :	6.887 (1000 M3)
Total Excess :	58.292 (1000 M3)	Discharge :	65.180 (1000 M3)

Project: Rock Creek

Simulation Run: RC-100YR Subbasin: Rock Creek

Start of Run:	01Aug2010, 12:00	Basin Model:	Rock Creek Drainage
End of Run:	03Aug2010, 12:00	Meteorologic Model:	100-year
Compute Time:	18Feb2011, 15:32:20	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Discharge :	9.039 (M3/S)	Date/Time of Peak Discharge :	01Aug2010, 22:04
Total Precipitation :	268.478 (1000 M3)	Total Direct Runoff :	69.136 (1000 M3)
Total Loss :	199.342 (1000 M3)	Total Baseflow :	6.887 (1000 M3)
Total Excess :	69.136 (1000 M3)	Discharge :	76.023 (1000 M3)

Project: Rock Creek
Simulation Run: RC-PMP Subbasin: Rock Creek

Start of Run:	01Aug2010, 12:00	Basin Model:	Rock Creek Drainage
End of Run:	03Aug2010, 12:00	Meteorologic Model:	PMP
Compute Time:	18Feb2011, 15:32:20	Control Specifications:	Control 1

Volume Units: 1000 M3

Computed Results

Peak Discharge :	89.298 (M3/S)	Date/Time of Peak Discharge :	01Aug2010, 22:02
Total Precipitation :	813.105 (1000 M3)	Total Direct Runoff :	498.187 (1000 M3)
Total Loss :	314.918 (1000 M3)	Total Baseflow :	6.888 (1000 M3)
Total Excess :	498.187 (1000 M3)	Discharge :	505.075 (1000 M3)

Project: Rock Creek
Simulation Run: PTF-PMP Subbasin: PTF

Start of Run:	01Aug2010, 12:00	Basin Model:	Tailings Facility
End of Run:	03Aug2010, 12:00	Meteorologic Model:	PMP
Compute Time:	29Mar2011, 11:53:20	Control Specifications:	Control 1

Volume Units: MM

Computed Results

Peak Discharge :	34.484 (M3/S)	Date/Time of Peak Discharge :	01Aug2010, 22:04
Total Precipitation :	269.240 (MM)	Total Direct Runoff :	205.639 (MM)
Total Loss :	63.601 (MM)	Total Baseflow :	0.000 (MM)
Total Excess :	205.639 (MM)	Discharge :	205.639 (MM)

Attachment 2

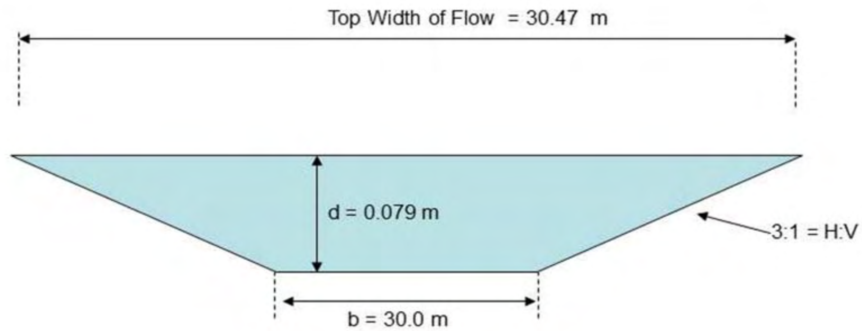
Rock Creek Designs

Causway Through Existing Road at Base of Rock Creek Drainage

Drainage:	Rock Creek	
Precipitation Event:	10-Year	24-Hour
Peak Discharge:	1.253	m^3/s
Total Storm Discharge Volume:	30.241	1000 m^3

Assume Trapazoidal Cut			
Manning's n	0.035	excavated smooth cut fill with grass	
Channel Slope	0.01	m/m	1.0 percent

Flow depth (d)	0.079	m
Free Board	0.33	m
Channel Depth with free board (D)	0.41	m
Channel bottom width (b)	30.0	m
Side Slopes (z)	3	m/m
Top Width of Flow	30.47	m
Top Width with free board	32.45	m
Hydraulic Radius [R]	0.08	m
Velocity	0.52	m/sec
Flow X-Sectional Area	2.4	m^2
X-Sectional Area w/ free board	12.8	m^2
Discharge	1.25	m^3/sec



Rock Creek Drainage Causeway Cut: Flow Dimensions
10-Year 24-Hour Storm
Not to Scale

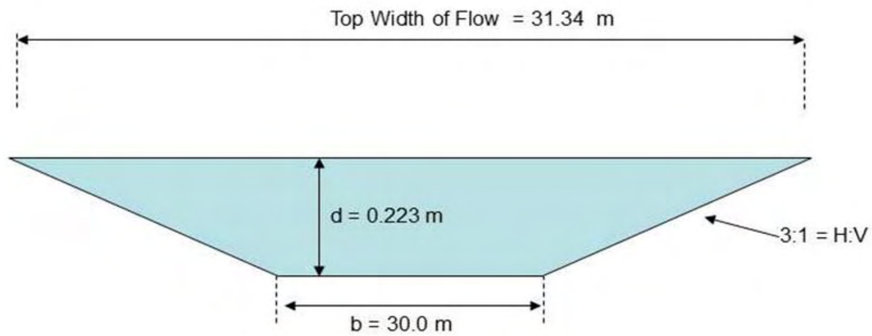
Causway Through Existing Road at Base of Rock Creek Drainage

Drainage:	Rock Creek	
Precipitation Event:	50-year	24-Hour
Peak Discharge:	7.08	m^3/s
Total Storm Discharge Volume:	65.18	1000 m^3

Assume Trapazoidal Cut

Manning's n	0.035	excavated smooth cut fill with grass		
Channel Slope	0.01	m/m	1.0	percent

Flow depth (d)	0.223	m
Free Board	0.33	m
Channel Depth with free board (D)	0.55	m
Channel bottom width (b)	30.0	m
Side Slopes (z)	3	m/m
Top Width of Flow	31.34	m
Top Width with free board	33.32	m
Hydraulic Radius [R]	0.22	m
Velocity	1.03	m/sec
Flow X-Sectional Area	6.8	m^2
X-Sectional Area w/ free board	17.5	m^2
Discharge	7.07	m^3/sec

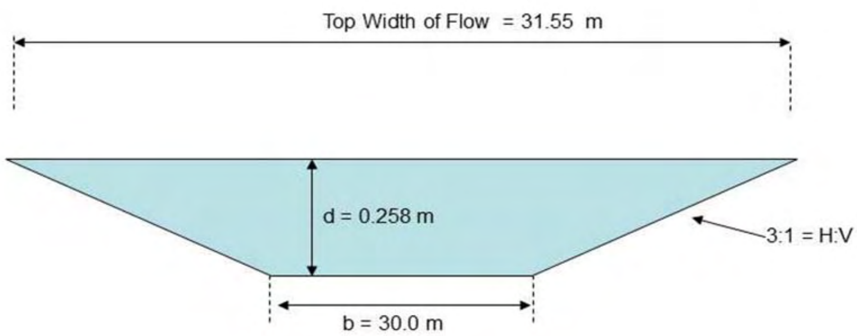


Rock Creek Drainage Causeway Cut: Flow Dimensions
50-Year 24-Hour Storm
Not to Scale

Causway Through Existing Road at Base of Rock Creek Drainage

Drainage:	Rock Creek			
Precipitation Event:	100-Year	24-Hour		
Peak Discharge:	9.039	m^3/s		
Total Storm Discharge Volume:	76.023	1000 m^3		
Assume Trapazoidal Cut				
Manning's n	0.035	excavated smooth cut fill with grass		
Channel Slope	0.01	m/m	1.0	percent

Flow depth (d)	0.258	m
Free Board	0.33	m
Channel Depth with free board (D)	0.59	m
Channel bottom width (b)	30.0	m
Side Slopes (z)	3	m/m
Top Width of Flow	31.55	m
Top Width with free board	33.53	m
Hydraulic Radius [R]	0.25	m
Velocity	1.14	m/sec
Flow X-Sectional Area	7.9	m^2
X-Sectional Area w/ free board	18.7	m^2
Discharge	9.03	m^3/sec



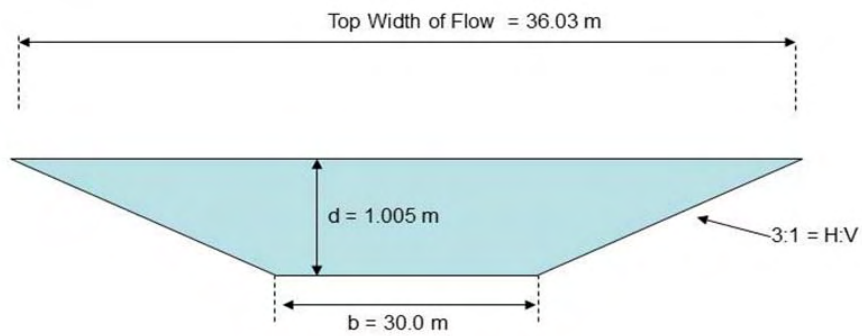
Rock Creek Drainage Causeway Cut: Flow Dimensions
100-Year 24-Hour Storm
Not to Scale

Causway Through Existing Road at Base of Rock Creek Drainage

Drainage:	Rock Creek			
Precipitation Event:	PMP	24-Hour		
Peak Discharge:	89.298	m^3/s		
Total Storm Discharge Volume:	505.075	1000 m^3		

Assume Trapazoidal Cut				
Manning's n	0.035	excavated smooth cut fill with grass		
Channel Slope	0.01	m/m	1.0	percent

Flow depth (d)	1.005	m
Free Board	0.33	m
Channel Depth with free board (D)	1.34	m
Channel bottom width (b)	30.0	m
Side Slopes (z)	3	m/m
Top Width of Flow	36.03	m
Top Width with free board	38.01	m
Hydraulic Radius [R]	0.91	m
Velocity	2.69	m/sec
Flow X-Sectional Area	33.2	m^2
X-Sectional Area w/ free board	45.4	m^2
Discharge	89.20	m^3/sec



Rock Creek Drainage Causeway Cut: Flow Dimensions
PMP 24-Hour Storm
Not to Scale

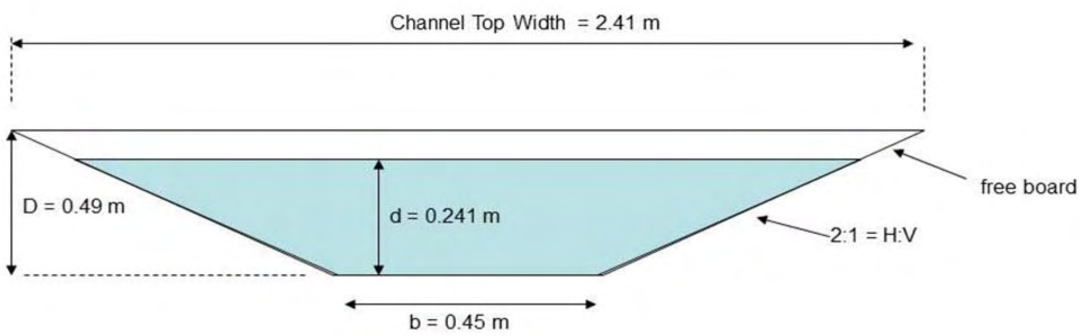
Rock Creek Channel Invert through Causway Cut

Drainage:	Rock Creek	
Precipitation Event:	2-year	24-Hour
Peak Discharge:	0.157	m^3/s
Total Storm Discharge Volume:	11.437	1000 m^3

Assume Trapazoidal Channel Based on 2-Year Peak Discharge (50th percentile)

Manning's n	0.04	Rip Rap Drainage		
Channel Slope	0.01	m/m	1.0	percent

Flow depth (d)	0.241	m
Free Board	0.25	m
Channel Depth with free board (D)	0.49	m
Channel bottom width (b)	0.45	m
Side Slopes (z)	2	m/m
Top Width of Flow	1.41	m
Top Width with free board	2.41	m
Hydraulic Radius [R]	0.15	m
Velocity	0.70	m/sec
Flow X-Sectional Area	0.2	m^2
X-Sectional Area w/ free board	0.7	m^2
Discharge	0.156	m^3/sec



Rock Creek Channel Dimensions through Causeway
PMP 2-Year 24-Hour Storm
Not to Scale

Attachment 3

Tailings Storage Facility

Dam Breach

Drainage:	TSF Drainage Area			
Precipitation Event:	PMP	24-Hour		
Peak Discharge:	34.48	m^3/s		
Total Storm Discharge Volume:	214.806	1000 m^3		

Assume Trapazoidal Cut				
Manning's n	0.05	rip rap jagged rock cut		
Channel Slope	0.07	m/m	7.0	percent

Flow depth (d)	0.4	m		
Free Board	0.0	m		
Channel Depth with free board (D)	0.4	m		
Channel bottom width (b)	30.0	m		
Side Slopes (z)	3.0	m/m		
Top Width of Flow	32.4	m		
Top Width with free board	32.4	m		
Hydraulic Radius [R]	0.4	m		
Velocity	2.8	m/sec	9.1	f/s
Flow X-Sectional Area	12.4	m^2		
X-Sectional Area w/ free board	12.4	m^2		
Discharge	34.48	m^3/sec		
Rip Rap Size	12	inches	0.30	meters

Lower Tailing Storage Facility Channel Invert

Drainage:	Tailings Storage Facility			
Precipitation Event:	PMP	24-Hour		
Peak Discharge:	34.34	m^3/s		
Total Storm Discharge Volume:	214.806	1000 m^3		

Assume Trapazoidal Cut				
Manning's n	0.04	rip rap jagged rock		
Channel Slope	0.008	m/m	0.8	percent

Flow depth (d)	1.6	m		
Free Board	2.4	m		
Channel Depth with free board (D)	4.0	m		
Channel bottom width (b)	5.0	m		
Side Slopes (z)	3	m/m		
Top Width of Flow	14.4	m		
Top Width with free board	29.0	m		
Hydraulic Radius [R]	1.0	m		
Velocity	2.3	m/sec	7.4	ft/s
Flow X-Sectional Area	15.2	m^2		
X-Sectional Area w/ free board	68.0	m^2		
Discharge	34.34	m^3/sec		
Rip Rap Size	8	inches	0.20	meters

Rip Rap Toe of Dam

Drainage:	Tailings Storage Facility			
Precipitation Event:	PMP	24-Hour		
Peak Discharge:	17.17	m^3/s		
Total Storm Discharge Volume:		1000 m^3		

Assume Trapazoidal Cut

Manning's n	0.04	rip rap jagged rock		
Channel Slope	0.015	m/m	1.5	percent

Flow depth (d)	1.5	m		
Free Board	0.0	m		
Channel Depth with free board (D)	1.5	m		
Channel bottom width (b)	0.3	m		
Side Slopes (z)	3	m/m		
Top Width of Flow	9.1	m		
Top Width with free board	9.1	m		
Hydraulic Radius [R]	0.7	m		
Velocity	2.5	m/sec	8.1	ft/s
Flow X-Sectional Area	7.0	m^2		
X-Sectional Area w/ free board	7.0	m^2		
Discharge	17.17	m^3/sec		
Rip Rap Size	10	inches	0.25	meters

Rip Rap Size Look Up Table

Velocity ft/s	D50 inches	Weight lbs
5	4	3
6	6	10
7	8	24
8	10	47
9	12	81
10	15	158
11	18	273
12	20	375
13	24	650
14	17	925
15	30	1268
16	35	2013

ATTACHMENT 2

GEOCHEMISTRY SUMMARY

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Technical Memorandum

To:	Tim Havey	From:	Dave Richers Patsy Moran
Company:	Tetra Tech	Date:	July 8, 2011
Re:	Updated Rock Creek Geochemistry Summary	Project #:	114-310979
CC:	Ron Rimelman, file		

SUMMARY

NovaGold plans to backfill the main pit at the Rock Creek Site near Nome, Alaska as part of the closure plan. Concerns by Bering Straits Native Corporation (BSNC) and their subsidiary, Golden Glacier, Inc. (GGI) have resulted in a request for additional information related to the Rock Creek Mine Reclamation and Closure Plan that was submitted to the Alaska Department of Natural Resources (ADNR) and the Alaska Department of Environmental Conservation (ADEC), Division of Water in April of 2011. The specific additional information requested includes:

- Detailed information on acid-base accounting (ABA);
- Detailed information concerning the waste cap to be placed on the pit;
- Detailed information on the point of compliance for water quality; and
- Explanation of rational to place demolition debris in the pit.

This memorandum addresses the geochemical aspects of their inquiries, namely, what is the predicted overall acid rock drainage and metal leaching (ARD/ML) character of the backfill materials and the potential effect on surface and groundwater quality. Specifically, this memorandum addresses ABA and the quality of runoff/effluent resulting from placement of backfilled materials compared to the surrounding groundwater and surface water quality.

This study shows that placement of the materials into the pit as backfill will not appreciably deteriorate groundwater quality to below the pre-mining water quality. To arrive at this conclusion, water quality resulting from contact with development rock, ore and tailings in the proportions anticipated in the backfilled pit were predicted using a geochemical mixing model. The resulting solution was then compared to surrounding pre-mining groundwater quality, surface water quality within project ponds (i.e., main pit, sump pit, and recycled water pond), and surface stream water quality. This model is extremely conservative because it is based on the assumption that the backfill will be completely saturated following closure which is highly unlikely due the present of the soil cover. As the pit will most likely refreeze after infilling and covering, influx of surface waters and oxygen intrusion will eventually revert to pre-mine conditions due to the formation of a permafrost barrier.

While a small portion of development rock/ore is potentially acid generating, overall these materials are anticipated to produce near neutral pH solutions under the unlikely event that the cover materials become compromised. Additionally, the overall geochemical character of the modeled backfilled development rock, tailings and ore water quality is in the range of the pre-mining groundwater quality with the exception of antimony which appears elevated compared to reported groundwater concentrations. Surface waters, downstream from the active mining disturbance and from areas not mined, show similar quality, such that one can conclude that backfilling the pit is unlikely to adversely affect surface water quality.

This comparison demonstrates that backfilling the pit with development rock, ore and tailings is unlikely to degrade water quality, particularly if the backfilled pit is covered and re-gains its pre-mining permafrost condition.

Backfilled Pit Water Quality

The Rock Creek deposit is hosted in the Mixed Unit of the Nome Group. These rocks are assumed to be derived from a continental shelf setting during the Cambrian to Devonian periods. They have been subjected to prograde blueschist facies metamorphism during the Jurassic period that resulted in northerly trending isoclinal folding. Later northerly directed compression resulted in east-west striking folds and thrust faulting. Later retrograde greenschist facies metamorphism during the Cretaceous period accompanied recumbent isoclinal folding of the earlier fabric.

Gold at Rock Creek is contained in two distinct types of mineralization. Tension veins (TVs) account for approximately 75% of the tons and 65% of the gold content in the deposit. The Albion Shear accounts for most of the rest of the deposit.

The Albion Shear also strikes northeast and dips to the southwest and is present the length of the deposit. Gold in the Albion is hosted primarily in quartz veins that are up to 10 ft (3 m) wide. The quartz veins are often broken or brecciated. The quartz is often bluish in color because of the presence of fine-grained pyrite and lead sulfosalts. Free gold is locally present in Albion veining, but less so within the tension veins. Gangue minerals in the Albion include: lead sulfosalts, arsenopyrite, pyrite, stibnite, and minor base metal sulfides.

TVs are northeast striking, steeply northwest dipping, sheeted veins, rarely greater than 4 inches wide. Tension veining is most common at the southern end of the deposit; however, vein density also increases proximal to the Albion Shear. Gold is strongly associated with arsenopyrite; other gangue minerals include: quartz, carbonate, arsenopyrite, and pyrite, with lesser stibnite, base metal sulfides, and lesser lead sulfosalts.

The Rock Creek project area geology described above is extracted from BEESC (2006).

Development rock and ore samples representative of the rock types that make up the majority of the materials to be backfilled into the pit include:

- Calcareous Quartz-Muscovite (CQMS)
- Graphite Quartz-Muscovite Schist (GQMS)
- Quartz-Muscovite Schist (QMS)

- Quartzitic Graphite Schist (QS)
- Calcareous Schist (CS)
- Albion (Tailings/Ore)
- Tension Vein (Tailings/Ore)

The relative proportions of the materials that are to be placed in the backfilled pit appear in Table 1. By applying the relative proportions of these materials to the geochemical model and assuming that there is complete mixing of the leachates derived from the inundation of these materials by meteoric water (a worst case scenario that is unlikely to occur), one can calculate the stoichiometric composition of the "liquors" that would be available to interact with groundwater or surface waters. This calculation utilized the USGS program PHREEQC version 2.18-0. It should be noted that this is extremely conservative since complete saturation of the development pile by meteoric waters is not expected due to the existence of the soil cover.

Table 2 shows leachate quality resulting from kinetic testing of the various rock types and tailings described above. These kinetic test results as well as Meteoric Water Mobility Procedure (MWMP) testing show that some constituents (e.g., arsenic, antimony and manganese) could be released at levels elevated above background water quality. However, hydrologic and geochemical modeling of the proposed development rock storage facilities with and without a cover suggested that none of the metals are predicted to exceed the background water quality for both runoff and seepage (Water Management Consultants, 2006b).

To further confirm that water quality associated with the backfilled pit will not appreciably impact water quality, the proportions of each material and their respective leachate quality were used to build a stoichiometric model of the mixture for comparison with the reported chemistries of the groundwater, holding ponds, and streams. The associated PHREEQC input and output files can be provided upon request. The major constituent concentrations assuming a 1:1 mix of "pure" water with the backfill (five major development rock types and the two ore/tailings mixes) appear in Table 3. The resulting solution has a pH of 7.85 which demonstrates that even with complete inundation of these materials in the pit acidic conditions will not result.

These findings are consistent with those reported in the Alaska Gold Company (AGC) report (2006), which showed that the majority of development rock and ore samples are highly unlikely to generate acid when considering the ABA character. For example, Figure 1 depicts the neutralization potential (NP) versus the acid-generation potential (AP) of Rock Creek Project core samples that are representative of the overall ABA character of the area which illustrates the low potential for ore and development to produce acid. In additional, long-term kinetic tests produced leachates with neutral or slightly alkaline pH and generally no measurable acidity (AGC, 2006). It should also be noted that no evidence of acid generation from the development rock or ore stockpiles has been observed to date.

Table 1. Approximate Rock Type Percentages for Backfill – Rock Creek Closure	
Rock Types	**Percent of Backfill**
Quartzitic Graphite Schist (QGS)	5.8
Quartz-Muscovite Schist (QMS)	22.9
Graphitic Quartz-Muscovite Schist (GQMS)	20.5
Calcareous Quartz-Muscovite Schist (CQMS)	22.2
Calcareous Schist (CS)	11.9
Albion (Tailings/Ore mix)	8.2
Tension Vein (Tailings/Ore mix)	8.2

After WMC, 2006a.

Table 2. Development Rock and Tailings - Leachate Quality
Published Humidity Cell Test Summary

	Development Rock					Tailings/Ore Mix	
Compound	**QGS**	**QMS**	**CS**	**CQMS**	**GQMS**	**Albion**	**Tension Vein**
pH	7.75	7.8	7.97	7.87	7.91	7.63	7.92
Alkalinity	44	90	80	66	100	49	83
Silver	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Aluminum	0.054	0.0225	0.0225	0.0225	0.16	0.225	0.0025
Arsenic	0.27	0.0078	0.051	0.007	5.6	3.5	1.8
Barium	0.05	0.005	0.005	0.005	0.023	0.005	0.013
Beryllium	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Calcium	21	28	55	47	37	22	39
Cadmium	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Chloride	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chromium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Copper	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Fluoride	0.28	0.05	0.05	0.05	0.05	0.18	0.05
Iron	0.005	0.005	0.005	0.005	0.005	1.9	2.6
Mercury	0.0001	0.0001	0.0001	0.0001	0.5199	0.0001	0.0001
Potassium	1.2	0.74	1.7	1.4	0.25	0.25	0.68
Lithium	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Magnesium	4.4	5.9	12	14	11	9.2	9.9
Manganese	0.011	0.07	0.06	0.072	0.019	0.025	0.09
Sodium	0.68	0.84	1.1	0.89	0.73	1	1.4
Nickel	0.005	0.005	0.005	0.005	0.005	0.005	0.018
Phosphorus	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lead	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Sulfate	30	31	140	140	57	49	42
Antimony	2	0.001	0.077	0.001	0.36	1.2	0.22
Selenium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
Strontium	0.05	0.05	0.14	0.11	0.11	0.05	0.05
Thallium	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Vanadium	0.005	0.005	0.015	0.02	0.005	0.005	0.015
Zinc	0.005	0.005	0.005	0.005	0.005	0.005	0.005

From: WMC, 2006a; Note: All values except pH are in mg/L
Published humidity cell test leachate quality

Table 3. Predicted Backfilled Development Rock/Tailings/Ore Leachate Quality-PHREEQC Summary

Elements	Molality	Moles	ppm
Ag	1.16E-08	1.16E-08	0.001247
Al	1.59E-06	1.59E-06	0.042847
As	1.08E-05	1.07E-05	0.803909
Ba	4.36E-08	4.35E-08	0.005971
Be	2.77E-08	2.77E-08	0.000249
C	6.42E-04	6.41E-04	7.695448
Ca	4.65E-04	4.64E-04	18.6002
Cd	2.22E-09	2.22E-09	0.000249
Cl	7.04E-06	7.03E-06	0.249284
Cr	2.40E-08	2.40E-08	0.001246
Cu	1.97E-07	1.96E-07	0.012468
F	1.95E-06	1.94E-06	0.036933
Fe	3.35E-06	3.34E-06	0.186634
Hg	2.66E-07	2.66E-07	0.053337
K	1.13E-05	1.13E-05	0.439856
Li	3.60E-06	3.59E-06	0.024928
Mg	2.05E-04	2.05E-04	4.982525
Mn	4.84E-07	4.84E-07	0.026563
N	1.68E-05	1.68E-05	0.234897
Na	1.98E-05	1.97E-05	0.453358
Ni	5.16E-08	5.16E-08	0.003026
P	4.03E-06	4.02E-06	0.124638
Pb	1.21E-08	1.20E-08	0.002493
S	3.95E-04	3.94E-04	12.63805
Sb	1.30E-06	1.30E-06	0.157923
Se	1.58E-08	1.58E-08	0.001247
Sr	4.93E-07	4.92E-07	0.0431
Tl	2.44E-09	2.44E-09	0.000499
V	1.02E-07	1.01E-07	0.005165
Zn	3.82E-08	3.81E-08	0.002493

pH reported at 7.85

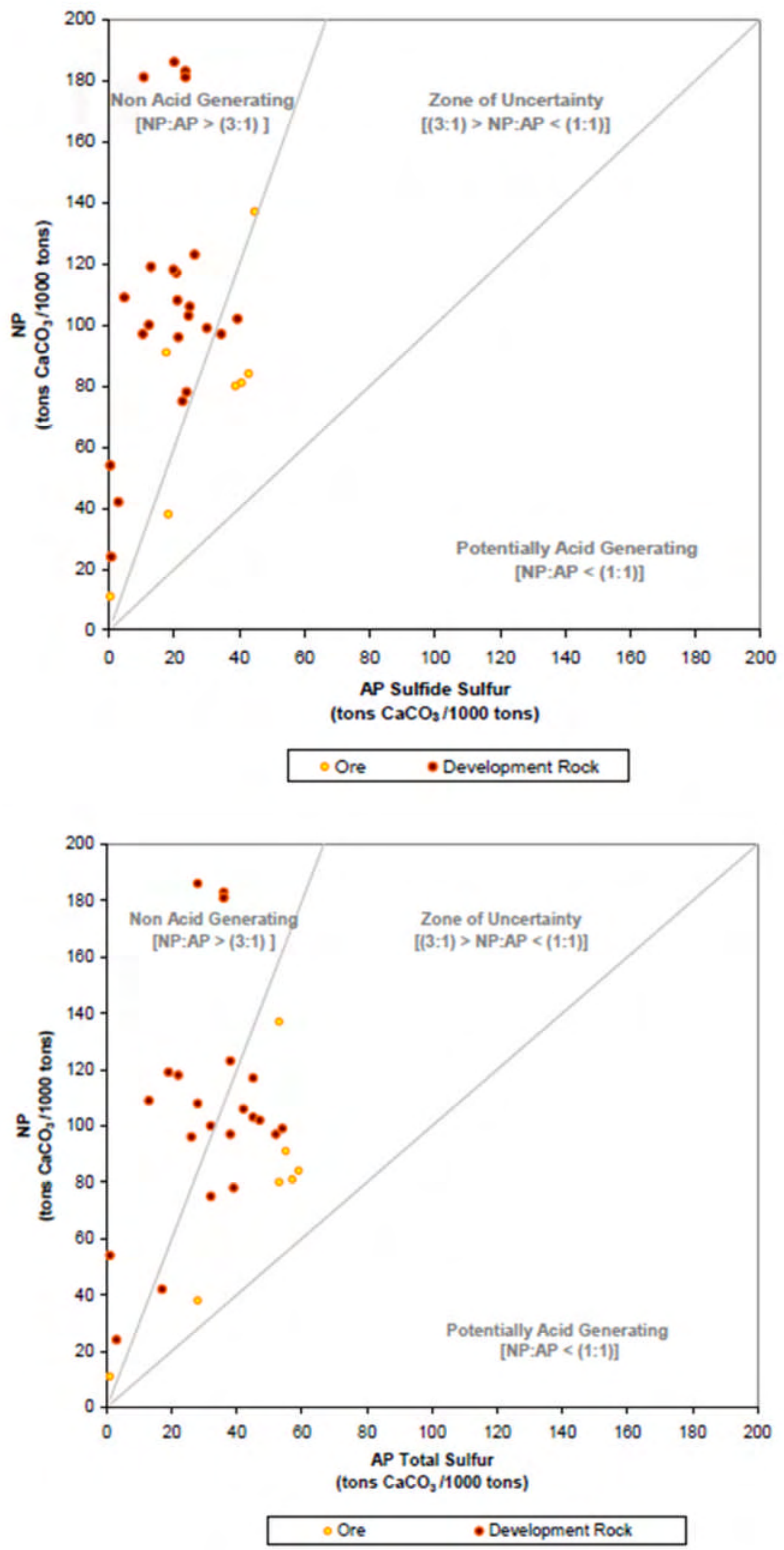

Figure 1: ABA Character, Rock Creek Area, Alaska, (from AGC, 2006)

Surrounding Groundwater Quality

Average concentrations for key constituents in pre-mining groundwater from monitoring wells situated in the area of the pit (Figure 2) and sampled between October 2003 and November 2005 are provided in Table 4. Comparison of groundwater quality to the mixing model results indicates that the quality of solutions from the backfilled pit are in the same range as the pre-mining background water quality with the expectation of antimony which is higher than the reported average in the groundwater, as was pH, although the maximum pH reported in several wells is at or above the mix pH.

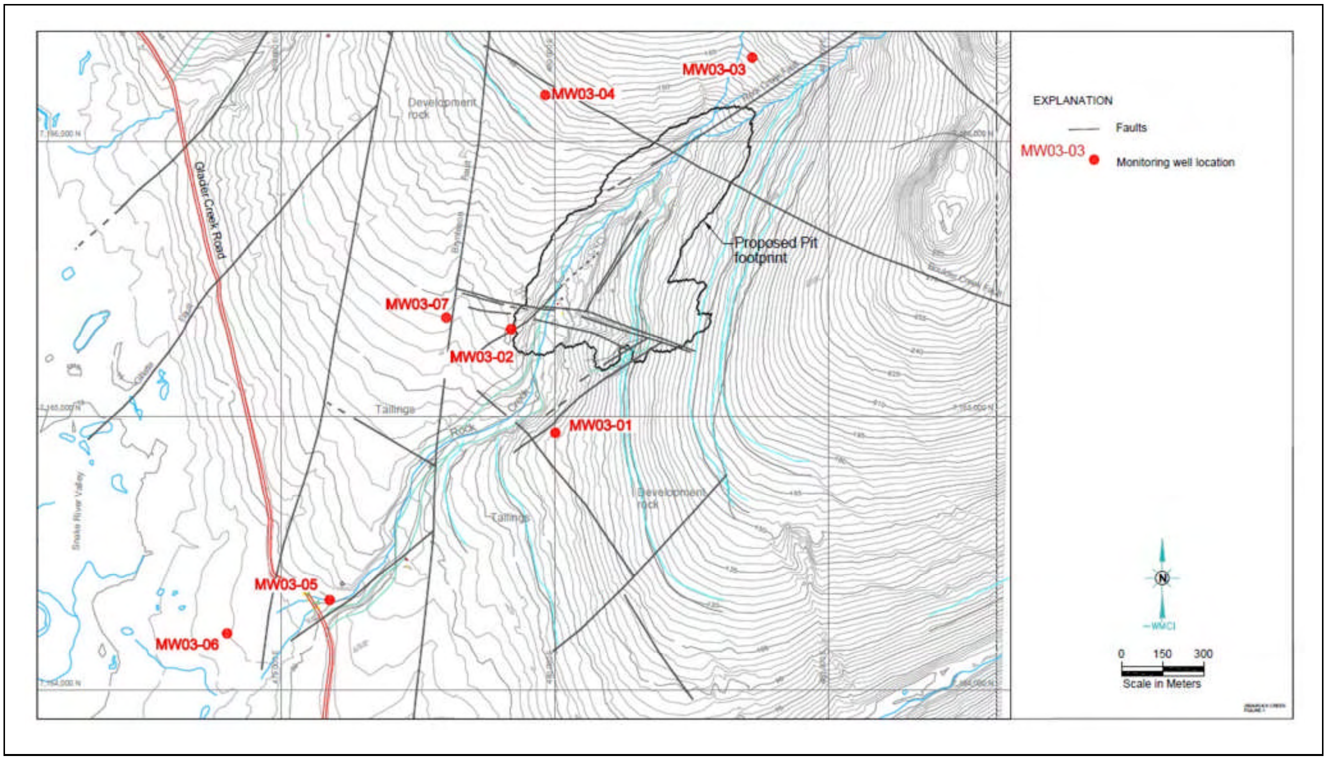

Figure 2. Groundwater Monitoring Wells, Rock Creek Area, Alaska (from WMC, 2006b)

Table 4. Average Groundwater Quality (Oct. 2003 – Nov. 2005)

Sample	As	Fe	Mn	Sb	pH
MW03-01	0.174	1.25	0.118	0.0040	7.68
MW03-02	1.822	17	2.09	0.0194	6.97
MW03-03	0.044	0.6	0.02	0.00015	7.6
MW03-04	0.006	0.77	0.038	0.00088	7.7
MW03-05	0.84	4.4	0.1	0.0025	7.7
MW03-06	0.238	15	0.168	0.0026	7.3
MW03-07	0.499	0.91	0.061	0.00036	7.4
Backfill Leachate	0.803	0.186	0.026	0.157	7.85

Note: Values below reporting limit set at 1/2 of the reported value; values are mg/L except for pH; From WMC, 2006b

Development Rock Facility and Recycle Water Pond – Surface Chemistry Considerations

Figure 3 shows the location of several holding ponds adjacent to or just down gradient of the tailings storage facility which has been in operation for several years. Runoff and to some extent, seepage from the base of the tailings shows that the effluents derived from such materials is not prone to generation of low pH solutions. Table 5 is a compilation of average values of waters sampled from the Recycle Water Pond (RWP), the Main Pit, and the Main Sump and several surface streams. This water quality data was collected between December 2008 and April 2011. In this assessment, the Main Pit chemistry reflects likely conditions of development rock/water interaction on the pit walls. The main sump reflects, on the other hand, what runoff or meteoric water impingement of the tailings would look like. The chemistry of the RWP should reflect the effluent coming off of ore material. Surface stream waters represent the following:

- Rock Creek – Samples are downstream of the most active mined areas.
- Glacier Creek – These waters are south of mined areas. No appreciable mining occurred in this watershed.
- Snake River (SABC) – Above mined areas, should reflect “background”.
- Snake River (SRTB) – Should reflect any mining effects on surface streams.

As shown, pH for all the surface ponds is near neutral (range 7.38 – 7.68) and the metals reported are not appreciably higher than those reported for groundwater nor those derived from the predicted PHREEQC runs for the backfill. Based upon the study of data representing a period of over 2 years, the likelihood of generating ARD/ML through placement of the development rock, ore and tailings in the pit with a soil cover that is not completely inundated are minimal. Similarly, samples collected from Rock Creek, Glacier Creek, and the Snake River are within the same pH range. As two of these surface streams (SABC and Glacier Creek) are in areas of little or no mining, and the other two, SRTB and Rock Creek are in areas associated with mining activities, one can readily see that the existing tailings, ore, and development rock do not have a major impact on the chemistry of the surface waters.

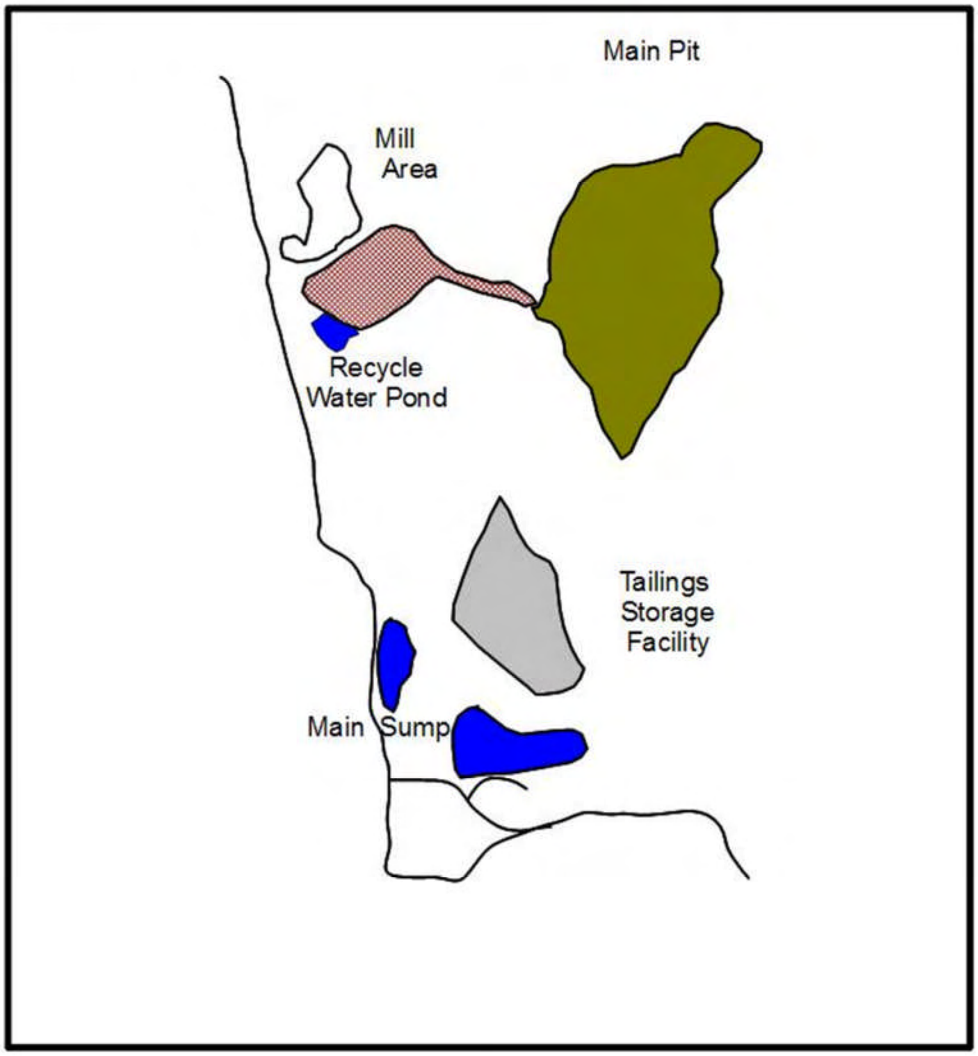

Figure 3. Surface Pond Locations, Rock Creek Area, Alaska, (from AGC, 2010)

Table 5. Surface Pond and Creek Water Chemistry

(Dec 2008 – Apr 2011)

Compound	RWP	Main Pit	Main Sump	Rock Creek	Glacier Creek	Snake SABC	Snake SRTB	Backfill Leachate
pH	7.64	7.68	7.38	7.50	7.62	7.41	7.4	7.85
Alkalinity	158	59.3	164.3	125	94.4	84.8	80.1	
Silver	0.00001	0.0000	0.00001	0.0000	0.0000	0.000	0.00	0.00125
Aluminum	0.584	0.116	0.945	0.021	0.011	0.011	0.030	0.04285
Arsenic	0.159	0.078	0.311	0.070	0.004	0.0000	0.002	0.80391
Barium	0.030	0.006	0.036	0.010	0.005	0.008	0.015	0.00597
Beryllium	0.00003	0.0000	0.000006	0.0000	0.0000	0.0000	0.000	0.00025
Calcium	44.2	58.6	109.3	65.37	33.3	32.2	30.23	18.6
Cadmium	0.0005	0.0003	0.0003	0.0000	0.0000	0.0000	0.000	0.00025
Chloride	28.3	5.67	6.51	3.22	2.46	2.44	5.67	0.249
Chromium	0.008	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000	0.0012
Copper	0.016	0.001	0.009	0.0007	0.0001	0.0004	0.0005	0.0125
Fluoride	0.09	0.039	0.090	0.071	0.051	0.0000	0.072	0.0369
Iron	0.004	0.497	5.055	0.044	0.014	0.02	0.13	0.1866
Mercury	0.000002	0.000001	0.000004	0.0000008	0.000001	0.0000008	0.0000005	0.0533
Potassium	11.9	1.35	5.341	0.858	0.250	0.282	0.843	0.4399
Magnesium	23.7	14.16	22.92	18.13	7.63	6.79	6.36	0.0249
Manganese	0.780	0.207	0.629	0.017	0.003	0.003	0.024	0.0262
Nickel	0.0.31	0.059	0.030	0.003	0.0008	0.0009	0.0009	0.003
Sodium	27.3	1.44	8.949	2.904	1.963	1.897	2.95	0.4533
Phosphorus	0.102	0.000	0.099	0.0000	0.0000	0.0000	0.0000	0.1246
Lead	0.003	0.580	0.006	0.00004	0.0000	0.0002	0.00008	0.0025
Sulfate	207.1	142.6	197.2	101.7	19.6	23.2	20.4	12.64
Antimony	0.159	0.028	0.011	0.004	0.0000	0.0004	0.0000	0.1579
Selenium	0.0027	0.0028	0.001	0.0005	0.00000	0.0000	0.0000	0.0012
Strontium	0.484	0.177	0.351	0.208	0.105	0.0001	0.0002	0.0431
Thallium	0.00	0.00	0.00	0.00.1050	0.00	0.000	0.0000	0.0005
Vanadium	0.0025	-	0.0018	0.0000	0.0000	0.0000	0.0000	0.0052
Zinc	0.160	0.555	0.153	0.007	0.0009	0.0000	0.003	0.0025

Note: All values in mg/L except for pH

REFERENCES

Alaska Gold Company (2006) Rock Creek Mine, Plan of Operations Volume 8, Geochemistry and Groundwater Reports for Rock Creek and Big Hurrah, May, 2006.

Alaska Gold Company (2010) Rock Creek Mine Background Baseline Ground Water Quality Statistics, January, 2010.

BEESC (2006) Alaska Gold Company, Rock Creek Project, Plan of Operations, Volume 2. Prepared by Bristol Environmental & Engineering Services Corporation. May, 2006.

Tetra Tech (2010) Rock Creek Mine, Background Baseline Ground Water Quality Statistics. Prepared for Alaska Gold Company, a Subsidiary of NovaGold Resources. January 15, 2010.

Water Management Consultants (2006a) Tailings and Development Rock Storage Facilities Geochemical Modeling. Prepared for NovaGold Resources. March 27, 2006.

Water Management Consultants (2006b) Rock Creek Baseline Groundwater, Prepared for Nova Gold Resources. March 27, 2006.

APPENDICES

Appendix 1 – PHREEQC Input and Output Run Files

Phreeqc-2.18.0 Input File – Development rock Tailings HCT Summary Data
(File: Appendix1_Input.txt)

Phreeqc-2.18.0 Output File – Development rock Tailings HCT Summary Data
(File: Appendix1_Output.txt)

ATTACHMENT 3

CIL TAILINGS DISPOSAL

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Technical Memorandum

To:	Heather White, NovaGold Resources, Inc.	**From:**	Tim Havey, Tetra Tech, Inc.
Cc::	Ron Rimelman, NovaGold Resources, Inc. John Odden, Alaska Gold Company, Inc. David Hollinger, Tetra Tech, Inc.	**Date:**	July 7, 2011
Subject:	CIL Solids Disposal and Confinement—Revised		

This memorandum documents the proposed plan for on-site disposal and permanent confinement of tailings solids produced during treatment of water contained in the Rock Creek Mine carbon-in-leach (CIL) circuit. Tetra Tech has reviewed available options for on-site disposal and developed an execution plan suitable for submission to the Alaska Department of Environmental Conservation (ADEC) for approval. This plan does not address handling and final disposal of Prussian Blue/ferric hydroxide generated during the CIL treatment process, which will be temporarily stored on site until a final disposal method is determined at a future date.

Background

Approximately 580,000 gallons of CIL fluid and solid tailings are currently stored in 7 tanks at the Rock Creek site, of which an estimated 13,000 ft^3 are solid tailings. Tetra Tech previously developed a CIL treatment plan (*CIL Treatment—Rock Creek WTP*, memo from Sam Billin to Ron Rimelman, June 8, 2011), which was approved by ADEC on June 17, 2011. As part of the approved treatment plan, CIL tailings/solids will be removed from the CIL/destruct tanks and belt filter pressed to produce a filter cake estimated to be 50% solids by weight. The solids produced during this treatment process are excluded from classification as hazardous material under 40 CFR 261.4(7) (Bevill Exclusion).

The fluid and solid tailings contain free cyanide, iron-cyanide complexes, and indigenous metals concentrations primarily consisting of aluminum, arsenic, antimony, and manganese. Iron-cyanide compounds were mostly generated when ferrous sulfate and ferric chloride reagents were added to the solution to complex free cyanide. By mass, iron comprises approximately half of the solids content (Table 1). Major cations (calcium, magnesium, potassium) are also abundant, as expected. Quantities of aluminum, arsenic, and manganese reflect the general mineralization of the Rock Creek site and tailings geochemistry.

Table 1. CIL Tank Solids Analysis

Analyte	CIL Tank #1		CIL Tank #2		CIL Tank #3	
	mg/kg	% by mass	mg/kg	% by mass	mg/kg	% by mass
Iron	53100	47.8%	51800	49.8%	144700	45.7%
Calcium	28600	25.8%	24000	23.1%	85100	26.9%
Magnesium	11200	10.1%	8640	8.3%	31640	10.0%
Aluminum	8710	7.8%	5980	5.8%	24140	7.6%
Arsenic	7240	6.5%	11600	11.2%	24200	7.6%
Potassium	965	0.9%	598	0.6%	2793	0.9%
Manganese	497	0.4%	491	0.5%	1627	0.5%
Sodium	163	0.1%	141	0.1%	779	0.2%
Lead	117	0.1%	138	0.1%	398	0.1%
Zinc	107	0.1%	82.8	0.1%	325.8	0.1%
Copper	105	0.1%	166	0.2%	393	0.1%
Nickel	96.5	0.1%	109	0.1%	247	0.1%
Chromium	18.1	0.0%	14.1	0.0%	49.8	0.0%
Antimony	11.4	0.0%	14.5	0.0%	38.7	0.0%
Cyanide	4	0.0%	120	0.1%	186	0.1%
Cadmium	0.669	0.0%	0.563	0.0%	2.019	0.0%
WAD CN	0.32	0.0%	6.5	0.0%	9.52	0.0%

Source: CIL tank sample collected 7/18/2010; analyzed by SGS Labs, Anchorage, AK

General Design

Tetra Tech was tasked with evaluating disposal options at the Rock Creek site for CIL tailings, provided that the final disposal site was within AGC patented claim areas, would not pose any long-term risk to groundwater quality, and would provide a stable, permanent structure requiring no long-term care and maintenance. Tetra Tech evaluated two separate disposal locations that met these conditions: a) the southern portion of the Main Pit, and b) the northern half of the West Pit. The West Pit option (Figure 1) provides the most practical disposal location due to its relatively easy access points and the ability to segregate the final CIL disposal structure from other reclamation and closure activities that will occur in the Main Pit over the next year. Segregating the disposal location in the smaller West Pit reduces the potential to rupture or puncture the liner and requires less preparation than a comparable site in the Main Pit. Thus, the West Pit location is immediately available and will not interfere with the CIL treatment schedule.

Dewatered CIL solids will be placed on a prepared bed that is lined with impervious membrane material and underlain with drainage rock to eliminate potential interaction with meteoric and/or groundwater. The final disposal bed will be sized to accommodate 600 yd^3 of material. This estimate is based on 13,000 ft^3 of CIL solids plus a 25% contingency. As-built drawings will be developed and included with the final project record. The project design is consistent with AGC's overall reclamation goal of re-establishing near-natural conditions at the Rock Creek site following closure.

Execution Plan

1. Site Preparation

   Upon approval of this plan, contractor staff will delineate the AGC claim boundary within the West Pit using stakes and other markers. The disposal bed will be similarly delineated. Small volumes of stormwater can accumulate in the West Pit following spring breakup and seasonal storm events. If present prior to excavation, standing water within the area will be removed. If necessary, benches on either side of the disposal bed will be graded or cut to ensure adequate access for equipment.

The disposal bed will then be excavated and graded consistent with the dimensions in Figure 1. In general, a 175-foot rectangular bed will be excavated in the northeastern portion of the West Pit along a line running southwest to northeast. The rectangular design will allow easier placement of the filter cake without compromising the integrity of the liner. The disposal bed will be approximately 35 feet wide from edge to edge, with side and terminal slopes of 2.5:1 (H:V). To provide adequate drainage around the final disposal structure, granular fill or small crushed rock no larger than 3/8 inch will be placed over the excavated bed to a depth of no less than 5 inches.

2. Liner Installation (Bottom)

The entire disposal bed will be lined with new 60-mil high density polyethylene (HDPE) liner that meets acceptable industry standards. Installation and quality control will be overseen and approved by Tetra Tech's project engineer. Quality control measures will include:

- Pre-weld testing
- Non-destructive testing (air test for double wedge welding and vacuum test for extrusion welds)
- Destructive testing

Liner will be cut into segments of approximately 60 feet in length and placed over the bedding material such that each section lies perpendicular to the disposal bed's longitudinal axis. Successive segments will be overlapped and welded according to the manufacturer's specifications. Double wedge welding will be the primary welding method; any necessary repairs will be welded using the extrusion method. Segments will be secured with ground anchors on each side of the disposal bed, with edges clearly marked. Exposed liner material above the fill layer on either side will be covered or otherwise protected to prevent damage from vehicle traffic while solids are being placed within the disposal bed.

To stabilize the liner and establish a drivable surface within the disposal bed, granular material made from crushed ore rock will be placed over the liner to a depth of 2 feet and compacted using a low ground pressure D-5 (Figure 1, Section F-2). This material has a naturally high clay fraction that, when compacted, results in a layer with very little interstitial space.

3. Solids Placement

Solids will be collected at the filter press discharge auger using a 6-yard bucket front end loader (Caterpillar 966) and placed in a 25-yard haul truck (Volvo A250). Individual loads will be restricted to approximately 80% of truck bed capacity to prevent spillage during transit. Solids will be dumped directly into the lined disposal bed from benches on either side, or removed from the haul truck and placed using a track hoe if more practical. Care will be taken to avoid driving equipment over liner material. Depending on the solids consistency, the track hoe may also be used to spread the material within the disposal bed to a uniform level. Solids will be placed to a depth where they are flush with the side benches, forming an even surface with the surrounding ground.

4. Stabilization

   Following placement of all solids, any excess space in the excavated disposal bed will be filled with small/granular fill material to form an even surface with the surrounding ground. No notable settling or slumping is expected due to the low permeability of the crushed ore rock layer that will act as an underlayment to the CIL solids. If necessary, ventilation measures will be incorporated into the final design per manufacturer's recommendations.

5. Liner Installation (Top)

   Once the final surface is achieved and stabilized, the liner cover will be installed in a similar fashion as the bottom layer. Liner segments will be welded according to the manufacturer's specifications and pulled into place from the sides across the disposal bed. The top layer will then be welded to the bottom liner according to manufacturer's specifications. The Tetra Tech project engineer will observe and verify final liner installation and welding.

6. Backfill and Cover

   The sealed disposal bed will be covered with approximately 2 feet of small/granular fill to minimize puncture risk and establish a working surface. Loose fill stockpiled during excavation will be placed over the granular fill to a depth sufficient to support larger equipment that will be used during later stages of closure and reclamation (approximately 4 feet). Final grading and reclamation will be completed as part of site-wide closure reclamation activities. The surface will be contoured to promote natural drainage patterns and blend with surrounding topography.

Safety and Environmental Compliance

All activities conducted for this project will conform to the Rock Creek Health and Safety Plan (HASP) and all relevant environmental plans and procedures. AGC will be responsible for installing BMPs, if necessary, to ensure containment of all solids within the disposal bed area and to minimize stormwater runon/runoff. Extra liner material will be kept at the site to use as temporary cover during rain events while the disposal bed is open.

The haul truck will be visually inspected during loading and after dumping to verify no solids have been deposited on the truck exterior. The loading and dumping areas will be routinely inspected for fugitive deposits. Care will be taken to ensure the haul truck and other equipment/vehicles handling the solids or accessing the areas do not track any solids. All spills will be cleaned up in accordance with the site HASP and environmental compliance plan.