Alaska Gold Company

A NovaGold Subsidiary

ROCK CREEK MINE
PLAN OF OPERATIONS
VOLUME 7
Monitoring Plan
May, 2006

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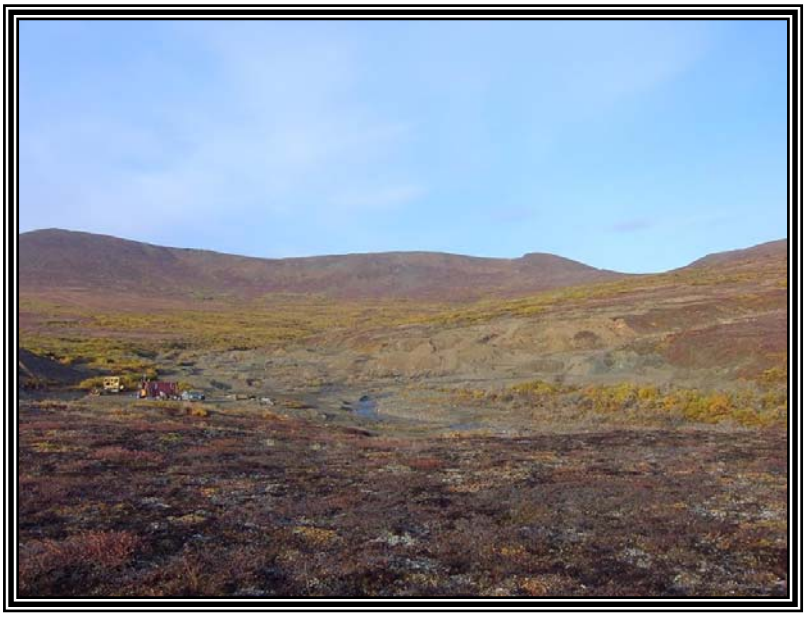
Placer mining on the Rock Creek deposit, 1902



NovaGold

ROCK CREEK PROJECT

OPERATIONAL AND CLOSURE MONITORING PLAN

May 8, 2006

Prepared by The Humphries Group

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DEFINITIONS AND ABBREVIATIONS

µg/L	micrograms per liter
µm	Micrometers
µmhos/cm	micromhos per centimeter
µS/cm	microsiemens per centimeter
AAC	Alaska Administrative Code
ABA	Acid-Base Accounting
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT	Alaska Department of Transportation
Alaska Gold	Alaska Gold Company
AP	Acid Generating Potential
Asl	above sea level
BSNC	Bering Straits Native Corporation
Cm	Centimeter
DSR	Dam Safety Report
FSI	Facility Safety Inspection
Km	Kilometers
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MRL	Method Reporting Limit
MWMP	Meteoric Water Mobility Procedure
NP	Neutralization Potential
PAG	Potentially Acid Generating (material determined by site specific ABA ratio)
Plan	Rock Creek Project Operational and Closure Monitoring Plan
Project	Rock Creek Mine Project
QA/QC	Quality Assurance/Quality Control
S.U.	Standard Units
TSF	Tailings Storage Facility
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAD	weak acid dissociable
WQD	Water Quality Division

1.0 GENERAL INTRODUCTION

Alaska Gold Company (Alaska Gold), a wholly owned subsidiary of NovaGold Resources Inc., is planning to develop the Rock Creek Mine Project (Project) to extract and mill gold. This document presents the monitoring program to be implemented during operations and after closure of the Project to ensure that the environment is not significantly impacted.

1.1 DOCUMENT PURPOSE

This Monitoring Plan (Plan) describes monitoring activities to be performed to allow the Project to operate in a manner that ensures the protection of air, surface and groundwater quality. This Plan will assist Alaska Gold with the establishment of procedures to ensure the long-term protection of these natural resources. Periodic updates of the Plan will coincide with regulatory changes, periodic reviews, process modifications, or anomalies noted as a result of the monitoring activities prescribed in this Plan. This Plan is a comprehensive, facility-wide plan that includes a description of environmental and other monitoring that will be performed for the Project. This Plan does not cover internal mill process monitoring of fluids not released outside the mill or resource assay work. To minimize duplication of information, the Plan works with the Plan of Operations document (Volume One – Project Description, and Volume Two - Environmental Information Document), and, although an effort was made to present pertinent background information, the reviewer may need to reference them for operational specifics to understand the rationale for the monitoring contained herein.

This Plan is closely modeled after examples[1,2] provided by the Alaska Department of Environmental Conservation (ADEC) Division of Water (DoW). Much of the text is taken verbatim from these publicly available documents, although no effort is made to identify the verbatim text.

The operational and closure monitoring programs described in this Plan are intended to meet the requirements of the Multi-Sector General Permit, and the Solid Waste Regulations 18 AAC 60.800-860, and include operational and closure monitoring of materials placed in the Tailings

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1 Mystery Creek Resources Inc., Nixon Fork Mine Monitoring Plan. June 28, 2005. Prepared by Golder Associates, Inc.

2 Solid Waste Monitoring Plan, Pogo Project. Revision 4.0. December 18, 2003. Prepared by TeckCominco.

Storage Facility (TSF), Development Rock Stockpiles and the pit dewatering wastewater injection system, which includes the injection wells and the Infiltration Gallery. Closure monitoring will also address impacts of water in and discharging from the residual mine lakes. The monitoring and reporting activities will be tracked by Alaska Gold using in-house personnel. Laboratory and other data will be managed using in-house personnel with assistance from consultants, as needed. Copies of inspection and sampling logs will be maintained in the Alaska Gold project files for a minimum of five years. The mine facilities where operation and closure monitoring activities are performed, as well as the types and frequencies of monitoring are summarized in Table 1-1.

1.2 ADMINISTRATIVE INFORMATION

This section contains specific legal and corporate information about the applicant.

Corporate Information

Business Name:	Alaska Gold Company
Address:	P.O. Box 640 Nome, AK 99762
Telephone:	(907) 443-5272
President and CEO:	Rick Van Nieuwenhuyse
Vice President:	Doug Nicholson Doug.nicholson@novagold.net

Agent and Designated Contact Person

Name:	Charlotte MacCay
Title:	Environmental Management, Project Manager
Telephone:	(907) 443-5272 or (907) 743-9366
Email:	cmaccay@bristol-companies.com

Additional Land Owner Information

Business Name:	Bering Strait Native Corporation
Address:	P.O. Box 1008 Nome, AK 99762-1008
Telephone:	(907) 443-5252

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

Table 1.1 Rock Creek Mine Project Monitoring Activity Summary

Phase	Location	System Monitored	Type of Monitoring Station	Monitoring Category	Number of Sampling Points	Sampling Frequency
Pre-Operations	Rock Creek Mine/Mill	Injection Wells	Injection Well	Ground Water	to be determined	Bi-monthly for 6 months
	Big Hurrah Mine	Injection Wells	Injection Well	Ground Water	to be determined	Bi-monthly for 6 months
Operations	Rock Creek	Cumulative	Stream Station	Surface Water	6	Monthly May - Oct + Jan
	Mine/Mill	Cumulative	Operation-Wide	Wildlife	Operation-Wide	As Observed
		TSF	Monitoring Well	Ground Water	3	Quarterly
		TSF	Tailings Inflow	Geochemistry/ Moisture Content	1	Daily Weekly Quarterly
		TSF	System-Wide	Visual/ Geotechnical	System-Wide	weekly/3-year dam safety
		TSF Containment Dam	Structure-Wide	Visual/ Geotechnical	Structure-Wide	quarterly/3 year dam safety
		Infiltration Gallery/Injection Wells	Monitoring Well	Ground Water	2 (min)	Quarterly
		Infiltration Gallery/ Injection Wells	Grab	Discharge to System	Each Active Source	Varies by parameter
		Infiltration Gallery/ Injection Wells	System-wide	Visual	System-wide	weekly
		Development Rock Stockpiles	System-Wide	Visual/ Geotechnical	System-Wide	weekly
		Development Rock Stockpiles	Grab Sample	Seep	Up to 3	Quarters 2, 3 & 4
		Development Rock Stockpiles	Composite from blast holes	Geochemistry	1	Weekly Monthly Quarterly

Table 1.1 Rock Creek Mine Project
Monitoring Activity Summary (continued)

Phase	Location	System Monitored	Type of Monitoring Station	Monitoring Category	Number of Sampling Points	Sampling Frequency
	Big Hurrah	Cumulative	Stream Station	Surface Water	3	Monthly May-Oct + Jan
	Mine	Cumulative	Operation-Wide	Wildlife	Operation-Wide	As Observed
		Injection Wells	Monitoring Weels	Ground Water	2	Quarterly
		Injection Wells	Grab	Discharge to System	Each Active Source	Varies by Parameter
		Injection Wells	System-wide	Visual	System-wide	weekly
		Development Rock	Monitoring Well	Ground Water	1	Quarterly
		Development Rock Stockpiles	System-Wide	Visual/ Geotechnical	System-Wide	weekly
		Development Rock Stockpiles	Grab Sample	Seep	Up to 3	Quarters 2, 3 & 4
		Development Rock Stockpiles	To be established Per Rock Characterization Plan	Geochemistry	To be established Per Rock Characterization Plan	To be established Per Rock Characterization Plan
Closure*	Rock Creek	Cumulative	Stream Station	Surface Water	6 + pit lake	July
	Mine/Mill	Cumulative	Per Reclamation Plan	Vegetation	Various	Semi-Annually for 5 years
		TSF	Monitoring Well	Ground Water	3	July
		TSF	System-Wide	Visual/ Geotechnical	System-Wide	July/3-year dam safety
		TSF Containment Dam	Structure-Wide	Visual/ Geotechnical	Structure-Wide	July/3 year dam safety
		Development Rock Stockpiles	System-Wide	Visual/ Geotechnical	System-Wide	July
		Development Rock Stockpiles	Grab Sample	Seep	Up to 3	if present

Table 1.1 Rock Creek Mine Project Monitoring Activity Summary (continued)

Phase	Location	System Monitored	Type of Monitoring Station	Monitoring Category	Number of Sampling Points	Sampling Frequency
		Infiltration gallery/Injection wells	Monitoring Wells	Ground Water	to be determined	July
	Big Hurrah	Cumulative	Stream Station	Surface Water	3 + pit lake	July
	Mine	Cumulative	Per Reclamation Plan	Vegetation	Various	Semi-Annually for 5 years
		Development Rock Stockpile	Monitoring Well	Ground Water	1	July
		Development Rock Stockpiles	System-Wide	Visual/ Geotechnical	System-Wide	July
		Development Rock Stockpiles	Grab Sample	Seep	Up to 3	if present
		Injection wells	Monitoring Wells	Ground Water	to be determined	July

*During years 1, 2, 5, 10, 20 and 30 after closure

2.0 LOCATION AND SITE DESCRIPTION

The Project is located on the Seward Peninsula along the west coast of Alaska, north of Norton Sound. There are two Project components:

- The Rock Creek Mine/Mill Complex located about 6.2 miles or 10 kilometers (km) north of Nome in the Snake River watershed; and
- The Big Hurrah Mine located about 42 miles (68 km) east of Nome in the Solomon River watershed.

The locations of these facilities are shown in Figure 2.1.

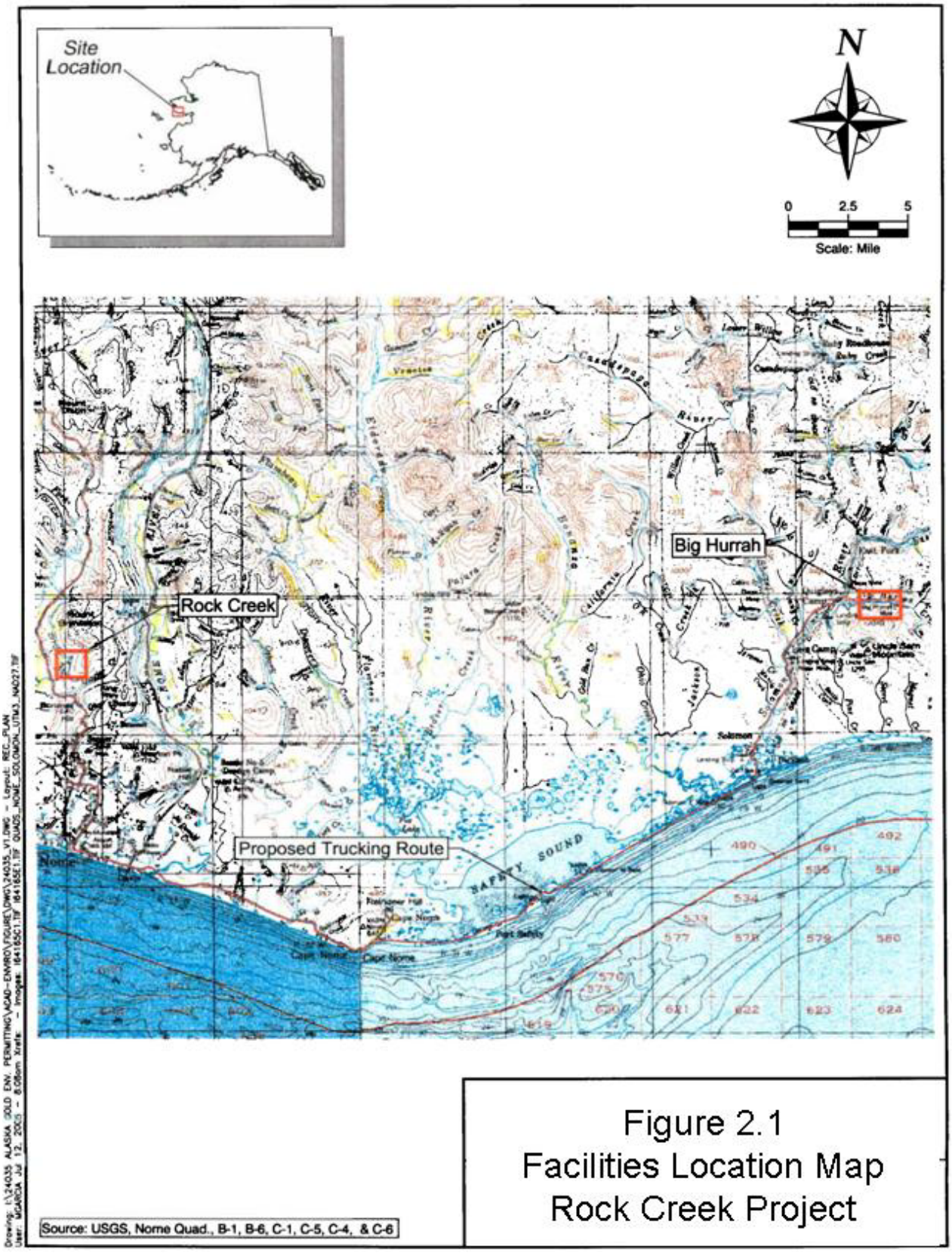


Figure 2.1
Facilities Location Map
Rock Creek Project

2.1 ROCK CREEK MINE/MILL COMPLEX

The Rock Creek Mine/Mill Complex 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 (refer to United States Geologic Survey [USGS] Quad Map Nome C-1).

The Rock Creek Mine/Mill Complex occurs partly on patented mining claims owned 100 percent by Alaska Gold and partly on land controlled by the Bering Straits Native Corporation (BSNC). BSNC also owns local mineral rights, with surface rights owned by Sitnasuak (the Nome Native village corporation). The mining operation does not involve the use of any state or federal lands.

The Rock Creek Mine/Mill Complex 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 100 feet above sea level (asl) (30 meters asl) to 650 feet asl (200 meters asl). The property is located within the Bering Straits Resource Area Coastal Management District. The Rock Creek area has been placer mined extensively in the past 100 years. Much of the area shows visible disturbance, and there are placer tailings piles located throughout the region.

The Rock Creek Mine/Mill Complex may operate at a water surplus at times during its operational life. To prevent a water surplus, an Infiltration Gallery and/or re-injection wells will be developed and placed into operation.

Electric power will be supplied from the Nome Joint Utility System. The Rock Creek Mine/Mill Complex is locally road accessible via the Glacier Creek Road and the state maintained Nome-Teller 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. There is no road access to Nome outside of the Seward Peninsula.

2.2 BIG HURRAH MINE

The Big Hurrah Mine is located within Sections 2,3,10 and 11, Township 10 South, Range 28 West, Kateel River Meridian (refer to USGS Quad Map Solomon C-5). The site occurs on

patented mining claims owned 100 percent by Alaska Gold. Adjacent land owners are BSNC and Solomon Native Corporation. The mining operation does not involve the use of any state or federal lands.

The Big Hurrah Mine site is bounded on the south by the Uncle Sam Mountains, on the north by Big Hurrah Creek, to the west by Linda Vista Creek, and by a small intermittent creek to the east (informally referred to as Charlotte's Creek). The elevations on the property vary from 150 feet asl (45 meters asl) to 500 feet asl (150 meters asl). The property is located within the Bering Straits Resource Area Coastal Management District. The Big Hurrah area has been extensively placer and hard rock mined in the past 100 years. There is an abandoned adit and a 20 stamp mill still in existence at the site.

The Big Hurrah Mine will be an open pit gold mine. Effluent from mine dewatering activities or from interceptor wells, if present, will either be discharged through permitted Class V injection wells and/or a land application permit. Power will be supplied by a small diesel generator. The ore will be transported by truck to the Rock Creek Mine/Mill Complex.

The Big Hurrah Mine is locally road accessible via an Alaska Department of Transportation (ADOT) right-of-way up Big Hurrah Creek, and the state maintained Nome-Council Highway, an all-weather paved and gravel road. The ADOT right-of-way will require road improvement to accommodate regular traffic of heavy equipment. The road construction is being cooperatively designed between the Alaska Department of Natural Resources (ADNR) Office of Habitat Management and Permitting, ADOT and Alaska Gold.

3.0 VISUAL MONITORING

The section describes visual monitoring activities to be performed during operations at both the Rock Creek Mine/Mill Complex and the Big Hurrah Mine during operations

3.1 ROCK CREEK MINE/MILL COMPLEX

Visual monitoring activities during operations at the Rock Creek Mine/Mill Complex will include inspections of facilities for signs of instability, erosion, or chemical contamination. The mining facilities will be observed on a regular basis, with Alaska Gold employees encouraged to report conditions that could impact the environment to their supervisor for review and

management. Operational facilities to be monitored visually include the TSF, the TSF containment dam and the development rock stockpiles and the pit dewatering wastewater injection system.

3.1.1 Tailings Storage Facility

Visual monitoring of the TSF physical characteristics will be conducted on a weekly basis by the operational staff and noted in weekly logs. Operation personnel will be instructed to look for unusual signs of settlement, seeps, and erosion in the TSF, as well as any unusual water color or sheens. If such conditions are noted, those personnel will notify their supervisor for review and management. DNR-required dam-safety inspections will be completed and documented in a report every three years.

Details for the visual monitoring of the TSF are presented in Table 3-1.

3.1.2 TSF Containment Dam

Operation personnel will view the dam and maintain a record as specified in the Dam Safety Operations Manual, including at least quarterly visual inspections. Other monitoring will be performed as specified in the Dam Safety Operation Manual.

Table 3-1 Visual Monitoring of TSF Physical Condition

Item	Personnel	Scope	Frequency	Deliverable
Inspections	Operational Personnel	Visual Assessment	Weekly	Weekly log
DNR Dam Safety Inspection Reports	Qualified Engineer	Detailed visual assessment and review of placement records	Once every 3 years	Report to DNR

3.1.3 Development Rock Stockpiles

The physical characteristics of the development rock stockpiles will be monitored regularly by mine personnel. Details for the visual monitoring will be similar to the TSF schedule presented in Table 3-1. Operation personnel will be instructed to look for unusual signs of settlement, seeps, erosion, as well as any unusual water color or sheens.

3.1.4 Pit Dewatering Wastewater Injection System

Visual monitoring of the area around the active pit dewatering wastewater injection system will be conducted on a weekly basis by the operational staff and noted in weekly logs. Operation personnel will be instructed to look for surfacing water, and seeps in the vicinity of the active injection site. Is such conditions are noted, those personnel will notify their supervisor for review and management.

3.1.5 Closure

The visual monitoring program, using the procedures listed above, will occur during the post-closure monitoring period during July in years 1,2,5,10,20, and 30 after closure.

3.2 BIG HURRAH MINE

This visual monitoring program during operations for the Big Hurrah mine will consist of monitoring the development rock stockpiles and the pit dewatering wastewater injection system. Monitoring will be performed using the same procedures and schedules to be applied for development rock stockpiles and the pit dewatering wastewater injection system at the Rock Creek Mine/Mill Complex discussed in Section 3.1.3.

3.2.1 Closure

The visual monitoring program, using the procedures listed above, will occur during the post-closure monitoring period during July in years 1,2,5,10,20, and 30 after closure.

4.0 SURFACE WATER MONITORING

The section describes surface water monitoring activities to be performed at both the Rock Creek Mine/Mill Complex and the Big Hurrah Mine during operations and after closure. Results of monitoring activities will be reported as described in Section 11 of this Plan.

Rock Creek Mine/Mill Complex

This section of the monitoring plan for surface water operational and closure monitoring at the Rock Creek Mine/Mill Complex will provide information on the following:

Monitoring locations and rationale;

- Sampling procedures;
- Parameters and analytical methods; and
- Quality Assurance / Quality Control (QA/QC) Program.

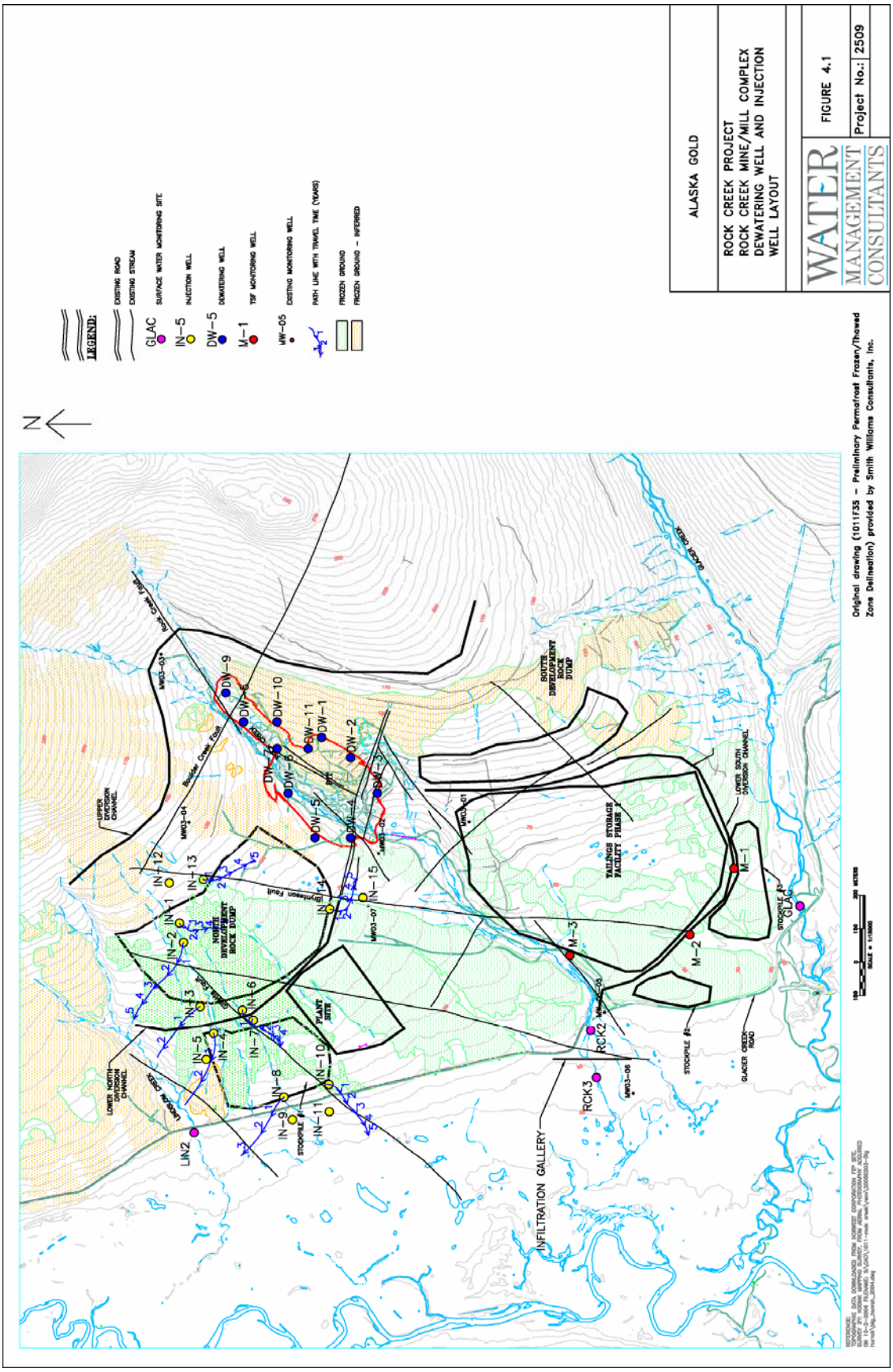
4.1.1 Operations

This section describes surface water monitoring activities during operations at the Rock Creek Mine/Mill Complex.

4.1.1.1 Locations and Rationale

Operational surface water monitoring at the Rock Creek Mine/Mill Complex will be conducted at six locations, shown on Figure 4.1. These locations were selected based upon the following rationale:

- GLAC. This station, used during baseline data collection, is located on Glacier Creek, above the confluence with the Snake River and downstream from potential impacts from operations at the Rock Creek Mine/Mill Complex. This station will provide data on operational impacts to Glacier Creek water quality.
- LIN2. This station will be located approximately 500 feet downstream from the LIND station that was utilized during baseline monitoring. This station will provide data on the potential operational impacts to Lindblom Creek water quality. The station is to be re-located downstream of the baseline monitoring location to provide for monitoring impacts from the operation of proposed injection wells. The proposed monitoring approach allows the discharge water to be closely monitored and provides, in a timely manner, a check on discharge water quality to ensure protection of groundwater and surface water quality. If it appears that road travel has an impact on the water quality at this sample site, the sampling location may be moved upstream of the road.
- RCK2. This station, used during baseline data collection, is located on Rock Creek, downstream from potential impacts from all operations at the Rock Creek Mine/Mill Complex, other than the proposed Infiltration Gallery. This station will provide data on operational impacts, other than infiltration, to Rock Creek water quality.
- RCK3. This station will be located on Rock Creek, approximately 100 meters downstream from the Infiltration Gallery. This station will provide data on impacts from use of that system.


LEGEND:
EXISTING ROAD
EXISTING STREAM
GLAC SURFACE WATER MONITORING SITE
IN-5 INJECTION WELL
DW-5 DEWATERING WELL
M-1 TSF MONITORING WELL
MW-05 EXISTING MONITORING WELL
PATH LINE WITH TRAVEL TIME (YEARS)
FROZEN GROUND
FROZEN GROUND - INFERRED
N
ALASKA GOLD
ROCK CREEK PROJECT
ROCK CREEK MINE/MILL COMPLEX
DEWATERING WELL AND INJECTION
WELL LAYOUT
WATER MANAGEMENT CONSULTANTS
FIGURE 4.1
Project No.: 2509
Original drawing (1011F35 - Preliminary Permafrost Frozen/Thawed Zone Delineation) provided by Smith Williams Consultants, Inc.
INFILTRATION GALLERY
PLANT SITE
NORTH DEVELOPMENT ROCK DUMP
SOUTH DEVELOPMENT ROCK DUMP
TAILINGS STORAGE FACILITY FEASIBILITY
UPPER DIVERSION CHANNEL
LOWER NORTH DIVERSION CHANNEL
LOWER SOUTH DIVERSION CHANNEL
STOCKPILE #1
STOCKPILE #2
GLACIER CREEK ROAD
GLACIER CREEK
Rock Creek Fault
Bladder Creek Fault
Jefferson Fault
LIN2
RCK2
RCK3
GLAC
M-1
M-2
M-3
IN-1
IN-2
IN-4
IN-5
IN-6
IN-7
IN-8
IN-9
IN-10
IN-11
IN-12
IN-13
IN-15
DW-1
DW-2
DW-3
DW-4
DW-5
DW-6
DW-7
DW-8
DW-9
DW-10
DW-11
MW03-01
MW03-02
MW03-03
MW03-04
MW03-05
MW03-06
MW03-07
SCALE = 1:15000

- LNDC. This station is located in the Lower North Diversion Channel down gradient of the North Development Rock Stockpile. This station will provide data on the potential operational impacts to Lindblom Creek water quality from any seepage and runoff from the North Development Rock Stockpile. The station is to be located at the downstream end of the Lower North Diversion Channel prior to discharge to Lindblom Creek. The proposed monitoring approach allows seepage and runoff water to be closely monitored and provides, in a timely manner, a check on water quality to ensure protection of surface water quality
- LSDC. This station is located in the Lower South Diversion Channel down gradient of the South Development Rock Stockpile and the TSF. This station will provide data on the potential operational impacts to Rock Creek water quality from any seepage and runoff from the South Development Rock Stockpile and the TSF. The station is to be located at the downstream end of the Lower South Diversion Channel prior to discharge to Rock Creek. The proposed monitoring approach allows seepage and runoff water to be closely monitored and provides, in a timely manner, a check on water quality to ensure protection of surface water quality.

4.1.1.2 Sampling Procedures

4.1.1.2.1 Sample Collection and Preservation

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. Stream discharge will be measured and calculated for every sampling event using standard methods of the U.S. Geological Survey (USGS).

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;
- 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 (except as noted above).

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.

All field parameter measurements, sampling activities and sample handling, transportation and custody control will be performed accord to the Surface Water Monitoring Quality Assurance Plan presented in Appendix A.

4.1.1.2.2 Sampling Frequency

Samples will be collected monthly from May through September of each year during operations at the Rock Creek Mine/Mill Complex to represent the seasonal hydrologic conditions. During the winter season (October through April), in the month of January, an attempt will be made to determine if there is flowing water under the ice. If a stream is frozen and sufficient flow is not available for sample collection, it will be noted in the appropriate monitoring report. If sufficient flow is available under the ice for sample collection, samples will be collected.

4.1.1.2.3 Shipping and Chain-of-Custody

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 accord to the Surface Water Monitoring Quality Assurance Plan presented in Appendix A.

4.1.1.3 Parameters and Analytical Methods

Tables 4-1, 4-2 and 4-3 list the parameters and analytical methods that will be utilized for the surface water samples collected at the Rock Creek Mine/Mill Complex.

4.1.1.4 Quality Assurance/Quality Control Program

The Project QA/QC Program for operational and closure surface water monitoring is presented in Appendix A. Samples will be submitted for analysis to a certified laboratory. The QA/OC program for the contract laboratory will be reviewed whenever there is a change in laboratories used for the monitoring program.

Table 4-1 Field Parameters
Surface Water Samples

Analyte	Method	Units	MDL*
pH	EPA 150.1	Standard	N/A
Temperature	Elect. Probe	Degrees Celsius	N/A
Conductivity	SM25 10B	µmhos/cm	0.477
Discharge	USGS	cfs	N/A

*Method Detection Limit

Table 4-2 Metals – Total and Dissolved Surface Water Samples

Analyte	Technique	Method	MRL*
Aluminum	ICP/Mass Spec	200.8	20
Antimony	Same	200.8	1
Arsenic	Same	200.8	2
Barium	Same	200.8	3
Beryllium	Same	200.8	0.4
Bismuth	Same	N/A	N/A
Cadmium	Same	200.8	0.1
Calcium	ICP only	200.7	200
Chromium	ICP/Mass spec	6010B/200.8	4
Cobalt	Same	200.8	4
Copper	Same	200.8	1
Iron	ICP only	200.7	10
Lead	ICP/Mass spec	200.8	0.4
Magnesium	ICP	200.7	200
Manganese	ICP/Mass spec	200.8	5
Mercury	cold vapor AFS	1631	0.0001
Molybdenum	ICP/Mass spec	6010B/200.8	10
Nickel	Same	6010B/200.8	5
Potassium	Same	200.9	500
Selenium	Same	200.8	2
Silver	Same	200.8	1
Sodium	Same	200.8	500
Strontium	ICP	200.7	5
Thallium	ICP/Mass spec	200.8	0.3
Tin	Same	200.8	20
Titanium	Same	200.8	20
Vanadium	Same	200.8	5
Zinc	Same	200.8	2

*Method Reporting Limit in Micrograms per liter (µg/L)

***Applicable parameters will be reviewed during and after mining operations and upon concurrence with ADEC, monitoring for some parameters may be discontinued if ongoing sampling reasonably indicates there to be negligible risk of exceeding water quality criteria*

***Laboratory will filter for dissolved metals

Table 4-3 Inorganic Parameters
Surface Water Samples

Analyte	Method	MRL*
Alkalinity	310.1	10
Ammonia	350.2	0.063
Chloride	300.0	0.2
Cyanide-total	SM20 4500	0.005
Cyanide-WAD	SM20 4500	0.005
Fluoride	300.0	0.2
Hardness	130.2	
Nitrate+Nitrite	300.0	0.2
Phosphorus-total	365.2	0.2
Settleable Solids	160.5	0.1 (mg/L)
Sulfate	300.0	0.2
Total Dissolved Solids	160.1	0.2
Total Suspended Solids	160.2	0.2

*Method Reporting Limit (µg/L), except where noted

**Hits that are between the Practicable Quantitation Limit and MDL will be reported with an "F"flag in the laboratory reports

****Applicable parameters will be reviewed during and after mining operations and upon concurrence with ADEC, monitoring for some parameters may be discontinued if ongoing sampling reasonably indicates there to be negligible risk of exceeding water quality criteria*

4.1.2 Closure

This section describes surface water monitoring activities during closure monitoring at the Rock Creek Mine/Mill Complex.

4.1.2.1 <u>Locations and Rationale</u>

The locations for closure surface water monitoring, and the rationale for those locations, are the same as for operational monitoring presented in Section 4.1.1.1 with the addition of samples collected form the pit lake using methodologies and at locations approved in advance by ADEC.

4.1.2.2 Sampling Procedures

4.1.2.2.1 Sample Collection and Preservation

Sample collection and preservation during closure monitoring will be conducted using the same procedures described for operations monitoring in Section 4.1.1.2.1, and according to the QA/QC procedures presented in Appendix A.

4.1.2.2.2 Sampling Frequency

Surface water monitoring for closure will be conducted once in July during years 1, 2, 5, 10, 20 and 30 after closure. During those years, samples will be collected for analysis during May and September at the Rock Creek Mine/Mill Complex. During the winter season (October through April), it is expected that the streams will be frozen and sufficient flow will not be available for sample collection.

4.1.2.2.3 Shipping and Chain-of-Custody

Sample shipping and custody control during closure monitoring will be conducted using the same procedures described for operations monitoring in Section 4.1.1.2.3, and according to the QA/QC procedures presented in Appendix A.

4.1.2.3 Parameters and Analytical Methods

Surface water samples collected during closure monitoring will be analyzed for the same parameters as during operations. Tables 4-1, 4-2 and 4-3 list those parameters and the analytical methods that will be utilized for the surface water samples collected at the Rock Creek Mine/Mill Complex.

4.1.2.4 Quality Assurance/Quality Control Program

The Project QA/QC Program for operational and closure surface water monitoring is presented in Appendix A. Samples will be submitted to a certified laboratory. The QA/OC program for the contract laboratory will be reviewed whenever there is a change in laboratories used for the monitoring program.

4.2 BIG HURRAH MINE

This section of the monitoring plan for surface water operational and closure monitoring at the Big Hurrah Mine will provide information on the following:

Monitoring locations and rationale:

- Sampling procedures;
- Parameters and analytical methods; and
- QA/QC Program.

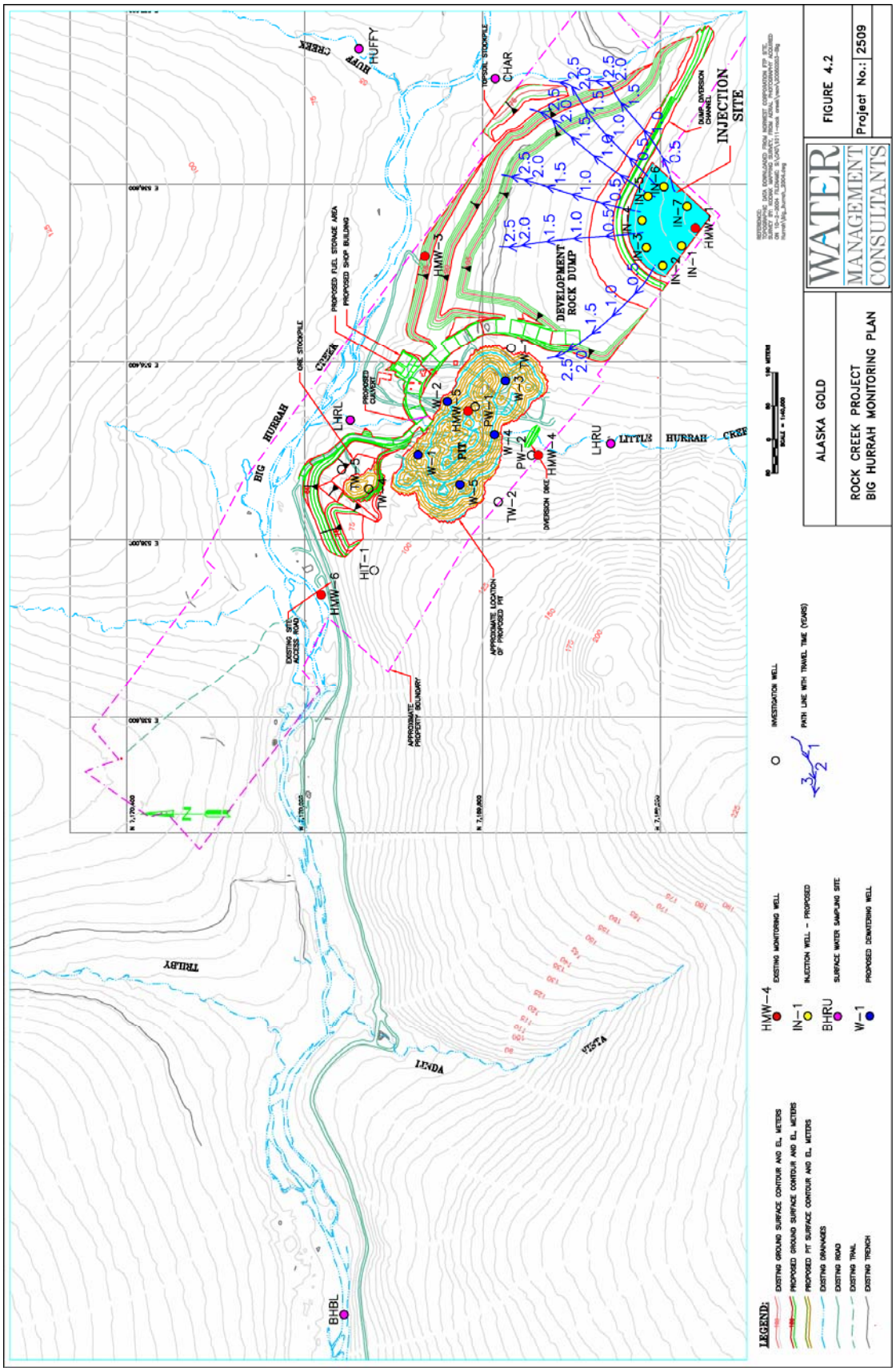
4.2.1 Operations

This section describes surface water monitoring activities during operations at Big Hurrah Mine.

4.2.1.1 Locations and Rationale

Operational surface water monitoring at the Big Hurrah Mine will be conducted at 3 locations, show on Figure 4.2. These locations were selected based upon the following rationale:

- BHBL. This station, used during baseline data collection, is located on Big Hurrah Creek, downstream from potential impacts from operations at the Big Hurrah Mine. This station will provide data on operational impact on Big Hurrah Creek water quality.
- LHRL. This station, used during baseline data collection, is located on Little Hurrah Creek, downstream from the mine pit, downstream from where diverted flow re-enters the natural stream course, and upstream of the confluence with Big Hurrah Creek. This station will provide data for operational impacts on Little Hurrah Creek water quality. The station will also provide for monitoring impacts from the operation of proposed injection wells. The proposed monitoring approach allows the discharge water to be closely monitored and provides, in a timely manner, a check on discharge water quality to ensure protection of groundwater and surface water quality.
- CHAR. This station will be located on an unnamed creek east of, and down-gradient from, the location of the proposed development rock stockpile (the stream is informally known as Charlotte's Creek). Flow at this station may be intermittent. This station will provide data on operational impacts on the water quality of this stream. The station will also provide for monitoring impacts from the operation of proposed injection wells.


INJECTION SITE
DEVELOPMENT ROCK DUMP
PIT
HUFFY
CHAR
LHRU
LHRL
BHRU
BHBL
HIT-1
HMW-1
HMW-3
HMW-4
HMW-5
HMW-6
IN-1
IN-2
IN-3
IN-4
IN-5
IN-6
IN-7
W-1
W-2
W-3
W-4
W-5
PW-1
PW-2
TW-1
TW-2
TW-3
TW-4
TW-5
BIG HURRAH CREEK
LITTLE HURRAH CREEK
HUFFY CREEK
TRILBY
LINDA
VISTA
PROPOSED FUEL STORAGE AREA
PROPOSED SHOP BUILDING
ORE STOCKPILE
PROPOSED CULVERT
DIVERSION DIKE
APPROXIMATE LOCATION OF PROPOSED PIT
APPROXIMATE PROPERTY BOUNDARY
EXISTING SITE ACCESS ROAD
TOPSOIL STOCKPILE
PUMP DIVERSION CHANNEL
LEGEND:
EXISTING GROUND SURFACE CONTOUR AND EL. METERS
PROPOSED GROUND SURFACE CONTOUR AND EL. METERS
PROPOSED PIT SURFACE CONTOUR AND EL. METERS
EXISTING DRAINAGES
EXISTING ROAD
EXISTING TRAIL
EXISTING TRENCH
HMW-4 EXISTING MONITORING WELL
IN-1 INJECTION WELL - PROPOSED
BHRU SURFACE WATER SAMPLING SITE
W-1 PROPOSED DEWATERING WELL
INVESTIGATION WELL
PATH LINE WITH TRAVEL TIME (YEARS)
SCALE = 1"=40,000'
1 MILE METERS
ALASKA GOLD
ROCK CREEK PROJECT
BIG HURRAH MONITORING PLAN
WATER MANAGEMENT CONSULTANTS
FIGURE 4.2
Project No.: 2509

4.2.1.2 Sampling Procedures

Sample collection, preservation, frequency, shipping, custody control, and quality assurance/quality control will be conducted for operational surface water monitoring at Big Hurrah Mine using the same methods and procedures as described in Sections 4.1.1.2, 4.1.1.3 and 4.1.1.4 for the Rock Creek Mine/Mill Complex and in the Surface Water Monitoring Quality Assurance Program presented in Appendix A. Also, the samples will be analyzed for the same parameters, as listed in Tables 4-1, 4-2, and 4-3. As noted, flow at Charlotte's Creek is intermittent and there may not be sufficient flow for monitoring during one or more events.

4.2.2 Closure

This section describes surface water monitoring activities during closure monitoring at the Big Hurrah Mine.

4.2.2.1 Locations and Rationale

The locations for surface water monitoring after closure at the Big Hurrah Mine, as well as the rationale for those locations, are the same as for operational monitoring presented in Section 4.2.1.1 with the addition of samples collected from the pit lake using methodologies and at locations approved in advance by ADEC.

4.2.2.2 Sampling Procedures

4.2.2.2.1 Sample Collection and Preservation

Sample collection, preservation, frequency, shipping, custody control, and quality assurance/quality control will be conducted for closure surface water monitoring at Big Hurrah Mine using the same methods and procedures as described in Sections 4.1.1.2.1, and according to the QA/QC procedures presented in Appendix A.

4.2.2.2.2 Sampling Frequency

Surface water monitoring for closure will be conducted once in July during years 1,2,5,10,20 and 30 after closure.

4.2.2.2.3 Shipping and Chain-of-Custody

Sample shipping and custody control during closure monitoring will be conducted using the same procedures described for operations monitoring in Section 4.1.1.2.3, and according to the QA/QC procedures presented in Appendix A.

4.2.2.3 Parameters and Analytical Methods

Surface water samples collected during closure monitoring will be analyzed for the same parameters as during operations. Table 4-1, 4-2, an 4-3 list those parameters and the analytical methods that will be utilized for the surface water samples collected at the Rock Creek Mine/Mill Complex.

5.0 GROUND WATER/SEEP MONITORING

The section describes ground water and seep monitoring activities to be performed at both the Rock Creek Mine/Mill Complex and the Big Hurrah Mine during operations and after closure. Results of monitoring activities will be reported as described in Section 11 of this Plan.

5.1 ROCK CREEK MINE/MILL COMPLEX

This section of the Plan describes activities for monitoring ground water and seeps during operations and after closure at the Rock Creek Mine/Mill Complex. The section provides information on the following:

- Monitoring locations and rationale;
- Sampling procedures;
- Parameters and analytical methods; and
- QA/QC Program.

5.1.1 Operations

Operations at the Rock Creek Mine Pit likely will necessitate working “in-the-dry”, by dewatering the mine pit and/or by the installation and operation of interceptor wells around the perimeter of the mine pit. In either case, ground water elevations in the vicinity of the Rock Creek Mine/Mill Complex will be lowered and, locally, the direction of ground water flow will be toward the mine pit.

The purpose of ground water monitoring during operations is to identify the occurrence of ground water migrating off-site, and to determine the chemical quality of such water. Thus, the monitoring program is designed to detect the presence of such groundwater. Given that mine dewatering will be occurring during operations, it is feasible that there may be no groundwater flow at one or more wells during any given monitoring event.

5.1.1.1 Locations and Rationale – Wells

As shown on Figure 4.1, depending on the wastewater injection locations, at least five wells will be monitored during operations of the Rock Creek Mine/Mill Complex. These wells are:

- M-1, M-2 and M-3. These wells will be monitored to detect seepage to shallow ground water from operations of the TSF. The TSF is designed with a seepage collection system to prevent releases of tailings-related waters to the natural environment. These wells will be monitored to confirm performance of the seepage collection system. The wells will be installed by advancing borings to a depth below the ground surface as approved by ADEC, and installing 4-inch diameter casing, with a screened interval at a depth below ground surface elevation approved by ADEC. Given the operations of the collection system and the operation of mine dewatering and/or interceptor well systems, shallow ground water may not be present in this vicinity during certain periods of operation, and sampling may not be possible in one or more wells during one or more operational sampling events.
- MW03-06. This existing well, used during baseline data collection, is located within the area of potential impacts from the Infiltration Gallery at the Rock Creek Mine/Mill Complex. This well will provide data on operational impacts from that gallery. If MW03-06 is not down gradient of the final location of an infiltration gallery a new monitoring well(s) will be installed to depths and in a locations(s) approved by ADEC. If a new monitoring well(s) is installed, six months of bi-monthly water quality sampling (12 samples) will be conducted prior to discharge of treated pit dewatering water to the infiltration gallery.
- MW-XXX. New monitoring wells will be installed to depths and at locations approved by ADEC down gradient of any areas where injection well clusters will be installed. If a new monitoring well(s) is installed, six months of bi-monthly water quality sampling (12 samples) will be conducted prior to discharge of treated pit dewatering water to the injection wells.

The collected data will provide necessary information on baseline natural water quality within the lithologic intervals into which injection will occur for ongoing statistical comparison in accordance with 18 AAC 60.830. The clusters, shown on Figure 4.1, are:

- RCIN-8, RCIN-9,RCIN-10 and RCIN-11;
- RCIN-3, RCIN-4, RCIN-5, RCIN-6and RCIN-7;
- RCIN-1, RCIN-2, RCIN-12 and RCIN-13; and
- RCIN-14 and RCIN-15.

5.1.1.2 Locations and Rationale – Seeps

No direct groundwater sampling is planned at this time specifically associated with development rock stockpiles using traditional monitoring wells. However, as noted in Section 3.1.3, the hillsides below the development rock stockpiles will be inspected during Quarters 2, 3 and 4 of each year of operation for seeps. If seeps are noted, generally up to three separate seeps will be setup for sample collection. Care will be taken to ensure that the seeps sampled are representative seeps. Additional seeps may require sampling by ADEC at their discretion. Samples will then be collected from those seeps on the same schedule. It is anticipated that, during the winter period (Quarter 1), any seepage will freeze, and sufficient flow volumes will not be available for sampling.

5.1.1.3 Sampling Procedures - Wells

5.1.1.3.1 Sample Collection and Preservation

All samples will be collected in bottles provided by the analytical laboratory with appropriate preservatives in the bottles. Field parameters as noted in Section 5.1.1.5 will be measured in the field when weather conditions allow and in protected mine facilities during inclement weather.

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 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.

All field parameter measurements, sampling activities and sample handling, transportation and custody control will be performed according to the Ground Water and Seep Monitoring Quality Assurance Plan presented in Appendix B.

5.1.1.3.2 Sampling Frequency

Ground water monitoring wells, and seeps identified for monitoring will be sampled quarterly during each year of operations at the Rock Creek Mine/Mill Complex. If the groundwater is frozen, it will not be sampled and will be noted in the appropriate monitoring report. Monitoring wells installed down gradient of injection well clusters will be monitored bi-monthly during a 6-month period prior to the implementation of injection operations at the specific cluster each represents (See Section 5.1.1.1). Once monitoring has begun at a monitoring well down gradient of an injection well cluster, monitoring will continue quarterly throughout the operational period of the facility.

5.1.1.3.3 Shipping and Chain-of-Custody

Standard methods will be followed for shipping 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 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 accord to the Ground Water and Seep Monitoring Quality Assurance Plan presented in Appendix B.

5.1.1.4 Sampling Procedures – Seeps

If seeps occur at development rock stockpiles and a seep sampling program is initiated (see Section 5.1.1.2), sampling will be accomplished through the following procedures.

- Samples will be collected at the point exhibiting the greatest flow and/or highest conductivity from the seep, to the extent practicable.
- If practicable, seep samples will be collected by direct submergence of a de-contaminated plastic bucket or similar sampling vessel. The container will be submerged at sampling point such that mouth of container is under water surface at least 2 to 3 inches, if feasible. The container will be allowed to partially fill, rinsed by shaking, and emptied of the rinsate away from the seep. This procedure will be repeated three times. The actual sample will then be collected in the plastic bucket and transferred to laboratory sample bottles. Dissolved metals samples will be field filtered with a 0.45 µm filter as they are transferred to the laboratory sample bottles.
- If the above referenced procedures are not practicable due to lack of adequate flow, field personnel will use best efforts to collect a sample and document the methods used in their field notes.

- Field data form(s) will be completed as appropriate using field documentation procedures are described in Appendix B.
- Except for the specific procedures described above, samples will be collected, preserved, handled, transported and analyzed using the quality control procedures described in Appendix B. Custody and control of the samples will be documented as described in Section 5.1.1.3.3.

5.1.1.5 Parameters and Analytical Methods

Tables 5-1 and 5-2 list the parameters and analytical methods that will be utilized for the ground water and seep samples collected at the Rock Creek Mine/Mill Complex. Table 5-2 also presents parameters and analytical methods fro pre-operational injection well monitoring.

Table 5-1 Field Parameters
Groundwater and Seep Samples

Parameter or Analyte	Method (range)	Units	Detection Limit
Depth to water*	Electric sounder (0 to 300)	Feet	0.1
Flow**	USGS	gpm	N/A
pH	EPA 150.1	Standard units	1
Conductivity	EPA 120.1	µS/cm	0
Temperature	EPA 170.1	Degrees C	0
Redox potential	ORP meter (-999 to 999)	Millivolts	NA
Ferrous Iron concentration	HACH Ferrous Iron test kit	mg/L	0.1

*Ground water wells, only. Not applicable to seeps.

5.1.1.6 Quality Assurance/Quality Control Program

The Project Quality Assurance Program for operational and closure ground water and seep monitoring is presented in Appendix B. Samples will be submitted to a certified laboratory. A QA/OC program for the contract laboratory will be reviewed whenever there is a change in laboratories used for the monitoring program.

5.1.2 Closure

This section describes ground water monitoring activities during closure monitoring at the Rock Creek Mine/Mill Complex. No seepage from development rock stockpiles after closure is anticipated, but samples from seeps will be collected if seeps are observed.

5.1.2.1 Locations and Rationale

At closure, groundwater monitoring will continue at the locations as approved by ADEC prior to closure. The locations for post-closure monitoring will be selected to ensure that any potential long term impacts to ground water quality are detected.

Table 5-2 Parameters for Laboratory Analysis Ground Water and Seep Samples

Analyte	Method	Method Reporting Limit*
Aluminum, total and dissolved	200.8	20
Antimony, total and dissolved	200.8	1
Arsenic, total and dissolved	200.8	5
Barium, total and dissolved	200.8	3
Beryllium, total and dissolved	200.8	0.4
Cadmium, total and dissolved	200.8	0.5
Calcium, total and dissolved	200.7	200
Chloride**	300.0	0.2
Chlorine (total residual)**	SM 20 4500-Cl G	0.1
Chromium, total and dissolved	6010B/200.8	1
Chromium III**	Calculated	1
Chromium VI**	SW7196A	.02
Cobalt, total and dissolved	200.8	4
Copper, total and dissolved	200.8	1
Iron, total and dissolved	200.7	40
Lead, total and dissolved	200.8	0.2
Magnesium, total and dissolved	200.7	200
Manganese, total and dissolved	200.8	1
Mercury, total and dissolved	1631	
Molybdenum, total and dissolved	6010B/200.8	10
Nickel, total and dissolved	6010B/200.8	2
Potassium, total and dissolved	200.8	500
Selenium, total and dissolved	200.8	5
Silver, total and dissolved	200.8	1
Sodium, total and dissolved	200.8	500
Strontium, total and dissolved	200.7	10

Table 5-2 Parameters for Laboratory Analysis Ground Water and Seep Samples (continued)

Analyte	Method	Method Reporting Limit*
Thallium, total and dissolved	200.8	1
Tin, total and dissolved	200.8	1
Titanium, total and dissolved	200.8	5
Vanadium, total and dissolved	200.8	20
Zinc, total and dissolved	200.8	5
pH	150.1	0.1 (S.U.)
Conductivity	120.1	1 (µS/cm)
Alkalinity	SM20 320B	20 (mg/L)
Ammonia	350.2	100
Chloride	300	100
Fluoride	300	100
Nitrate + Nitrite	300	1000
Phosphorus-total	365.2	200
Sulfate	300	100
Sulfide	376.2	100
Silicon	200.8	200
Total Dissolved Solids	160.1	100 (mg/L)

*units are µg/L unless otherwise noted

***Applicable parameters will be reviewed during and after mining operations and upon concurrence with ADEC, monitoring for some parameters may be discontinued if ongoing sampling reasonably indicates there to be negligible risk of exceeding water quality criteria*

5.1.2.2 Sampling Procedures

5.1.2.2.1 Sample Collection and Preservation

Sample collection and preservation during closure monitoring will be conducted using the same procedures described for operations monitoring in Sections 5.1.1.3.1 and 5.1.1.4, and according to the QA/QC procedures presented in Appendix B.

5.1.2.2.2 Sampling Frequency

Groundwater monitoring will be conducted during the post-closure period once in July during the years 1,2,5,10,20, and 30 after closure.

5.1.2.2.3 Shipping and Chain-of-Custody

Sample shipping and custody control during closure monitoring will be conducted using the same procedures described for operations monitoring in Section 5.1.1.3.3, and according to the QA/QC procedures presented in Appendix B.

5.1.2.3 Parameters and Analytical Methods

Ground water samples collected during closure monitoring will be analyzed for the same parameters as during operations. Tables 5-1 and 5-2 list those parameters and the associated analytical methods.

5.1.2.4 Quality Assurance/Quality Control Program

The Ground Water and Seep Monitoring Quality Assurance Program for operational and closure ground water and seep monitoring is presented in Appendix B. Samples will be submitted to a laboratory certified to conduct analysis in the State of Alaska. The QA/OC program for the contract laboratory will be reviewed whenever there is a change in laboratories used for the monitoring program.

5.2 BIG HURRAH MINE

The primary potential impacts to ground water at the Big Hurrah mine are the disposal of the potentially acid generating development rock and injection pit dewatering water. This section provides the following information for ground and water seep monitoring to evaluate the impacts from those activities:

- Monitoring locations and rationale;
- Sampling procedures;
- Parameters and analytical methods; and
- QA/QC Program.

5.2.1 Operations

This section describes operational ground water and seep monitoring at the Big Hurrah Mine.

5.2.1.1 Locations and Rationale (Wells)

As shown on figure 5, at least three monitoring wells will be monitored during operations of the Big Hurrah Mine. These wells are:

- HMW-3 This existing well, used during baseline data collection, is located within the area of potential impacts form the wastewater injection site at the Big Hurrah Mine. This well will provide data on operational impacts from that injection location. If HMW-3 is not down gradient of the final location of the injection well system, or if it will be rendered inaccessible due to development rock placement or recontouring, a new monitoring well(s) will be installed to depths and in a locations(s) approved by ADEC. If a new monitoring well(s) is installed, six months of bi-monthly water quality sampling (12 samples) will be conducted prior to discharge of treated pit dewatering to the injection well system.
- HMW-6 This existing well, used during baseline data collection, is located down gradient of potential impacts from the Big Hurrah Mine. This well will provide data on potential operational impacts from that facility.
- HMW XX A monitoring well will be installed at the toe of the development rock stockpile and northwest of the topsoil stockpile in a location approved by ADEC. This monitoring well will be installed to a depth approved by ADEC down gradient of the proposed injection well cluster. If a new monitoring well is installed, six months of bi-monthly water-quality sampling (12 samples) will be conducted prior to discharge of treated pit dewatering water to the injection wells.

5.2.1.2 Locations and Rationale (Seeps)

No direct groundwater sampling is planned at this time specifically associated with the development rock stockpile using traditional monitoring wells. However, as noted in Section 3.1.3, the hillsides below the development rock stockpiles will be inspected during Quarters 2, 3 and 4 of each year of operation for seeps. If seeps are noted, up to three separate seeps will be setup for subsequent sample collection on the same schedule. In addition, surface water monitoring will detect significant impacts from shallow ground water discharging to the streams.

5.2.1.3 Sampling Procedures

Sample collection, preservation, frequency, shipping, custody control, and quality assurance/quality control will be conducted for operational ground water and seep monitoring at Big Hurrah Mine using the same methods and procedures as described in Sections 5.1.1.3, 5.1.1.4, 5.1.1.5 and 5.1.1.6 for the Rock Creek Mine/Mill Complex and in the Ground Water and

Seep Monitoring Quality Assurance Program presented in Appendix B. Also, the samples will be analyzed for the same parameters, as listed in Tables 5-1 and 5-2.

5.2.2 Closure

This section describes ground water monitoring activities during closure monitoring at the Big Hurrah Mine. No seepage from development rock stockpiles after closure is anticipated, but samples from seeps will be collected if seeps are observed.

5.2.2.1 Locations and Rationale

At closure, groundwater monitoring will continue at the locations as approved by ADEC prior to closure. The locations for post-closure monitoring will be selected to ensure that any potential long term impacts to ground water quality are detected.

5.2.2.2 Sampling Procedures

5.2.2.2.1 Sample Collection and Preservation

Sample collection and preservation during closure monitoring will be conducted using the same procedure described for operations monitoring in Sections 5.1.1.3.1 and 5.1.1.4, and according to the QA/QC procedures presented in Appendix B.

5.2.2.2.2 Sampling Frequency

Groundwater monitoring for closure will be conducted once in July during years 1,2,5,10,20, and 30 after closure.

5.2.2.2.3 Shipping and Chain of Custody

Sample shipping and custody control during closure monitoring will be conducted using the same procedures described for operations monitoring in Section 5.1.1.3.3, and according to the QA/QC procedures presented in Appendix B.

5.2.2.3 Parameters and Analytical Methods

Groundwater samples collected during closure monitoring will be analyzed for the same parameters as during operations. Table 5-1 and 5-2 list those paramters and the associated analytical methods.

5.2.2.4 Quality Assurance/Quality Control Program

The Groundwater and Seep Monitoring Quality Assurance Program for operational and closure groundwater and seep monitoring is presented in Appendix B. Samples will be submitted to a certified laboratory. The QA/QC program for the contract laboratory will be reviewed whenever there is a change in laboratories used for the monitoring program.

6.0 INJECTION WELL/INFILTRATION GALLERY INFLUENT MONITORING

Operations at the Project will generate various non-process effluents, such as discharges from mine dewatering. Typically, that water will be consumed through operational uses. However, there may be periods where a surplus of water will be generated. In those instances, the surplus water, not including any process water, will be treated, as appropriate, and returned to the subsurface through either the Infiltration Gallery or injection wells.

6.1 ROCK CREEK MINE/MILL COMPLEX

This section describes monitoring for effluents discharged to the Infiltration Gallery or injection wells during operations and after closure at the Rock Creek Mine/Mill Complex. Results of monitoring activities will be reported as described in Section 11 of this Plan.

6.1.1 Operations

During operations at the Rock Creek Mine/Mill Complex may generate non-process effluents such as dewatering effluent and water from interceptor wells. When necessary, these surplus water effluents will be treated, as appropriate, and discharged into either the Infiltration Gallery and/or injection wells. Prior to disposal of this treated wastewater, the effluent from the water treatment plant will be sampled as specified in Table 6-1. If treated wastewater injection is not occurring, samples will not be collected and it will be noted that injection was not occurring in the applicable monitoring reports.

Table 6-1 Parameters For Laboratory Analysis of Injection Well Samples

Analyte	Method	Practical Quantitation Limit*	Frequency*
Antimony, total and dissolved	200.8	1	Weekly
Arsenic, total and dissolved	200.8	5	Weekly
Copper, total and dissolved	200.8	1	Weekly
Iron, total and dissolved	200.7	40	Weekly
Manganese, total and dissolved	200.8	1	Weekly
pH	150.1	0.1 (S.U.)	Daily
Conductivity	120.1	1 (µS/cm)	Daily
Chloride	300	100	Weekly
Cyanide -WAD	SM20 4500	0.005	Weekly
Hardness	130.1	10 -400 (mg/L)	Weekly
Nitrate + Nitrite	300	1000	Weekly
Sulfate	300	100	Weekly
Temperature	170.1	NA	Daily
Total Dissolved Solids	160.1	100 (mg/L)	Weekly
Flow	Meter	NA	Continous

6.1.2 Closure

There will be no wastewater injection from either the Rock Creek Mill/Mine Complex or from the Big Hurrah Mine after the facilities have entered the post-closure period. Visual monitoring, surface water monitoring, seep monitoring, and groundwater monitoring will occur at both sites as listed in previous sections of this plan.

6.2 BIG HURRAH MINE

Although no process effluents or tailings will be generated at the Big Hurrah Mine, there will be water from pit dewatering during operations and outflow from the mine lake after closure. This section describes monitoring for mine pit dewatering wastewater during operations and after closure.

6.2.1 Operations

To allow for mining “in-the-dry”, mine water will be pumped from the pit, and/or interceptor wells will be used, to prevent pit inflow. Collected waters will be disposed of via injection wells, after appropriate treatment. Water to be injected will be sampled weekly after any appropriate treatment, for the parameters and frequency presented in Table 6-1. If treated wastewater injection is not occurring samples will not be collected and it will be noted that injection was not occurring in the applicable monitoring reports.

6.2.2 Closure

There will be no wastewater injection from either the Rock Creek Mine/Mill Complex or from the Big Hurrah Mine after the facilities have entered the post-closure period. Visual monitoring, surface water monitoring, seep monitoring, and groundwater monitoring will occur at both sites as listed in previous sections of this plan.

7.0 GEOCHEMICAL MONITORING

This section describes geochemical monitoring activities to be performed during operations at both the Rock Creek Mine/Mill Complex and the Big Hurrah Mine. Geochemical monitoring of the tailings and development rock will be conducted for ongoing characterization of materials as the mine operates, and to use in management of development rock Also, additional samples will be collected if substantial volumes of lithologies, sufficiently different from those already characterized, are encountered during mining. Results of monitoring activities will be reported as described in Section 11 of this Plan.

7.1 ROCK CREEK MINE/MILL COMPLEX

At the Rock Creek Mine/Mill Complex geochemical sampling of both development rock and tailings will be performed.

7.2 DEVELOPMENT ROCK

Development rock will be sampled and tested to confirm material specifications for deposition in development rock facilities or use as construction material. Samples will be collected and analyzed as summarized in Table 7-1.

Table 7-1a Rock Creek: Monitoring of Development Rock

Analyte	Method	Frequency
In-house Analyses		
Paste pH	Standard	Weekly composite of every 10th blast hole[1]
Carbon/Sulfur (total)	Leco	
NP/AP ratio	Standard Sobek	
Outside Lab Analyses		
Paste pH	Standard	Split of one weekly composite (from above) analyzed monthly[1]
Carbon/Sulfur (total)	Leco	
NP/AP ratio	Standard Sobek	
CaNP	TIC	
Siderite corrected NP	Modified Sobek	
Bulk rock chemistry	ICP/MS	
MWMP[2]	NDEP[3]	Quarterly composite of weekly blast hole composite
Humidity Cell Test	ASTM or other approved method	Humidity cell tests may be required by ADEC if geochemistry analyses indicate that the development rock may have the potential to produce acid and/or leach metals.

1. After 1 year of monitoring AGC may apply to ADEC for reduction in monitoring frequencies
2. Meteoric Water Mobility Procedure
3. Nevada Department of Environmental Protection test method or other procedure approved by ADEC

7.2.1 Tailings

A sample of paste tailings will be collected from the inflow point to the TSF, or from representative tailings in the facility, from the upper 3 to 6 inches of materials, as presented in Table 7-2.

Table 7-1b Rock Creek: Monitoring of Tailings

Analyte	Method	Frequency
WAD Cyanide	SM 4500–CN I	Daily grab
Paste pH	Standard	
Carbon/Sulfur (total)	Leco	Weekly composite of daily grab samples[1]
NP/AP ratio	Standard Sobek	
CaNP	TIC	
Siderite corrected NP	Modified Sobek	
Bulk tailings solids chemistry	ICP/MS	
MWMP[2]	NDEP[3]	Quarterly composite of weekly grab composite
Humidity Cell Test	ASTM or other approved method	Humidity cell tests may be required by ADEC if geochemistry analyses indicate that the tailings may have the potential to produce acid and/or leach metals.

1. After 1 year of monitoring AGC may apply to ADEC for reduction in monitoring frequencies
2. Meteoric Water Mobility Procedure
3. Nevada Department of Environmental Protection test method or other procedure approved by ADEC

Table 7-2 Tailings Geochemical Testing
MWMP Test Parameter List

Analyte	MDL	Method
pH unit	0.01	EPA 150.1
Alkalinity	1 mg/L	SM 2320
Bicarbonate	1 mg/L	SM 2320
Total Dissolved Solids	10 mg/L	EPA 160.1
Cyanide (WAD)	0.01 mg/L	SM4500- CN I
Chloride	0.5 mg/L	EPA 300
Fluoride	1 mg/L	EPA 300
Nitrate as Nitrogen	0.5 mg/L	EPA 300
Nitrite as Nitrogen	0.5 mg/L	EPA 300
Total Nitrates as Nitrogen	0.5 mg/L	EPA 300
Sulfate	1 mg/L	EPA 300
Mercury	0.0005 mg/L	CVAAS
Silver	0.003 mg/L	ICP-OES
Aluminum	0.02 mg/L	ICP-OES
Arsenic	0.01 mg/L	ICP-MS
Boron	0.01 mg/L	ICP-MS
Barium	0.002 mg/L	ICP-MS
Beryllium	0.00 1 mg/L	ICP-MS
Calcium	0.5 mg/L	ICP-OES
Cadmium	0.002 mg/L	ICP-MS
Chromium	0.004 mg/L	ICP-MS
Copper	0.003 mg/L	ICP-MS
Iron	0.03 mg/L	ICP-OES
Potassium	1 mg/L	ICP-OES
Magnesium	0.5 mg/L	ICP-OES
Manganese	0.01 mg/L	ICP-OES
Sodium	0.5 mg/L	ICP-OES
Nickel	0.01 mg/L	ICP-OES
Lead	0.02 mg/L	ICP-MS
Strontium	0.02 mg/L	ICP-OES
Selenium	0.02 mg/L	ICP-MS
Thallium	0.03 mg/L	ICP-MS
Zinc	0.04 mg/L	ICP-OES

*Applicable parameters will be reviewed during and after mining operations and upon concurrence with ADEC, monitoring for some parameters may be discontinued if ongoing sampling reasonably indicates there to be negligible risk of exceeding water quality criteria

7.3 BIG HURRAH MINE

7.3.1 Development Rock

Development rock will be sampled and characterized in accordance with the Rock Characterization Plan included in Appendix D of this document.

8.0 REVEGETATION MONITORING

The section describes revegetation monitoring activities to be performed at both the Rock Creek Mine/Mill Complex and the Big Hurrah Mine. Results of monitoring activities will be reported as described in Section 11 of this Plan.

8.1 ROCK CREEK MINE/MILL COMPLEX

Revegetation criteria for reclaimed areas are 50 percent vegetation cover achieved prior to requesting bond release. Alaska Gold will monitor the revegetation process every spring and fall for 5 yeas from re-seeding, or until a stable revegetated stand is achieved.

8.2 BIG HURRAH MINE

Revegetation criteria for reclaimed areas are 50 percent vegetation cover achieved prior to requesting bond release. Alaska Gold will monitor the revegetation process every spring and fall for 5 yeas from re-seeding, or until a stable revegetated stand is achieved.

9.0 WILDLIFE MONITORING

The section describes wildlife monitoring activities to be performed at both the Rock Creek Mine/Mill Complex and the Big Hurrah Mine.

9.1 ROCK CREEK MINE/MILL COMPLEX

All Alaska Gold employees will be instructed to report unusual circumstances involving wildlife encounters and wildlife mortalities to their supervisor. Wildlife mortalities for bald eagles, migratory birds and any endangered species occurring at the Rock Creek Mine/Mill Complex also will be reported to the United States Fish and Wildlife Service (USFWS) Specific areas that will be monitored on a regular basis will include the TSF (because of the open water and potential for soft unconsolidated tailings) and the Mine Recycle Water Pond (because of the presence of open water).

Wildlife mortalities discovered in operational areas of the mine and mill will require special collection and sampling procedures. After reporting the mortalities to their supervisor, the species and a standing solution (e.g., water or liquid associated with soft tailings) sample will be collected. The standing solution sample will be collected as close to the site of the carcass as possible. The solution sample will be preserved immediately with sodium hydroxide to attain a pH>10 and submitted to an outside laboratory for WAD cyanide analysis.

As noted, USFWS will be contacted to report mortalities to bald eagles, migratory birds or any endangered species. Such reports will be made by mine management within 24 hours or during the next scheduled workday. A written follow-up report will be submitted to USFWS with the date the mortality was discovered, identification of species, and WAD cyanide level of the solution sample. The follow-up report will be submitted within 7 days of the initial verbal notification to allow verification of analytical results. An annual summary will be prepared by Alaska Gold and will review mortality occurrences during the ice-free period (generally May through September) and during the ice cover (October through April). The annual report will be submitted within 30 days of the end of the reporting period if mortalities have occurred.

All bald eagle, migratory bird or endangered species carcasses will be available for final collection by USFWS. Laboratory results of analysis for WAD cyanide concentration from solution samples will determine final disposal procedure for all carcasses collected. WAD cyanide levels ~ 25 parts per million will trigger a necropsy to determine cause of death. WAD cyanide levels < 25 parts per million will not require further analytical analysis. Final deposition of all carcasses will be determined by the appropriate agency.

Terrestrial animals mired in unconsolidated tailings material will be extracted and moved or herded to a safe area. All attempts to extract mired animals will be based on evaluation as to the health and safety of employees and that of the animal. The Alaska Department of Fish and Game, Division of Wildlife Conservation (907-443-2271), and the Alaska Department of Public Safety, Bureau of Wildlife Enforcement (907-443-2429), shall be immediately contacted if it is determined that a mired animal cannot be safely extracted.

9.2 BIG HURRAH MINE

Since all milling operations will occur at the Rock Creek Mine and Mill Complex, neither tailings nor stored standing water to be recycled are expected to be present at the Big Hurrah Mine. Therefore, no routine inspections are necessary for the Big Hurrah site. However, employees will report and observed mortalities to their supervisors for review and management utilizing the same procedures described in Section 10.1. All mortalities at Big Hurrah will be included in annual reporting for the Rock Creek Mine/mill Complex.

10.0 MONITORING RECORDS AND REPORTING

This section describes the procedures to be used to record and document monitoring activities for the Project.

10.1 FIELD MEASUREMENTS AND RECORDS

All field activities pursuant to this monitoring plan will be recorded on field forms that will include the following information, as applicable:

- Location, date, time of inspection, observations, measurements;
- The person(s) performing the inspection or monitoring activity;
- The laboratory performing the analysis;
- Chain-of-Custody records;
- Laboratory reports; and
- Consultant or engineering report.

10.2 RETENTION OF RECORDS

During the period of operation, closure, and reclamation, all records associated with the monitoring activities will be retained by Alaska Gold or an Alaska Gold representative for a period of 3 years.

10.3 MONITORING REPORTS AND SUBMISSION SCHEDULES

Monitoring reports, other than wildlife and vegetation monitoring reports, will be submitted quarterly to ADEC and ADNR. All quarterly reports will be submitted on or before the 15th day of the month following the end of the quarter. Wildlife reporting will occur annually, as

described in Section 9.0. Vegetation monitoring will be reported as described in the Rock Creek Gold Mine Project Reclamation Plan.

An annual report will be prepared for each year, through December 31, and will be submitted to ADEC on or before February 15 of the subsequent year. The annual reports will include laboratory reports and will summarize all visual, geochemical, and water monitoring that has taken place during that year.

APPENDIX A

Surface Water Monitoring Quality Assurance Plan

Operational and Closure Surface Water Monitoring will be preformed in accordance with the previously prepared and submitted Quality Assurance Plan, attached. Although the plan refers to baseline monitoring all pertinent sections will be applied during operation and closure as well. Where this Operational and Closure Monitoring Plan contains specific information, such as monitoring locations and sampling frequencies, this Plan takes precedence over the attached baseline plan.

SURFACE-WATER MONITORING QUALITY ASSURANCE PLAN

For:

ALASKA GOLD PROJECTS
NOME, AK

Prepared by:

HMH Consulting, LLC
5630 Silverado Way, A2
Anchorage, AK

Revision 1
April 13, 2005

A. PROGRAM SUMMARY

A1. Title and Approval Sheets

Program Title: Alaska Gold Projects, Baseline Surface-Water Monitoring Program

Organization: Alaska Gold

Signatures (please include dates):

	Signature	Date
Alaska Gold's Personnel Charlotte MacCay Project Director, Quality Assurance Manager, Project Manager E-mail: cmaccay@beesc.com Phone: 907-743-9366	_____	
ADEC Personnel William D. "Pete" McGee Project Manager, Water Discharge Permits E-mail: pmcgee@envircon.state.ak.us Phone: 907-451-2101	_____	
Jim Gendron Quality Assurance Manager E-mail: jgendron@envircon.state.ak.us Phone: 907-465-5305	_____	

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Appendices
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Appendix B – Monitoring System Technical Information
Appendix C – SOP Checklists & Log Forms
Appendix D – Statement of Qualifications
Appendix E – Program References
Appendix F – Safety Methods

A3. Distribution List

Organization	No. Copies
ADEC	**2**
Alaska Gold/Nova Gold	**2**
HMH Consulting	**1**

For each recipient's title, phone number and email address see section A.1.

A4. Program Organization

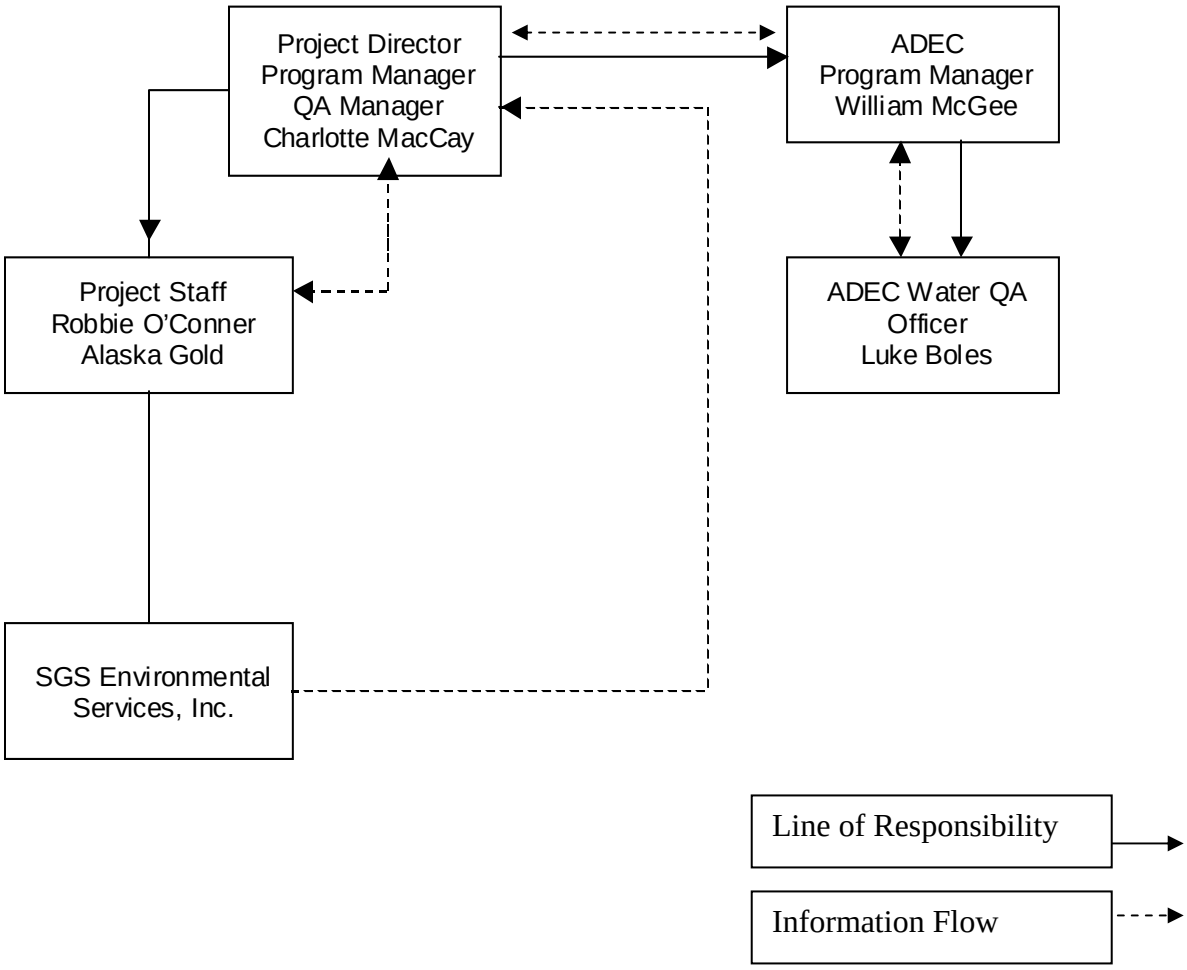
Alaska Gold

Charlotte MacCay	Project Director-Directs/oversees Water Monitoring Project
	Program Manager-Performs field sampling./monitoring tasks, data input and summary reporting
	Project QA Manager-Performs data reviews and field assessments on at least 10% of field data
Robbie O'Conner	Environmental technician

ADEC

William "Pete" McGee	Project Manager
Luke Boles	Quality Assurance Manager

Program Organization Chart



A5. Monitoring Program Objectives

Introduction

An environmental monitoring program is being conducted to develop baseline surface water flow and geochemical data for Alaska Gold projects.

Objectives of the Program

Alaska Gold, Inc., is in the process of evaluating the projects listed in Appendix A. Alaska Gold is performing a surface-water monitoring project as part of this evaluation. Objectives of the surface water program include the following:

1. Collect data to establish the status of the surface water system in the area that will be potentially affected by development of the various projects. Data will be collected for both quality and flow. These data will be used to establish existing baseline conditions for National Environmental Policy Act (NEPA) activities and permitting.

2. Collect hydrology data that can be used to aid in facility design.

Sets of monitoring locations at each project site are being used for this program. Representative surface water has been identified as local creeks in the area that bound the mineralized zone. The monitoring locations are found above and below projected mine activities so that surface water in and out of the area will be monitored. It is important that creeks that currently have elevated metal concentrations be identified during this phase so that baseline conditions can be adequately established.

Water quality and stream-flow data near the sites are critical in determining the effects associated with the projects. The focus of the sampling program will be used to characterize water quality and flow data before project development. Results of analyses will also identify effects of historic and current mining activities.

The water quality standards used to evaluate the samples come from the most recent of the State of Alaska Water Quality Standards (18 AAC 70), and the State of Alaska Drinking Water Standards (18 AAC 80). These standards can be found in Appendix E.

Alaska Gold/NovaGold Environmental Policy Statement

Alaska Gold, a subsidiary of NovaGold recognizes environmental management as a corporate priority. NovaGold cares about preserving our environment for future generations, while also providing for safe, responsible, and profitable operations by developing our natural resources for the benefit our employees, shareholders, and community.

In adopting the following Statement of Principles throughout all stages of exploration, development, mining, and closure, NovaGold intends to set and maintain standards of excellence for environmental performance at all our operations.

I. NovaGold will communicate our commitment to excellence in environmental performance to our subsidiaries, employees, contractors, other agents, and the community.

II. All new activities and operations will be managed to ensure compliance with applicable laws and regulations. In the absence of regulation, best management practices will be applied to minimize environmental risk.

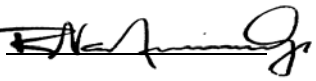
III. Remediation and mitigation of historic mining impacts on properties acquired by NovaGold will be managed through the cooperative involvement of NovaGold with previous owners, government agencies, and the community.

IV. In order to achieve our commitment to environmental excellence, NovaGold will utilize an Environmental Management System that ensures prioritization, planning, implementation, monitoring, and honest reporting.

V. NovaGold will strive to minimize releases to the air, land, or water and will ensure appropriate treatment and disposal of waste.

VI. NovaGold will allocate the necessary resources to meet our reclamation and environmental obligations.

VII. NovaGold will continuously seek opportunities to improve our environmental performance through adherence to these principles. NovaGold will regularly report progress to our employees, shareholders and the community.

CEO Signature:  Date: **October 10, 2003**

A6. Project/Task Description, Program Schedule

Parameters, Sample Locations and Sampling Frequency

The list of laboratory analyses that will be used in the monitoring program is shown in Table C-1. Analysis will include the following: total and dissolved metals, total dissolved solids (TDS), and total settleable solids (TSS), alkalinity, anions (chloride, fluoride, sulfate, nitrate, nitrite), mercury, cyanide, ammonia and total phosphorous. A summary of sample containers, preservation, storage conditions, and holding time requirements is listed in Table C-2. The laboratory will be contacted at least one (1) week in advance of each field mobilization effort to arrange for sample bottles and coolers. Additional field parameter data can be collected whenever possible.

Geographic Location of Alaska Gold Projects

Please refer to Appendix A for geographic locations, descriptions, site location maps and sampling frequencies for all Alaska Gold Projects.

A7. Data Measurement Criteria

Data Uses and Data Quality Objectives

The principal objectives of the quality assurance project plan (QAPP) program are to maintain the quality of field activities, sample collection, sample handling, laboratory analysis, and data analysis and to document the quality of data at each processing level. This program clearly identifies major aspects of the project requiring specific quality control and demonstrates that quality control is a major focus for this project.

Quality assurance (QA) requirements are established in this quality assurance plan (QAP) to achieve the project objectives for the data uses. Applicable quality control (QC) procedures, quantitative target limits, and level of effort for assessing the data quality are dictated by the intended use of the data and the nature of the required field and analytical methods. The project objectives are to collect data of known and sufficient quality for Alaska Gold to rely upon as accurate pre-development data.

Federal and state levels of concern (for example, ambient water quality criteria or maximum contaminant levels) exist for many of the parameters being analyzed in the surface-water monitoring program. Analytical methods will be specified that will allow detection of chemical constituents at or below levels of concern. Data quality objectives for the Alaska Gold Projects are listed in Table B-3, page 26.

Data Quality Parameters

The quality of laboratory data is measured by the precision, accuracy, representativeness, comparability, and completeness of the data. These parameters and the applicable quality control procedures and levels of effort are provided in Table B-3.

Quantitative definitions of precision, accuracy, completeness, and method detection limits are presented below.

Precision

Precision is a qualitative measure of the reproducibility of a measurement under a given set of conditions. For duplicate measurements, analytical precision can be expressed as RPD (relative percent difference). The level of effort for precision will be at a minimum frequency of 1 in 20, (5 percent) or one per sampling batch, whichever is more frequent.

If calculated from duplicate measurements:

$$RPD = [(C_1 - C_2) \times 100\%] \div [(C_1 + C_2) / 2]$$

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, use relative standard deviation (RSD) rather than relative percent difference (RPD):

$$RSD = (s / y) \times 100\%$$

RSD = relative standard deviation
s = standard deviation
$\overline{y}$ = mean of replicate analysis

Standard deviation, S, is defined as follows:

$$S = \{\sum_{i=1}^{i=n-1} (y^i - \overline{y})/2\}^{0.5}$$

S = standard deviation
y_1 = measured value of the ith replicate
$\overline{y}$ = mean of replicate measurements
n = number of replicates

Accuracy

For samples processed by the analytical laboratory, accuracy will be evaluated with MS (matrix spikes) and SRMs (standard reference materials) to establish the average recovery. For metals and general chemical parameters, MS will be analyzed at an overall frequency of 5 percent throughout the project duration. Two (2) SRMs will be submitted and analyzed for metals during this 1-year program.

For measurements where matrix spikes are used:

$$\%R = 100\% \times [S-U/C_{SA}]$$

%R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{SA} = actual concentration of spike added

For situations where a standard reference material is used instead of or in addition to matrix spikes:

$$\%R = 100\% \times [C_m/C_{srm}]$$

%R = percent recovery
C_m = measured concentration of SRM
C_{srm} = actual concentration of SRM

Completeness (Statistical)

Defined as follows for all measurements:

$$\%C = 100\% \times [V/n]$$

%C = percent completeness
V = number of measurements judged valid
n = total number of measurements necessary to achieve a specific statistical

Precision will be evaluated differently for different parameter groups, as shown in Table A-1.

Table A-1

Precision Evaluation for Parameter Groups

Parameter Group Level of Effort	Type of Precision Test
Inorganic analytes 5 percent[a]	Blind field duplicates
5 percent[b]	Laboratory replicates

[a]Frequency of QA samples may be 5 percent, or one per sampling event, whichever is greater.
[b]Frequency of laboratory replicates will be 5 percent, or once per analytical batch, which ever is more frequent.

Representativeness

Representativeness is a measure of how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the water sampled. Sites are representative of current chemical distribution in surface waters. The sites were chosen so that surface water in and out of the mineralized zone will be analyzed and monitored. The sites were picked according to U.S. Geological Survey TWRI book 9, chapter A1 recommendations. These include: straight reaches with uniform flow, a distance from confluences to avoid flows that are poorly mixed or not unidirectional, and so that they can be sampled from in all seasons.

Sampling plan design, sampling techniques, and sample handling protocols (storage, preservation, and transportation) have been developed and are discussed in other sections of this document. Proposed documentation will establish that protocols have been followed and sample identification and integrity assured.

Field blanks will be used to assess the types of field contamination and method variation. One field blank will be submitted per sampling event. A summary of field QA samples is shown in Table A-2. Laboratory sample retrieval, storage, and handling procedures have also been developed and are discussed in other sections of this document. Laboratory method blanks will be run at the minimum frequency of 5 percent, or one per analytical batch, to assess the potential for laboratory contamination.

Table A-2

Summary of Field QA samples

Type of Field QA Sample Sampling Events	Analysis	Frequency
Field duplicates	All parameters	Each sampling event
SRM[a]	Dissolved Metals	Two times per year

a = Standard Reference Materials, issued by the National Institute for Standards and Technology (NIST). SRMs are certified for specific chemical or physical properties and are issued with certificates that report the results of the characterization and indicate the use of the material. Selected SRMs will be randomly submitted to the laboratory. Two SRMs will be submitted and labeled in such a way as to present a blind project sample to the laboratory.

Comparability

Comparability is the level of confidence with which one data set can be compared with another. Comparability of the past and future data will be maintained by using EPA-approved procedures. Comparability will also be maintained by the use of consistent units.

Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system. The quantitative definition of completeness is given in Appendix B. The target completeness objectives are approximately 90 percent for each analytical parameter; the actual completeness can vary with the intrinsic nature of the samples. The completeness of the data will be assessed during the data review.

A8. Monitoring Personnel Experience

All field technicians will use procedures and methods listed in Section B1-B3. Personnel that provide sampling and data gathering will be trained according to sampling techniques outlined in USGS's *"National Field Manual for the Collection of Water-Quality Data*" by the HMH Water Quality Manager. For Project Manager experience, refer to Appendix D.

A9. Documents and Records

The following reports will be prepared over the program duration:

- Annual Report - Draft in 30 days after end of 12-month period, Final report in 45 days
- File Compilation in 45 days after conclusion of program
- Report copies can be found at Alaska Gold

Also, see Chapter C2 - Reports to Management

B. DATA GENERATION AND ACQUISITION

B1. Sampling Process Design

Purpose

Producing data of known quality that are considered representative of the sampling environment at an appropriate level of detail is achieved by establishing a QAPP program with specified data gathering protocols overseen by the Alaska Gold Project Director. The main components of the proposed QAPP program include the following:

- Verification of use of proper sample containers
- Collection and analysis of blank/duplicate samples
- Specific procedures for handling, labeling, and shipping samples
- Field equipment calibration
- Equipment decontamination
- Field documentation
- Field corrective action

All blanks/duplicates will be noted on the field form. Blanks will use BLNK as the location abbreviation.

B2. Sampling Methods

Streamflow Measurement and Wading Technique

1. Visually check wading rod and current/velocity meter for damage. Repair damage to equipment as necessary.

2. Evaluate reach of stream to determine suitability of the site and type of equipment necessary to make flow measurements. The criteria of a good measuring section of a stream are as follows:

    - The channel is straight
    - The flow in the reach is confined to a single channel
    - The flow lines of the reach are distributed proportionately across the channel
    - The reach has a uniform slope, and the measurement is done midway between the slope controls
    - There are few in stream obstructions within the reach to disrupt flow lines, such as fallen logs, boulders, sand or gravel bars
    - There are no downstream obstructions that may cause backwater at the measurement section, such as beaver dams or road culverts
    - There is good access to the gauging site under all flow conditions, including flooding conditions

3. Attach current meter to wading rod.

4. Anchor surveyor's tape tautly across the stream perpendicular to the direction of stream flow and attach on either side of the stream. Provide at least a foot of clearance between the water surface and surveyor's tape.

5. Note the time and stage (water level as noted on staff gauge) at the beginning of the measurement.

6. Divide the cross section of the stream into 6-inch partitions if less than 10-feet wide, 1-foot intervals if stream is wider than 10-feet.

7. Person wading in-stream calls out to data recorder on shore the location of the first measuring point with respect to the surveyor's tape. Person in stream measures water depth at that vertical, using wading rod or tape measure, to the nearest 0.1 foot, if possible.

8. Data recorder calls out height(s) above the streambed at which velocity measurements are to be made. If the water is more than 2.5 feet deep, measurements should be made at 20 and 80 percent of the water column height. For water columns less than 2.5 feet deep, a single velocity measurement at 40 percent of the water column height (above the bed) will suffice. Person wading adjusts height of current meter on the wading rod accordingly.

9. Person wading stands downstream of the surveyor's tape, facing upstream, holding the wading rod vertical in the water with the current meter facing directly into the current. Person should not stand directly behind the meter, rather to either side to not influence velocity readings.

10. The meter visual output is recorded.

11. Repeat procedure at each vertical.

12. Data recorder reduces data on site and records other appropriate information on the field form.

Surface Water Sampling

1. Use clean sampling containers provided by the laboratory (SGS).

2. Locate sampling site at a point in the stream exhibiting greatest flow and/or highest velocity.

3. Submerge sample container at sampling point such that mouth of container is under water surface 2 to 3 inches, if possible. Each site will use its own set of sampling containers and they will not be used for more than one site.

4. Collect sample in non-preserved cubie (one for each site) and pour into pre-preserved sampling bottles. Carefully note the sample number, sampling location, date, time, gage height, and other pertinent information on the sample bottles.

5. Fill out appropriate field form(s) documenting sample number, sampling location, date, time, gage height, station or vertical in the stream cross section and other pertinent information before leaving the site.

6. Filtration will be performed by the laboratory when necessary.

Field Measurement of Electrical Conductance

Electrical conductance measurement generally is conducted directly in the stream. If the instrument is not temperature compensated, the temperature of the sample must be recorded, and included with the value in the report, or the conductivity value must be corrected by calculation prior to reporting. Under very cold conditions, it may be necessary to collect a sample in the field and conduct the measurement in the field office. In this case, a sample specifically for field measurements is taken in a pre-cleaned, unpreserved, laboratory-supplied bottle.

1. Rinse probe with deionized water and place conductivity probe in sample water.

2. Turn instrument on to appropriate scale for sample analyzed. Record to the nearest 1 microsiemen per centimeter (µS/cm). Measure sample temperature to nearest 0.1ºC from conductivity meter. Record temperature.

3. Remove probe from sample and rinse probe with deionized water.

Field Measurement of pH

Measurement of pH is generally conducted directly in the stream. However, under very cold conditions it may be necessary to collect a sample in the field and conduct the measurement in the field office. In this case, a sample specifically for field measurements is taken in a pre-cleaned, unpreserved laboratory-supplied bottle.

1. Rinse pH electrode with deionized water.

2. Check meter using standard that is nearest the expected field pH. If not within 0.1 pH units, recalibrate meter using appropriate standards.

3. If measurement is read *ex-situ*, fill beaker with sample water.

4. Immerse electrode and temperature probe in sample while swirling the sample to provide thorough mixing. Turn on meter. Electrode filler level should be ½ inch above sampling surface level. Read pH to nearest 0.1 after the reading has stabilized.

5. Record sample pH. Note any problems such as erratic readings.

6. Rinse probe with deionized water and store according to manufacturer's directions.

Field Measurement of Dissolved Oxygen

Dissolved oxygen measurement generally is conducted directly in the stream. Under very cold conditions, it may be necessary to collect a sample in the field and conduct the measurement in the field office. In this case, a sample specifically for field measurements is taken in a pre-cleaned, unpreserved, laboratory supplied bottle.

1. Inspect dissolved oxygen meter for damage; repair as necessary.
2. Rinse probe and cable with deionized water.
3. Prepare probe and dissolved oxygen meter in accordance with instrument manufacturer's operating procedures. Make certain probe contains sufficient electrolyte, and oxygen membrane is in good repair. Repeat this process for maintenance of the meter.
4. Calibrate probe and meter using the manufacturer's calibrating procedures.
5. Measurements should be collected *in-situ* at a site with a representative flow. Care should be taken to avoid sites with excessive disturbance or non-laminar flow.
6. Read dissolved oxygen value. Record appropriate data on field forms.

Field Measurements of Turbidity

Turbidity measurement generally is conducted directly in the stream. Under very cold conditions, it may be necessary to collect a sample in the field and conduct the measurement in the field office. In this case, a sample specifically for field measurements is taken in a pre-cleaned, unpreserved, laboratory supplied bottle.

1. Calibrate turbidity meter before each sampling event using pre-manufactured Formazin gel calibrating blanks.

2. Collect sample in appropriate container, wipe off remaining water from sample bottle and smear silicone oil to remove fingerprints with cloth.

3. Place container in turbidity meter and read and record the value.

Dump contents from sample bottle. Clean the instrument with a clean dry cloth while avoiding the photocell on the inside of the meter before storage

Sample Collection and Analysis

Sample collection, handling, and shipping procedures include the following:

- Collection
- Labeling
- Packaging
- Chain-of-custody forms
- Shipping

The Program Manager is responsible for implementing the following sample handling and shipping procedures. The QA Manager will check for quality assurance measures on these activities and will check at least 10% of field data.

Collection

Surface water samples will be collected for analysis in the following order:

1. Mercury
2. Total metals
3. Dissolved metals
4. Total suspended solids, total dissolved solids, etc.
5. Settleable solids (Imhoff cones in the field)
6. Miscellaneous parameters (ammonia, phosphorus, Cyanide WAD, etc.)

EPA Method 1631 Mercury Sampling And Analysis In Ambient And Effluent Waters

Many states are establishing new NPDES limits for metals at very low levels based on maintaining water quality standards in the receiving streams. The new limits may approach or even be less than the detection limit of routine analytical methods.

To ensure that reliable data is produced at these trace levels additional emphasis must be placed on clean sampling and clean laboratory practices to minimize contamination. The following procedures are recommended by Columbia Analytical Services, the laboratory we will use for Mercury analysis for Alaska Gold.

- Document sampling cleanliness with the use of trip blanks and field sampling blanks.
- Use non-metallic sampling equipment and do not allow any metal object to come into direct or indirect contact with the sample or sample containers.
- Use non-talc gloves.
- Collect samples directly into sample containers that are documented clean at the levels of concern.
- Double bag all sample containers.
- May need to designate one "clean hands" sampler to perform all operations involving direct contact with the sample, and one "dirty hands" sampler for all other operations.
- The laboratory should use ultra clean reagent, specially cleaned glassware and other precautions such as the use of laminar flow hoods for sample digestion and preparation.
- Laboratory method detection limits (MDL's) should be significantly lower than the maximum compliance level specified.

Sampling Technique and Contamination Avoidance Procedures

- Ensure any object or substance that contacts the sample is nonmetallic and free from any materials that may contain metals of concern.
- Mercury must be eliminated or reduced to a level that will not compromise the measurement.
    - Sampling bottles
    - Sampling equipment
    - Reagents
- A two-person sampling team is required.
    - One person designated "clean hands" and performs operations involving direct contact with the samples and bottles
    - Other person is designated "dirty hands" and is responsible for operation of machinery and activities not involving direct contact with the sample
    - Sampling personnel must wear clean, non-talc gloves, and may need to wear other clothing such as disposable coveralls or nylon windsuits, caps and shoulder length glove liners, to prevent sample contamination

- To minimize contamination-
    - Collect samples facing upstream and upwind
    - Avoid collection of samples during precipitation events
    - Collect samples as far as possible from metal supports, bridges, wires, and heavily traveled roads
- Method includes procedures for collection of samples for determination of total and dissolved metals.
- Sample filtration-
    - For dissolved metals, samples are filtered through a 0.45um capsule filter or a tortuous path filter at the field site
    - A continuous-flow sampling system (peristaltic pump and tubing) can simplify sample collection and filtration
- Sample preservation-
    - Conducted in field or laboratory
    - Field preservation must be performed in a glove bag or a designated clean area
- Equipment blanks-
    - Bottle blanks
    - Sampler check blanks are generated by processing reagent water through the sampling equipment using same procedures as the field collection of samples and then analyzing the water-this will allow knowledge of possible contamination
- Field Blanks-
    - Must be collected to assess the likelihood of contamination in the samples
    - Field blanks are collected before samples
- Field Duplicates-
    - Collected to assess precision of the sampling and analytical processes

Use of Method 1631 Mercury analysis follows an Equipment Sampler Check Blank, determining if contamination has occurred in the winter from the ice auger. Although contamination exists due to the metal ice auger (results at 2.9 and 3.2 ng/L), it is less than the drinking water standard of 2000 ng/L and the chronic aquatic life standard of 12 ng/L. The method will be used with ice-free conditions via a peristaltic pump and in the winter with ice conditions via a bailer assembly, with filtering done in the lab as the pump and hose assembly will freeze during cold temperatures.

Table B-1 shows the parameters, volume of containers, container type, preservatives added and maximum holding times of the samples.

Table B-1

Sample Containers and Holding Conditions

Parameter	Container volume (per sample)	Container Type	Handling and Storage (cool to 4ºC)	Holding Time
Total Metals	250 mL	Polyethylene	HNO_3 to pH <2	6 months
Dissolved Metals	60 mL	Polyethylene	HNO_3 to pH <2	6 months
Mercury	1 Liter	Polyethylene	HNO_3 to pH <2	90 days
TDS	1L Cubitaner	Polyethylene	Cool to 4ºC ± 2	7 days
TSS	w/above	Polyethylene	Cool to 4ºC ± 2	7days
Alkalinity	"	Polyethylene	Cool to 4ºC ± 2	28 days
Anions	"	Polyethylene	Cool to 4ºC ± 2	14 days
Ammonia	120 mL	Polyethylene	H_2SO_4 to pH <2	28 days
Phosphorous	With above	Polyethylene	H_2SO_4 to pH <2	28 days

All field measurements will be performed and documented following collection of samples for analysis. Calibration of field instruments will be performed in accordance with the instrument manual (Appendix B). A yearly survey of creek staff gauges will be performed and stream flow data validated.

Field Documentation**.** Field observations, field equipment calibration information, field measurements, and sample documentation, including sample identification, sample duplicates, and date and time the sample was collected, will be the responsibility of the entire sampling team. Field forms will be maintained for each task. Field forms will consist of waterproof bound pages, in ink, and every appropriate area marked. Blank pages will be marked as such with a diagonal line across the page, when appropriate. See Appendix C for additional information on field documentation.

Proper documentation for sample custody includes keeping records of all materials and procedures involved in sampling. Project field forms will be used to record field data. All information on the sampling station and respective samples and blanks collected at each site, including the positions of the station, will be recorded by the field crew. The field crew leader will review all data before leaving the sampling station. Completed field forms will be kept on file by the Program Manager for future reference.

Corrections to Documentation. Unless weather conditions prevent it, all original data will be recorded with waterproof ink. No accountable documents will be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on an accountable document assigned to one person, that person must make corrections by drawing a line through the error, initialing and dating the lined-out item, and entering the correct information. The erroneous information is not to be obliterated, but must remain legible. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry. All such subsequent corrections will be initialed and dated.

The stream-flow measuring device should be sent to a certified testing facility for calibration once per year. The use of continuous monitors (data loggers of water depth) will be placed in several locations to verify results.

Decontamination Procedures. All sample collection equipment which are exposed to a sample will be decontaminated by means of the following procedure:

1. Rinse in water
2. Wash with Alconox, or equivalent, in tap water
3. Rinse with deionized water
4. Rinse with dilute nitric acid (ultra pure HNO_3)
5. Rinse with deionized water
6. Air dry

The purpose of the water and Alconox, or equivalent, is to remove all visible particulate matter. This is followed by a deionized water rinse to remove the detergent, a nitric acid rinse to assure all metals are removed, and a second deionized water rinse.

Field Corrective Action. Field sampling corrective actions includes procedures to follow when field data results are not within the acceptable error tolerance range. The responsible party for any corrective action is the Program Manager, Charlotte MacCay.

These procedures include the following:

- Compare data readings currently measured with readings previously recorded
- Compare dissolved oxygen (D.O.) readings with the saturation value for water at the temperatures recorded. In the absence of gross pollution, D.O. in flowing water should be at or near saturation
- Recalibration of equipment (pH meters)
- Replacing or repairing faulty equipment
- Re-sampling when feasible

The Program Manager is responsible for ordering appropriate field corrective actions when deemed necessary. All field corrective actions will be recorded in the field book.

B3. Sample Handling and Custody

Labeling. Each sample container will have a waterproof label large enough to contain the information needed to easily identify each sample. The information to be included on each label will include the project name, date, time, preservative (if added), sampling code, and sampler's initials. Sample code will be formatted to indicate sample number and location. Each sampling location will be identified by the sampler on the field form. Each sample will be identified with a unique sample site name that will include the sample location and identification number of the sample. An example of sample identification is as follows: SABC-1001

Packaging. Each analytical sample bottle will be packed to prevent breakage and placed in an iced cooler to keep the samples cooled to 4° C. One copy of the chain-of-custody form will be placed in a sealed plastic bag, and then will be placed on the inside of the cooler. In addition, the cooler lid will be sealed with tape and chain-of-custody seals will be attached to the outside of the cooler so that the seals must be broken if the cooler is opened.

Chain-of-Custody. Chain-of-custody forms will be used for all samples. Once collected, the samples will remain within sight of the sampler or will be secured until the samples are prepared for shipment. Each time the cooler changes hands, both the sender and the receiver will sign and date the chain-of-custody form. The laboratory will forward the original to the Program Manager. The Program Manager will verify all chain-of-custody forms before sample shipment and will make a copy of each to maintain a duplicate set of records.

The following information is to be included on the chain-of-custody form:

- Sample identification code
- Signature of sampler
- Date and time of collection
- Project name
- Type of sample
- Number and type of containers
- Sample analysis requested
- Inclusive dates of possession
- Signature of receiver

Other chain-of-custody components will include sample labels, field notebook, sample shipment receipts and the laboratory logbook. The lists of analytical parameters are presented in Section B4, Tables B-2A, B-2B and B-3.

Shipping. Samples will be shipped from the project site and delivered to the laboratory in Anchorage as soon as feasible after collection.

B4. Analytical Methods

Table B-2A

Metals – Total and Dissolved

Analyte	Technique	Method	SGS MRL*
Aluminum	ICP/Mass Spec	200.8	20
Antimony	Same	200.8	1
Arsenic	Same	200.8	2
Barium	Same	200.8	3
Beryllium	Same	200.8	0.4
Bismuth	Same	N/A	N/A
Cadmium	Same	200.8	0.1
Calcium	ICP only	200.7	200
Chromium	ICP/Mass spec	6010B/200.8	4
Cobalt	Same	200.8	4
Copper	Same	200.8	1
Iron	ICP only	200.7	10
Lead	ICP/Mass spec	200.8	0.4
Magnesium	ICP	200.7	200
Manganese	ICP/Mass spec	200.8	5
Mercury	CAS labs	1631	0.0001
Molybdenum	ICP/Mass spec	6010B/200.8	10
Nickel	Same	6010B/200.8	5
Potassium	Same	200.9	500
Selenium	Same	200.8	2
Silver	Same	200.8	1
Sodium	Same	200.8	500
Strontium	ICP	200.7	5
Thallium	ICP/Mass spec	200.8	0.3
Tin	Same	200.8	20
Titanium	Same	200.8	20
Vanadium	Same	200.8	5
Zinc	Same	200.8	2

*Method Reporting Limit (ug/L)

Table B-2B

Inorganic Parameters

Parameter	Analysis SGS Method	SGS MRL
Alkalinity	SM20 2320B	10
Ammonia	350.2	0.063
Chloride	300.0	0.2
Cyanide-total	SM20 4500	0.005
Cyanide-WAD	SM20 4500	0.005
Fluoride	300.0	0.2
Nitrate+Nitrite	300.0	0.2
Phosphorus-total	365.2	0.2
Settleable Solids	160.5	0.1 (ml/L)
Sulfate	300.0	0.2
TDS	160.1	0.2
TSS	160.2	0.2

**SGS can not analyze for Bismuth
***Hits that are between the PQL and MDL will be reported with an “F” flag
****Lab will filter for dissolved metals
*****SGS will forward mercury samples to Columbia Analytical Services

Table B-3

Alaska Gold Projects - Data Quality Objectives

Parameter	**EPA Method**	**Initial Calibration (linearity or $R^{2)}$**	**Calibration Verification (% Recovery)**	**LCS (% Recovery)**	**Accuracy (Spike % Recovery)**	**Precision (% RPD)**
Metals by ICP	200.7 & 200.8	0.995 or greater	90.110	85-115	70-130	20
Metals by GFAA	6010B	0.995 or greater	90.110	85-115	70-130	20
Mercury	1631	0.995 or greater	90.110	85-115	70-130	20
Chloride	300.0	0.995 or greater	90.110	90-110	80-120	20
Cyanide	SM20 4500					
Fluoride	300.0	0.995 or greater	90.110	90-110	80-120	20
Sulfate	300.0	0.995 or greater	90.110	90-110	80-120	20
Ammonia as N	350.2	0.995 or greater	90.110	75-125	75-125	25
Nitrate – Nitrite	300.0	0.995 or greater	90.110	90-110	80-120	20
Phosphorous	365.2	Per manufacturer	NA	75-125	75-125	25
TDS	160.1	NA	NA	NA	NA	25
TSS	160.2	NA	NA	NA	NA	20
Alkalinity	SM20 2320B	Per manufacturer	Per manufacturer	90-110	NA	20

B5. Quality Control

The QAPP program consists of three components:

- Field QA identifies the procedures to be used in the field to verify that water samples and field monitoring data are collected according to the requirements of the project. The objective of field QA is to produce data, both field measurements and samples collected for laboratory analyses, that can be demonstrated to be representative of the environment sampled and are of known and acceptable quality. The QA Manager is responsible for reviewing at least 10% of the field data, and data review records will be kept in a log by the Project QA Manager.

- Laboratory QA identifies the protocols to be used by the laboratories, demonstrating to Alaska Gold that project data are analyzed according to U.S. Environmental Protection Agency (EPA) acceptable methods, and that reported values are accurate. SGS/CT&E is the subcontracted lab and ADEC has SGS/CTE's Quality Management Plan on file. The objective of the laboratory QA/QC program is to produce data that will meet state and federal analytical requirements.

- Data QA identifies the protocols to be used to verify that laboratory and field data have been reported accurately. The objective of the data QA/QC program is to demonstrate that the data reported meet the project-specified requirements.

Data Uses and Data Quality Objectives

Quality assurance requirements are established in this QAPP program to achieve the project objectives for the data uses. Applicable quality control procedures, quantitative target limits, and level of effort for assessing the data quality are dictated by the intended use of the data and the nature of the required field and analytical methods. The project objectives are to collect data of known and sufficient quality for Alaska Gold to comply with the requirements of state and federal environmental regulations.

Federal and state levels of concern (e.g., ambient water quality criteria or maximum contaminant levels) exist for many of the parameters being analyzed in the water-monitoring program. Analytical methods have been specified that will allow detection of chemical constituents at or below levels of concern.

Quality control procedures, detection limits, and data quality requirements are dictated by the intended use of the data and the nature of the analytical methods.

Data Quality Assurance/Quality Control Program

The proposed data QA/QC program serves four major functions:

- Maintenance of a duplicate record of all field data
- Sample tracking through laboratory analysis
- Data validation
- Oversight of data management

The second major component of the proposed data QA program is sample tracking throughout the laboratory analytical process. The Program Manager will maintain close communications with all analytical laboratories to verify sample receipt, proper sample management, and strict adherence to sample holding times. The laboratories will immediately inform the Program Manager of sample breakage, inadequate sample media to meet QA objectives, and other sample problems. The Program Manager/Project Director will then implement corrective action as deemed necessary.

Following receipt of the analytical data package, the Program Manager will verify that all sample parameter data have been received and will be compared to detection limits and preliminary results with previous results. Should major discrepancies be found, the Project Director/Program Manager will evaluate these so that possible corrective measures could be taken.

A data review or validation process will also be performed on a portion of all analytical data received from the laboratory. Chemical data will be reviewed with regard to the following:

- Analytical methodology
- Detection limits
- Cross-contamination as indicated by blank data
- Accuracy and precision
- Adherence to holding times

Where data do not meet the requirements specified in this QAPP program, the data will be flagged with qualifiers. These reviews of data will be summarized and included in the report of sampling data.

Laboratory Quality Assurance/Quality Control Program

Specific protocols to ensure laboratory data of known and consistent quality are presented in the attached SGS/CT&E Environmental Services Quality Assurance Manual. The Program Manager and laboratory operations manager will oversee implementation of these protocols. Project specific criteria are provided in Tables B-1, B-2A and B, and B-3.

Data validation will be conducted by QA Manager. Any discrepancies will be noted and discussed with Ms. Bayly, laboratory operations manager for this project with SGS/CT&E.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

Charlotte MacCay, the Program Manager, is responsible for all equipment maintenance decisions. The stream-velocity measuring device should be sent to a certified testing facility for calibration once per year. The use of continuous monitors (data loggers of water depth) will be placed in up to three locations to verify results.

For specific maintenance of field-parameter instruments refer to Appendix B.

B7. Instrument/Equipment Calibration and Frequency

Field Equipment Calibration

Field equipment used for collection, measurement, and testing is subject to a strict program of control, calibration, adjustment, and maintenance. Calibration will be conducted just before each sampling event, and as needed in the field. Calibration data will be included on the first page on the field forms per sampling event. Portable water quality instruments will be used for the *in-situ* measurement of pH, temperature, dissolved oxygen, turbidity and conductivity. The meters are self-replicating and present the data as such – presented data are recorded. The standards of calibration are in accordance with applicable criteria such as the National Institute of Standards Technology (NIST), American Society for Testing and Materials (ASTM) standards, or other accepted procedures outlined in the manufacturer's specifications. All calibration activities will be documented on appropriate field calibration notebooks or forms.

For specific instrument-calibration procedures refer to Appendix B.

The stream-flow measuring device should be sent to a certified testing facility for calibration once per year. The use of continuous monitors (data loggers of water depth) will be placed in up to three locations to verify results.

B8. Inspection/Acceptance of Supplies and Consumables

All supplies and consumables (Sample Reference Materials and reagents) will be inspected and checked in by the Project Manager or the Quality Assurance Officer. Please see Section B7.

B9. Non-direct Measurements

Global Positioning Satellites (GPS) and data collected from previous years are non-direct measurements in use for this project.

B10. Data Management

Field Forms

All pertinent field survey and sampling information shall be recorded on field forms during each day of the field effort and at each sample site. The field crew leader shall be responsible for seeing that sufficient detail is recorded on the forms. No general rules can specify the extent of information that must be entered on the forms; however, they shall contain sufficient information so that all field activity can be reconstructed without relying on the memory of the field crew. All entries shall be made in indelible ink. All corrections shall consist of initialed, single line out deletions.

At a minimum, entries on the field sheet shall include the following:

- Date and time work starts, and weather conditions
- Names of field crew leader and team members
- Project name or type
- Description of site conditions and any unusual circumstances
- Location of sample site, including map reference, if relevant
- Equipment identification numbers
- Details of actual work effort, particularly any deviations from the field operations plan or standard operating procedures
- Field observations
- Any field measurements made (e.g. pH)

For sampling efforts, specific details for each sample should be recorded. In addition to the items listed above, the following general information should be included on the forms during the sampling efforts:

- Sample identification, collection date, and time
- Type and number of samples collected
- Sampling method, particularly deviations from the field procedures

Strict custody procedures shall be maintained with the field forms used. While being used in the field, forms shall remain with the field team at all times. Upon completion of the field effort, forms shall be filed in an appropriately secure manner in a bound notebook labeled "original data". These forms will remain with the task manager. Photocopies of the original data will be used as working documents. Sample forms are provided in Appendix C.

In case of stream discharge measurements with or without water level recorders, specific information should be recorded for all site visits. Manual discharge measurements taken during the site visits must include: location, site name, name of people doing measurement, date, time, data logger reading, staff gage reading, and the difference between these two readings.

All data shall be recorded in Excel spreadsheets and included for analysis in the year-end report. Computer transfer of laboratory data results to compact disc and then to spreadsheets will occur upon receipt of said results to Program Manager. SGS/CT&E also sends paper copies of analysis results to the Program Manager.

B11. Preventive Maintenance & Spare Parts

Please refer to Appendix B for monitoring instrument technical information.

C. ASSESSMENT AND OVERSIGHT

C1. Assessments and Response Actions

Field assessments will be determined by Project QA Manager/Project Director. Any response actions will then be undertaken by the Program Manager during regular field sampling/monitoring events. Internal assessment for the laboratory will be performed according to SGS/CT&E's QMP, which is kept on file with ADEC.

C2. Reports to Management

Following the receipt of the analytical data package, the QA Manager will review the data with regard to the following:

1. Analytical methodology
2. Detection limits
3. Accuracy, precision, and adherence to holding times

The Project QA Manager will perform a review on at least 10% of field data and analysis results. These QA/QC checks of data will be kept on file by the QA manager, and included in yearly summary reports of the data. Where data do not meet the requirements specified in this QA/QC program, the data will be flagged with qualifiers. Should major discrepancies be found, possible corrective measures will be evaluated as deemed necessary. These data reviews will be summarized and included in the report by Alaska Gold.

<u>Reporting Procedures</u>

The laboratory will include the following information in all data packages submitted for this project:

1. A case narrative outlining any problems encountered during sample analysis, corrective actions initiated (if applicable) and the outcome, and any data not meeting the quality control criteria listed in Table B-3.

2. Sample data reports that cross-reference laboratory identification and identification assigned by field samplers, analyte and method, sample results, method reporting limit and method detection limit, dilution factor, date prepared, date analyzed, data qualifiers, and definitions of qualifiers. Also, include results of field blanks and SRMs.

3. Results of LCS/LCSD (laboratory control sample and sample duplicate), spike level, sample result, percent recovery, recovery limits, and RPD.

4. Results of MS, including spike level, results, and percent recovery. Matrix spikes must be prepared and analyzed on 5 percent of the total number of samples submitted for each Alaska Gold project.

5. Chain-of-custody forms and copies of sample receiving forms.

D. DATA VALIDATION AND USABILITY

D1. Data Review

Data Review

Data generated for this project will be reviewed by both the laboratory and QA Manager. The laboratory has primary responsibility for correctly identifying and quantifying analytes and compounds of interest, identifying matrix interferences, and for identifying, and correcting if possible, instrument anomalies. The laboratory is also responsible for the technical quality of the data and for meeting all quality control parameters by correctly following the analytical methods using instrumentation that is in proper working order for the given method.

The review process will be coordinated initially by the bench-level scientists who will review all data for accuracy and completeness. The bench scientist will also compare all QC sample results with control criteria outlined in Table B-3 and initiate appropriate corrective action if criteria are not met.

Prior to summary reports, the data will be reviewed by QA Manager to assure that the data is representative, complete, and accurate.

Data Validation

Data validation is the review process to screen data for anomalies and possible errors.

D2. Validation and Verification Methods

Data accepted from the laboratory will have been verified and validated. See Sections B and C on assessments and quality control for field verification and validation methods.

D3. Reconciliation with User Requirements

A periodic review of the objectives of this project will be accomplished on a yearly basis to determine if user requirements have changed.

APPENDIX B

Ground Water and Seep Monitoring Quality Assurance Plan

Operational and Closure Ground Water and Seep Monitoring will be preformed in accordance with the previously prepared and submitted Quality Assurance Plan, attached. Although the plan refers to baseline monitoring all pertinent sections will be applied during operation and closure as well. Where this Operational and Closure Monitoring Plan contains specific information, such as monitoring locations and sampling frequencies, this Plan takes precedence over the attached baseline plan.

ROCK CREEK PROPERTY
GROUNDWATER SAMPLING AND ANALYSIS
QUALITY ASSURANCE PROJECT PLAN

APPROVALS

_____ _____
Doug Nicholson, Alaska Gold Company

_____ _____
Rod Smith WMC

_____ _____
Ursula Williams, WMC

_____ _____
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B. Standard Operating Procedures
C. Boring Logs and Well Construction Diagrams

1. INTRODUCTION

1.1. Distribution List

This QAPP will be provided to all those responsible for background data collection. In particular, copies will be received by:

- Doug Nicholson
- Charlotte Mac Kay
- John Chahbandour
- Rod Smith
- Ursula Williams
- Brent Johnson

1.2. Task Organization

Alaska Department of Environmental Conservation (ADEC) representatives

Alaska Gold Manager - Mr. Doug Nicholson is Environmental manager for the Rock Creek Property, and will be responsible for the groundwater monitoring program, including any discussions with ADEC on behalf of Alaska Gold. Mr. Nicholson will be responsible for data collection activities on the site and will review major technical evaluations and reports.

Environmental Coordinator - Ms. Charlotte MacKay will coordinate sampling activities on the site on behalf of Alaska Gold. Ms. McKay will be responsible for implementation of the QAPP for all non WMCI staff involved in this program.

WMCI Field Manager - Ms. Ursula Williams will manage overall field activities for WMCI. She will be responsible for coordination and management of WMCI field staff, and will be responsible for implementation of the QAPP for field activities involving WMCI staff.

WMCI Water Chemistry Specialist - Mr. Brent Johnson will be responsible for quality aspects of water chemistry data

WMCI Project Manager - Mr. Rod Smith will be responsible for general coordination of data collection and analysis and assessments performed by WMCI for this program. He will develop and review technical evaluations and reports and will participate in technical discussions as needed. He will be responsible for implementing all project plans for WMCI personnel.

WMCI Quality Assurance Manager - Mr. John Chahbandour will be the WMCI QA manager for this program. The QA manager will retain the necessary independence and authority within the organization to identify conditions impacting data quality and to inform the project manager of need corrective action. He will be responsible for review and approval of the QAPP, subsequent reports, along with ensuring that appropriate aspects of the program are performed in accordance with the plans.

2. BACKGROUND

2.1. Introduction

The Rock Creek project area is located approximately 12 km north of Nome, AK, on private lands owned by the Bering Straight Native Corporation and Alaska Gold Corporation (a wholly owned subsidiary of NovaGold Resources). Figure 1 is a generalized site location map. Plan 1 shows the site layout and groundwater monitoring locations. The general area is drained by the Snake River, which drains into Norton Sound near Nome. The proposed mine is currently in the pre-feasibility development stage. In anticipation of proceeding with development of the mine, this QAPP to document baseline groundwater hydrology and groundwater quality has been prepared. This guide has been prepared with an understanding of the site conditions, the planned activities on the site and the waste management regulations for Alaska.

This documents summarizes the physical and groundwater conditions on the site, and develops a rationale for the monitoring system, describes the monitoring equipment available, and finally describes the recommended procedures to collect, preserve and ship samples, analyze samples, and manage groundwater data.

This guidance must be considered a work in progress with adaptations to fit the findings of ongoing data collection and management. As such, the procedures proposed here should be reviewed and modified on a regular basis.

2.2. Site Description

General *setting*
The project area is located near the middle of the Snake River drainage basin and is drained by Rock Creek and its tributary Albion Creek. A small portion of waste dumps SI and NI are proposed to be placed within the Lindblom Creek drainage. Several old diversion ditches once diverted water to placer operations in the upper portions of the Rock Creek drainage. One of these ditches is listed as a heritage feature.

Topography is moderately steep within most of the valley, with steep rock slopes near the top of the catchment. Thin overburden covers most of the slopes, with both colluvial and glacial deposits. Vegetation includes grasses, with brush in wet areas lower on the slopes.

In the vicinity of the Rock Creek project, precipitation is estimated to be about 415 mm per year (Nome Airport). A study by Munter et al (1992) indicated that measured snowfall at the airport may be less than actual due to drifting. Measured snow pack at three sites on the south slopes of Anvil Mountain during that study was 41.7 cm of water equivalent compared to 17.5 cm of snowfall measured a the airport.

Evapotranspiration has not been studied in detail, but was estimated to be about 36 cm per year (Munster et. al., 1992, Report of Investigations 92-2). A study by Fraser (2003) indicated potential evapotranspiration in the vicinity of Council to range up to about 20 cm from mid June to fall for wetland sites, indicating a similar potential evapotranspiration.

Extensive but not continuous permafrost is likely present in the project area in areas where ambient air temperature and incident solar radiation may be reduced, such as north facing slopes and heavily vegetated areas.

Geology

Alluvium infills Rock Creek and the Snake River Valleys. Although there is little site-specific knowledge, we expect the undisturbed alluvium to be similar to alluvial deposits in other locations, i.e., interbedded sands silts and clays. However, some of the alluvium has been extensively reworked by dredging operations. Surficial materials at other locations include silty glacially derived materials and organic deposits in low relief areas. Bedrock outcrops are significantly disturbed by freeze thaw activity.

The primary bedrock geologic units in the area are metamorphic units from the Nome Group. The Nome Group is thought to be a coherent lithostratigraphic succession of four units:

- a basal, complexly deformed pelitic schist;
- a "mixed unit" of mafic, pelitic, and calcareous schists and marble;
- a mafic-dominated schist package; and
- an impure marble package.

The protoliths of the units are likely Cambrian to Devonian sediments consisting of shales, siltstones, marls. and limestones, deposited in a shallow-water continental platform. The mafic volcanics are probably younger mafic sills (NovaGold Resources, 2000). Bedrock outcrops along Rock Creek are fractured and disturbed. Core from exploration drilling indicates that rock quality improves quickly with depth.

There appear to be four major types of structural deformation of the Nome Group rocks:

- Major high-angle faults striking northeast, and likely having strike-slip movement which appear to be young and still active.
- High-angle, northeast-trending tension fractures extend across the district and are related to the high angle faults mentioned above. These occasionally host veins. Some movement along these features is occasionally seen near faults.
- A late shear, up to 30 m wide, which hosts Albion veins appears to offset all other structures. The shear does not exhibit recessive weathering, possibly due to resistant quartz veins.
- Low angle to flat thrust faults are mapped throughout the Nome District, including one in the Rock Creek area. Low angle faults show evidence of remobilization. The thrust fault in the Rock Creek area has both a carbon/calcite component and a gouge/clay component.

Groundwater

Groundwater flows through the project area from recharge areas located higher in the watershed to discharge areas lower in the watershed. In general, the potentiometric surface tends to mimic the surface topography. There is little indication of tributary development on the slopes of Rock Creek Valley. Discharge of interflow or shallow groundwater occurs in few areas on the slopes and extensively along the banks of the creek. The discharge of groundwater constitutes much of the creek flow. Discharge of deeper groundwater was observed at three sites, possibly from old exploration drill holes. Iron precipitates are present in the vicinity of these discharges. Photographic records indicate that the flow continues into late summer and local information indicates that glaciation occurs in winter, indicating that groundwater discharge continues into the winter. The dredged Rock Creek alluvium is expected to be very permeable, resulting in a significant interaction between surface water and groundwater along the creek. Both the creek and the alluvium are fed primarily by the shallow groundwater, but with some contribution from deeper groundwater that has passed through the mineralized rock. The water from both the creek and the alluvium travel across an alluvial fan and discharge to surface water and alluvium of the Snake River.

Proposed Mine

Alaska Gold is investigating the feasibility of an open pit gold gine within the catchment of Rock Creek. The facility will include the open pit, a mill, tailings facility and waste rock areas. During mining, surface water will be diverted around the facility to minimize the quantity of water impacted by mining. The facility will be operated as a closed system, so that water brought on site will remain on site or evaporate. A seepage collection pond will be constructed downstream of the tailings facility to further reduce the volume of water impacted by mining that will move off site. This QAPP addresses a monitoring program to provide background groundwater quality data prior to mining activity on the site.

2.3. Objectives

The objective of the proposed monitoring plan is to document the existing, natural groundwater chemistry and flow regime within the areas where mine development is proposed. The three main types of facilities that may affect groundwater are shown on Plan 1 and include the following:

- *Pit development.* Excavation of the pit will intersect both shallow and deeper mineralized groundwater during operations. On closure, the pit will provide storage for surface water and groundwater.
- *Waste-rock storage.* Waste rock will be placed over natural ground. Precipitation and snowmelt will pass through the waste rock prior to recharging the shallow groundwater or flowing over the natural ground surface.
- *Tailings storage.* The tailings storage area is proposed for an area straddling Rock Creek. The foundations of the storage area include bedrock outcrops, glacial deposits, colluvium and alluvium.

All of these facilities are located within the Rock Creek surface water and groundwater drainage areas. A small portion of dumps SI and NI are located within the Lindblom Creek watershed.

2.4. Task Descriptions

Groundwater samples will be collected from monitoring wells to characterize the groundwater conditions on site prior to construction of an open pit mine. Samples will be collected during each season (four times a year) from a total of eight monitoring wells. The planned collection times are:

- January;
- April;

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- July; and
- October.

The well locations are illustrated on Plan 1. Table 2.1 lists the completion information and purpose of each monitoring well. Well completion diagrams are presented in Appendix B. All wells were drilled with air rotary techniques and completed with 0.51 mm factory-slotted screens, 10/20 Colorado silica sand packs, and bentonite holeplug seals. A lockable steel monument was also installed. Submersible sampling pumps were installed in each of the wells. Each sampling round will include:

- Visual observations of conditions in the vicinity of the well, weather and any other aspect that may impact water quality.
- Well purging so that sampled water is representative of groundwater conditions.
- Measurement of field parameters during well purging to verify that water quality has stabilized.
- pH, electrical conductivity, temperature, redox potential and depth to water will be measured in the field.
- Collection of groundwater samples for total metals, pH, alkalinity, ammonia, chloride, total and Wad cyanide, fluoride, nitrite and nitrate, total phosphorus, sulfate, sulfide, silicon and TDS. Samples will also be collected for dissolved metals by filtering through a disposable filter
- Samples will be preserved according to standard protocols and shipped to the laboratory.

The samples will be analyzed at SGS/CE&E Environmental Services (SGS), an Alaskan laboratory. Methods and anticipated method reporting limits are presented on Table 2.2. SGS's QAPP is presented as Appendix A

Some additional items may be required during sampling. In particular, it may be necessary to energize a heat trace to allow sampling from the well. In addition, QA/QC samples (one duplicate and one equipment blank) will be collected each sample round.

Each data set will be examined for quality. The field records and the quality assurance samples collected in the field and the quality control provided by the laboratory will be examined to provide assurance that the program has met the data quality objectives. The process will be reviewed by the WMCI project manager and quality assurance manager.

The data will then be entered into the project water quality data base. Samples that do not meet the objectives will be entered, but the data will be qualified. After the four sampling events have been completed, a data report will be prepared including characterization of the groundwater and the data quality.

2.5. Data Quality Objectives

Requirements

Data quality objectives define how accurate, precise, complete, comparable, sensitive and representative the measurements will be. The data quality objectives have been defined based on experience and by observation of water quality guidelines for Alaska.

For parameters measured in the lab, the data quality objectives are presented on Table 2.2. The data quality objectives for parameters measured in the field are presented on Table 2.3.

Table 2.1: Summary of Monitoring Wells

Well M	Purpose	Geology	Surface elevation (m)	wATER Level Elevation (1/04) (m)	Interval monitored (m)	Total depth drilled (m)	Casing diameter (mm)
MW03-01	Monitors areas upgradient from the proposed tailings facility.	Graphitic schist	89.49	76.28	10.67-24.09	24.39	102
MW03-02	Monitors areas downstream of the mineralized zone. Will document the quality of groundwater that flows from the mineralized zone to the Snake River alluvium.	Graphitic schist	75.2	65.31	27.13-42.29	45.73	102
MW03-03	Monitors areas upgradient from the mineralized zone.	Graphitic schist	162.3	158.69	27.44-35.98	36.59	102
MW03-04	Monitors areas upgradient from the proposed waste rock facilities.	Graphitic schist	133.08	129.16	12.50-21.349	21.34	102
MW03-05P	Piezometer monitors groundwater elevations in deeper aquifer down gradient from the tailings facility	Graphitic schist	29.97		49.7-53.35	89.94	25
MW03-05	Monitors areas downgradient from the proposed tailings facility.	Graphitic schist	30.90	28.03	19.21-26.83	27.04	102
MW03-06	Monitors alluvium downgradient from the mine area.	Alluvium	22.39	19.70	3.35-9.15	7.62	102
MW03-07	Monitors areas downgradient from the proposed waste rock facilities.	Graphitic schist	70.00	67.86	25.3-33.54	33/54	102

Table 2.2 Groundwater analytes for laboratory determination (units are µg/L unless otherwise noted)

Analyte	Method	Sensitivity (Practical quantitation limit)	Precision (Relative percent difference)	Accuracy (Spike percent recovery)
Aluminum, total and dissolved	200.8	20	20	70-130
Antimony, total and dissolved	200.8	1	20	70-130
Arsenic, total and dissolved	200.8	5	20	70-130
Barium, total and dissolved	200.8	3	20	70-130
Beryllium, total and dissolved	200.8	.4	20	70-130
Cadmium, total and dissolved	200.8	.5	20	70-130
Calcium, total and dissolved	200.7	200	20	70-130
Chromium, total and dissolved	6010B/200.8	1	20	70-130
Cobalt, total and dissolved	200.8	4	20	70-130
Copper, total and dissolved	200.8	1	20	70-130
Iron, total and dissolved	200.7	40	20	70-130
Lead, total and dissolved	200.8	.2	20	70-130
Magnesium, total and dissolved	200.7	200	20	70-130
Manganese, total and dissolved	200.8	1	20	70-130
Mercury, total and dissolved	1631		20	70-130
Molybdenum, total and dissolved	6010B/200.8	10	20	70-130
Nickel, total and dissolved	6010B/200.8	2	20	70-130
Potassium, total and dissolved	200.8	500	20	70-130
Selenium, total and dissolved	200.8	5	20	70-130
Silver, total and dissolved	200.8	1	20	70-130
Sodium, total and dissolved	200.8	500	20	70-130
Strontium, total and dissolved	200.7	10	20	70-130
Thallium, total and dissolved	200.8	1	20	70-130
Tin, total and dissolved	200.8	1	20	70-130
Titanium, total and dissolved	200.8	5	20	70-130
Vanadium, total and dissolved	200.8	20	20	70-130
Zinc, total and dissolved	200.8	5	20	70-130
pH	150.1	0.1 (S.U.)	0.2 (S.U.)	0.2 (S.U.)
Conductivity	120.1	1 (µS/cm)	10(µS/cm)	10(µS/cm)
Alkalinity	SM20 2320B	20 (mg/L)	10 (mg/L)	10 (mg/L)
Ammonia	350.2	100	25	75-125
Chloride	300.0	100	20	80-120
Cyanide-total	SM20 4500	5		
Cyanide-WAD	SM20 4500	5		
Fluoride	300.0	100	20	80-120
Nitrate + Nitrite	300.0	1000	20	80-120
Phosphorus-total	365.2	200	25	75-125
Sulfate	300.0	100	20	80-120
Sulfide	376.2	100		
Silicon	200.8	200		
TDS	160.1	100 (mg/1)	25	

Table 2.3 - Parameters for field determination

Parameter	Method (range)	Units	Detection Limit	Sensitivity	Precision	Accuracy
Depth to water	Electric sounder (0 to 300)	ft	0.01	0.01	± 0.01	± 0.02
pH	pH meter (0.00 to 14.00)	pH units	0.1	0.01	± 0.2	± 0.01
Electrical conductivity	Conductivity meter (0 to 3999)	jS/cm	1	1	±1 0%	± 2 %
Temperature	Thermometer (0 to 60)	°C	0	0.1	± 0.5	± 0.5
Redox potential	ORP meter (-999 to 999)	mV	NA	1	± 4	± 4
Ferrous Iron concentration	HACH Ferrous Iron test kit	mg/L	0.1	0.1	± 0.1	± 0.1

Detection Limit Detection limitshavebeen extracted from instrument manuals andmethod descriptions. These values have been included in Tables 2.2 and 2.3.

Sensitivity
Sensitivity is the ability of the instrumentation system to detect one concentration from the next. Expected sensitivities are noted in Table 2.2 and 2.3.

Precision
The precision objectives in Tables 2.2 and 2.3 apply to in laboratory duplicate programs run by the laboratory. Field duplicates or split may include additional scatter due to field generated chemistry changes.
Accuracy
Accuracy describes how close the measurement is to its true value. The accuracy of measurements will be determined in the laboratory by performing tests on standards as part of the standard methods. The laboratory will report the results of QA accuracy program with the water chemistry results.

Completeness
Completeness is the fraction of planned data that must be collected in order to fulfill the criteria of the project. Samples are required for each of the four seasons for background information. However, with difficulties in field sampling and the potential for overlap between environments, it is expected that 80% of all measurements anticipated should be completed.

2.6. Training requirements

Training is required for personnel assigned to collect groundwater samples at the Rock Creek site. Training was completed for:

- Brian Booth; and
- Robbie O'Conner

Training was carried out by Ursula Williams from January 13, to January 23, 2004. Training included

- Pre-sampling event procedure;
- Equipment checklist;
- Calibration of field equipment;
- Thawing and purging wells;
- Measurement of field parameters, pH, EC, temperature and ferrous iron;
- Collection and preservation of sample including filtration of dissolved metals fraction;
- Filling out chain of custody forms; and
- QA/QC sample collection.

2.7. Documentation and Records

This QAPP forms documentation for this program. This QAPP needs to be read prior to going to the field and needs to be taken to the field as guidance in carrying out the plan. Field logbooks, notebooks and/or data sheets will be filled out using "write in the rain" ink or pencil and will not be erased. Changes will be made by crossing out errors and adding corrected information. The field log books and or field forms will be used to document field conditions, water levels, all field activities, and field chemistry parameters. Any procedural or equipment problems will be recorded along with data results. Any variance from this plan will be noted.

Chain of custody or transmission forms will be kept with the sample transport.

All pages of a field book and all field forms will be photocopied at as early a time as possible and stored at a separate location to provide data backup. Copies of the field data will be placed in a field file in Alaska Gold office files in Nome during the course of the work.

Laboratory results will be received by Alaska Gold or a designated party and copies forwarded to WMCI. Alaska Gold will retain laboratory results for a minimum of five years.

WMCI will enter field and laboratory data, with QA data, into a spreadsheet database. The data will be assessed to verify that the data meets the requirements of this QAPP by WMCI, and correlate and corroborate data with known site conditions.

All of the data collected in this program prior to mine construction will be included in a groundwater report prepared by WMCI.

The WMCI QA manager or designee will periodically review database management and methods used in the program for conformance with this QAPP and compliance with industry standard. Deficiencies will be noted and corrected in a timely fashion. Any modifications to data handling and analysis will be reported to Alaska Gold.

3. MONITORING METHODOLOGY

3.1. Sampling Process Design

Monitoring Objectives and Data Quality Objectives

Alaska Gold is proceeding with a mine feasibility project for this site. As part of the mine feasibility, water quality information is required for development of a water management plan. This program will contribute to that process. Construction, operation and closure of a mine at this site has the potential to degrade groundwater quality, and, as groundwater discharges to surface water, impact local surface water quality. To assess the impact of the mine on existing groundwater requires an understanding of pre-mine conditions. This program will address that need. Finally, evaluating the impact of an operating mine will require reliable pre-mine water quality data for comparison. This program will meet those needs.

Generally, groundwater movement is relatively slow, with little change in water quality over short periods of time. However, there may be seasonal variations, primarily in response to recharge during snowmelt. For that reason, this program does include collection of samples in each season of the year. In addition, section 18 AAC 60.830 requires that background groundwater data must be collected in each of the four seasons before waste is placed. This program will therefore also meet this waste management regulatory requirement.

Parameters to be analyzed are listed on Tables 2.2 and 2.3. The parameters to be measured on the site were selected to address the constituents that may be impacted by site operations, the constituents that are associated with mining activities and the constituents that may contribute to the behavior of contaminants that may be related to the mining operations. As this is a gold mine with associated metals, the full suite of metals is appropriate. It is generally assumed that only dissolved metals are mobile in the groundwater system. Dissolved metals therefore are required analyses. However, state regulations require that an analysis of totals metals also be carried out, to verify that contaminants of concern have not been filtered out of the sample. Significant differences between total and dissolved metal concentrations should lead to changes in sampling sites or methods. The major cations in groundwater (Na, K, Ca, Mg) will be analyzed for within the metals group. The major anions (HCO_3, SO_4, Cl) are also included in the analytical list. The remainder of the constituents represents important parameters for understanding the groundwater system (especially pH) or are constituents that assist in understanding the environment, are historically related to mining activities, or provide important information to refine quality evaluations. The methods have been selected to meet detection limit and accuracy requirements. Typically, detection limits are defined by water quality guidelines or standards defined by the state as required for protection of health and the environment.

These values can be found primarily in 18 AAC 70 Water Quality Standards, 18 AAC 80 Drinking Water and in Alaska Water Quality Criteria Manual.

Sampling methods have been defined to meet state of practice in the industry and to further meet constraints imposed on this site, particularly the requirement to collect samples in cold conditions. All monitoring well sampling protocols require procedures to eliminate or significantly reduce the quantity of water in the sample that has been resident in the monitoring well casing while minimizing the quantity of water purged from the well prior to sample collection. In addition, procedures include methods that minimize the turbidity generated from inside and near the well that does not represent constituents transported within the groundwater system. Finally, sampling procedures include methods to reduce the influence of cross contamination and air-borne sample contaminants that may be introduced during the sampling and handling procedures. The sampling method includes dedicated downhole pumps. This reduces the generation of turbidity common with insertion of sampling equipment into a well. Reduction of stagnant well water is addressed by pumping of a minimum volume prior to collection, but requiring field parameter stabilization prior to sample collection. The dedicated pumps eliminate most of the potential for cross contamination, and use of disposable field filtering apparatus and direct flow into sample bottles reduce the likelihood of air-borne contamination. Measurement of pH at the well head results in an improved understanding of in-situ pH. Laboratory pH measurements provide a measure of the change in sample chemistry during transport and storage.

Preservative required will be sent to the site in the bottles by the laboratory.

Monitoring Well Locations
This monitoring program has been developed to obtain background groundwater quality data for the Rock Creek site. Monitoring wells are listed on Table 2.1 and the locations illustrated on Plan 1. These well locations were selected to represent groundwater quality in alluvium, shallow bedrock and deep bedrock. In addition, wells were sited to represent conditions upstream and downstream of anticipated locations for the open pit, waste rock dump and tailings facility. Samples of springs are included in the surface water program.

Field Quality Assurance Samples
Quality control methods in the laboratory include blanks and spikes to verify that laboratory measurements meet the criteria of the selected methods. These are described in detail in the lab's QAPP, Appendix A. However, it is also necessary to collect and submit quality assurance samples from the field. For this site, this includes a duplicate sample from one of the wells and one equipment blank for each sampling round.

Monitoring Well Testing and Maintenance

Monitoring wells are subject to degradation with time that may require maintenance or replacement. Problems may include damage at the surface due to construction or operations, breakage of casing, often due to freeze thaw ground movement and loss of well capacity due to screen plugging. As this initial program is over a limited period for background conditions, well testing and maintenance is not included.

Health and Safety
Field procedures will meet standard safety requirements for this type of work. Outdoor work in cold conditions will be carried out within strict Alaska Gold guidelines to reduce the chance of injury due to cold working conditions.

There are no known chemicals with an impact on human health if not ingested that will be sampled during this program

3.2. Sampling Method

Detailed procedures for sampling at this site are included within Appendix B. While sampling, considerable effort will be required to collect representative samples. This will include avoiding contaminating equipment by setting on the ground or other contaminated surface, handling bottles or equipment with clean hands or gloves and minimizing the time that samples are left open to airborne dust. Following are abbreviated directions and comments.

Preparation for Field Activity

- One month prior to sampling
    - Call lab and order sample kits for quarterly groundwater sampling (Columbia for Hg and SGS for others). Total of 9 kits: (7 wells and 2 QA/QC samples).
    - When sample sets arrive, verify all the bottles are there that you need.
    - Go through checklist and inventory; order anything you do not have.
- Two weeks before:
    - Go through checklist again and call suppliers to verify materials/equipment ordered have been shipped.

Supplies and Consumables

- Keys
- Field sheets/Log book
- Calculator
- Well completion table
- Pencils and pens for labeling bottles and writing on field sheets
- Extension cord for heat trace (standard, grounded, three-prong)
- Special extension cord for pump (Male/female L14-30, 30A, 125/250V)
- Pump discharge plumbing, including valve
- Water level indicator
- Hand warmers or other heat source
- PH/EC/Temp meter (calibrated using procedure below)
- ORP meter
- Ferrous Iron (Fe2+) test kit
- Sample bottles
- Field filtering apparatus
- Vacuum pump
- Graduated container to measure volume of water purged
- Generator and fuel
- New trash bags
- Latex gloves (4 pair per well)

Table 3.1: Quarterly Groundwater Sampling Kit for each monitoring well

Quantity	Volume	Preservative	Analytes
1	1 L	None	Total metals before filtering
1	1 L	HNO_3	Total metals
1	1 L	None	TSS
1	1 L	None	pH, EC, TDS, Alk
1	1 L	H_2SO_4	NH_3, (NO_2+NO_3)
1	250 ml	NaOH + Zinc Acetate	Sulfide
1	250 ml	NaOH	Cyanide (Total and WAD)
1	60 ml	None	Cl, F, SO4
1	500 ml	HCl	From Columbia Labs for total Hg
1		None	Field parameters
1	1 L	, Filtered	Dissolved metals after filtering

Bottles from SCS except for mercury, which arefrom Columbia Labs.

Observation

Sampling of the seeps will be part of the surface water monitoring program. The groundwater monitoring program will also include documentation of the condition of each well (lock, surface casing), if well is frozen, the presence of standing water, the weather at the time of sampling and any other conditions that may have an impact on the sampling..

Pre-sampling activities at each wellhead

- If the well is frozen:
  - energize heat trace and record time on field form.
  - When well is thawed, de-energize heat trace and record time on field form.
  - Remove heat trace wearing clean latex gloves and store in clean trash bag while sampling.
  - Measure depth to water in riser pipe and record on the field form.
- Confirm well thawed to pump by sounding down riser pipe (pump discharge).
- Record total depth of well from well completion table on field form.
- Calculate depth of water column and minimum volume of water to be pumped.
- Begin purging by attaching discharge pipes and valve and energizing pump.
- Measure field parameters during purging (pH, EC and Temp):
  - 1st when approximately 1/2 the minimum volume has been purged
  - 2nd when approximately 2/3 the minimum volume has been purged
  - 3 when the entire minimum volume has been purged
- If last set of field parameters is not within 10% of previous reading, continue to purge until they meet this condition.
- Fill out labels with date, time, location. Write location on plastic bottle with permanent marker.

Sample Collection

- Collect sample directly into bottles <u>except for one of the two 1 L cubes preserved with HNO_3.</u>
- Collect extra sample for field parameters and measure using methods in Appendix B field parameters ORP, Fe^{e+}, pH, EC, and Temp)
- Measure Ferrous Fe with test kit using procedure in Appendix B.
- Filter dissolved metals sample and place in reserved I L cube preserved with HNO3.

Sample Preservation
Sample bottles are shipped from the laboratory with the appropriate quantity of preserving material. It is imperative that the samples be placed in the correct bottles and be labeled appropriately. Immediate sample labeling is imperative. Samples require transportation at around 4°C. For some of the sampling events, the challenge may be to keep the samples from freezing rather than keeping them cool during shipment. Pack the coolers provided by the laboratory to minimize damage or the chance for contamination. Seal each container prior to shipment.

QA *Samples*
Collect both of the following QA/QC samples during each sampling event.

- One duplicate: collect a second sample from on of the wells just as you do for the normal samples. Label it with the date and call it "duplicate". Record on the field sheet that a duplicate was collected from that location.
- One equipment blank: while at one of the well locations, use distilled/DI water to fill sample bottles just as if it were a sample from a well. Filter distilled/DI water for dissolved metals just as you normally do. Record on the field sheet for that well that an equipment blank was collected.

Completion of monitoring at well

- Remove pump discharge plumbing and extension cord.
- Replace heat trace.
- Lock well.

Equipment Storage and Transportation.
Between sampling events, the equipment needs to be treated as precision equipment. It should be stored in a temperature controlled and clean environment. When transported, the equipment needs to be protected from shock loading. Storage procedures recommended by the manufacturer need to be followed.

3.3. Sample Handling and Custody

Sample handling includes sample labeling, sample collection and sample transportation. Chain of custody forms are required for every shipment of samples. Custody forms will be supplied by the laboratory. Seal the sample container (cooler) prior to shipping. Ship the samples to the lab by air from Nome.

3.4. Analytical Methods

Facility laboratory standard operating procedures (SOP's) will be available upon request.

4. DATA MANAGEMENT

4.1. Quality Assurance and Quality Control

Sample data Validation
Data and field forms will be examined after each sampling event to detect correctable problems. The checks will include consideration of charge balance, accuracy and precision and a check on completion of all forms. Following validation, the data will be entered into the monitoring data system.

Well Inspection and Maintenance
Well inspection and maintenance is periodically required. For this background data program using new wells, inspection will be limited to visual inspection. Damaged monitoring wells will be repaired.

Equipment inspection and Maintenance
Before each sampling event, all equipment will be inspected. Routine maintenance for all meters will be conducted according to schedules and procedures described in manuals provided by the manufacturer, and a maintenance log will be kept for each instrument.

Equipment calibration
All field and laboratory instruments and equipment will be calibrated according to the manufacturers instructions. Records of calibration will be kept on calibration log sheets that will be Available for inspection.

Acceptance of Supplies and consumables
All chemicals and supplies will be checked for expiration date, sufficient quantity and discoloration. Upon receipt. New equipment will be checked to verify that it is within technical specifications for use.

4.2. Data presentation and filing

Following data verification, data will be entered into the monitoring data system. The data will be available to all study team members.

All of the data and forms related to sampling will be kept at the Alaska Gold facility in Nome. This information will include:

- Training records
- Field equipment and chemicals maintenance, cleaning and calibration records.

- **Field log book and/or filed data forms**
- **Laboratory data including concentration, and QA records**

The data will be presented in a report after four seasons of data has been collected.

4.3. Reporting

After completion of the **four sampling events, one for each season of** the **year, a groundwater monitoring report will be prepared. The report will include a description of** the **sampling events, reference this QAPP for methods used, report** the **water** chemistry results **and** the **quality assurance. Standard procedures such as charge balance and water quality type will also be presented** together **with a comparison with water quality standards and guidelines for Alaska.**

APPENDIX A

SGS/CT&E ENVIRONMENTAL SERVICES QAPP

APPENDIX B

STANDARD OPERATING PROCEDURES

APPENDIX B - Standard Operating Procedures

RC-1 Water-Level Measurement

RC-2 Calibration of Field Equipment

RC-3 Measurement of Field Parameters

RC-4 Groundwater Sampling Using the Dedicated Sampling Pump

RC-5 Collection of Field-Blank, Field-Duplicate, and Equipment-Blank Samples

RC-6 Sample Packaging and Shipping

RC-7 Equipment Decontamination

RC-1 **Water-Level Measurement**

1.0 Equipment

- Solinst or Slope Indicator Company electronic water-level probe, or equivalent
- Distilled water
- Extra battery
- Map, GPS, and well coordinates

2.0 Decontamination procedure

1. Rinse the first 5 m or 15 ft of measuring tape with distilled water and roll the tape and probe back onto the reel.

3.0 Operating procedure

1. Turn the sensitivity knob to the highest setting.

2. Press the battery test button; the buzzer should sound and the red light will come on if the battery is in good condition. If the battery is bad, refer to the equipment operating manual for the battery changing procedure.

3. Lower the probe and tape into the sounding tube. Stop lowering the probe when the buzzer sounds and the red light comes on.

4. Turn the sensitivity knob to the lowest setting at which the buzzer sounds and the light stays lit.

5. Slowly lift the cable until the light and buzzer go off. Lower the cable to the point where the light and buzzer just come on. It may be necessary to do this several times to accurately find this point.

6. Read the depth off the cable at the designated reference point (Rock Creek monitoring wells are referenced to the top of the 6 or 8 inch steel casing closest to 1" sounding tube) to the nearest hundredth of a meter or hundredth of a foot (record time and date).

7. Reel the probe back up out of the well and turn the sensitivity knob to the off position.

RC-2 Calibration of Field Equipment

Field equipment should be calibrated at the beginning of each day that the equipment will be used. A calibration record should be maintained and kept with the meter. The record should indicate the date of calibration, which standards were used to calibrate, whether the calibration was successful and any other notes that seem important.

1.0 Equipment

- Combination pH/temp/conductivity meter and probe
- Buffer solutions (pH 4, and 7)
- Conductivity standards
- Distilled or deionized water
- Calibration record book
- Tissue paper.

2.0 pH/temp/conductivity -meter calibration procedure

1. Attach the HI 1288 probe to the DIN socket on the top of the meter body by aligning the pins and pushing in the plug. Tighten the nut to ensure a good connection. Remove the protective cap from the HI 1288 probe before taking any measurement.

2. If the probe has been left dry, soak in pH 7 buffer solution for at least one hour to reactivate it.

3. Press and hold the ON/OFF/MODE button for two seconds to switch on the meter. All of the used portions on the LCD display will be visible for a few seconds, followed by an indication of battery life remaining. Check the battery status and replace if less than 25%.

4. Press and release the SET/HOLD button until the pH symbol appears in the upper right corner of the display.

5. While in pH measurement mode, press and hold the MODE button until TEMP and the current temperature unit are displayed on the lower portion of the LCD display. E.g. TEMP ^{oc}

6. Press the mode button again to show the current buffer set: ^{pH} 7.01 (for (4.01/7.01/10.01). Press the SET/HOLD button to change the buffer set if necessary.

7. Press the MODE button to return to normal pH measurement mode.

8. While in normal pH measurement mode, press and hold the MODE button until CAL is displayed on the lower portion of the LCD, then release the button. The LCD will display pH 7.01 USE.

9. Remove the protective cap from the probe. For the first calibration point, place the probe in pH 7 buffer solution being careful to submerge the glass bulb. The meter will automatically recognize the buffer value and then display pH 4.01 USE.

10. Remove the probe from the pH 7.01 solution. Rinse the probe with distilled water and gently blot the glass bulb with tissue.

11. Place the probe in the second buffer solution pH 4.01. When the second buffer is recognized, the LCD will display OK for 1 second and the meter will return to normal measurement mode. Note: The two buffer solutions used should bracket the expected concentrations of the water to be measured. In acidic environments, use the pH 4.01 and 7.01 solutions. In environments were the pH is above 7, use the 10.01 buffer instead of the 4.01, following the same procedure outlined above.

12. Change the mode to measure electrical conductivity (EC) by pressing And releasing the SET/HOLD button until the "uS" symbol appears in the upper right corner of the display. Remove probe from 4.01 buffer solution and rinse with distilled water, shaking off any excess water. Press and hold the MODE button until CAL is displayed on the lower LCD, then quickly release. Immerse the probe in the EC calibration solution (for Rock Creek use 1413 pS solution).

13. The meter will automatically calibrate. When the meter has finished calibrating the LCD will display OK for 1 second and return to normal measurement mode.

14. Record date, calibration solutions, whether the calibration was successful and any pertinent notes. If there were problems with the calibration, make a note on the log book and call any and/or all of the following: Charlotte, Ursula, Manufacturer.

RC-3 **Measurement of Field Parameters**

1.0 Equipment

- Combination pH/temp/conductivity meter and probe
- Ferrous Iron test kit
- Oxidation/reduction potential (ORP) meter
- Buffer solutions (pH 4, and 7)
- Conductivity standards
- Distilled or deionized water
- Tissue paper.

2.0 pH/temperature/conductivity measurement procedure

1. Select the pH mode with the SET/HOLD button.
2. Rinse probe with distilled water and shake off any excess. Then rinse probe with a small amount of sample.
3. Immerse the probe in the sample while stirring it gently. Wait until the clockface stability symbol in the top left of the LCD disappears.
4. The pH value, automatically compensated for temperature is shown on the primary LCD while the secondary LCD shows the temperature of the sample.
5. Rinse the probe thoroughly and shake off any excess water.
6. Record these readings in the field log book and/or sampling forms.
7. Switch the mode to obtain EC readings with the SET/HOLD button.
8. If the probe is not already in the sample to be measured, rinse the probe as in step two and immerse in the sample. Tap the probe gently on the bottom of the container to remove any trapped air bubbles. Wait a few minutes for the temperature sensor to reach thermo equilibrium. (i.e. until the clock face symbol disappears). Gently stir the probe while measuring.
9. The meter will show the temperature compensated EC value and the temperature of the sample.
10. Record these readings in the field book or sampling form.

3.0 Ferrous iron determination

- Fill one small viewing tube with sample from the well. This is the blank.
- Place vile in outside slot of black color wheel holder.
- Fill large measuring vile to 25 mL line with sample from the well.
- Add contents of one Ferrous Iron Reagent Powder packet into the measuring vial.
- Swirl to mix allowing three minutes for color to develop fully. An orange color will develop if ferrous iron is present.
- Pour mixture into second viewing tube.

- Place small vile with mixture into inside slot of color wheel holder.
- Place color wheel on pin in center of color wheel holder so that it spins freely.
- Hold color wheel holder up against a light source such as the sky and look through openings in the front.
- Turn color wheel until the color matches in both openings.
- Read the mg/L ferrous iron in the scale window and record on the field sheet.

4.0 ORP Measurement Procedure

- Turn on meter.
- Wait till self calibration indicator goes off.
- Place a small portion of the sample into the small plastic cup provided with the meter.
- Remove the protective cap from the probe and place in cup. This should be a snug fit.
- Wait until meter equilibrates.
- Read and record value on field sheet.

RC-4 **Groundwater Sampling Using the Dedicated Sampling Pump**

1.0 Equipment

- 5000-kilowatt portable generator, this description may be revised
- Fuel and oil for generator.
- Manual for Grundfos pumps.
- Discharge port and valve
- 1-1/2" to 1" discharge port connector (MW-03-06)
- Five gallon bucket or other vessel with which to measure water volume
- Total depth of well from well completion table
- Field book and forms
- Monitoring well keys
- pH/temp/conductivity meter and calibration solutions
- ORP meter and associated plastic cup
- Ferrous iron test kit
- Electronic water-level indicator
- Pre packaged, disposable field filtering transfer vessel and pump (0.45-micron disposable filters)
- Pre-preserved sample bottles
- Sample labels, zipper-locking plastic bags, coolers, ice, chain-of-custody forms, custody seals
- Clear mailing tape and nylon strapping tape
- Paper towels
- Personal protection equipment (as specified in the health and safety plan)
- Disposable latex gloves or the equivalent
- Permanent marker and ball point pen.
- New plastic trash bags

2.0 Sampling procedure

This section provides a detailed description of sequential steps involved in collecting groundwater samples using a dedicated pump. Detailed protocols for activities associated with each step have been developed based on methods established by the United States Geological Survey (USGS), US EPA, equipment manufacturers' recommendations, and site-specific conditions. The appropriate personal protective equipment shall be donned prior to

sampling. Know your sample holding times and be sure samples are sent to lab accordingly, let the lab know when they will be taken and when they will arrive.

1. Inspect wellhead for damage and/or vandalism (well head, lock) and record observations. Also record weather, if well is frozen, and any other condition that may influence sampling event.

2. Fill generator with unleaded gas and check the oil. Add oil if necessary.

3. Set the generator automatic throttle control switch to the manual position.

4. Start the generator with the circuit breaker switched off. Allow the generator to warm up until a constant voltage output is obtained.

5. Unlock and remove well cap.

6. Determine if the water in the well is frozen by lowering and raising the water level indicator several feet below the water surface.

7. If the well is not frozen, measure and record the depth to static water level to nearest 0.01 m or 0.01 ft in accordance with SOP CQ-1. This measurement shall be made from the established reference point on the wellhead. (Rock Creek monitoring wells shall be measured from to the top of the steel casing closest to the 1" sounding tube). Skip step 8.

8. If water surface is determined to be frozen,

   - Record the depth to the frozen plug;
   - energize (plug into generator and turn on breaker) heat trace and record time on field form.
   - When well is thawed, de-energize heat trace and record time on field form.
   - Remove heat trace wearing clean latex gloves and store in clean trash bag while sampling.
   - Measure depth to water in the 1" riser pipe. Record the time and level and note that it was taken inside the riser.
   - Confirm well thawed to pump by sounding down riser pipe (pump discharge).

9. Label the sample bottles. Secure the labels in place using clear mailing tape. Write in permanent marker on bottles in case labels become separated or destroyed.

10. Using the total depth of well from the well construction details table, calculate the volume of water to be purged as follows:
    a. Depth of water in well (D, ft) = Total depth of well (ft)- depth to water (ft)
    b. Volume of water in well (cu ft) = 0.087 * D (ft) (Pi * * depth of water, (where r is the radius of the casing in feet)
    c. Volume of water to purge (cu ft)= volume of water in well * 3
    d. To convert to gallons, multiply volume of water to purge by 7.48.

Attach the valve and discharge pipe.

11. Start the pump by plugging it into the generator and turning on the circuit breaker. Record the time. Adjust the discharge rate of the pump by turning the valve. If the pump stops inadvertently during normal operation, do not restart it until all the water in the discharge line has drained back through the pump and into the well.

12. Purge three well volumes from the well to remove the stagnant water from the well casing and filter pack measuring the volume.

13. measure field parameters during purging (pH, EC and Temp) in accordance with RC-02:
    - 1st when approximately 1/2 the minimum volume has been purged
    - 2"d when approximately % the minimum volume has been purged
    - 3 when the entire minimum volume has been purged

    If the last set of filed parameters is not within 10% of previous reading, continue to purge in multiples of Y4 of the purge volume until the field parameters stabilize to within 10%.

14. Collect water samples in the appropriate containers (preserve and filter as required). Collect the sample for unfiltered (raw) analyses directly into the appropriate sample bottles. Completely fill and tightly cap the bottles. If the bottles contain preservatives, do not overfill them. A clean transfer container rinsed three times with discharge water may be used to carry sample to a warmer location if temperatures are extreme. However, samples should be filtered and preserved as soon as possible.

15. Collect the sample fraction to be filtered directly into the top portion of the disposable filter apparatus or into a new or triple-rinsed, unpreserved 1 Liter sample container. Attach the tygon tubing from the hand pump to the vacuum port on the filter apparatus. Apply vacuum by squeezing the pump handle several times. When upper chamber is empty, disconnect the lower chamber and empty into the appropriate pre-preserved sample container. Reconnect to the filtering apparatus. Repeat this process until sufficient sample has been filtered. Additional filters may be needed for very dirty samples. Collect extra sample for field parameters and measure using methods in RC-3.

16. Place the samples in a cooler containing ice to maintain the samples at about 4°C.

17. Dispose of used filter units.

18. Record pertinent data in the field log book.

19. Stop the pump by turning off the circuit breaker and unplugging it.

20. Disconnect all power cables and store.

21. Remove valve and discharge port.

22. Replace heat trace in well before freezing occurs. This is very important.

23. Replace well cap and lock.

Sample bottles are shipped from the laboratory with the appropriate quantity of preserving material. It is imperative that the samples be placed in the correct bottles and be labeled appropriately. Immediate sample labeling is imperative. Samples require transportation at around 4°C. For some of the sampling events, the challenge may be to keep the samples from freezing rather than keeping them cool during shipment. Pack the coolers provided by the laboratory to minimize damage or the chance for contamination. Seal each container prior to shipment.

RC-5 Collection of Field-Blank, Field-Duplicate, and Equipment-Blank Samples

For every sampling event, one field-blank and one field-duplicate sample are required.

1.0 Field-blank samples

1. Take a container of deionized water and a set of new sample bottles into the field. The deionized water should be obtained from the laboratory that will analyze the samples.

2. Label the field-blank sample bottles with a code that will not alert laboratory personnel that this is a blank sample.

3. During the middle of the sampling day, after some environmental samples have been taken, fill a set of new sample containers with the deionized water. Use exactly the same procedures as are being used for environmental samples. Use the same preservatives, if any.

4. Measure field parameters in the normal field-parameter container, rinsing the container and instruments beforehand with deionized water in the typical manner.

5. Record all activities on field sheets or logbook, in the same manner as for normal environmental samples. Record that this is a field-blank sample, but do not allow this information to reach the laboratory.

6. Place the field-blank sample bottle(s) in the same cooler as the normal samples, and deliver all samples to the laboratory in the same manner and at the same time.

2.0 Field-duplicate samples

1. Take a set of new sample bottles into the field.

2. Label the field-duplicate sample bottles with a code that will not alert laboratory personnel that this is a duplicate sample.

3. Take the primary sample in the normal manner, after purging the well and measuring field parameters. Rinse the field-parameter container and instruments with deionized water in the normal manner.

4. Do not re-purge the well, but otherwise take the duplicate sample in exactly the same manner as the primary sample. Add preservative if it was added to the primary sample. Re-measure field parameters in newly recovered water.

5. **Record all activities in the same manner as for normal environmental samples. Record that this is a field-duplicate sample, but do not allow this information to reach the laboratory.**

1. **Place the field-duplicate sample bottle(s) in the same cooler as the normal samples, and deliver all samples to the laboratory in the same manner and at the same time.**

RC-6 Sample Packaging and Shipping

1.0 Equipment

- Coolers
- Clear mailing tape
- Nylon strapping tape
- Custody seals
- Zipper-locking plastic bags
- Packing material (vermiculite or bubble wrap)
- Shipping labels
- Ice.

2.0 Procedures

1. Check the caps on the sample.

2. Place the sample containers in the cooler, leaving room for ice. Surround the samples with sufficient packing material to prevent breakage. Plastic sample containers may be used to separate glass containers from each other.

3. Check the chain-of-custody form to ensure that all samples in the cooler have been properly recorded. Sign the chain-of-custody form to relinquish custody. If using a shipping company, write their name in the "received by" section of the form and their bill number on an appropriate place on the form.

4. Place two copies of the completed chain-of-custody form in a zipper-locking plastic bag and tape the bag to the inside lid of the cooler.

5. Fill the remaining cooler volume with ice that has been placed in plastic bags.

6. Seal the cooler using nylon strapping tape at both ends. Use at least three wraps of tape around the cooler body.

7. Sign, date, and place a custody seal across the opening of the cooler and secure with clear tape.

8. Secure the shipping label to the top of the cooler.

9. Transport the cooler to a secure storage area or to the shipping agent.

RC-7 **Equipment Decontamination**

1.0 Equipment

- Plastic tubs and/or buckets
- Clean (drinking) water
- Distilled or deionized water
- Nonphosphate detergent (alconox or liquinox)
- Hard bristle brushes
- Plastic sheeting
- Plastic garbage bags
- Nitrile gloves
- Squeeze bottles or garden sprayers
- Paper towels.

2.0 Decontamination procedures

1. If equipment contamination may be hazardous, use appropriate personal protection equipment (gloves, goggles, etc.).
2. Remove gross contamination (mud, grease, etc.) with a stiff brush.
3. Wash equipment using solution of detergent and clean (drinking) water.
4. Rinse equipment with clean water.
5. Triple-rinse equipment with distilled or deionized water.
6. For sensitive equipment such as meters, use paper towels to clean surfaces that contact the sample.
7. Store decontaminated equipment in clean plastic bags or plastic sheeting until needed.
8. Rinse cleaning equipment (brushes, tubs, etc.) with clean water, and store in clean containers.
9. Properly dispose of used paper towels gloves, etc.

APPENDIX C

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

BORING LOG

Hole No: MW03-01	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 480011 E, 7164903N	Descriptive Loc: Upgradient from tailings	Loc. Elev: 283'	
Drilling Co: T&J Enterprises	Logged By: Bill Coolash, U. Williams	Checked By: Coord not final	
Driller: Roy Brown	Rig Type: Exploration Rotary w 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: Sept 25, 2003	Screen Type: 0.02" factory slot PVC	From: 65	To: 45
Comp. Date/Time: Sept 25, 2003	Gravel Pack Type: 10-20 sand (CO silica)	From:80	To: 35
Final Depth: 80	Seal Type: Medium holeplug	From: 35	To: 25

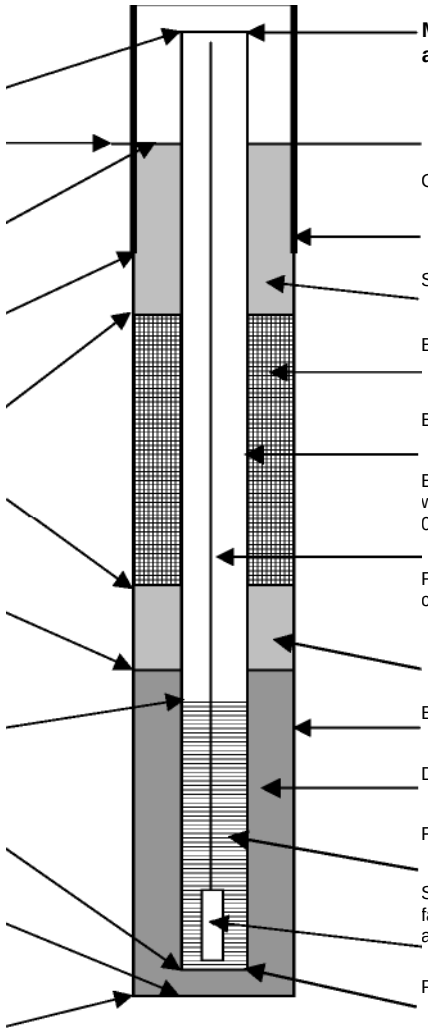
Penetration	Description	Remarks
	Ground Seam	
	BEDROCK	
	graphitic schist	
	slightly weathered	
		10:45 end
		10:47 begin
		inflow less than 1 gpm; wet at 37'
		11:43 end
		11:55 begin
		12:15 end
		let hole sit (shutdown) for 15 minutes, blew water from 10' off bottom

Monitoring Well Completion Schematic

Project Name:	Rock Creek	**Well I.D.:**	MW03-01
UTM Northing (m):	7164903	**UTM Easting (m):**	480011
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	**86.49**
Pump model number:	5SQE03A-140	**Depth of pump (m):**	**18.29**
Driller:	**R. Brown**	**Datum:**	**NAD 27, ZONE 3**

Completion detail	Depth (m) (bgs)
Top of Riser Pipe	**-0.95**
Ground Surface	0
Top of Bentonite Seal	0
Bottom of Surface Casing	1.98
Bottom of Bentonite Seal	3.05
Top of Bentonite Seal	7.62
Top of Filter Pack	10.67
Top of Screen	13.72
Bottom of Screen	19.82
Bottom of Filter Pack	24.09
Total Depth Drilled	24.39

Completion Details
(not drawn to scale)



Completion Materials and Installation Specifications

Locked well cap

Measuring point is top of riser pipe adjacent to lock hasp

Ground Surface

Steel surface casing: 203 mm dia. Steel

Bentonite: medium holeplug

Backfill: Drill cuttings and bentonite holeplug

Blank casing: 101 mm dia., sch 80 PVC with ASTM F-480 flush-joint threads and teflon 0-rings

Riser pipe: 25 mm dia., sch 40, PVC, NPT coupled joints

Bentonite: medium holeplug

Drilled hole: 203 mm dia.

Filter Pack: 10/20 Colorado silica sand

Screen: 101 mm dia., sch. 80 PVC, 0.51 mm factory slot, with ASTM F-480 flush-joint threads and teflon 0-rings

Pump: 76 mm dia., submersible grunfos

End cap

BORING LOG

Hole No: MW03-02	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 479855E, 7165284N	Descriptive Loc: Downgrade from pit	Loc. Elev: 24T	
Drilling Co: T&J Enterprises	Logged By: Bill Coolash, U. Williams	Checked By: Coord not final	
Driller: Roy Brown	Rig Type: Exploration Rotary 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: 9/25/03	Screen Type: 0.02 factory slot	From: 138.7'	To: 98.7'
Comp. Date/Time: 9/26/03	Gravel Pack Type: 10-20 silica sand (22)	From: 138.	To: 89'
Final Depth: 150'	Seal Type: Medium Holeplug	From: 89'	To: 84'

Penetration	Description	Remarks
	Ground Surface	
	BEDROCK	
	graphitic schist weathered	little overburden
		schist a little harder
		first water
		slightly more water
		water surge (small)

BORING LOG

Hole No: MW03-02 | Project Name: Rock Creek | Job No: 2509 | Client: AKGold

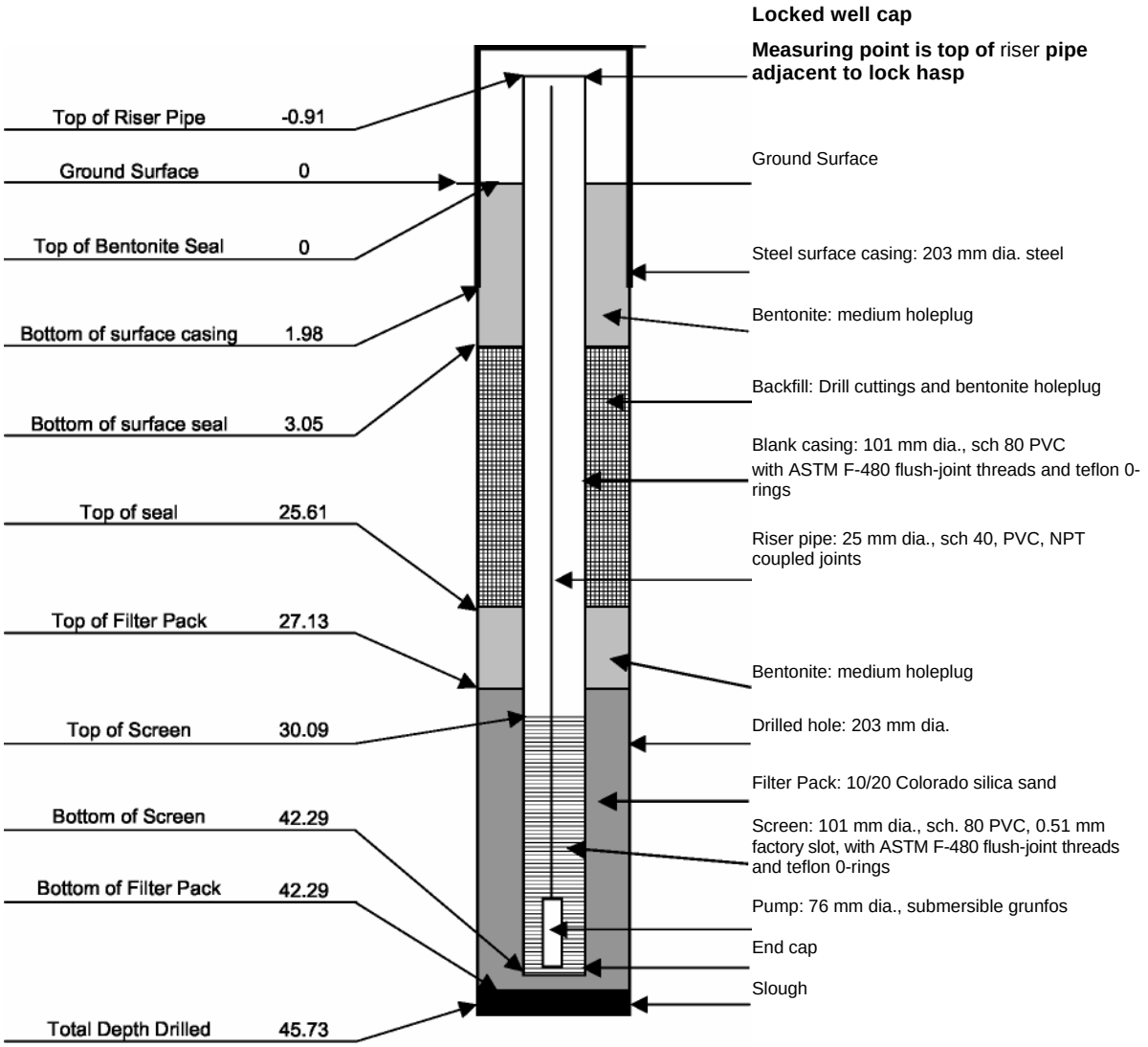
			Penetration				Description				Remarks
90-										6:08	
100-										6:30	
110-	34	a 0 W									
120-											slightly more water soft
130-											small slug of water making mor water
140-										7:35 am 9/26/C3	
	~ 44										2 - 3 gpm; let hole recover for 15 minutes and unloaded **30-45** gal
150							End of Borehole				

60-											

Monitoring Well Completion Schematic

Project Name:	**Rock Creek**	**Well I.D.:**	**MW03-02**
UTM Northing (m):	**7165284**	**UTM Easting (m):**	**479855**
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	75.20
Pump model number:	5SQE03A-140	**Depth of pump (m):**	**42.68**
Driller:	**R. Brown**	**Datum:**	**NAD 27, ZONE 3**

Completion detail	**Depth (m) (bgs)**	Completion Details *(not drawn to scale)*	**Completion Materials and Installation Specifications**



BORING LOG

Hole No: MW03-03	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 480751E, 7166260N	Descriptive Loc: Up pit	Loc. Elev: 532'	
Drilling Co: T&J Enterprises	Logged By: D. Dander	Checked By: Coord not final	
Driller: Roy Brown	Rig Type: Exploration Rotary 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: 10/03/03 9:00 am	Screen Type: 0.02 factory slot PVC	From: 118'	To: 98'
Comp. Date/Time: 10/04/03 8:00 pm	Gravel Pack Type: 10 - 20 sand (CO silica)	From: 122'	To: 102'
Final Depth: 122'	Seal Type: Bentonite Chips	From: 90'	To: 80'

							Description				Remarks
			Penetration				Ground Surface				
0	O						**OVERBURDEN/COLUVIUM** silt, gravely, subangular to subrounded	£			
10-											becoming clayey
20		w								Fgravels	< 20mm gravels < 10mm
											water
1 -		z					**BEDROCK** graphitic schist weatheredd				
30-	1 - 10				2 C						sharp angular chips <10mm
40-				-WM #1		ia	NON WEATHERED				
50							solid; sharp angular chips 40mm				
50-		g					as above; flat platty chips				grouted surface flat platy chips
70-	20 ~	m									

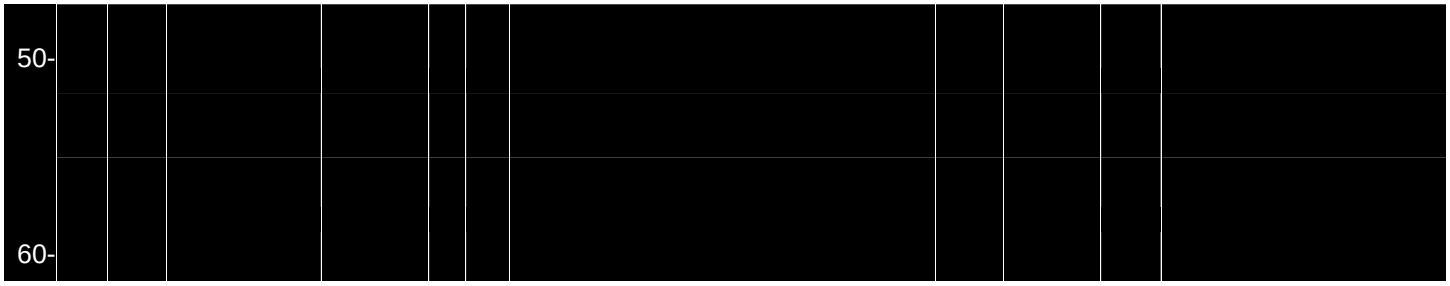
30-										:	:		i s	moderate oxidation

BORING LOG

Hole No: MW03-03 | Project Name: Rock Creek | Job No: 2509 | Client: AKGold

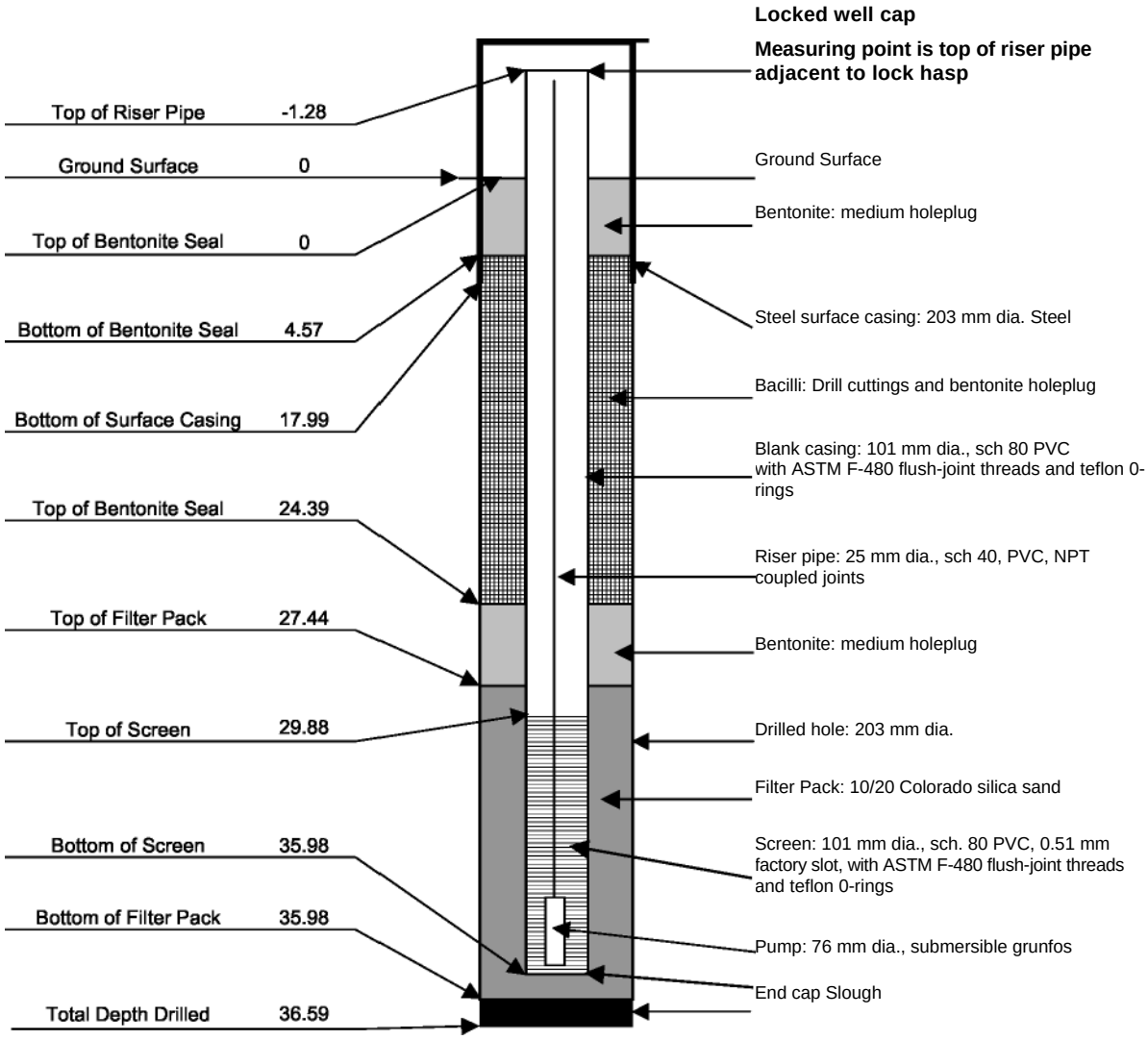
			Penetration			Description				Remarks
						as above; mod. oxidation				
90-										(8 min) 7-8 gpm
						as above; tr. oxidation				slightly oxidized
100-						as above; abundant oxidation; tr. qtr				some quartz good oxidation
										large chips/qua rtr
110-	34					fractures:				35 gpm recovery to 15'
										some fracturing; Recovery Test fracturing stops
120-										
						End of Borehole				
140-	Q4 4									

Monitoring Well Completion Schematic



Project Name:	**Rock Creek**	**Well I.D.:**	**MW03-03**
UTM Northing (m):	**7166260**	**UTM Easting (m):**	480751
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	**162.30**
Pump model number:	5SQE03A-140	**Depth of pump (m):**	30.49
Driller:	**R. Brown**	**Datum:**	**NAD 27, ZONE 3**

Completion detail	Depth (m) (bgs)	Completion Details *(not drawn to scale)*	Completion Materials and Installation Specifications



Monitoring Well Completion Schematic

BORING LOG

Hole No: MW03-04	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 479994E, 7166135N	Descriptive Loc: Up Dump	Loc. Elev: 436.5'	
Drilling Co: T&J Enterprises	Logged By: D. Dander	Checked By: Coords not final	
Driller: Roy Brown	Rig Type: Exploration Rotary 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: 10-10-03/5:20 pm	Screen Type: 0.02" factory slot PVC	From: 66'	To: 46'
Comp. Date/Time: 10-12-03/11:45 am	Gravel Pack Type: 10-20 sand (CO silica)	From: 70'	To: 41'
Final Depth: 64.9'	Seal Type: Bentonite Chips	From: 41'	To: 32'

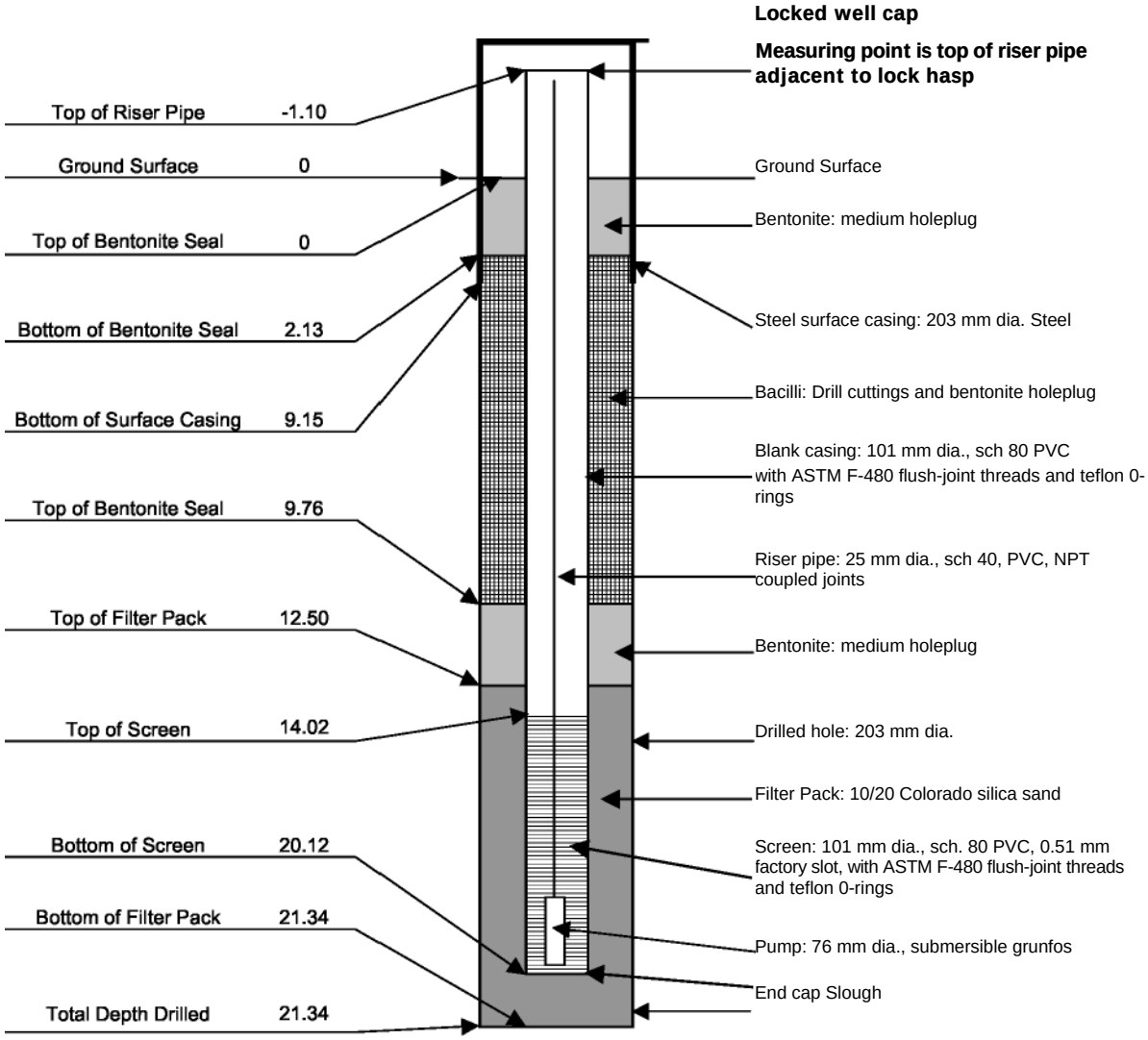
	Penetration	Description	Remarks
		Ground Surface	
		COLUVIAL OVERBURDEN	(drill rate)
			(10 min)
		BEDROCK	
10-		graphitic schist weathered	6:12
			(17 min)
20		NON WEATHERED	6:52
			11/10/3 (18 min)
30			7:1E
		some oxidation; variable chip size	(10 min)
40			7:2E
			(14 min) some indication of frac.
		End cap Slough	
50			some water and variable ship sizes

0	20				v o m		Frac water strong fracturing stops	ɔ	;;	c i o y	8:O1	(13 min) good fractures good recovery good fractures pilotWL16' increasting at 1'/min
(0 30-												Airlift at 85' in pilot approx. 15 gpm

Monitoring Well Completion Schematic

Project Name:	Rock Creek	**Well I.D.:**	MW03-04
UTM Northing (m):	**7166135**	**UTM Easting (m):**	479994
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	**133.08**
Pump model number:	5SQE03A-140	**Depth of pump (m):**	**18.29**
Driller:	**R. Brown**	**Datum:**	**NAD 27, ZONE 3**

Completion detail	**Depth (m) (bgs)**	Completion Details *(not drawn to scale)*	**Completion Materialsand Installation Specifications**



BORING LOG

Hole No: MW03-05	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 479178E, 7164306N	Descriptive Loc: Downtailings Faciity	Loc. Elev: 101'	
Drilling Co: T&J Enterprises	Logged By: D. Dander	Checked By: Coord not final	
Driller: Roy Brown	Rig Type: Exploration Rotary 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: 10-14-03/11:30 am	Screen Type: 0.02" factory slot PVC	From: 88'	To: **68'**
Comp. Date/Time: 10-14-03/5:00 pm	Gravel Pack Type: 10-20 sand (CO silica)	From: 88'	To: 63'
Final Depth: 88.T	Seal Type: Bentonite Chips	From: 63'	To: 55'

Depth	Penetratio	Description	Remarks
		Ground **Seam**	
0		**ALLUVIAL** muskeg; large gravel to sand	11:3(
10-		**BEDROCK** graphitic schist weathered	12:3(
20		solid unweathered bedrock	cut off surface casing and cont. drilling; 14:2(some fracturing; good water in pilot not in MW
30-			14:2(
40-			**14:4(**
50-			15:0C
50-			15:1;
70-		Frac	fracturing large chips; Airlift approx. 6 gpm; produced water; 15:3t solid rock
30-			

BORING LOG

Hole No: MW03-05 Project Name: Rock Creek Job No: 2509 Client: AKGold

G	~ 2 'C G	Penetration	v J	~	1i	Description	O 0 C~ G		Remarks
-			tS ~				w		good fracturing Airlift approx. 7 gpm
90-						End of Borehole			
1 00-									
1 10-	_-34								
1 20-									
1 30-									
1 40-	Q44								

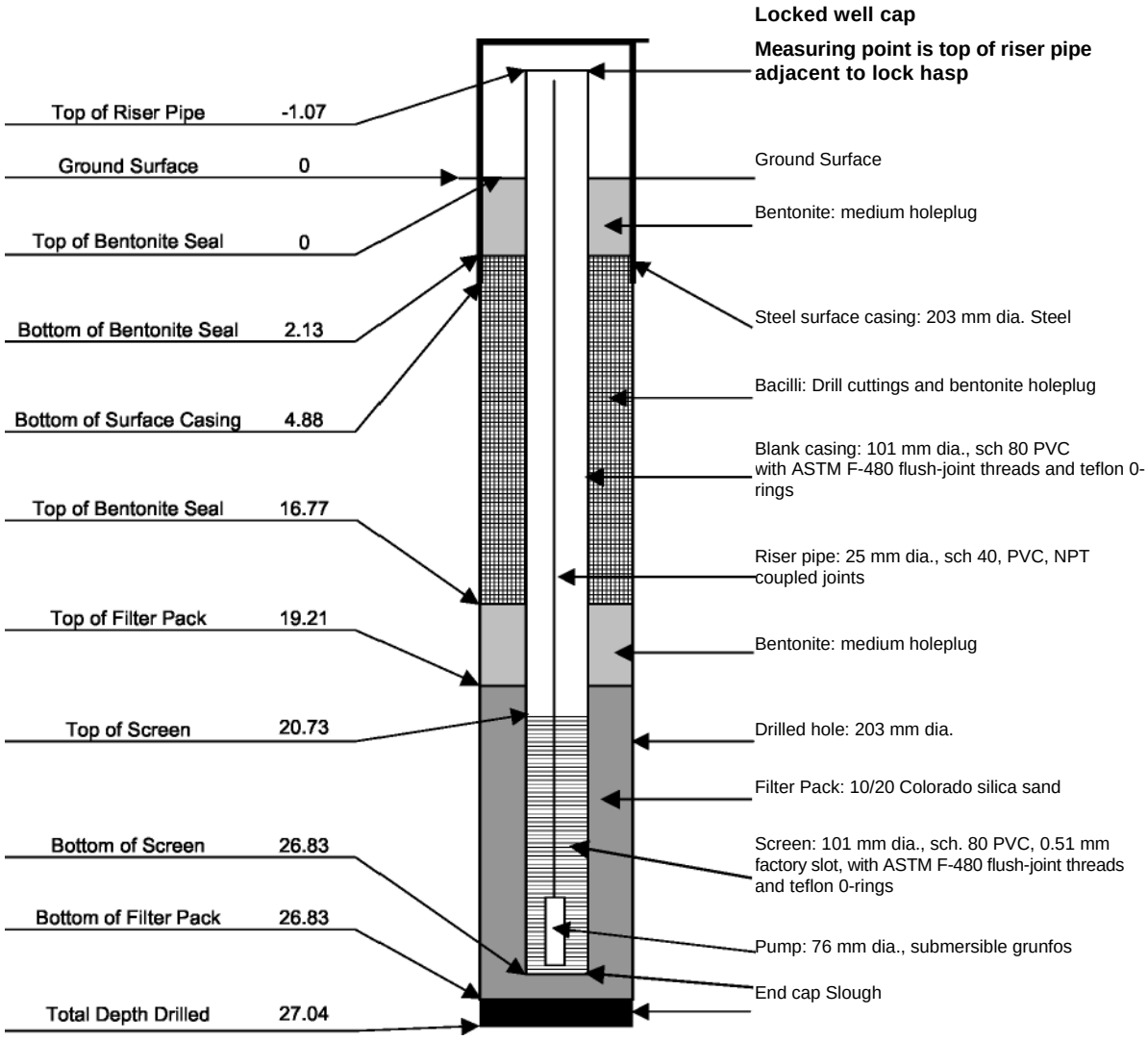
1

1

Monitoring Well Completion Schematic

Project Name:	**Rock Creek**	**Well I.D.:**	**MW03-05**
UTM Northing (m):	7164306	**UTM Easting (m):**	479178
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	30.90
Pump model number:	5SQE03A-140	**Depth of pump (m):**	**24.39**
Driller:	**R. Brown**	**Datum:**	**NAD 29, ZONE 3**

Completion detail	Depth (m) (bgs)	Completion Details *(not drawn to scale)*	Completion Materials and Installation Specifications



Monitoring Well Completion Schematic

BORING LOG			
Hole No: MW03-06	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 478802E, 7164190N	Descriptive Loc: Alluvial Well	Loc. Elev: 73.4'	
Drilling Co: T&J Enterprises	Logged By: D. Dander	Checked By: Coord not final	
Driller: Roy Brown	Rig Type: Exploration Rotary 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: 10-15-03/2:30 pm	Screen Type: 0.02" factory slot PVC	From: 26'	To: 16'
Comp. Date/Time: 10-15-03/10:30 pm	Gravel Pack Type: 10-20 sand (CO silica)	From: 30'	To: 11'
Final Depth: 30'	Seal Type: Bentonite Chips	From: 11'	To: surface

ft	m	Description	Remarks
		Ground Surface	
0	0	ALLUVIAL very slow, problems	
		coarse gravels and pebbles chips of various sizes and colors	getting centrex bit to casing, spent 1 hr
10-			in the meantime, topo hole degraded from up and down movement, cavatating near surface
20-		increase in larger pebbles very well rounded <1	when adding sand around 4' PVC and pulling steel casing, lower portion seemed OK
30-		increase in clays decrease in pebbles	upper 10' cavatated lots of bentonite
40-		very heavy clays	steel casing sank in it and had top hold until set
50-			after that, final well completed; considered

Pump: 76 mm dia., submersible grunfos

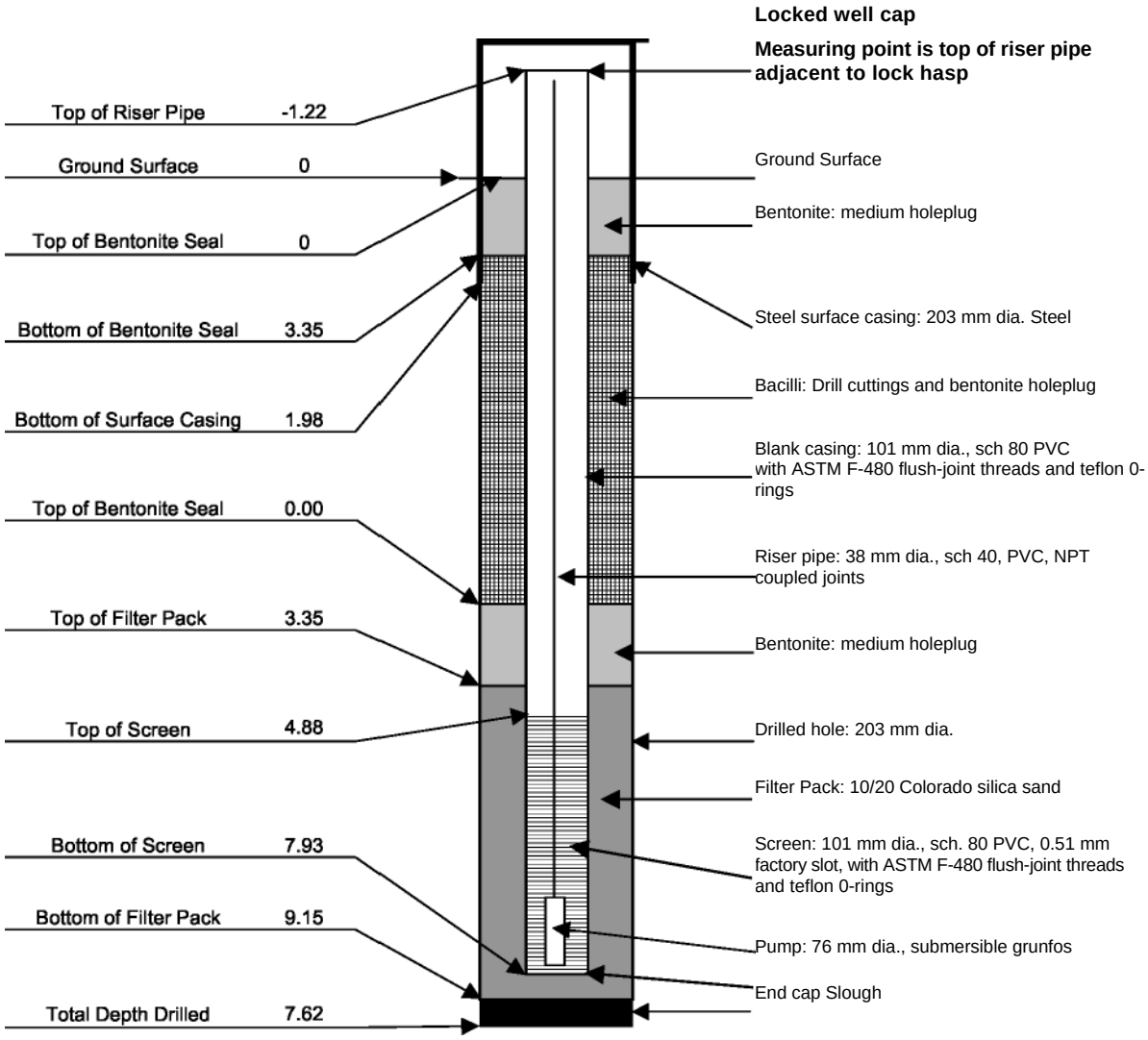
End cap Slough

70-	2C	6 9 +		SSS'S $:%<			**BEDROCK** pilot weathered			alright

Monitoring Well Completion Schematic

Project Name:	**Rock Creek**	**Well I.D.:**	**MW03-06**
UTM Northing (m):	7164190	**UTM Easting (m):**	478802
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	**22.39**
Pump model number:	30SQE10C-130	**Depth of pump (m):**	6.10
Driller:	**R. Brown**	**Datum:**	**NAD 210, ZONE 3**

Completion detail	**Depth (m) (bgs)**	Completion Details *(not drawn to scale)*	**Completion Materials and Installation Specifications**



BORING LOG

Hole No: MW-03-07	Project Name: Rock Creek	Job No: 2509	Client: AKGold
Loc. Coords: 479620E, 7165330N	Descriptive Loc: Down Dump	Loc. Elev: 229.6'	
Drilling Co: T&J Enterprises	Logged By: D. Dander	Checked By: Coords not final	
Driller: Roy Brown	Rig Type: Exploration Rotary 3" rods	Drill Bit: hammer	Bit Size: 8"
Start Date/Time: 10-18-03/8:30 am	Screen Type: 0.02" factory slot PVC	From: 108'	To: **88'**
Comp. Date/Time: 10-18-03/5:OOpm	Gravel Pack Type: 10-20 sand (CO silica)	From: 110'	To: 83'
Final Depth: 110'	Seal Type: Bentonite Chips	From: 83'	To: 75'

G		Description		Remarks
		Ground surfam		
0	0	FOR GEOLOGIC DESCRIPTIONS AND COMMENTS SEE PILOT HOLE LOGS MW03-07P and MW03-07P2	A	(drill rate)
10-				
20-				(5 min)
30-	1C			(5 min)
40-				(5 min)
50-				(5 min)
60-				(8 min)
70-	2C			(8 min)
80-				(8 min)

BORING LOG

Hole No: MW-03-07 Project Name: Rock Creek Job No: 2509 Client: AKGold

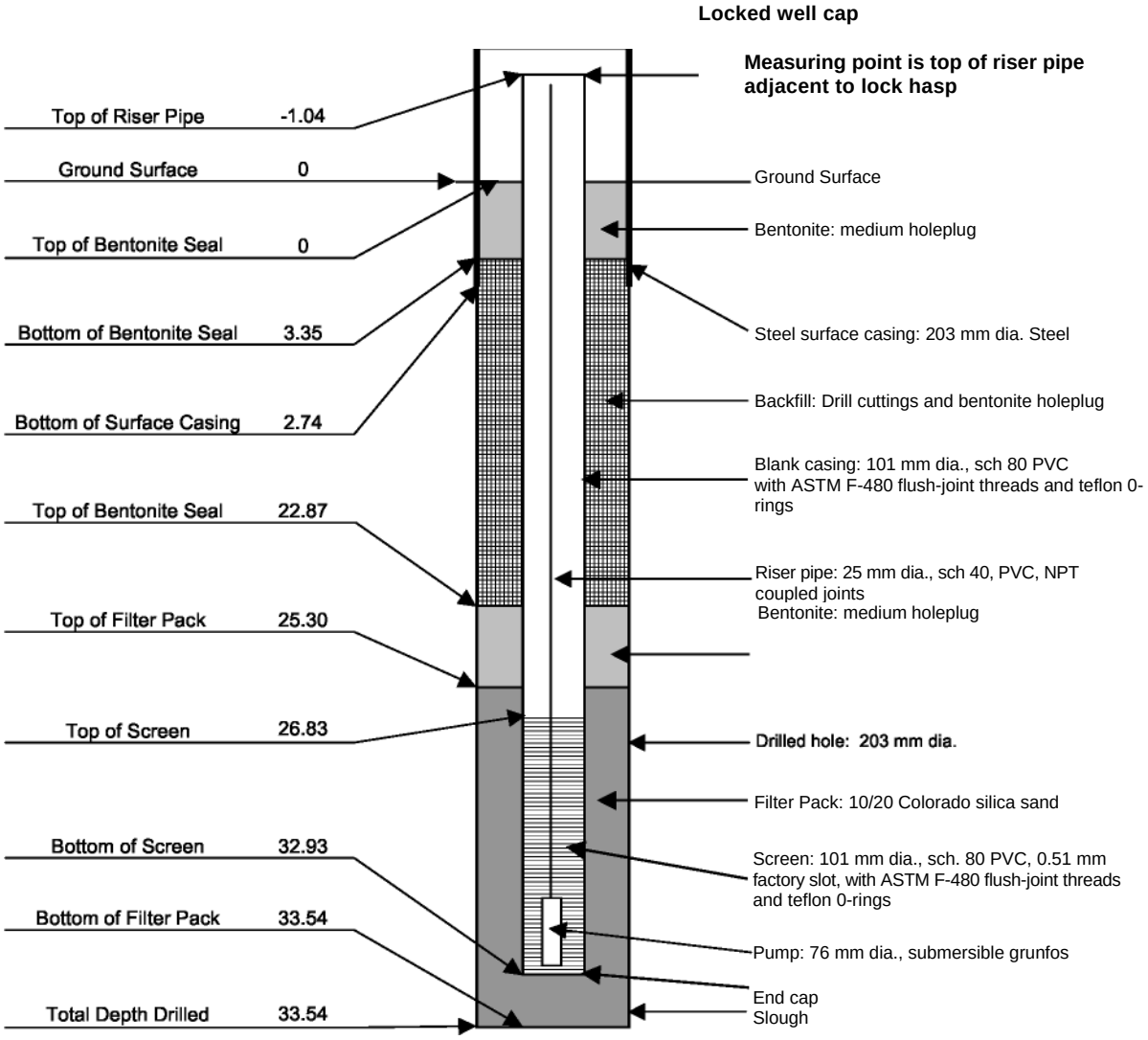
							Description			Remarks
90-										
100								a: a		Airlift approx. 5 gpm, good water in hole
110	34						End of Borehole			Airlift approx. 10 gpm good water
120-								w u'		
130-										
140-	--44									
150-										

60-										

Monitoring Well Completion Schematic

Project Name:	Rock Creek	**Well I.D.:**	MW03-07
UTM Northing (m):	**7165330**	**UTM Easting (m):**	479620
Drilling Co.:	T&J **Enterprises**	**Elevation (m):**	70.00
Pump model number:	**5SQE05A-270**	**Depth of pump (m):**	30.49
Driller:	**R. Brown**	**Datum:**	**NAD 211, ZONE 3**

Completion detail	Depth (m) (bgs)	Completion Details *(not drawn to scale)*	Completion Materials and Installation Specifications



APPENDIX C

Development Rock Composite Sampling Procedure

APPENDIX C DEVELOPMENT ROCK SAMPLING

Development rock samples will be collected at the surface by an Alaska Gold technician in the area most actively being used at the time. No consideration for rock type will be made during the collection of approximately 20 pounds of sample in a sack. The sample will be stored out of the weather until it is time to composite all the samples collected over the period for the laboratory. All the samples, normally four, will be mixed by the geologic technician and then split in to 4 samples. One of these samples will be randomly selected and submitted to the laboratory for analysis, with the three remaining samples stored on site for additional analysis, if needed.

APPENDIX D

Big Hurrah Rock Characterization Plan

TECHNICAL MEMORANDUM

WATER MANAGEMENT CONSULTANTS

1875 LAWRENCE STREET, SUITE 500
DENVER, COLORADO 80202, USA

TELEPHONE: (303) 297 9005
TELEFAX: (303) 297 9007
www.watermc.com

To: Doug Nicholson (doug.nicholson@novagold.net)

Company: NovaGold Resources Inc.

Project No.: 2573

From: Brent Johnson (bjohnson@watermc.com)
Jennifer Beck (jbeck@watermc.com)

Date: May 26, 2006

Subject: Big Hurrah - Development Rock Handling Plan

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1 INTRODUCTION

This Technical Memorandum presents recommendations for the handling and management of development rock to minimize impacts at the Big Hurrah Project site near Nome, Alaska. This assessment utilizes geochemical test data obtained from development rock samples for the determination of non-acid-generating (NAG) and potentially-acid-generating (PAG) material. Operational sampling of the development rock will confirm the NAG or PAG designation, and the material will be handled accordingly. The NAG material will be handled and stored in the development rock storage area. The PAG material with a NP:AP ratio of 1.0 or less, and up to a volume of 1,305,000 cubic yards (998,000 cubic meters) will be separated, handled, and temporarily stored in the PAG staging area, adjacent to the development rock storage area for later backfilling of the pit. Additional geochemical testing, will be designed and approved by ADEC and ADNR to refine the estimates of PAG at various NP:AP ratios. If it is estimated that the volume of PAG with a minimum NP:AP ratio of 1.0 comprises less than 1,305,000 cubic yards, then the NP:AP ratio used for determining backfill PAG material will be refined and raised to a NP:AP ratio estimated to approximate the volume 1,305,000 cubic yards. By doing so, the storage capacity within the pit is optimized while keeping the PAG material inundated. All remaining PAG material with a NP:AP ratio above the final cutoff ratio will be blended with the NAG material in the development rock storage area and will have a net NAG composition. Upon completion of mining, the segregated PAG material will be placed into the open pit where it will be inundated with water, reducing exposure and mineral oxidation.

2 MINE OPERATION

The final mine design will be determined upon completion of the economic feasibility study, which is currently being developed. However, the working plan for the operation of the mine suggests that operations will begin by 2007 and continue for 3 years, consisting of 3 months of stockpiling per year and hauling up to 12 months per year. The development rock storage facility will be constructed during this time period.

The proposed handling and storage management of development rock is based on rock tonnages and types as summarized in Table 1, with a total of approximately 7 million tons (Mt) of excavated rock mass. Based on percentages provided by NovaGold, the focus of the development rock analysis was on quartz graphite schist (QGS) and the graphite muscovite schist (GMS), which comprise the majority of the development rock. At the time of closure, it is estimated that 5.7 million tons of excavated development rock will need to be managed in a way that minimizes impact to the area surrounding the Big Hurrah site.

Table 1 Big Hurrah Project rock types and tonnages

Description of rock types	Tonnage of ore	Tonnage of development rock	Percent of ore	Percent of development rock
Quartzitic graphite schist (QGS)	696,669	2,985,281	66	52
Quartz-muscovite schist (QMS)	10,556	114,819	1	2
Ore graphite calcareous schist (GCS)	52,778	459,274	5	8
Marble (MBL)	31,667	287,046	3	5
Graphitic Marker Unit (GMU)	10,556	114,819	1	2
Graphitic-muscovite schist (GMS)	242,778	1,779,687	23	31
Ore quartz vein (QVN)	10,556	0	1	0
Totals	1,055,560	5,740,926	100	100

2 CHARACTERIZATION OF DEVELOPMENT ROCK

Development rock properties were characterized based on ABA, bulk chemistry, and depletion calculations estimated from three humidity cell tests (HCTs). Depletion calculations are used for the prediction of long-term weathering behavior of the different development rock types.

Results from depletion time calculations for development rock lithologies in the three HCTs are presented in Table 2. Depletion time estimates were calculated based on sulfate mass generated (for acid depletion) and calcium and magnesium mass generated (for neutralization depletion). Depletion rates were compared to sulfide sulfur (converted to the carbonate equivalent) AP and carbonate NP to estimate whether NP or AP would be depleted first. For cells 1 and 3, NP was predicted to far outlast AP. For Cell 2 (QMS acidic), the sulfate concentrations are very low indicating negligible pyrite oxidation is occurring. With such low rates of pyrite oxidation, it is likely that pyrite is relatively unreactive and/or unavailable for reaction. For this reason, cell 2 was not used in the determination of a site specific NP:AP value.

For the purpose of development rock handling, the percentage of NAG and PAG development rock has been estimated based on a site-specific NP:AP ratio for the Big Hurrah materials. The site-specific NP:AP ratio is calculated from the NP and AP depletion rates measured in the HCTs of NAG waste rock samples once depletion rates have stabilized. This method assumes that the available NP in the samples persists over time, which has been evaluated based on the depletion time calculations which predict that NP will far outlast AP in these samples (Section 3, HCT). The NP:AP ratios are calculated for each HCT and a weighted average was calculated based on the percentage of development rock represented by each HCT. The weighted average was calculated at 1.7, however, a value of 1.9 was selected to provide an additional measure of conservatism.

The depletion calculations indicate that, at the 1.9 cutoff, the NP outlasts the AP by a significant margin. HCT 1 has a ratio of days NP to days AP is 2.2 and for HCT 3 it is 2.9. This indicates that the actual cutoff for the PAG determination is lower than either the 1.7 or the 1.9. The actual cutoff may be refined by further test work, however, at a minimum, the PAG material with a NP:AP ratio of 1.0 or less will be placed into the pit for submergence by the pit lake by at least 5 feet of water. The actual volume of PAG material for submergence will be optimized such that the most acidic material will be submerged and the remaining volume of PAG will be managed by blending with the NAG material in the development rock dump. Data are presented in Table 3.

In order to estimate the approximate percentage of development rock which will be considered PAG material, all of the development rock ABA data are presented in a scatter plot (Figure 1) and compared to the site-specific NP:AP ratio of 1.9. The ABA data presented in Figure 1 are based on siderite-corrected

NP values and sulfide-sulfur AP values. Table 4 presents a comparison of the estimated PAG material using corrections to the NP value, as determined through the confirmatory ABA testing (Big Hurrah Project – Preliminary Materials Geochemical Testing Results (WMC, May 2006)). The estimated percentage of PAG material varies from 37%, based on the standard Sobek determination of NP, to 51%, based on modifying the NP value using both siderite and TIC calculated corrections. For the purpose of planning and development rock handling, the siderite-corrected, TIC NP values are used to estimate PAG material quantity. Approximately 51% (141 samples) of development rock samples plot below the site-specific NP:AP ratio. Therefore, approximately 51% of development rock will be considered PAG material. Actual PAG quantities will be determined by operational sampling and analysis during mining.

Table 2 NP and AP depletion calculation results summary

Rock type	HCT #	Ca (mg/L)	Mg (mg/L)	SO4 (mg/L)	Carbonate molar ratio	Initial AP (Sulfide S) (%)	AP depletion rate (mg SO4/kg/wk)	AP depletion rate (mg CaCO3/kg/wk)	Remaining AP (weeks)	Initial NP (g CaCO3/kg)	NP depletion rate (mg CaCO3/kg/wk)	Remaining NP (weeks)	Prediction of outcome	NP:AP molar ratio
QGS	1	58	4	98	1.58	0.71	43	45	**495**	78	71	**1103**	Non Acid	1.6
QGS	2	10	4.4	7.5	5.51	0.94	3.8	4.0	**7412**	50	22	**2292**	Acid	----
GMS	3	210	6.7	285	1.86	0.35	131	136	**80**	58	254	**229**	Non Acid	1.9

The AP depletion rate is based on the sulfate production rate over the period of stable kinetic data.

Table 3 Big Hurrah site specific NP:AP ratio for development rock

Client ID	Development Rock Quantity		AP depletion rate	NP depletion rate	NP:AP molar ratio
	Mass of mined rock (ton)	Percent of QGS and GMS development rock	(mg/kg/wk)	(mg/kg/wk)	
HCT 1 (QGS), 4269, 60-75	2,927,872	51%	45	71	1.6
HCT 3 (GMS), 4269, 50-60	2,813,054	49%	136	254	1.9
Site-specific NP:AP ratio (weighted average value for development rock):					1.9

Table 4 PAG development rock estimates based on NP corrections

	NP:AP NP by standard Sobek (AP by sulfide S)		NP:AP NP with siderite correction (AP by sulfide S)		NP:AP NP with siderite/TIC correction (AP by sulfide S)	
	# Samples	**Percent**	**# Samples**	**Percent**	**# Samples**	**Percent**
NP:AP < 1.9	102	37%	120	43%	141	**51%**
NP:AP > 1.9	177	63%	159	57%	138	**49%**
Total	279	100%	279	100%	279	**100%**

3 DEVELOPMENT ROCK STORAGE

Attachment A.1 presents the Big Hurrah mine site plan during operations. This figure illustrates the position and orientation of the development rock stockpile. The development rock stockpile site will serve as the permanent, storage for the 49% (2.8 MT) of development rock that is considered NAG material, which will be blended with the PAG material having an NP:AP ratio that is greater than the final cutoff ratio and will not be used as backfill. The development rock storage area will result in a net NAG composition. The PAG development rock with an NP:AP ratio of 1.0 and up to a volume of 1,305,000 cubic yards (998,000 cubic meters) will be temporarily stored in the PAG staging area adjacent to the main development rock stockpile until mining has been completed. The development rock stockpile area will be graded so that drainage from the PAG staging area will drain towards the pit. Seepage and/or drainage from the development rock stockpiles will be monitored in accordance with the Rock Creek Project Operational and Closure Monitoring Plan.

Attachment A.2 illustrates the Big Hurrah mine site plan upon completion of mining. The development rock stockpile containing only the NAG development rock has been reclaimed. The PAG material has been placed in the pit during the first month of the first spring runoff. Inflowing ground and surface water will inundate the pit, limiting exposure of the PAG material. The pit will fill during the first spring after mine closure. Once the pit is full, surface water drainage will be diverted using pre-existing diversion structures during the summer months. This will allow the suspended solids in the pit lake to settle out. Drainage will be re-directed towards the pit again in the fall, which will flush the upper most layer of the pit lake.

4 OPERATIONAL SAMPLING

Additional sampling and testing will be conducted during operations to confirm NAG or PAG rock designations. One composite sample per 14,000 tons of excavated development rock material is recommended for the maintenance of the handling plan. Each blasthole represents approximately 36 tons of rock (389 blastholes represent 14,000 tons). A 30 g split will be collected from the sample pulp of every tenth blasthole. This will result in a pulp composite weighing approximately 1200 grams. This composite will then be riffle split down to 250 grams for further ABA analysis. Samples will be collected, processed, and analyzed onsite for maximum turn-around times. Samples may alternatively be shipped to an outside laboratory facility for analysis.

Neutralization potential (NP) and acid-generation potential (AP) will be determined by the standard Sobek method. If the analyses are conducted onsite, the standard Sobek method will be used and a correction factor will be applied to the results. If the analyses are shipped off-site, the standard Sobek method will be used and the correction calculation applied. Approximately 10% of the samples, if shipped off-site, will also be analyzed using the siderite correction and TIC methods. NP and AP will

subsequently be used to calculate interpretive indices including net neutralization potential (NNP) and NP:AP ratios.

Neutralizing potential (NP)

Values of NP indicate the capacity of rock materials to buffer acidity produced by sulfide oxidation or other proton-generating reactions. The standard Sobek method along with the siderite-corrected Sobek method will be used for the determination and comparison of NP values.

The standard Sobek method (Sobek, et al., 1978) will be applied to a mixture containing 1-2 grams of crushed rock sample, and a volume of hydrochloric acid (HCl). The solution is heated for two hours in order to expel any dissolved carbon dioxide (CO_2) and bring the reaction to completion. A neutralizing potential (NP) will then be calculated based upon the normality of the acid and base applied and the mass of the sample.

An alternate method that will be used to determine NP values is the peroxide siderite correction for the standard Sobek method (Skousen, et al., 1997). This method will address potential erroneously high NP calculations from the above described standard Sobek method. For this method, a 2 gram sample is boiled in HCl for 5 minutes, and then filtered. The filtrate is then added to a 30% peroxide solution and boiled for 5 minutes to drive the oxidation of ferrous to ferric iron. The solution is then titrated to determine the calcium carbonate equivalent for the acid consumed during the test.

For these methods described above, the results will be normalized to a conventional unit of tons $CaCO_3$ (equivalent) per 1,000 tons of rock. The reported results will not necessarily imply that calcite ($CaCO_3$) is present.

The NP of the material may also be calculated based on the total inorganic carbon (TIC) content of the sample. TIC content is determined in the laboratory as the difference between the total carbon content and the total organic carbon (TOC) content. Total carbon is measured using the standard LECO furnace method. For TOC determination, inorganic carbon must be removed from the samples by bathing the samples in 2N HCl for 24 hours, followed by rinsing and centrifuging. The sample is then analyzed for TOC using the LECO furnace method. The difference between total carbon and TOC is the TIC content of the material. The NP is calculated based on the TIC, and converted to standard units (i.e., TIC, as percent carbon, is multiplied by a factor of 83.3 to convert to NP, as tons $CaCO_3$ per 1,000 tons of rock).

Acid generation potential (AP)

Numerous procedures exist for the determination of AP. All include the analytical derivation of the various forms of sulfur, including total and sulfide-sulfur. For all Big Hurrah samples, total sulfur will be determined using a LECO induction furnace (EPA method 600). Sulfur speciation will be assessed following the US-EPA method 600 sequential leach procedure, in which sulfate-sulfur and sulfide-sulfur are differentiated on the basis of their respective solubilities in HCl and HNO_3.

The potential proton yield will then be calculated in accordance with the stoichiometry of pyrite oxidation. Options for the derivation of AP using an appropriate sulfur value include:

- the assignment of total sulfur within a sample to stoichiometric pyrite;
- the analytical differentiation of sulfide-sulfur from other sulfur species, and assignment of the former to stoichiometric pyrite; and
- the mineralogical determination of pyrite sulfur.

The Sobek (1978) method, involving the use of sulfide-sulfur for AP calculation, is most-widely deployed worldwide and is most appropriate for determination of AP for unweathered rock samples. This procedure may be considered conservative for samples containing a significant component of sulfide-sulfur in non-pyrite phases. For this evaluation, values of AP will be calculated for samples using both (a) total sulfur and (b) sulfide-sulfur data. All results will be converted to ton equivalents of $CaCO_3$ per 1,000 tons of material, using a conventional multiplier of 31.25 (moles of calcite required to neutralize protons liberated by 1 mole of oxidized pyrite).

5 DATA MANAGEMENT

Data obtained from the operational sampling will be used for real-time input for the characterization of development rock. The data will also be incorporated into a database for ongoing analyses and closure support. Corrections to the handling plan will be updated as warranted by the data.

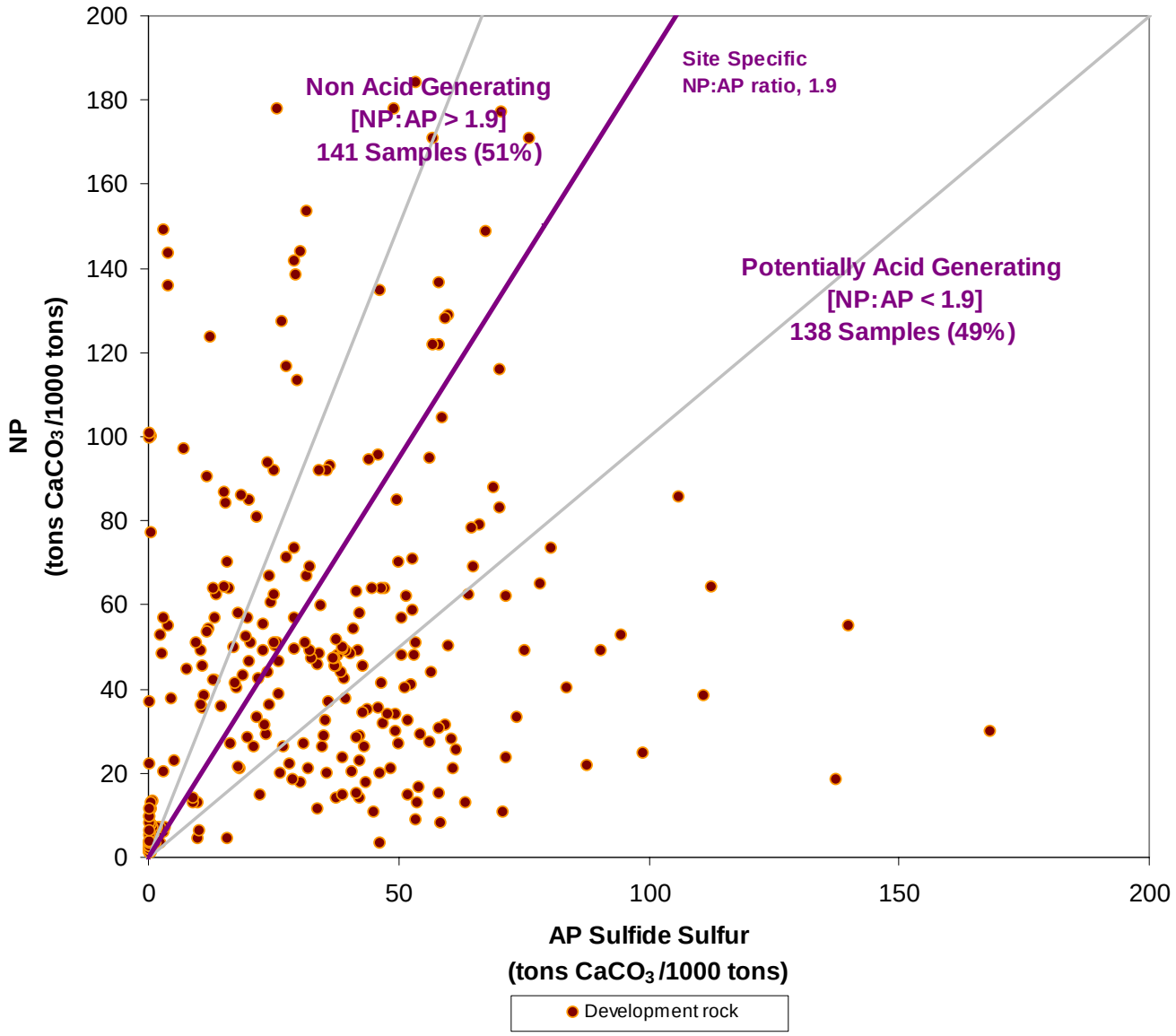
6 REFERENCES

EPA, 1999. EPA and Hardrock Mining: A Sourcebook for Industry in the Northwest and Alaska. Draft Guidance Document from EPA Region 10; EPA-10-R-99-016.

Skousen, J., Renton, J., Brown, H., Evans, P., Leavitt, B., Brady, K., Cohen, L. and P. Ziemkiewicz, 1997. Neutralization Potential of Overburden Samples containing Siderite. Journal of Environmental Quality, v26, n3, p673-681.

Sobek, A.A., W.A. Schuller, J.R. Freeman, and R.M. Smith, 1978. Field and laboratory methods applicable to overburden and minesoils. U.S. E.P.A. Report EPA-600/2-78-054.

FIGURE



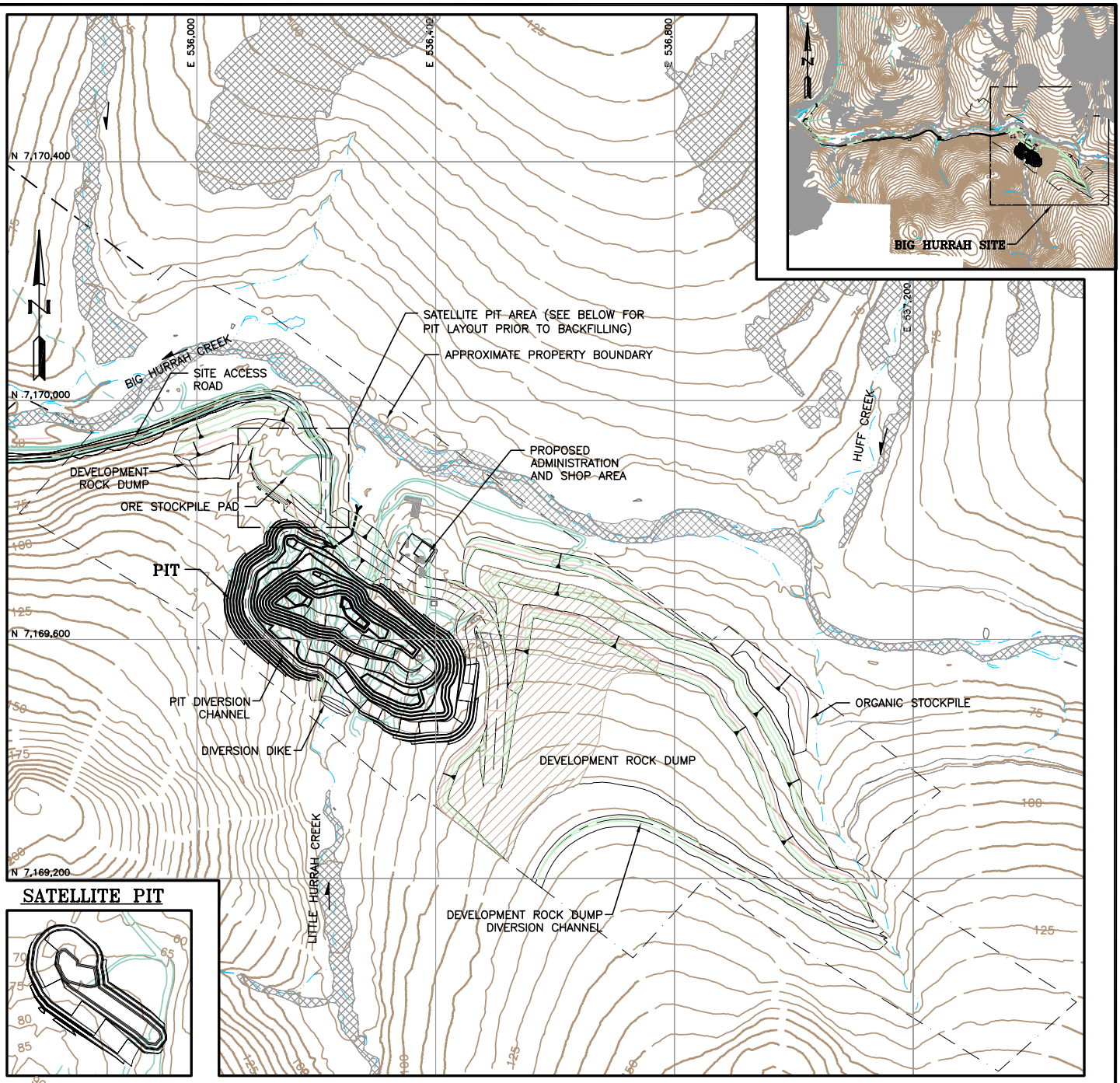
AP is calculated based on sulfide-sulfur.
NP is based on siderite-corrected values.

WATER MANAGEMENT CONSULTANTS
Denver, CO

PAG DEVELOPMENT ROCK BASED ON SITE SPECIFIC NP:AP RATIO			
CLIENT: NovaGold RESORCES, INC.		PROJECT: BIG HURRAH	
JOB: 2509	FILE: FIGURE-1.DWG	DRAWN: RN	CHECKED: PR
DATE: MAY 2006		FIGURE: 1	

F:\2573 - BIG HURRAH\GEOCHEMISTRY\DEVELOPMENT ROCK HANDLING PLAN\FIGURES DRAWINGS\FIGURE-1.DWG

ATTACHMENT A.1



LEGEND:

- EXISTING GROUND SURFACE CONTOUR AND EL, METERS
- PROPOSED GROUND SURFACE CONTOUR AND EL, METERS
- EXISTING ROAD
- EXISTING STREAM
- EXISTING DITCH
- EXISTING POND/WATER
- EXISTING STRUCTURE
- WETLANDS
- APPROXIMATE LIMITS OF PAG DEVELOPMENT ROCK STAGING AREA
- PROPOSED CULVERT

DEVELOPMENT ROCK HANDLING PLAN

CLIENT: ALASKA GOLD COMPANY

PROJECT: ROCK CREEK PROJECT

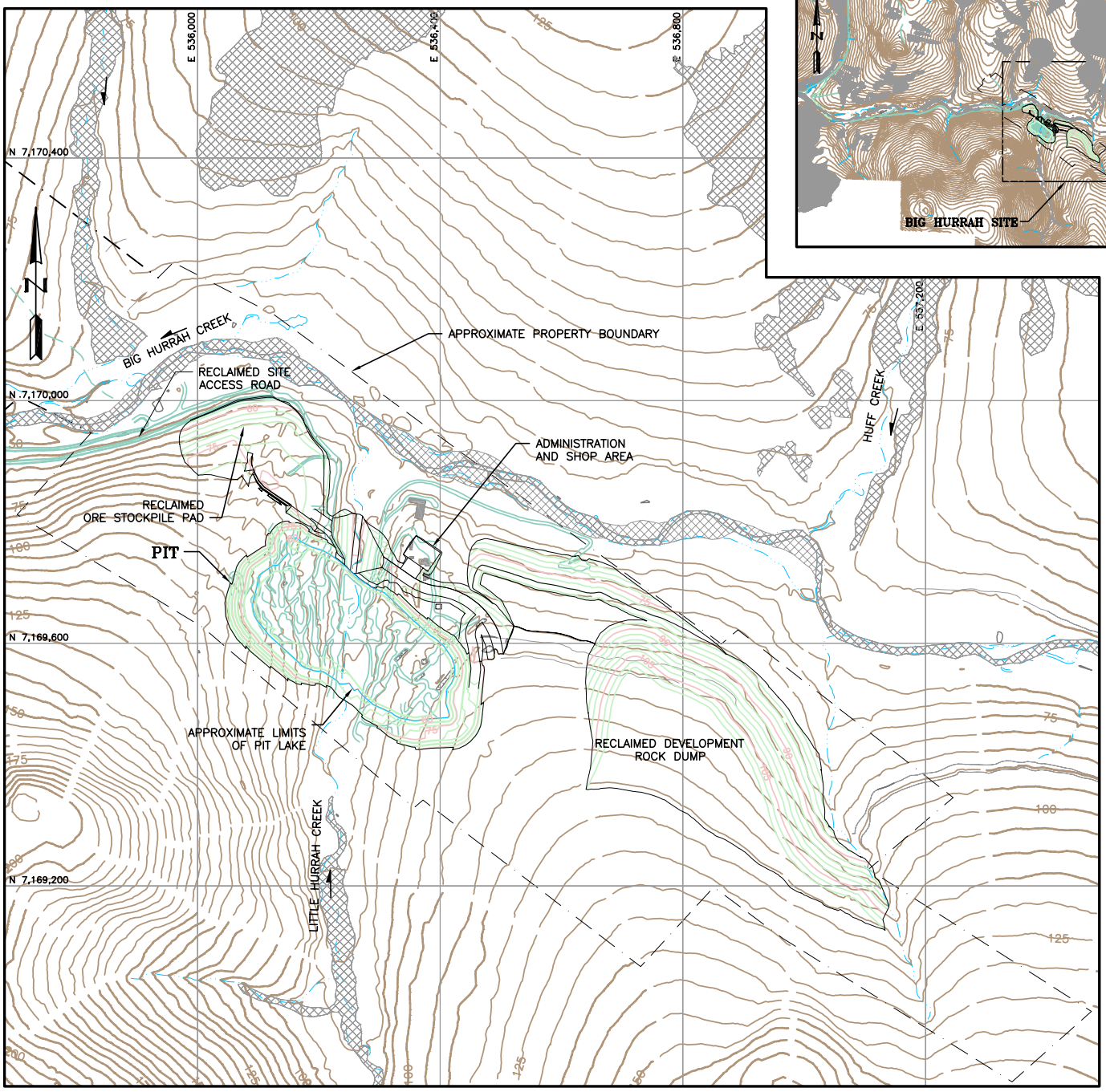
TITLE: BIG HURRAH MINE SITE PLAN

SMITH WILLIAMS CONSULTANTS, INC.
304 Inverness Way South, Suite 490, Englewood, Colorado 80112
Phone: 303-433-0262 Fax: 303-433-0362

DESIGNED BY	JNM	CHECKED BY	RTB	DATE
DRAWN BY	JNM	APPROVED BY	RTB	4/27/06

FILENAME	FIGURE No.	REV.
1011F212	A.1	B

ATTACHMENT A.2



100 0 100 200 m

SCALE = 1:10,000

LEGEND:

- EXISTING GROUND SURFACE CONTOUR AND EL, METERS
- PROPOSED GROUND SURFACE CONTOUR AND EL, METERS
- EXISTING ROAD
- EXISTING STREAM
- EXISTING DITCH
- EXISTING POND/WATER
- EXISTING STRUCTURE
- WETLANDS

DEVELOPMENT ROCK HANDLING PLAN

CLIENT: ALASKA GOLD COMPANY

PROJECT: ROCK CREEK PROJECT

TITLE: RECLAIMED BIG HURRAH MINE SITE PLAN

SWC
SMITH WILLIAMS CONSULTANTS, INC.
304 Inverness Way South, Suite 490, Englewood, Colorado 80112
Phone: 303-433-0262 Fax: 303-433-0362

DESIGNED BY	RTB	CHECKED BY	RTB	DATE
DRAWN BY	JNM	APPROVED BY	RTB	4/27/06

FILENAME	FIGURE No.	REV.
1011F214	A.2	B