

# Alaska Gold Company

A NovaGold Subsidiary

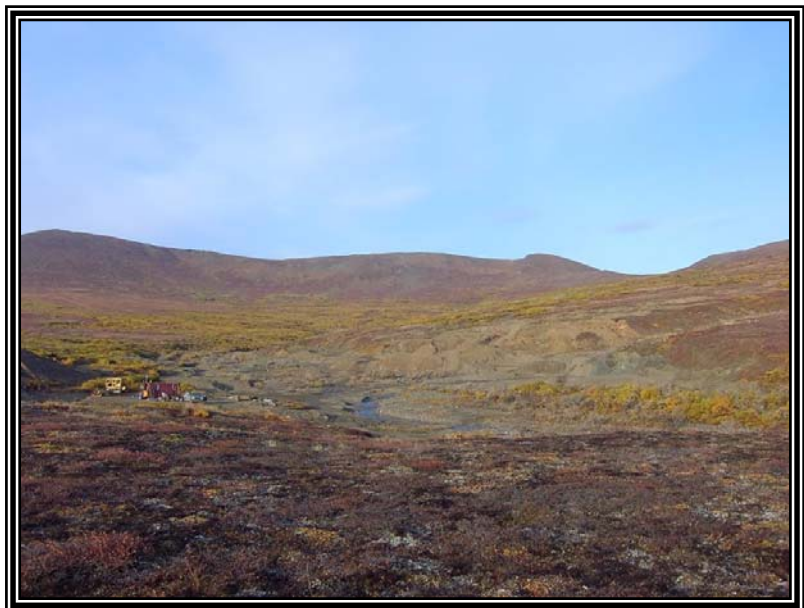
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## ROCK CREEK MINE PLAN OF OPERATIONS VOLUME 1 PROJECT DESCRIPTION May, 2006



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*Placer mining on the Rock Creek deposit, 1902.*



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## ACRONYMS AND ABBREVIATIONS

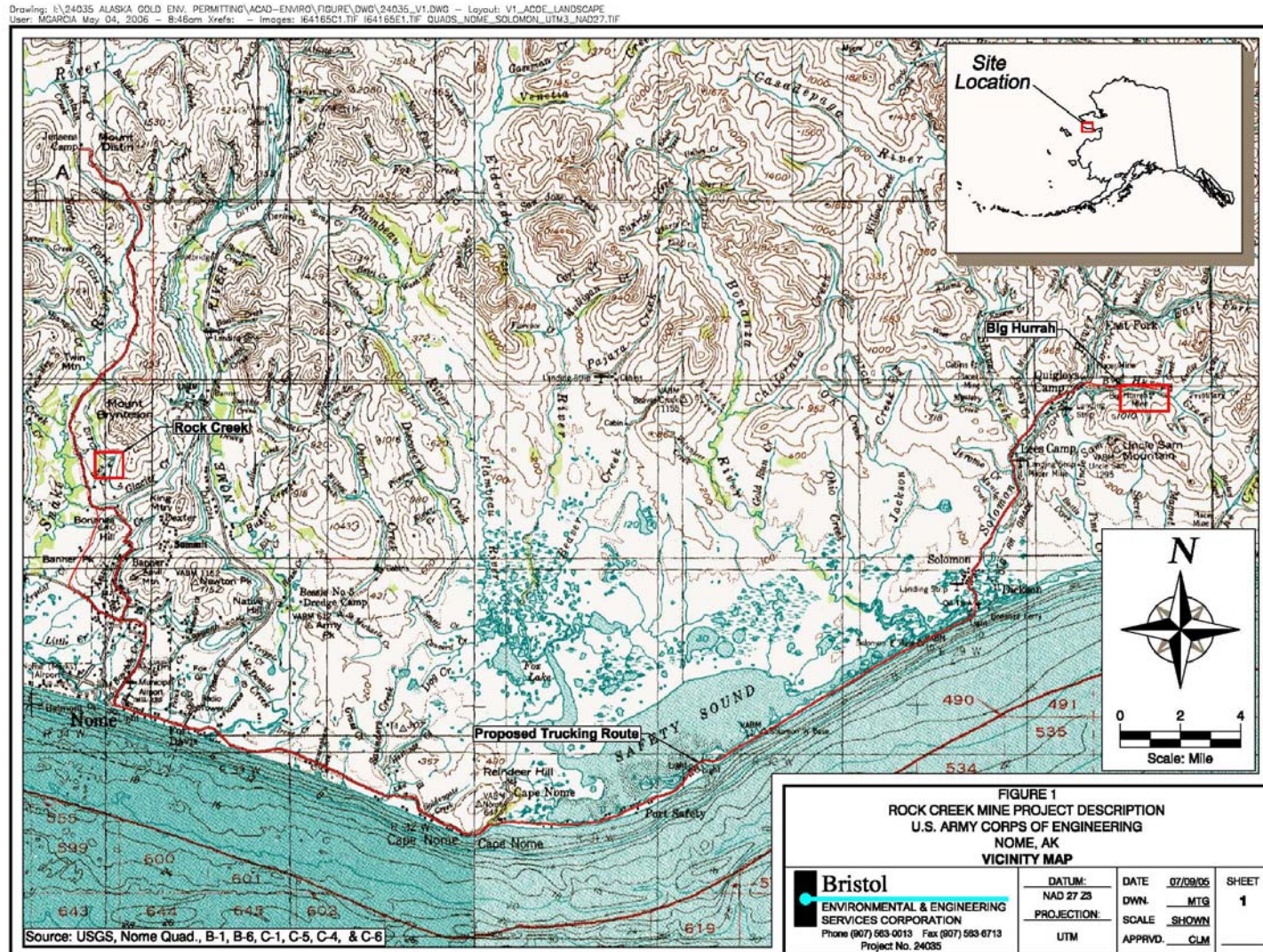
|                |  |
|----------------|--|
| %              | percent  |
| °              | degrees  |
| ABA            | Acid Base Accounting   |
| AGC            | Alaska Gold Company (subsidiary of NovaGold Resources, Inc.) |
| AN             | ammonium nitrate   |
| ANFO           | ammonium nitrate and fuel oil blasting agent                 |
| AV             | Albion shear vein (ore type)                                 |
| cm             | centimeter   |
| km             | kilometers   |
| kV             | kilovolt   |
| kw             | kilowatt   |
| L              | liter  |
| lt             | light vehicle  |
| m              | meter  |
| m <sup>3</sup> | cubic meter  |
| mm             | millimeter   |
| MSHA           | Mine Safety and Health Administration                        |
| Mt             | million tonnes   |
| Project        | Rock Creek Mine Project                                      |
| t/h            | tonnes per hour  |
| tpd            | tonnes per day   |
| TSF            | tailings storage facility                                    |
| TV             | tension vein (ore type)                                      |

## **1.0 OVERVIEW**

The Rock Creek Mine Project (Project) is located on the Seward Peninsula along the west coast of Alaska. There are two project components: the Rock Creek Mine/Mill Complex located about 6.2 miles (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.

Alaska Gold Company (AGC) is permitting the mine based on the economic resource as defined by the core drill-hole data. Reverse circulation drill-hole data indicates the resource may be substantially larger. However, this data is not accepted under the criteria of the bankable feasibility study and is not presently sufficiently documented to be incorporated in the planning process or permitting process. If the additional resources are substantiated in the future, permits will require modification to address an expanded pit design and longer mine life.

Figure 1



## **1.1 PROJECT SCHEDULE**

Construction is planned for the third quarter of 2006, with operations commencing in the third quarter of 2007.

## **1.2 ROCK CREEK MINE/MILL COMPLEX OVERVIEW**

The Rock Creek Mine/Mill Complex will consist of an open pit gold mine, two non-acid generating development rock dumps, a gold recovery plant, and a paste tailings storage facility (TSF). The Rock Creek site layout is presented in Figure 1. Ore milling rates will be about 2.5 million tonnes (Mt) per year, while development rock stripping volumes will be in the range of 4 to 5 Mt per year. The process plant site area will include: a three stage crushing and screening plant, a crushed ore stockpile, a mill facility, a maintenance shop, an administration and mine dry building, warehouse, explosive storage and fuel storage.

The mine will be operated on a schedule of two 12-hour shifts per day for 365 days per year. The total project manpower is estimated at about 135 personnel.

Summary design criteria for the Rock Creek Mine/Mill Complex consists of:

- Annual ore milling rate of 2.5 Mt/year (7,000 tonnes per day [tpd]). The Big Hurrah Mine will supply about 1,000 tpd of the mill feed, with Rock Creek Mine providing the remainder.
- Annual waste production of 4 to 5 Mt/year.
- Mill operating availability of 90 percent (%).
- Production scheduling and mining equipment requirements are based on an operating schedule of two 12-hour shifts per day for 365 days per year.
- Projected mine life: 4-5 years.

## **1.3 BIG HURRAH MINE OVERVIEW**

The Big Hurrah Mine facilities will include: an open pit gold mine, a non-acid generating development rock dump, a temporary stockpile of potentially acid generating development rock to be backfilled in the pit, a run-of mine ore stockpile, a truck maintenance shop, a small administration and mine dry building, explosive storage and diesel fuel storage. The Big Hurrah site layout is presented in Figures 2.1 and 2.2. The ore mining rate will be about 1,500 tpd and the stripping rate will be 5,000 tpd. Ore will be stockpiled and delivered to the Rock Creek Mill at an average rate of about 1000 tpd.

The Big Hurrah Mine will be operated on the same schedule as the Rock Creek Mine/Mill Complex, with two 12-hour shifts per day. Mine operations will likely only occur for 3 to 6 months out of the year, but could be extended to be year-round. Trucking will likely occur on a year round basis.



Summary design criteria for the Big Hurrah Mine consists of:

- Annual ore production of approximately 270,000 tonnes per year
- Annual development rock production of approximately 1 Mt per year
- Production scheduling and mining equipment requirements are based on an operating schedule of two 12-hour shifts per day for 180 days per year, with a total projected manpower of approximately 50 personnel. Personnel and equipment will be allocated on a seasonal basis from the Rock Creek crew and fleet resources.
- Projected mine life: 4 years.

## **2.0 PROJECT RESOURCES**

### **2.1 ROCK CREEK MINE**

The known gold resource at the Rock Creek Mine and Mill Complex lies within land owned approximately 66% by Alaska Gold Company (Alaska Gold), a wholly owned subsidiary of NovaGold Resources Inc. with the remainder within Bering Straits Native Corporation (BSNC) lands.

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

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

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

Tension veins (TV) are northeast striking steeply northwest dipping sheeted veins, rarely greater than 4 inches (10 centimeters) wide. Tension veining is most common at the southern end of the deposit, however vein density also increases proximal to the Albion shear. Gold is strongly associated with arsenopyrite, other gangue minerals include: quartz, carbonate, arsenopyrite, and pyrite, with lesser stibnite, base metal sulfides and lesser lead sulfosalts.

## 2.2 BIG HURRAH MINE

The Big Hurrah deposit will be mined as an open pit mine to supply supplemental ore to the Rock Creek Mill. The known gold resource lies within land owned 100 % by Alaska Gold Co., with the surrounding lands owned by Solomon Native Corporation Lands.

The Big Hurrah deposit is also hosted in the Mixed Unit of the Nome Group. These rocks are assumed to be derived from a continental shelf setting during the Cambrian to Devonian Periods. They have been subjected to prograde blueschist facies metamorphism during the Jurassic Period and later retrograde greenschist facies metamorphism during the Cretaceous Period.

Gold mineralization at Big Hurrah is hosted in quartz veins contained within fault zones that strike northwest dipping variably to the southwest and varying in thickness from less than 3 feet (1 meter) to greater than 33 feet (10 meters). The mineralized zones can be traced along strike for roughly 1,300 feet (400 meters) and are cutoff by north striking post-mineralization faults. The gold in these mineralized zones is contained primarily in sub-parallel quartz veins containing carbon on the vein margins or as thin films within the veins giving them a ribbon texture. Stockwork quartz veins that vary in thickness from a few millimeters to 2 inches (5 cm) are also present and can be auriferous. While the mineralized zones are quite consistent, individual quartz veins are irregular and vary in thickness, pinching and swelling along strike and down dip. Gold often occurs along with graphite, scheelite, pyrite or arsenopyrite. While arsenic is present at Big Hurrah and spatially related to the gold within the same mineralized envelope, it was laid down as two separate fluids flowed through the same rock and is not mineralogically associated with the gold. Due to the spatial relationship, however, much of the arsenic will be shipped with the gold to the mill. Big hurrah ore will be treated at the Rock Creek mill using the same process used for the Rock Creek ores.

Figure 2.1

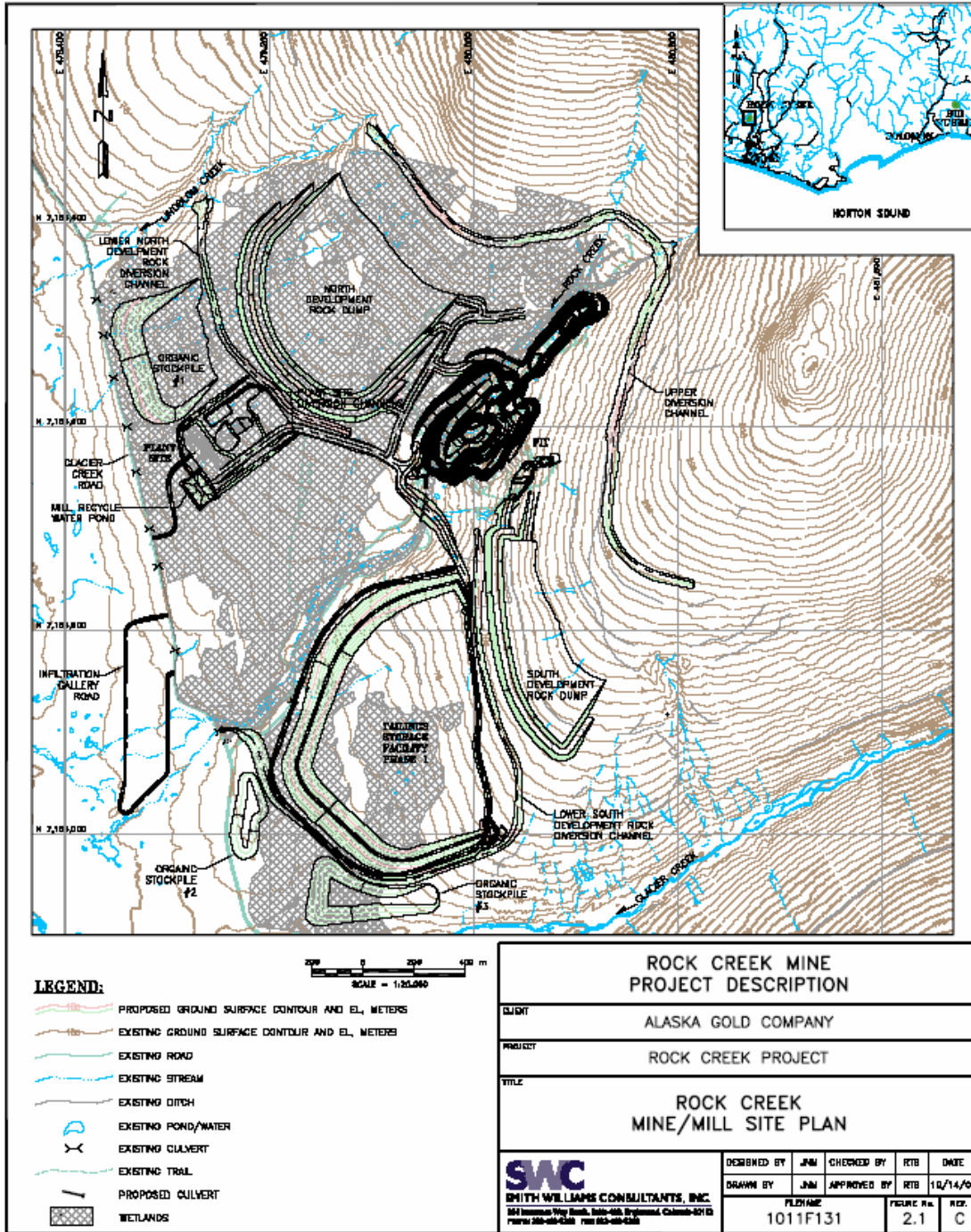


Figure 2.2

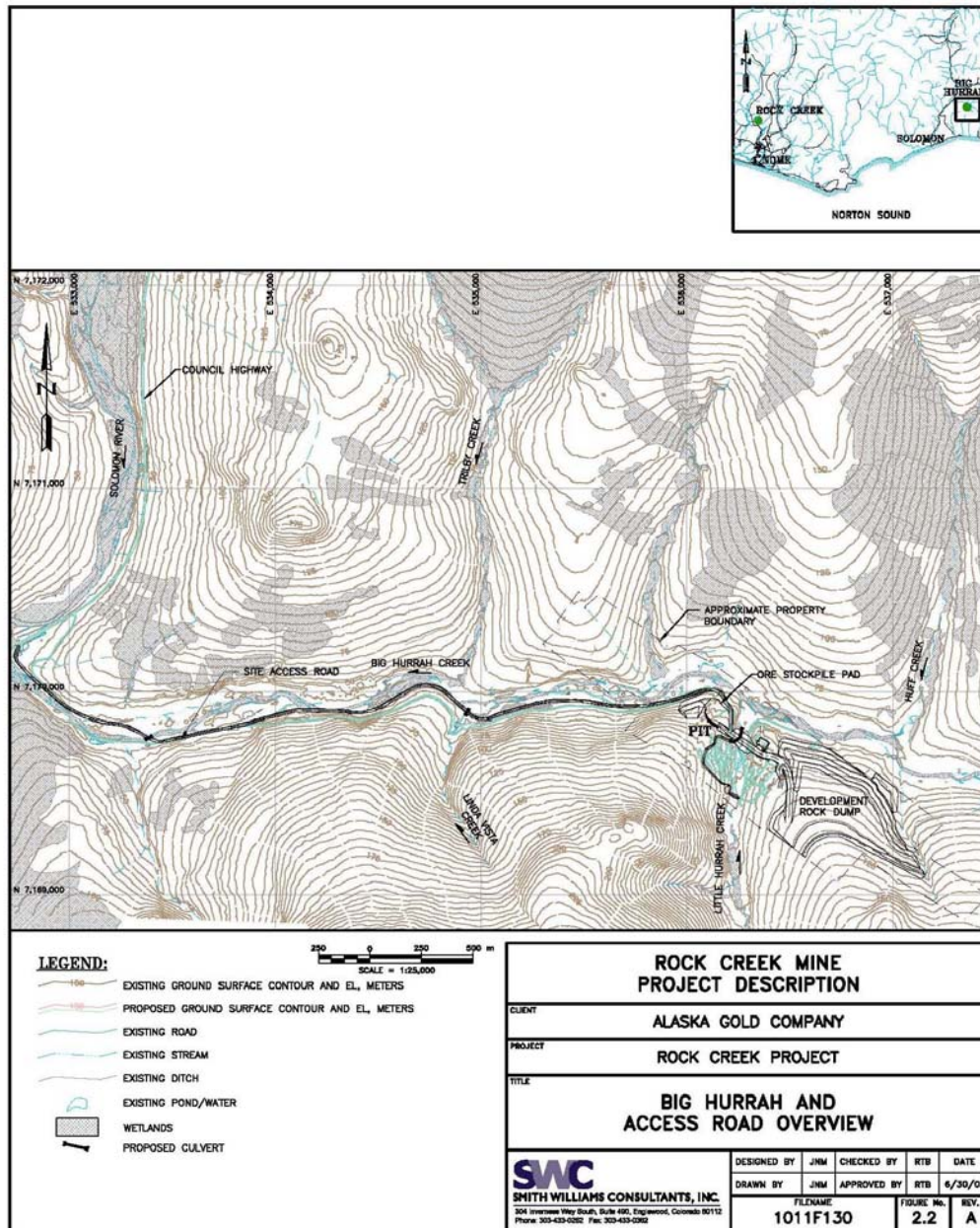
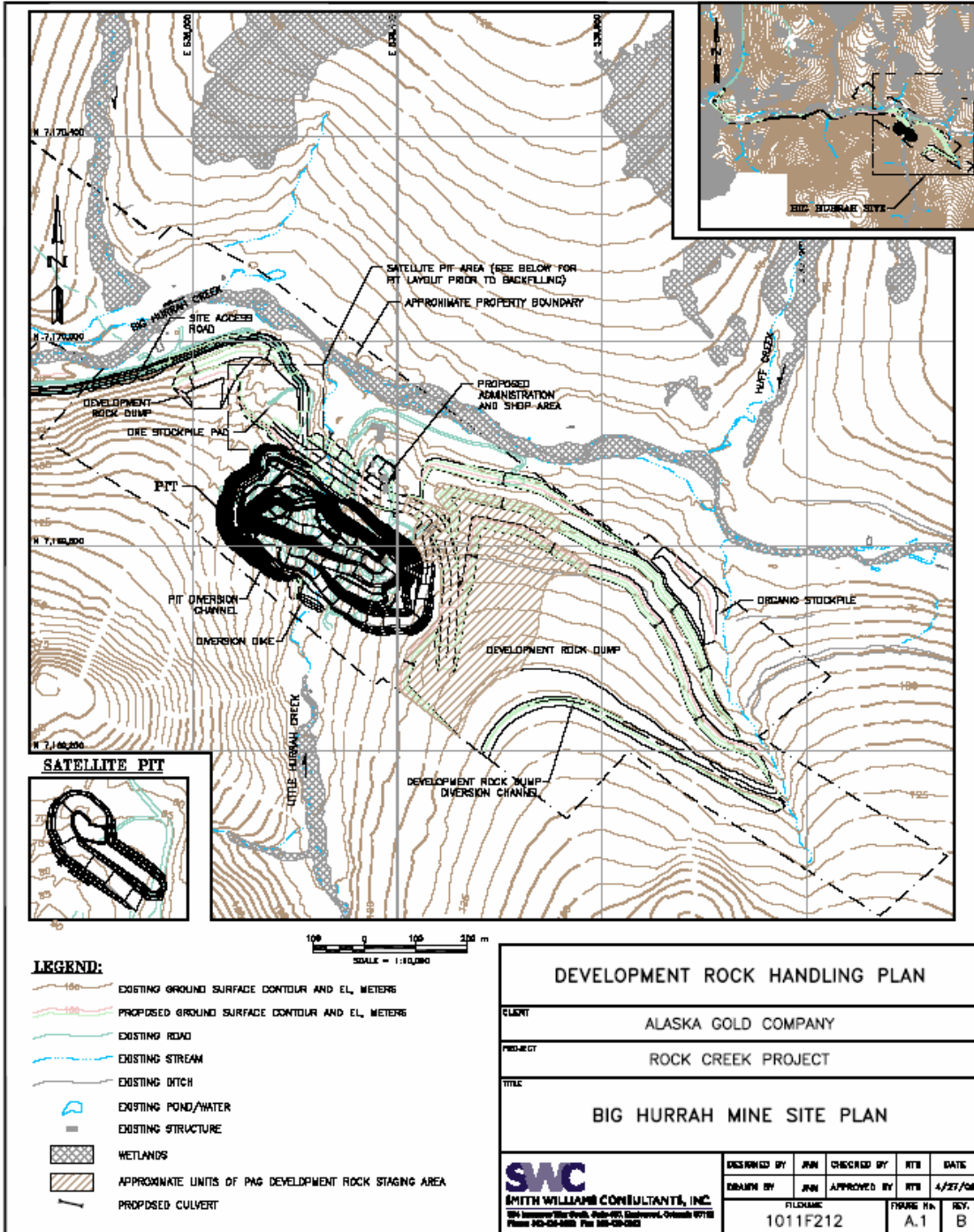


Figure 2.3



## **3.0 MINING**

The Rock Creek Mine open pit will produce about 6000 tpd of ore feed for processing at the Rock Creek mill. The plan also anticipates approximately 1,000 tpd of gold ore from the Big Hurrah Mine for processing at the Rock Creek mill. There is potential to mine other satellite deposits in the Nome area. Exploration efforts are underway to characterize additional local resources.

### **3.1 MINING METHOD**

#### **3.1.1 Rock Creek Mine**

The Rock Creek Mine will consist of a conventional open pit mining operation.

Standard drilling and blasting techniques will be used to break the ore on 16.5-foot (5-meter [m]) high benches. Ore will be drilled using rotary blasthole drills and 4-inch (100-mm) diameter blastholes. Blasting using ammonium nitrate and emulsion will occur once a day. The blasted ore and development rock will be loaded using a 16-cubic yards (12-cubic meters [m<sup>3</sup>]) front-end loader. A series of four 100 tonne haul trucks will be used to transport ore from the mine to the process plant, or development rock to the rock dumps.

#### **3.1.2 Big Hurrah Mine**

Standard drilling and blasting techniques will be used to break the ore on 16.5-ft (5-m) high benches. Ore will be drilled using rotary blasthole drills and 4-inch (100-mm) diameter blastholes. Blasting using ammonium nitrate and emulsion will occur once a day, seven days a week. The blasted ore and development rock will be loaded using a 16-cubic yards (12-m<sup>3</sup>) front-end loader. A series of 100 tonne haul trucks will be used to transport ore from the mine to the stockpile area, or development rock to the rock dump.

### **3.2 PIT DESIGNS**

#### **3.2.1 Rock Creek Pit**

Pit limits and crest setbacks at the Rock Creek Mine are not restricted by public roads, protected areas, or any other external constraints. In the design of pit slopes at Rock Creek, the relatively competent, intact rock will not present a realistic failure mode. Wall stability will be governed by the presence of discontinuities such as jointing, shearing, and faulting, that can act as planes of weakness along which movement can occur. Based on geotechnical studies, the pit slope criteria are:

- Inter-ramp slope angles ranging from 38 to 52 degrees (°) in different sectors of the pit,
- Bench face angles of 65° to 70°,
- Bench height of 16.5 feet (5 m), double benching may be used,
- In-pit haul ramp grade to be 8% maximum, and

- In-pit ramp width is 82 feet (25 m) (includes 59-foot [18-m] dual lane travel way, a 13-foot [4-m] safety berm, and a 10-foot [3-m] toe ditch).

The deepest mining elevation is -32 feet (10 m) in the south area, while the maximum crest elevation is about +492 feet (150 m), Pit wall heights will range around 410 feet (125 m). The dimension of the pit will be about 3,445 feet (1,050 m) in a north-south direction and 1,312 feet (400 m) in an east-west direction.

### **3.2.2 Big Hurrah Pit**

Pit limits and crest setbacks at the Big Hurrah Mine are not restricted by public roads, protected areas, or any other external constraint. Wall stability is anticipated to be governed by the presence of discontinuities such as jointing, shearing, and faulting, that can act as planes of weakness along which movement can occur.

Based on geotechnical studies, the pit slope criteria are:

- Inter-ramp slope angles about 45°,
- Bench face angles of 65° to 70°,
- Bench height of 10 to 20 feet (3 to 6 m),
- In-pit haul ramp grade to be 8% maximum, and
- In-pit ramp width is 82 feet (25 m) (includes 59 feet [18 m] dual lane travel way, a 13 feet [4 m] safety berm, and a 10 feet [3 m] toe ditch).

The Big Hurrah mine will consists of a main pit and a smaller satellite pit located to the west of the main pit. The deepest mining elevation in the main pit is +16.5 ft (5 m), while the maximum crest elevation is about 361 feet (110 m). The deepest mining elevation in the satellite pit is +174 ft (53 m) while the maximum crest elevation is 279 feet (85 m). Ultimate pit wall heights will range around 262 feet (80 m).in the main pit and 66 feet (20 m) in the satellite pit.

The dimension of the main pit will be about 1,640 feet (500 m) in a northwest -southeast direction and 820 feet (250 m) in a northeast-southwest direction. The main pit will be partially backfilled at closure with 1,305,000 yd<sup>3</sup> (998,000 m<sup>3</sup>) of potentially acid generating development rock. The satellite pit will be about 656 feet (200 m) times 328 feet (100 m). The total capacity of the satellite pit is 123,667 yd<sup>3</sup> (94,550 m<sup>3</sup>). It will be partially backfilled with 78,500 yd<sup>3</sup> (60,000 m<sup>3</sup>) of development rock to create a flat stable bench that will serve as a foundation for the ore stockpile.

## **3.3 DEVELOPMENT ROCK DUMPS**

### **3.3.1 Rock Creek Mine/Mill Complex**

Development rock stripping volumes at the Rock Creek pit will be in the range of 3 to 5 Mt per year. Development rock stripped from the pit will be placed into rock stockpiles located

adjacent to the pit (Figure 1). Some development rock will also be used periodically for raising the tailings dam structure, capping the tailings facility, and building roads at the site.

There are no plans to segregate different rock types in the Rock Creek development rock stockpiles. Surface runoff from the rock stockpiles is expected to be benign and will meet all applicable state and federal standards. Monitoring will be conducted as specified in an ADEC approved monitoring plan. A NPDES Stormwater Multi-sector General Permit will be required.

Development rock stockpiles will be built in 49 feet (15 m) levels, by advancing a 49 foot (15 m) high lift. The face slope on each stockpile will be about 1.4:1 (angle of repose), while the overall stockpile slope will be about 3:1. A section along the toe of each stockpile will be sub-excavated to remove ice-rich overburden soils down to bedrock to provide a stable foundation for dump development. These soils may be stockpiled in the Organic Overburden Soil Stockpiles as described in Section 3.4.1.

The rock stockpile sites have been located to minimize haulage distances. Diversion ditches above the dumps will prevent contact between runoff from undisturbed uplands and development rock. Water outflows from the Development Rock Dumps will be routed to either Rock Creek or Lindblom Creek; however, there will be opportunity to retain this water if needed to supply the mill operations.

The two selected stockpile locations were based on the following factors:

- Minimizing the impact to higher value wetlands.
- Minimizing truck haul distances outside the pit,
- Ensuring a minimum 164 foot (50 m) setback from the stockpile toe to the pit crest,
- Minimizing the number of separate stockpile areas developed,
- Maintaining development rock placement within the project watershed already being disturbed by project activities,
- Maximizing stockpile stability, and
- Locating stockpile sites to optimize site drainage.

The dimensions of the Rock Creek Development Rock Stockpiles are listed in Table 3-1.



**Table 3-1 Rock Creek Mine Development Rock Stockpile Design Basis**

| <b>Stockpile</b> | <b>Wetland Fill Volume (cubic yards)</b>             | <b>Rockfill Quantity (cubic yards)</b>               | <b>Storage (million tonnes)</b> | <b>Crest Elevation (feet)</b> | <b>Wetland Disturbance (acres)</b> | <b>Footprint Area (acres)</b>      |
|------------------|--|--|---------------------------------|-------------------------------|------------------------------------|------------------------------------|
| North Stockpile  | 4,230,000<br>(3,233,000 m <sup>3</sup> )             | 4,230,000<br>(3,233,000 m <sup>3</sup> )             | 5.98                            | 404<br>(123 m)                | 119<br>(48 hectares)               | 131<br>(53 hectares)               |
| South Stockpile  | 0  | 720,000<br>(550,000 m <sup>3</sup> )                 | 1.01                            | 453<br>(138 m)                | 0                                  | 62<br>(25 hectares)                |
| <b>Total</b>     | <b>4,230,000</b><br><b>(3,233,000 m<sup>3</sup>)</b> | <b>4,950,000</b><br><b>(3,783,000 m<sup>3</sup>)</b> | <b>6.99</b>                     |                               | <b>119</b><br><b>(48 hectares)</b> | <b>193</b><br><b>(78 hectares)</b> |

The balance of the development rock will be used in construction of the tailings facility embankment.

### 3.3.2 Big Hurrah Mine

Development rock stripped from the Big Hurrah pit will be sampled and potentially acid generating rock will be segregated from the rest of the waste rock. The non-acid generating development rock will be placed in a development rock stockpile east of Little Hurrah Creek and south of Big Hurrah Creek, and to the northwest of the satellite pit. Potentially acid-generating development rock will be temporarily stockpiled in a designated area of the development rock stockpile and backfilled into the main pit at closure. Non-acid generating development rock will be used as backfill within the satellite pit to create a stable bench where ore will be stockpiled until it is transported to the Rock Creek Mill Facility and mixed with the Rock Creek ore. Surface drainage off the ore stockpile will be routed back to the pit along a ditch system.

The development rock stockpiles, with the exception of the backfilling in the satellite pit, will be built in 49 foot (15 m) lifts and will be allowed to fall at angle of repose (1.4:1) between benches, with bench setbacks of sufficient width to result in overall stockpile slopes on the order of 3:1. A section along the exposed toe of the stockpiles will be excavated to bedrock to remove the ice-rich overburden soils down to bedrock to provide a stable foundation for stockpile development. The stockpiles have been sited within the current Alaska Gold property boundary. Monitoring of the stockpiles will be conducted in accordance with an ADEC approved monitoring plan.

A diversion channel above the stockpile will prevent contact between runoff from undisturbed uplands and development rock.

The stockpile locations were selected based on the following factors:

- Minimizing impacts to wetlands.
- Minimizing truck haul distances outside the pit,
- Siting within the property boundary,
- Minimizing disturbance area,
- Maintaining development rock placement in a watershed already disturbed by the mining activities, and
- Maximizing stockpile stability.

The dimensions of Big Hurrah Development Rock Stockpiles are listed below in Table 3-2.

**Table 3-2 Big Hurrah Mine Development Rock Stockpile Design Basis**

| Stockpile  | Wetland Fill Volume (cubic yards) | Rockfill Quantity (cubic yards)                      | Storage (million tonnes) | Crest Elevation (feet) | Wetlands Disturbance (acres) | Footprint Area (acres)              |
|--|-----------------------------------|--|--------------------------|------------------------|------------------------------|-------------------------------------|
| #1 East of Pit – Operations w/ Temporary PAG Stockpile | 0                                 | 3,921,000<br>(2,998,000 m <sup>3</sup> )             | 5.5                      | 414<br>(126 m)         | 0                            | 59<br>(24 hectares)                 |
| #1 East of Pit at Closure                              | 0                                 | 2,616,000<br>(2,000,000 m <sup>3</sup> )             | 3.7                      | 414<br>(126 m)         | 0                            | 42<br>(17 hectares)                 |
| #2 West of Satellite Pit                               | 0                                 | 65,400<br>(50,000 m <sup>3</sup> )                   | 0.1                      | 278<br>(84 m)          | 0                            | 4<br>(1.5 hectares)                 |
| Backfill in Satellite                                  | 0                                 | 78,500<br>(60,000 m <sup>3</sup> )                   | 0.1                      | 230<br>(70 m)          | ----                         | ----                                |
| Backfill of PAG in Main Pit at Closure                 | 0                                 | 1,305,000<br>(998,000 m <sup>3</sup> )               | 1.8                      | 192<br>(58.5 m)        | ---                          | -----                               |
| <b>Total</b>   | <b>0</b>                          | <b>4,064,900</b><br><b>(3,108,000 m<sup>3</sup>)</b> | <b>5.7</b>               | _____                  | <b>0</b>                     | <b>63</b><br><b>(25.5 hectares)</b> |

### 3.4 ORGANIC OVERBURDEN SOIL STOCKPILES

#### 3.4.1 Rock Creek Mine/Mill Complex

Although organic overburden soils at the Rock Creek facility are relatively thin (4 to 8 inches [10 to 20 cm]) and small in volume, they will be salvaged where practical in areas disturbed by construction or mining. Within the plant site, tailings dam and storage facility footprint, and stockpile foundation sub-cuts, the organic soils will be dozed into piles and hauled to local stockpiles for future reclamation purposes. In addition, some overburden soils below the organic layer, if suitable for use as growth media, will be incorporated into the organic stockpiles for future reclamation purposes. The overburden soils will not be recovered from beneath the main part of development rock stockpile, however since they are anticipated to be benign they will not constitute fill of a wetlands with a pollutant.

Maximum anticipated soil stockpile dimensions are listed in Table 3-3.

**Table 3-3 Maximum Rock Creek Soil Stockpile Dimensions**

| Soil Stockpile | Wetland Fill Volume (cubic yards)                    | Rockfill Quantity (cubic yards)                      | Average Height (feet) | Wetlands Disturbance (acres)        | Footprint Area (acres)              |
|----------------|--|--|-----------------------|-------------------------------------|-------------------------------------|
| 1              | 1,602,240<br>(1,225,000 m <sup>3</sup> )             | 1,602,240<br>(1,225,000 m <sup>3</sup> )             | 26<br>(8 m)           | 41<br>(16.5 hectares)               | 41<br>(16.5 hectares)               |
| 2              | 15,695<br>(12,000 m <sup>3</sup> )                   | 241,971<br>(185,000 m <sup>3</sup> )                 | 20<br>(6 m)           | 1.5<br>(0.5 hectares)               | 10<br>(4 hectares)                  |
| 3              | 660,515<br>(505,000 m <sup>3</sup> )                 | 837,089<br>(640,000 m <sup>3</sup> )                 | 26<br>(8 m)           | 15<br>(6 hectares)                  | 22<br>(9 hectares)                  |
| <b>Total</b>   | <b>2,278,450</b><br><b>(1,742,000 m<sup>3</sup>)</b> | <b>2,681,300</b><br><b>(2,050,000 m<sup>3</sup>)</b> | —                     | <b>57.5</b><br><b>(23 hectares)</b> | <b>73</b><br><b>(29.5 hectares)</b> |

The soil stockpiles may be re-seeded to minimize erosion and dust generation.

#### 3.4.2 Big Hurrah Mine

As with the Rock Creek Mine, organic overburden soils at the Big Hurrah Mine are relatively thin (4 to 8 inches [10 to 20 cm]) and small in volume, they may be salvaged where practical in areas disturbed by mining. Within the stockpile foundation sub-cuts, the organic soils may be dozed into piles and hauled to local stockpiles for future reclamation purposes. In addition, some overburden soils below the organic layer may be stockpiled for future reclamation purposes. Soils that are suitable for use as growth media may be incorporated into the organic stockpiles. Maximum anticipated soil stockpile dimensions are listed in Table 3-4.

**Table 3-4 Maximum Big Hurrah Soil Stockpile Dimensions**

| <b>Soil Stockpile</b> | <b>Wetland Fill Volume (cubic yards)</b> | <b>Rockfill Quantity (cubic yards)</b>         | <b>Average Height (feet)</b> | <b>Wetlands Disturbance (acres)</b> | <b>Footprint Area (acres)</b>    |
|-----------------------|--|--|------------------------------|-------------------------------------|----------------------------------|
| 1                     | 0  | 26,159<br>(20,000 m <sup>3</sup> )             | 13<br>(4 m)                  | 0                                   | 2.5<br>(1 hectare)               |
| <b>Total</b>          | <b>0</b>                                 | <b>26,159</b><br><b>(20,000 m<sup>3</sup>)</b> | _____                        | <b>0</b>                            | <b>2.5</b><br><b>(1 hectare)</b> |

The soil stockpiles may be re-seeded to minimize erosion and dust generation.

### **3.5 WATER MANAGEMENT**

#### **3.5.1 Rock Creek Mine/Mill Complex**

Surface water and precipitation runoff from undisturbed areas upslope of the Rock Creek facility development rock stockpiles and open pit will be diverted around the project area in a northerly flowing channel that empties into Lindblom Creek.

Precipitation runoff from the South Development Rock Stockpile will filter through the vegetative mat into the surrounding area and/or be routed along a channel and re-introduced back into lower Rock Creek. A similar channel system will direct precipitation runoff from the North Development Rock Stockpile into Lindblom Creek. Surface runoff from rock stockpiles is expected to be benign and to meet all applicable state and federal standards. A NPDES Stormwater Multi-sector General Permit will be required. Monitoring will be conducted in accordance with an ADEC approved monitoring plan.

Water collected in the open pit will primarily be from direct rainfall and snowmelt. Strategic placement of snowfences will minimize the collection of snowfall in the pit and mineralized area to the greatest extent practicable.

Water from the plant site area, along with water pumped from the open pit, seepage collected from the toe of the tailings dam, and rainfall and snowmelt within the TSF will be collected and directed to collection sumps, which will be pumped to the Mill Recycle Water Pond for recycle back to the process plant. The operating volume within the Mill Recycle Pond will be approximately 328,426 cubic feet (9,300 cubic meters). During normal operations, there will be 3.28 feet (1 meter) of freeboard. There is an additional 748,671 cubic feet (21,200 cubic meters) of available capacity within the pond's total design capacity of 1,077,097 cubic feet (30,500 cubic meters). The additional volume, in and of itself, is equal to the 100 year-24 hour storm event criteria of 748,671 cubic feet (21,200 cubic meters).

Water accumulation at Rock Creek is anticipated to meet and/or exceed process water volume requirements under most conditions. A complete water balance is contained within the Water Management Report attached to the Rock Creek Project Environmental Information Document (EID). To manage water during times of excess available water, groundwater

interception wells will be planned for the pit perimeter to intercept groundwater before it could drain into the mineralized zone. The interception wells will provide additional make-up water as needed. During periods of excess water, the groundwater will be reintroduced back into the groundwater system outside the mineralized zone under a Class V Injection Well permit. Ferric chloride water treatment will be provided, as required, to ensure that the groundwater meets all applicable state and federal groundwater quality standards. Ferric chloride is particularly effective in the removal of arsenic, as well as the removal of antimony and manganese.

**Table 3-5 Rock Creek Water Management Systems**

|                                    | <b>Wetland Fill Volume<br/>(cubic yards)</b> | <b>Rockfill Quantity<br/>(cubic yards)</b>  | <b>Wetlands Disturbance<br/>(acres)</b> | <b>Footprint Area<br/>(acres)</b> |
|------------------------------------|--|---|---|-----------------------------------|
| Stormwater Diversion Channels      | 131,449<br>(100,500 m <sup>3</sup> )         | 209,272<br>(160,000 m <sup>3</sup> )        | 23<br>(9 hectares)                      | 69<br>(28 hectares)               |
| Class V Injection System - wells   | 32,700<br>(25,000 m <sup>3</sup> )           | 32,700<br>(25,000 m <sup>3</sup> )          | 7.5<br>(3 hectares)                     | 7.5<br>(3 hectare)                |
| Class V Injection System - Gallery | 60,000<br>(45,900 m <sup>3</sup> )           | 60,000<br>(45,900 m <sup>3</sup> )          | 8.5<br>(3.5 hectare)                    | 8.5<br>(3.5 hectare)              |
| <b>Total</b>                       | <b>224,149<br/>(171,400m<sup>3</sup>)</b>    | <b>301,972<br/>( 230,900 m<sup>3</sup>)</b> | <b>39<br/>(15.5 hectare)</b>            | <b>85.0<br/>(34.5 hectare)</b>    |

### 3.5.2 Big Hurrah Mine

Surface water will be diverted around Big Hurrah facilities via a network of precipitation runoff channels. One channel will collect precipitation runoff upstream of the development rock stockpile and direct it into the unnamed creek to the east. Little Hurrah Creek will be diverted upstream of the pit, contained in a channel along the west side of the pit and directed back into Little Hurrah Creek downstream of the mine thereby avoiding the mineralized zone. The Little Hurrah Creek diversion channel will be positioned on a bench within the limits of the mine pit. This will be accomplished by mining the west side of the pit down to the 65m (213ft) bench. Mining activity will then switch to the east side of the pit, which will also be mined down to the 65m (213ft) bench. At this time a diversion channel will then be excavated into the bench around the west side of the pit. A diversion dike will then be constructed to divert the flow into the excavated channel. After the creek flow has been diverted, mining will resume within the pit limits below the 65m (213ft) bench level. Strategic placement of snowfences will minimize collection of snowfall in the pit and mineralized area to the greatest extent practicable.

Precipitation runoff from the development rock stockpiles is expected to be benign and to meet all applicable state and federal standards. Precipitation runoff will filter through the vegetative mat into the surrounding area or drain into the Big Hurrah Creek drainage. A

NPDES Stormwater Multi-sector General Permit will be required. Monitoring will be done in accordance with an ADEC approved monitoring plan.

Dewatering groundwater interception wells will be installed around the perimeter of the operating pit, as necessary, to intercept groundwater before it enters the pit. Intercepted water and pit water will be managed according to its chemistry and treated using a ferric chloride process, if necessary, so it can be re-injected to the local groundwater system via injection wells in accordance with a Class V injection well permit.

**Table 3-6 Big Hurrah Water Management Systems**

|                                  | <b>Wetland Fill Volume<br/>(cubic yards)</b> | <b>Rockfill Quantity<br/>(cubic yards)</b> | <b>Wetlands Disturbance<br/>(acres)</b> | <b>Footprint Area<br/>(acres)</b> |
|----------------------------------|--|--|---|-----------------------------------|
| Stormwater Diversion Channels    | 0  | 3,270<br>(2,500 m <sup>3</sup> )           | 0                                       | 5<br>(2 hectares)                 |
| Class V Injection System - wells | 0  | 2,616<br>(2,000 m <sup>3</sup> )           | 0                                       | 2.5<br>(1 hectare)                |
| <b>Total</b>                     | <b>0</b>                                     | <b>5,886<br/>(4,500 m<sup>3</sup>)</b>     | <b>0</b>                                | <b>7.5<br/>(3 hectares)</b>       |

### 3.6 HAUL ROADS

On-site access roads and haul roads will be constructed from non-acid generating development rock excavated from the pits. Construction of the Nome-Council Highway to the Big Hurrah Mine site will utilize historic mine tailings within the Big Hurrah floodplain and material excavated from the fish enhancement/material site developments along the access road.

Haul roads at both mine sites will conform to the following standards:

- Safety Berm Height: minimum is axle height of the largest vehicle, as required by the Mine Safety and Health Administration (MSHA).
- Out-of-pit Haul Road: crest width = 98 feet (30 m) (59 feet [18 m] travel way, plus two 20 feet [6 m] wide safety berms), base width variable (assume 1.5:1 slope from crest to ground surface).
- Access Roads: crest width = 26 feet (8 m), base width variable (assume 1.5:1 slope from crest to ground surface).
- Road ways will include safety signage, snow removal, and minimize dust from traffic by applying water or chemical treatment (calcium chloride, etc.). Chemical dust control treatments, such as calcium chloride, may be applied as needed.

## 3.7 MINING EQUIPMENT

Mining equipment has been selected to efficiently handle annual combined quantities of ore and development rock.

### 3.7.1 Rock Creek Mine/Mill Complex

**Loading Equipment.** Due to the limited production requirement and the need for operating flexibility, a 16 yards<sup>3</sup> (12 m<sup>3</sup>) front-end loader will provide sufficient capacity for the ore and development rock loading operations. Productivity is expected to be around 1,250 tonnes per hour (t/h).

**Hauling Equipment.** The truck fleet is to operate with four to five trucks. This minimizes the number of operators, yet provides flexibility during periods of truck downtime. 100-tonne trucks are generally considered to provide an efficient match for the loading equipment.

**Drilling and Blasting Equipment.** It is assumed that ore and development rock will utilize the same powder factors and blasting patterns. In actuality, the mineralized zone may be more fractured and could require less blasting effort. A blasthole drill, blasting truck, and ammonium nitrate and fuel oil (ANFO) truck will be used at the site. The drill and blast operation will be adjusted with experience during operations, but is initially based on a powder factor of 7 ounces (0.2 kilograms) per tonne and a 4-inch (100-mm) diameter blasthole, while the bench height is 16 feet (5 m) and the blasthole spacing will be about 10 feet (3 m). It is assumed that most holes in the permafrost will be dry, and that ANFO can be used. If wet holes are encountered, plastic liners are an option – or an emulsion blasting agent can be used.

**Mine Support and Miscellaneous Equipment.** Other support equipment that will be required at the Rock Creek Mine includes:

- Dozers,
- Graders,
- Backhoes,
- Water truck,
- Fuel and lube truck,
- Mechanic service vehicles,
- Pickup trucks,
- Crewcab trucks, 4x4, light,
- Light plants, and
- Forklift.

### 3.7.2 Big Hurrah Mine

**Loading Equipment.** Due to the limited production requirement and the need for operating flexibility, a 12-m<sup>3</sup> (16 yards<sup>3</sup>) front-end loader will provide sufficient capacity for the ore and development rock loading operations. Productivity is expected to be around 1,250 t/h.

**Hauling Equipment.** The truck fleet is to operate with approximately two trucks. This minimizes the number of operators, yet provides flexibility during periods of truck downtime. 100-tonne trucks are considered to provide an efficient match for the loading equipment.

**Drilling and Blasting Equipment.** It is assumed that ore and development rock will utilize the same powder factors and blasting patterns. In actuality, the mineralized zone may be more fractured and could require less blasting effort. A blasthole drill, blasting truck, and ANFO truck will be used at the site. The drill and blast operation will be adjusted with experience during operation, but is initially based on a powder factor of 5 ounces (0.15 kilograms) per tonne and a 4 inch (100 mm) diameter blasthole, while the bench height is 16 feet (5 m) and blasthole spacing will be about 10 feet (3 m). It is assumed most holes in the permafrost will be dry, and ANFO can be used. If wet holes are encountered, plastic liners are an option, or an emulsion blasting agent can be used. A contract blasthole loading operation is being considered.

**Mine Support and Miscellaneous Equipment.** Other support equipment that will be required at the Big Hurrah Mine includes:

- Dozers,
- Graders,
- Backhoes,
- Water truck,
- Fuel and lube truck,
- Mechanic service vehicles,
- Pickup trucks,
- Crewcab trucks,,
- Light plants, and
- Float trailer and tractor.

## 4.0 PROCESSING

All processing of ore from the Rock Creek and Big Hurrah pits will occur at the Rock Creek Mill/Mine Complex. Ore milling rates will be about 2.5 Mt per year.

Mineralization at Rock Creek is confined to quartz veining in two ore types: TV and the AV. The resource in the TV accounts for approximately 80% of the tonnes and 70% of the gold content in the deposit. The TV material yields higher gravity recoveries in the range of more



than 80%. Previous studies indicate that AV quartz poses the greater challenge in gravity recovery circuits, with recovery values in the range of 30% to 40% for coarse grind material. The gold appears to be finer in the AV material, possibly causing the lower recovery in gravity only circuits. Finer grinding tends to liberate gold and helps to improve overall recovery. Both ore types respond exceptionally well to flotation and cyanide in leach carbon pulp recovery process techniques yielding higher gold recovery.

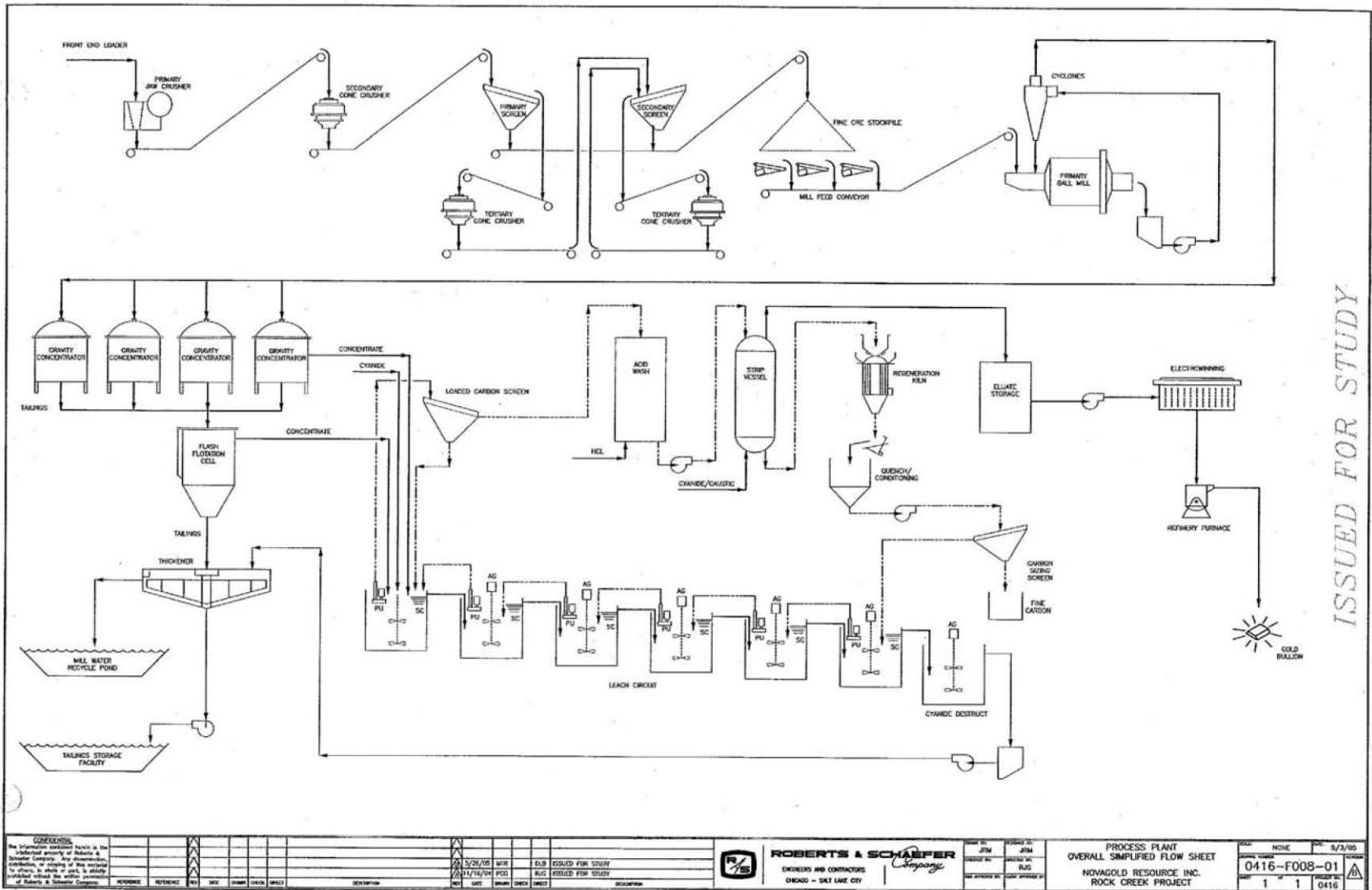
In the Big Hurrah ore, gold most commonly occurs as very fine particles of free gold. The gold is in veins composed of alternating layers of quartz and thin films of graphite. Common gangue minerals include: quartz, calcite, graphite, scheelite, pyrite, and arsenopyrite. Gold is moderately associated with tungsten and weakly with silver. While arsenic is present at Big Hurrah, it does not correlate with gold. Big Hurrah ore will be treated at the Rock Creek mill using the same flowsheet utilized for the Rock Creek ores.

Ore will be processed with the use of a gravity circuit, followed by a flotation circuit on the gravity tails. The flotation concentrates and gravity middling concentrates will be processed on site using a cyanide leach and carbon recovery circuit. Leached ore from the cyanide in leach carbon in pulp recovery process will be subjected to treatment for destruction of free cyanide and combined with the tailing from the flotation circuit. The combined tailings will be processed in a paste tailing thickener and deposited in a tailing impoundment.

Gold recovered in the carbon stripping circuit will be refined with the gravity concentrates in a furnace, and a doré bar will be produced on site. Gold doré will be shipped to a refinery for the final stages of refining and sale.

The Mill Process is depicted in Figures 4.1 and 4.2.

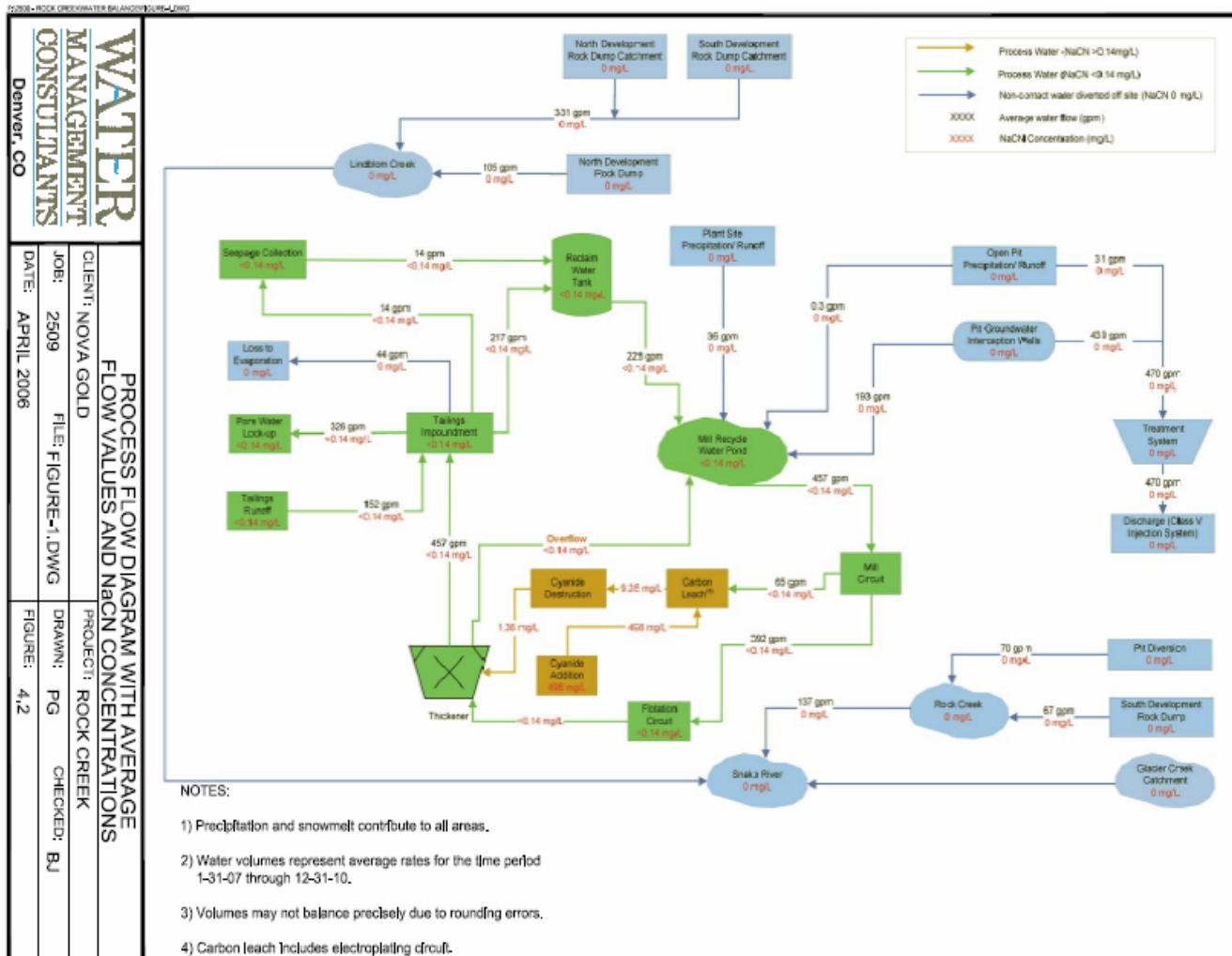
Figure 4.1 Mill Flow Sheet A



ISSUED FOR STUDY

|  |          |  |                  |         |          |    |      |  |  |  |  |   |  |      |    |          |             |         |     |     |                  |         |     |     |                  |  |  |   |  |  |  |  |  |
|--|----------|--|------------------|---------|----------|----|------|--|--|--|--|---|--|------|----|----------|-------------|---------|-----|-----|------------------|---------|-----|-----|------------------|--|--|---|--|--|--|--|--|
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| REVISED  | REVISION | BY   | DATE             |         |          |    |      |  |  |  |  |   |  |      |    |          |             |         |     |     |                  |         |     |     |                  |  |  |   |  |  |  |  |  |
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| 5/26/05  | MJR      | ELR  | ISSUED FOR STUDY |         |          |    |      |  |  |  |  |   |  |      |    |          |             |         |     |     |                  |         |     |     |                  |  |  |   |  |  |  |  |  |
| 7/11/04  | PCD      | RUC  | ISSUED FOR STUDY |         |          |    |      |  |  |  |  |   |  |      |    |          |             |         |     |     |                  |         |     |     |                  |  |  |   |  |  |  |  |  |

Figure 4.2 Mill Flow Sheet B



## **4.1 CRUSHING AND GRINDING**

Ore will be directly fed in run-of-mine stockpiles and fed to a jaw crusher. A grizzly-type feeder will allow material finer than 4-inch (100-mm) bypass the primary jaw crusher. Material larger than 4 inches (100 mm) will be fed into the crusher and crushed to minus 6 inches (150 mm). This material will be recombined with the finer bypass material and conveyed to a coarse ore bin, where it will feed to secondary and tertiary standard cone crushers. Material will remain in the cone crusher circuit until it is less than 0.35 inches (9 mm) and passes through a double deck screen that reports to the fine ore stockpile.

The fine ore stockpile will have 7,000 tonnes of live storage and will feed a conveyor that discharges into a ball mill. Rock in the ball mill will be ground to a fine sand size while being mixed with water to form a slurry. The slurry will circulate through cyclones that will sort the crushed ore by size, sending material coarser than 65 mesh and 30% solids back to the ball mill for additional grinding.

A coarse grind requirement of 80% passing the 65 mesh will be achieved most economically by a three stage crushing and a single 6,000 horsepower ball mill (length to diameter ratio of approximately 2:1).

The primary cyclones are sized to produce a P80 of 212 micrometers (65 mesh). The primary cyclones have been specified as long cone (15 inches [380 mm] diameter cyclones with 10.5° cone angles) to improve cyclone efficiencies and minimize heavy media re-circulation of gold and pyrite to the cyclone underflow.

## **4.2 GRAVITY CIRCUIT**

Approximately 75% of the gold is expected to be recovered in the primary gravity circuit. The primary gravity circuit will produce a relatively clean gold stream that will be refined into doré bars on site (approximately 75% of total recovered gold).

Gravity concentration separates particles according to differences in density. The material finer than 65 mesh will be processed through a primary gravity circuit made up of a combination of centrifugal concentrators and tables. Four Falcon semi-continuous type concentrators, each processing 80 t/h cyclone overflow solids, have been selected. The gravity concentrate from these units will be passed through a second Falcon concentrator to perform the first stage of cleaning. The first cleaner concentrate will report to table in order to provide a clean concentrate to the gold refinery furnace. Cleaner tails or middlings will be combined with flash flotation concentrate for further processing. Gravity circuit tails will report to the flotation circuit.

## **4.3 FLOTATION CIRCUIT**

The tailing from the gravity circuit will be fed to a flash flotation circuit. The flotation circuit concentrate will be subjected to a cyanide leach circuit for gold leaching and recovery. The gold from this circuit will be combined with gold from the primary gravity circuit, poured into doré bars, and shipped off-site for final refining and sale.

Flotation uses a chemical process which makes the desired mineral surface hydrophobic, which in turn makes the mineral attach itself to air bubbles. The air bubble carries the mineral to the surface, where it overflows as a froth out of the flotation cell. Alcohol is added to the slurry to stabilize the froth. The reagents used to facilitate the flotation process are chosen according to mineral type and slurry chemistry. Flotation times and reagent schemes have been based on laboratory and bench scale test work that indicated that optimal recovery of 38% solids was achieved with an extended flotation time. To ensure maximum recovery of the gold mineralization, one 20 m<sup>3</sup> flash cell was selected to provide an estimated two-minute retention time for 100% of the gravity tailing. Metallurgical test work indicated that there was a benefit in recovering liberated coarse sulfides from the grinding circuit by preventing over grinding.

The flotation concentrate amounts to approximately 12% by weight of the initial ore fed to the mill. Unlike the high grade gravity concentrates that are sent directly to the refinery for tabling and melting, the mid grade gravity concentrates (middlings) will be combined with the flotation concentrate for cyanide leaching.

#### **4.4 CYANIDE IN LEACH CARBON PULP RECOVERY CIRCUIT**

The flotation concentrate is mixed with lime and aerated prior to flowing into the first of six leach tanks. Cyanide is introduced to the first leach tank to begin the gold leaching process, and air is injected into the tanks to ensure adequate oxygen for the leach reaction. As the ore slurry cascades through the six leach tanks, the gold is dissolved from the concentrate.

Activated carbon is added fresh to the last leach tank and pumped upstream once a day in the opposite direction of the slurry flow. After six days, the carbon reaches the first leach tank and is loaded with gold. The carbon/slurry mixture is pumped from the first leach tank, across a vibrating screen which separates the carbon from the concentrate slurry. When 3 tonnes of the now loaded carbon is collected, the carbon is batch-treated for gold removal, washing, and reactivation. After reconditioning, the carbon is returned to the last leach tank to begin gold loading once again.

A hot caustic/cyanide solution called “strip solution” removes the gold from the carbon and is passed through an electrolytic cell, where the gold is reduced to the metallic state. Gold metal is cleaned from the electrolytic cell, dried, and then placed into a furnace for melting into doré bars.

The final stages of table cleaning, electrowinning, and doré melting and pouring will be performed in a secured area. All doré will be sampled during pouring and weighed prior to shipment to the outside refinery.

Cyanide complexation, a process wherein ferrous sulfate complexes with any free cyanide that remains in the tailings, will be used to convert cyanide to a stable, relatively non-toxic ferrocyanide complex. The ferrocyanide complex will be permanently captured as a solid precipitate within the tailings solids. Cyanide complexation will occur through the addition of ferrous sulfate to the tailings in an agitated tank. Monitoring for cyanide will be conducted in accordance with the ADEC approved Monitoring Plan.

#### 4.5 REAGENT HANDLING AND STORAGE

Reagents will be shipped by barge and stored at the Rock Creek Mine/Mill Facility in a secure area. The facility will be manned and in operation at all times.

Reagents will be handled and stored in accordance with all state and federal regulations. Lined containment, and provisions to keep reagents dry will be employed in accordance with the nature of the reagent.

Employees will be adequately trained in handling procedures in accordance with Mine Safety and Health Administration regulations and guidelines.

Reagent quantities are listed below in Table 4-1.

**Table 4-1 Typical Chemical and Reagents Used in the Process**

| Reagent           | Description                                   | Usage Rate (per t)   | Annual Consumption | Quantity Stored at Site | Containment Method              |
|-------------------|---|----------------------|--------------------|-------------------------|---------------------------------|
| MIBC              | Alcohol for froth stabilization               | 0.7 oz<br>(0.02 kg)  | 50 tons            | 50 tons                 | Lined containment area          |
| Xanthate          | Collector for gold/sulfide mineral            | 2.7 oz<br>(0.075 kg) | 190 tons           | 190 tons                | Lined containment area          |
| Flocculant        | Reagent to enhance water – solid separation   | 0.7 oz<br>(0.02 kg)  | 50 tons            | 50 tons                 | Lined containment area          |
| Lime              | pH modifier                                   | 8.8 oz<br>(0.25 kg)  | 625 tons           | 625 tons                | Stored dry – no containment     |
| Activated Carbon  | Medium for collecting gold ions from slurry   | 0.4 oz<br>(0.01 kg)  | 25 tons            | 25 tons                 | Stored dry – no containment     |
| HCl               | Muriatic acid for washing calcium from carbon | 0.7 oz<br>(0.02 kg)  | 50 tons            | 50 tons                 | Lined containment area          |
| NaOH              | pH modifier for carbon stripping              | 1 oz<br>(0.03 kg)    | 75 tons            | 75 tons                 | Stored dry in lined containment |
| NaCN              | Gold leachate                                 | 0.7 oz<br>(0.2 kg)   | 500 tons           | 500 tons                | Stored dry in lined containment |
| FeSO <sub>4</sub> | Reagent for cyanide destruction               | 1 oz<br>(0.30 kg)    | 750 tons           | 750 tons                | Stored dry – no containment     |
| Ferric chloride   | Water treatment chemical                      |                      |                    |                         | Stored Dry – no containment     |

Methyl Isobutyl Carbinol (MIBC) and xanthate are long chain hydrocarbons and are much like alcohols with respect to toxicity and degradation. These chemicals are subject to degradation and volatilization.

#### **4.6 TAILING PREPARATION**

Tailings will be processed into a paste to minimize area footprint and water storage volumes. A high density deep cone type thickener will be installed in the processing plant for final tailings.

#### **4.7 TAILING DISPOSAL**

#### **4.8 TAILINGS**

A single TSF, located at the Rock Creek Mine/Mill Complex, will be used to store mill tailings and act as a storm water runoff buffer. The design water balance is contained within the Rock Creek Water Management Report attached to the Rock Creek Project EID. The tailings storage facility (TSF) is designed to store approximately 9 million tonnes (9.9 million tons) of tailings, or all the tailings produced from the current known resources, as defined in the feasibility study. Additional details of the TSF design may be found in the Detailed Design Report submitted to Dam Safety and on file with the Alaska Department of Natural Resources.

The storage area will be prepared by removing the organic matter and setting down an engineered layer of development rock. A rockfill embankment with a naturally shaped upstream basin will be constructed with development rock at the downstream end of the TSF. The upstream slope of the embankment will be lined with a 1.5mm (60-mil) high-density polyethylene (HDPE) geomembrane underlain by a liner-bedding layer. Seepage collection drains will be installed above the bedrock surface, along the downstream toe of each embankment stage, to collect and transfer potential seepage to the seepage collection sump.

The materials to be stored in the TSF consist primarily of tailings from a gravity and flotation circuit. These tails from the gravity and flotation circuit, will not have been included in the cyanide in leach and carbon pulp recovery process, and will comprise 86.3% of the total tails within the facility. The remaining 13.7% of the total tails will be from the cyanide in leach and carbon pulp recovery process. These tails will be routed through a cyanide destruct process prior to disposal resulting in a small waste stream with a cyanide content of approximately 0.13 mg/kg of cyanide. All tailings are co-mingled prior to disposal in the TSF. As the paste tailings are discharged into the tailings pond, they will form a sloping beach (3 to 6% slope).

All tailings are produced through a beneficiation process that produces paste tailings with a solids content of 75%, instead of conventional tailings with a solids content of 35%. Several environmental advantages are gained through the decision to produce paste tailings. Tailings volume is reduced, and the tailings can sustain a steeper bank slope of 5 to 6%, resulting in a smaller footprint and less disturbance to wetlands. The lower moisture content in the paste tailings also negates the need for a supernatant pond and greatly reduces the propensity for tailings seepage. Paste tailings produce a stable tailings stockpile that will not readily erode,

and, with the deposition of a cap of organic matter, will be amenable to revegetation. As part of the reclamation plan, a silt layer will be deposited on top of the tailings, along with 1 to 2 feet (0.3 to 0.6 meters [m]) of overburden organic material.

Thermal modeling was also performed on several alternative designs involving liners and thermosiphons to evaluate their effectiveness in minimizing the seepage volume originating within the tailings storage facility. Multiple scenarios to the alternative designs were evaluated and it was determined that a design which extends the geomembrane liner into the underlying weathered bedrock provides a greater reduction in seepage than designs which incorporated thermosiphon systems. This design has been incorporated into the Rock Creek TSF.

Water accumulated within the TSF will be pumped to the Mill Recycle Water Pond. Water accumulation that still remains in the TSF at mine closure will be treated and discharged into the groundwater injection system. After the excess water has been discharged the facility will be capped and any drainage and/or seepage from the reclaimed TSF will be caught in the seepage collection system and monitored to determine if it meets applicable water quality standards. If the drainage and/or seepage does not meet applicable water quality standards, then the water will be treated and discharged through the groundwater injection system. When monitoring indicates that no further treatment is required, then drainage will flow unimpeded down the natural flow path of the Rock Creek watershed.

#### Tailing Storage Management Goals:

- Tailings placed sub-aerially.
- Ultimate crest elevations designed to minimize the height of the dams.
- Estimated average dry density of 1.52 tonnes per m<sup>3</sup>.
- Minimize solution stored in winter.

#### Tailings Dam Design Goals:

- Minimize dam height,
- Downstream dam construction,
- A 2.5:1 downstream slope,
- A 2.5:1 upstream slope,
- A 5% slope on paste deposit,
- Thermal modeling was performed on several alternative designs to evaluate their effectiveness in minimizing the seepage volume originating within the tailings storage facility. Multiple scenarios to the alternative designs were evaluated and it was determined that the design which extended the geomembrane liner into the underlying weathered bedrock provided a greater reduction in seepage than the designs which incorporated thermosiphon systems.



- A 33 ft (10 m) final crest width,
- A 3.3 ft (1 m) freeboard over maximum water pond level, and
- Sub-excavate foundation gravels and regolith down to bedrock across the dam foundation.

Any tailings seepage will be collected in a gravel and perforated pipe drain system. This system will be directed to a seepage recovery sump downstream of the TSF embankment and pumped back to the tailings facility for recycle back to the process plant.

Monitoring of ground water flows downstream of the TSF will occur throughout the life of the facility and the closure period. Three monitoring wells will be installed in the topographic lows defined by the Rock Creek and Bear Gulch drainages. These wells will be installed below the seepage recovery system and monitored in accordance with an ADEC approved monitoring plan.

In the unlikely event of a breach of the embankment, the potential of a catastrophic dam failure would be minimal. Any solution excursion would be minor, due to management of the solution pond at minimum volumes. The only solution that will be contained in the dam will be break-up runoff flow reporting to the tailings facility from the tailings facility footprint and meteoric water falling on the tailings facility; there is no upstream watershed that will report to the tailings facility. The embankment is stable even without the upstream liner system. Any breach in the liner system would simply result in a release of solutions over time as a function of the permeability of the rock fill. Breach seepage flow velocity would not be high enough to displace the massive rock fill behind the liner system as the embankment is stable.

**Table 4-2 Rock Creek TSF Fill Quantities**

|                 | <b>Wetland Fill Volume<br/>(cubic yards)</b>   | <b>Volume<br/>(cubic yards)</b>                  | <b>Maximum Elevation<br/>(feet)</b> | <b>Wetlands Disturbance<br/>(acres)</b> | <b>Footprint Area<br/>(acres)</b> |
|-----------------|--|--|-------------------------------------|---|-----------------------------------|
| TSF Embankment  | 6,212,765<br>(4,750,000 m <sup>3</sup> )       | 3,858,454<br>(2,950,000 m <sup>3</sup> )         | 328<br>(100 m)                      | 94<br>(38 hectares)                     | 173<br>(70 hectares)              |
| Tailings        |  | 9,351,847<br>(7,150,000 m <sup>3</sup> )         | 322<br>(98 m)                       |   |                                   |
| Cap on Tailings |  | 738,992<br>(565,000 m <sup>3</sup> )             |                                     |   |                                   |
| <b>Total</b>    | <b>6,212,765<br/>(4,750,000 m<sup>3</sup>)</b> | <b>13,949,293<br/>(10,665,000 m<sup>3</sup>)</b> |                                     | <b>94<br/>(38 hectares)</b>             | <b>173<br/>(70 hectares)</b>      |

## **5.0 INFRASTRUCTURE AND FACILITIES**

### **5.1 SITE PLAN LAYOUT**

#### **5.1.1 Rock Creek Mine/Mill Complex**

The plant site layout for the Rock Creek facility is shown on Figure 1. The plant is located to the west of the open pit and to the north of the TSF. The plant area includes space for the crushing circuit, crushed ore stockpile, mill, maintenance shop, administration-mine dry building, and fuel storage. All buildings will be constructed from pre-fabricated materials. Such structures can be transported to the site in containers and assembled on prepared concrete slabs.

#### **5.1.2 Big Hurrah Mine**

The plant site layout for the Big Hurrah Mine is shown on Figure 2. The plant is located to the north of the open pit. The plant area includes space for a maintenance shop, an administration mine dry building, fuel storage, and a run-of-mine stockpile. All buildings will be constructed from pre-fabricated components. Such structures can be transported to the site in containers and assembled on prepared concrete slabs.

### **5.2 ELECTRIC POWER SUPPLY**

#### **5.2.1 Rock Creek Mine/Mill Complex**

The Rock Creek facility will require about 9-11 megawatts of electric power, most of which is dictated by the milling operation. Power will be supplied from the Nome Joint Utility System and delivered to the site via a 25 kilovolt (kV) power line. A step-up transformer will be required at the Nome generating station, and the existing power line to Teller Highway must be upgraded from 12 kV to 25 kV capability. A new power line must be installed along the Glacier Creek By-pass Road to the mine site. The DOT right-of-way along the Glacier Creek By-pass Road includes adequate lands for power line installation. Power distribution around the Rock Creek site would be done at 4.16 kV.

Backup power to the plant will be provided by a 500 kW, 4.16 kV diesel generator, which will provide sufficient power to: maintain the operation of pumping systems sufficient to control the shutdown of the plant, prevent spills, and prevent freeze-up of process components. The generator will not have the power capability to operate the entire plant.

#### **5.2.2 Big Hurrah Mine**

Power to the Big Hurrah Mine facilities plant will be provided by a diesel-electric generator sufficient to provide ample power for a shop, office and water handling facility.

### **5.3 PROCESS WATER SUPPLY**

#### **5.3.1 Rock Creek Mine/Mill Complex**

Normal process water consumption at the Rock Creek facility is expected to be in the range of 264 million gallons (1,000,000 m<sup>3</sup>) per year, mainly due to water lost in the voids of the paste tailings deposit. Other water losses such as seepage and evaporation will be minimal compared to tailings void losses.

Process water will be provided from various sources, including water supply wells, pit seepage, precipitation on the tailings area, and surface runoff. A minimum operating water inventory will be maintained in the recycle pond.

#### **5.3.2 Big Hurrah Mine**

Process water considerations are confined to the Rock Creek Mine/Mill Complex, because there will be no ore processing at the Big Hurrah Mine.

### **5.4 POTABLE WATER SUPPLY**

#### **5.4.1 Rock Creek Mine/Mill Complex**

Due to limited amounts of potable water needed at the Rock Creek facility, potable water would be supplied via tanker truck and/or bottled water from Nome.

#### **5.4.2 Big Hurrah Mine**

Like the Rock Creek facility, limited amounts of potable water will be needed at the Big Hurrah Mine. Potable water would be supplied via tanker truck and/or bottled water from Nome.

### **5.5 SITE ACCESS**

#### **5.5.1 Rock Creek Mine/Mill Complex**

The Rock Creek facility is located adjacent to the existing Glacier Creek Highway. The on-site access roads and haul roads at Rock Creek will be constructed largely over frozen overburden soils. Estimated maximum quantities of rock fill required for developing the Rock Creek facility access are presented in Table 5-1.

**Table 5-1 Rock Creek Mine/Mill Complex Roads**

|                                    | <b>Wetland Fill Volume<br/>(cubic yards)</b> | <b>Rockfill Quantity<br/>(cubic yards)</b>   | <b>Wetlands Disturbance<br/>(acres)</b> | <b>Footprint Area<br/>(acres)</b> |
|------------------------------------|--|--|---|-----------------------------------|
| Access road and on-site haul roads | 510,101<br>(390,000 m <sup>3</sup> )         | 850,168<br>(650,000 m <sup>3</sup> )         | 49.5<br>(20 hectares)                   | 73<br>(29.5 hectares)             |
| Infiltration Zone access roads     | 45,778<br>(35,000 m <sup>3</sup> )           | 45,778<br>(35,000 m <sup>3</sup> )           | 6<br>(2.5 hectares)                     | 6<br>(2.5 hectares)               |
| Plant area general fill            | 117,716<br>(90,000 m <sup>3</sup> )          | 117,716<br>(90,000 m <sup>3</sup> )          | 44.5<br>(18 hectares)                   | 44.5<br>(18 hectares)             |
| <b>Total</b>                       | <b>673,595<br/>(515,000 m<sup>3</sup>)</b>   | <b>1,013,662<br/>(775,000 m<sup>3</sup>)</b> | <b>100<br/>(40.5 hectares)</b>          | <b>123.5<br/>(50 hectares)</b>    |

There will be a maximum of three crossings of Rock Creek required at the Rock Creek site, depending on the final choice of diversion ditch designs. One above the pit associated with the diversion channel, one below the pit associated with the plant site access to the tailings facility/diversion channels and explosive storage, and one below the TSF to allow access to the seepage recovery system and to the diversion channels. All culverts have been designed to pass the flow from the 100-year/24-hour storm event.

### **Big Hurrah Mine**

All stream crossings on-site occur upstream of known fish habitat in Little Hurrah Creek. On-site access roads and haul roads will be constructed from development rock excavated from the pit. Stream crossings will consist of rockfill from the development of the Big Hurrah pit. The rockfill will include culverts sized to pass storm flow from the 100-year/24-hour storm event and to allow fish passage. It is anticipated that two stream crossings will be required on Little Hurrah Creek. The first is below the pit to allow access to the administration buildings, maintenance shop, and development rock dump. The second is associated with the east diversion channel. Estimated maximum quantities of rock fill required for developing the on-site Big Hurrah Mine access roads are presented in Table 5-2.

The Big Hurrah Mine will be located 3.1 miles (5 km) from the Council Highway. An existing road crosses Big Hurrah Creek and leads up to the site. Road improvements within this road right of way will result in the removal of historic placer tailings from the floodplain, widening of the floodplain, deepening of the stream channel, and the installation of two or more fish ponds. These improvements will enhance fishery habitat within Big Hurrah Valley and be made in cooperation with the US Army Corps of Engineers and the Department of Natural Resources Office of Habitat Management and Permitting. Improvements to the stream crossings will be required to accommodate vehicles in excess of 10,000 lbs (4,500

kilograms) gross vehicle weight. Estimated quantities for developing the access road up the Big Hurrah Valley are presented in Table 5-3, and estimated quantities for the Big Hurrah Access Road Project Mitigation are presented in Table 5-4.

**Table 5-2 Big Hurrah Mine Roads**

|  | <b>Wetland Fill Volume<br/>(cubic yards)</b> | <b>Rockfill Quantity<br/>(cubic yards)</b> | <b>Wetlands Disturbance<br/>(acres)</b> | <b>Footprint Area<br/>(acres)</b> |
|--|--|--|---|-----------------------------------|
| On-site access road and on-site haul roads | 78,477<br>(60,000 m <sup>3</sup> )           | 240,663<br>(184,000 m <sup>3</sup> )       | 5<br>(2 hectares)                       | 31<br>(12.5 hectares)             |
| Plant area general fill                    | 0  | 6,540<br>(5,000 m <sup>3</sup> )           | 0                                       | 1.5<br>(1.5 acres)                |
| <b>Total</b>                               | <b>78,477<br/>(60,000 m<sup>3</sup>)</b>     | <b>247,203<br/>(189,000 m<sup>3</sup>)</b> | <b>5<br/>(2 hectares)</b>               | <b>32.5<br/>(13 hectares)</b>     |

**Table 5-3 Big Hurrah Access Road**

|                        | <b>Wetland Fill Volume<br/>(cubic yards)</b> | <b>Rockfill Quantity<br/>(cubic yards)</b> | <b>Wetlands Disturbance<br/>(acres)</b> | <b>Footprint Area<br/>(acres)</b>  |
|------------------------|--|--|---|------------------------------------|
| Big Hurrah Access Road | 0  | 103,000<br>(79,000 m <sup>3</sup> )        | 0                                       | 16 acres<br>(6.5 hectares)         |
| <b>Total</b>           | <b>0</b>                                     | <b>103,000<br/>(79,000 m<sup>3</sup>)</b>  | <b>0</b>                                | <b>16 acres<br/>(6.5 hectares)</b> |

**Table 5-4 Big Hurrah Access Road Project Mitigation**

|   | <b>Dimensions</b>                          | <b>Footprint Area<br/>(acres)</b>               |
|---|--|---|
| Full Bank Stream Width                        | 32 feet extended to 37 feet over two miles | 8.4 acres (within the floodplain improvements)  |
| FloodPlan Width                               | 71 feet extended to 81 feet over 2 miles   | 18.4 acres                                      |
| Fish Ponds                                    | 40 feet by 100 feet                        | 0.2 acres                                       |
| Historic Tailings Removed From the Floodplain | 83,000 cu yds                              | 11.3 acres                                      |
| Channel Deeping                               | 10,000 cu yds removed over 5000 ft         | 4.2 acres                                       |
| <b>Total Enhancement</b>                      | -----                                      | <b>42.48 acres (some areas are overlapping)</b> |

## 5.6 FUEL STORAGE

All diesel fuel and gasoline to be used by the project will be barged into Nome during the summer season. Near the Nome port area, several large diesel tank farms are available for use through independent suppliers.

### 5.6.1 Rock Creek Mine/Mill Complex

Diesel fuel will be delivered to the Rock Creek facility via tanker truck. Fuel storage at the site will be minimized. Assuming a one-week supply, the site will store about 30,000 gallons (113,530 L) of diesel fuel (Table 5-5). It is estimated that annual diesel fuel requirements for the Rock Creek facility will be in the range of 1 million U.S. gallons (3.8 million L).

**Table 5-5 Fuel and Lubricant Storage Requirements at the Rock Creek Mine/Mill Complex**

|              | Location   | Quantity Stored at Site         | Containment Method |
|--------------|------------|---------------------------------|--------------------|
| Diesel Fuel  | Plant site | 30,000 gallons (113,530 litres) | Lined bermed area  |
| Heating Fuel | Plant site | 1,500 gallons (6,000 litres)    | Lined bermed area  |
| Gasoline     | Plant site | 1,500 gallons (6,000 litres)    | Lined bermed area  |
| Lubricant    | Plant site | 3,000 gallons (11,350 litres)   | Lined bermed area  |

Gasoline consumption at the site will be less, mainly for service vehicles. On site storage is assumed to be 1,500 gallons (6,000 L).

The fuel storage tanks and/or bladders (diesel and gasoline) will be contained within lined and bermed areas, with a spill containment capacity equal to or greater than 110% of the largest container. The lined area will include a dual liner system. Dispensing lines will have automatic shutoff devices, and spill response supplies will be stored and maintained on site.

Lubricants will be delivered to the Rock Creek facility in drums and/or totes, and stored in a secured area. The lubricants will be distributed with hose reels in the truck shop. Lubricant drums and tanks will be stored within lined and bermed areas, with spill containment capacity equal to or greater than 110% of the largest storage vessel. The majority of the lubricants will be stored at AGC's laydown areas in Nome.

### 5.6.2 Big Hurrah Mine

Diesel fuel will be delivered to the Big Hurrah site via tanker truck. Fuel storage at the site will be minimized. Assuming a one-week supply, the site will store about 10,000 gallons (36,000 L) of diesel fuel (Table 5-6).

**Table 5-6 Fuel and Lubricant Storage Requirements at the Big Hurrah Mine**

|              | <b>Location</b>          | <b>Quantity Stored at Site</b> | <b>Containment Method</b> |
|--------------|--------------------------|--------------------------------|---------------------------|
| Diesel Fuel  | Plant site               | 10,000 gallons (38,000 litres) | Lined bermed area         |
| Heating Fuel | Plant site               | 530 gallons (2,000 litre)      | Lined bermed area         |
| Lubricant    | Plant site/laydown areas | 1,500 gallons (6,000 litres)   | Lined bermed area         |

The fuel storage tank will be contained within a lined and bermed area, with spill containment equal to or greater than 110% of the largest tank. Dispensing lines will have automatic shutoff devices, and spill response supplies will be stored and maintained on-site.

Lubricants will be delivered to the Big Hurrah in drums and/or totes, and stored in a secured area. The lubricants will be distributed with hose reels in the truck shop. Lubricant drums and tanks will be stored within lined and bermed areas, with spill containment capacity equal to or greater than 110% the largest storage vessel. The majority of the lubricants will be stored at AGC's laydown areas in Nome.

**5.7 ADMINISTRATION OFFICES AND MINE DRY**

**5.7.1 Rock Creek Mine/Mill Complex**

A single-level mine dry will be located adjacent to the Rock Creek administration offices and central to the site facilities. The dry will serve both the mill and mine operating personnel. All buildings will be modular mobile trailer structures. Where buildings are not directly connected, enclosed Arctic corridors may be used for personnel access from one building to the other.

An assay laboratory will be constructed adjacent to the mill. This lab will perform routine analysis of blasthole samples and processing samples.

**5.7.2 Big Hurrah Administration Offices and Dry**

A single-level mine dry will be located within the Big Hurrah administration offices and central to the site facilities.



## **5.8 SHOPS AND WAREHOUSES**

### **5.8.1 Rock Creek Mine/Mill Complex**

The Rock Creek facility maintenance shop for mobile equipment will be about 105 feet by 33 feet (32 m by 10 m) in size and include:

- Two large mobile equipment repair bays,
- A lubricant distribution system, and
- Offices for maintenance staff.

A warehouse and associated laydown area will be provided central to the facilities.

### **5.8.2 Big Hurrah Mine**

The Big Hurrah Mine maintenance shop for mobile equipment will be located central to the facilities and will include:

- One large mobile equipment repair bay,
- A lubricant distribution system, and
- Offices for maintenance staff.

A warehouse and associated laydown area will be provided central to the facilities.

## **5.9 EXPLOSIVE STORAGE**

### **5.9.1 Rock Creek Mine/Mill Complex**

All explosives handling and storage at the Rock Creek facility will comply with applicable state and federal regulations.

Blasting agents will be barged to Nome during the summer months; therefore, about eight months of bulk ammonium nitrate (AN) storage is required. A total of about 1,300 tonnes of AN (with a peak annual consumption of 2,200 tonnes) will require storage. Storage will be in accordance with BATF and MSHA regulations. Bulk AN may be stored in 1-ton super sacks.

High explosives will be segregated from the AN and stored in a separate bermed and locked magazine. The explosive storage will be located away from the rest of the project facilities, as required in the American Table of Distances referenced in the MSHA regulations.

## **5.9.2 Big Hurrah Mine**

All explosives handling and storage at the Big Hurrah Mine will comply with applicable state and federal regulations.

Blasting agents will be barged in to Nome during the summer months; therefore, about eight months of bulk AN storage is required and will be stored at Rock Creek. A total of about 100 tonnes of AN (with a peak annual consumption of 350 tonnes) will require storage at Big Hurrah at any one time. Storage will be in accordance with BATF and MSHA regulations. Bulk AN may be stored in 1-ton super sacks.

Explosives will be on site during active operations only. When explosives are on site, they will be stored in a separate, locked magazine. The explosive storage area will be bermed and located away from the rest of the project facilities. Explosives will be stored in accordance with MSHA regulations.

## **5.10 SECURITY**

Security personnel, also trained in mine safety and general first aid, will be on staff for both sites during all times of operation.

Access to both sites will be controlled. There will be a security gate at the entrance to the Rock Creek Mine/Mill Facility.

## **5.11 FIRE CONTROL**

### **5.11.1 Rock Creek Mine/Mill Complex**

AGC emergency response personnel will coordinate fire control and suppression at the Rock Creek facility. All such personnel will receive instruction in fire and emergency procedures during their MSHA training. In addition to a dedicated fire fighting vehicle, mine heavy equipment will be available for fire control. Available mine equipment will include a water truck, tracked dozers, and a front-end loader.

Handheld extinguishers will be installed in all heavy equipment and small vehicles.

Buildings will meet fire suppression codes.

### **5.11.2 Big Hurrah Mine**

As with the Rock Creek facility, AGC emergency response personnel will coordinate fire control and suppression at the Big Hurrah Mine, and will receive similar training.

Handheld extinguishers will be installed in all heavy equipment and small vehicles.

Buildings will meet fire suppression codes.

## **5.12 REFUSE DISPOSAL**

### **5.12.1 Rock Creek Mine/Mill Complex**

All wood and paper waste will be disposed of in the proposed on-site burn pit. Burning will be conducted once a week and in accordance with the Alaska Department of Environmental Conservation permit.

A small incinerator will be used for other waste such as oily rags, sack lunches, etc. Waste petroleum oils will be consumed in a waste oil burner.

All waste material either listed as, or meeting the characteristics of, hazardous waste will be shipped off site and disposed of according to applicable state, federal, and local regulations. Hazardous waste may consist of materials such as solvents, cleaners, reagent spills, batteries, and other hazardous wastes common to any industrial facility.

The AGC waste minimization strategy is to recycle all materials where possible, and promote innovative approaches to waste management. Refuse that cannot be recycled, burned, or incinerated on site, will be disposed of in a permitted, on-site landfill that will be constructed with the development rock dump.

### **5.12.2 Big Hurrah Mine**

The same refuse disposal practices will be followed at Big Hurrah, with the exception that refuse that cannot be recycled will be disposed of in an off-site Alaska Gold-permitted landfill, or in the Nome Municipal landfill.

## **5.13 SEWAGE DISPOSAL**

### **5.13.1 Rock Creek Mine/Mill Complex**

Due to the small workforce at the Rock Creek Mine/Mill Complex, chemical toilets or holding tanks will be utilized and managed through Nome facilities.

### **5.13.2 Big Hurrah Mine**

Due to the small workforce at the Big Hurrah site, chemical toilets or holding tanks will be utilized and managed through Nome facilities.

## **5.14 COMMUNICATIONS**

### **5.14.1 Rock Creek Mine/Mill Complex**

The primary methods of communication at the Rock Creek facility will be on-site telephone systems and mobile radios in mining and hauling equipment. The site security office will monitor all radio traffic and coordinate responses to accidents/emergency situations, as well as routine warnings for blasting and unsafe road conditions.

### **5.14.2 Big Hurrah Mine**

The primary methods of communication at the Big Hurrah site will be satellite telephone systems and mobile radios in mining and hauling equipment. The shop will monitor radio traffic and coordinate responses to accidents/emergency situations, as well as routine warnings for blasting and unsafe road conditions.

## **5.15 EMERGENCY RESPONSE**

### **5.15.1 Hazardous Material Incident Response**

#### **5.15.1.1 Rock Creek Mine/Mill Complex**

Alaska Gold staff will coordinate and control containment and cleanup of all Rock Creek facility on-site hazardous and non-hazardous material spills.

For off-site spills on the access road from Nome to the site, the contracted trucking company and/or product manufacturer will coordinate the initial response and cleanup according to applicable federal and state regulations.

#### **5.15.1.2 Big Hurrah Mine**

The same hazardous materials incident response practices as set for the Rock Creek facility will apply to Big Hurrah. Spill control equipment inventory will be sized with consideration of the site's remote nature and the time delay in transporting equipment from Nome.

## **5.16 TRANSPORTATION**

Personnel will provide their own transportation to and from the mine sites. Haulage of ore from the Big Hurrah Mine to the Rock Creek Mine/Mill facility will occur on a year round basis utilizing two standard over-the-road tractor-trailer units that can pull double trailers hauling legal loads. The two trucks are scheduled to travel together for safety reasons.

### **5.16.1 Medical Emergency Response**

#### **5.16.1.1 Rock Creek Mine/Mill Complex**

Alaska Gold safety and emergency response personnel will handle medical emergencies at the Rock Creek facility. Personnel will be trained to MSHA standards and will, to the best extent possible, be distributed throughout all operating shifts.

The Norton Sound Regional Hospital is located within 6.2 miles (10 km) of the site, and emergency services are also available there.

### **5.16.1.2 Big Hurrah Mine**

As with the Rock Creek Site, Alaska Gold safety and emergency response personnel will handle medical emergencies in a similar manner at Big Hurrah. Satellite phone communication will replace conventional phone service and will be available at all times to contact the AGC offices and emergency services.

The Norton Sound Regional Hospital is located approximately 40 miles (64 km) from the site, and emergency services are also available there. Helicopter services are available from Nome in the case of an emergency that requires quick transport to the hospital.