GREENS CREEK MINING COMPANY

GENERAL PLAN OF OPERATIONS

2004

GREENS CREEK MINE
GENERAL PLAN OF OPERATIONS

Prepared by

Kennecott Greens Creek Mining Company
Updated: April 2004

TABLE OF CONTENTS

TABLES AND FIGURES

Figures

1 INTRODUCTION

The Greens Creek project is a lead-zinc underground mine with a production rate of a nominal 1,300 tons per day. Major facilities include a mine, mill, tailings pond, docking facilities, mine service area, associated storage facilities, and waste rock sites.

The project area is approximately 18 miles southwest of Juneau, Alaska. Greens Creek drains into Hawk Inlet, which is on the northwest shore of Admiralty Island. Greens Creek Mining Company's valid mining claims are located in T44S, R66E, Copper River Meridian.

The Tongass National Forest, Chatham Area, is responsible for the administration and management of Admiralty Island. The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) designated most of the monument as wilderness. The majority of the project area is within the monument; however, none of the project falls within the Wilderness Area.

ANILCA, in Section 503 (f) (2) (A), permits any holder of a valid mining claim in the monument to carry out mining activities, to the extent feasible, consistent with the purposes for which the monument was established.

This Plan of Operations describes the activities which are conducted by Kennecott Greens Creek Mining Company (KGCMC), as operator for the Greens Creek Joint Venture, the location and timing of those activities, and how the environment and resources in the area are protected through compliance with federal and state requirements. References to KGCMC in this document means Kennecott Greens Creek Mining Company as operator on behalf of the Greens Creek Joint Venture. The Plan, as approved by the U.S. Forest Service, is a working agreement between KGCMC, for the Greens Creek Joint Venture, and the Forest Supervisor and his staff, on the management activities in the project area. As mine production proceeds, additional data relative to the configuration and grade of the orebody will be determined. Based on this additional data, changes in the mine plan and other aspects of the operation may be required. Such changes will necessitate revisions from time to time in this Plan of Operations.

An "Annual Work Plan" is prepared for each calendar year and approved by the USFS and the Department of Government Coordination (DGC) through the Alaska Coastal Management Program (ACMP). The Annual Plan defines activities for that year in greater detail than is presented in the overall Plan. Each of the Annual Work Plans is consistent with the overall Plan. Any significant changes in plans from that contained in the Greens Creek FEIS or this General Plan of Operations will be submitted for approval as a Supplemental Plan, as provided by 36 CFR 228.5(c).

1.1 Summary/Project Overview

As shown on the project map (Figure 1), the Greens Creek mine consists of several facilities in different locations on Admiralty Island.

During operation, approximately 260 persons are employed and permanently housed in Juneau. They travel by boat from Auke Bay to Young Bay on Admiralty Island. From there, they are transported by bus to various work stations.

The mill is located at the mine service area. Dry tailings are transported via truck to the cannery muskeg tailings pond. Mill and sediment pond effluent is transported via a waste water line to settling ponds and a treatment plant at the tailings facility before being discharged to the marine environment.

An 8.5 mile road was constructed to a width of 16 feet between the mine and marine terminal (Cannery), and a 4.85 mile road of 14 feet was constructed from the Cannery to Young Bay.

Power is supplied by diesel generators. Domestic and process water is provided from infiltration wells in Greens Creek.

In total, less than 273 acres of National Forest land is used or affected.

1.2 History of Greens Creek Operations

In early 1973, the Pan Sound Joint Venture was formed to conduct a base metal exploration program in Southeast Alaska. The companies originally involved were Marietta Resources International, Exalas Resources Corporation, Texas Gas Exploration, and Noranda Exploration. From 1974 through 1976, geological studies concentrated on areas where stream sediment sampling indicated high base metal anomalies on Admiralty Island. Claims were staked, and detailed exploration, including surface drilling began in the Greens Creek area. Lode claims (approximately 21 acres each) were staked in two large blocks: The Tom claims (122 claims) and the Big Sore claims (318 claims).

In 1976, Noranda Exploration assumed responsibility as operator for the field operations phase of the project and managed all initial work at Greens Creek. In early 1978, the Greens Creek claims were put into a development category and the Pan Sound Joint Venture was dissolved. Its legal successor, the Greens Creek Joint Venture, which included the four original companies plus Bristol Resources, Inc., was formed to develop the property.
During 1978, extensive underground diamond drilling and environmental baseline studies were begun. The entirely helicopter-supported exploration program completed a 4,224-foot adit, which provided the means for delineating the orebody. Additional access to the orebody was gained by means of a 600-foot crosscut from the existing adit into the ore zone.

On November 16, 1979, the Forest Service filed a Notice of Intent to prepare an Environmental Impact Statement (EIS) on the proposed Greens Creek Project. Public meetings were held in Juneau and Angoon to determine issues and concerns associated with the project. In February 1980, the agency released a scoping document that described the issues identified at those meetings. The February document was characterized as draft and the comment period was left open, to encourage public input.

On November 20, 1980, the Forest Service determined that Noranda had valid mineral discoveries on seven lode mining claims in the Greens Creek watershed.

In January 1981, Noranda Mining Inc. assumed control of the Greens Creek Project. Noranda Mining acted as the operator, manager, and representative for the Greens Creek Joint Venture. All permitting activities and the ultimate responsibility for operation of the Greens Creek Project was held by Noranda Mining Inc.

A Forest Service interdisciplinary team (IDT) and a team leader were designated by the Chatham Area Forest Supervisor in 1981. The team was responsible for following and recording the National Environmental Policy Act (NEPA) process, conducting and monitoring the environmental analysis and preparing the EIS. A geologist, civil engineer, fisheries biologist, hydrologist and wildlife biologist were members of the core

IDT. A support team composed of the Admiralty Island National Monument Manager, an archaeologist, botanist, economist, editor, forester, geologist, landscape architect, soil scientist, and planning officer assisted the IDT.

In May 1982, Noranda Mining completed a draft Environmental Assessment Report on the project, and in January of 1983 the U.S. Forest Service published the final Environmental Impact Statement. The public comment period terminated on March 7, 1983, with no appeals filed against the final EIS.

In March 1983, one additional lode claim was found to be a valid core claim.

In 1985, Marietta Resources' interest was acquired by Anaconda Minerals Company who subsequently sold their shares to Amselco Minerals, Inc.

In 1986, Noranda's claim was acquired by Amselco, and Amselco Resource took control of Project Operations.
When Amselco assumed control of the project, they initiated several studies, reviewed existing information, and developed an annual work plan in 1987.

In 1988 additional claims were judged to be valid. In February Kennecott, as a result of merger of two oil companies (Standard Oil and British Petroleum) assumed control of the project.

In March 1988, the U.S.D.A. Forest Service issued the *Environmental Assessment For Proposed Changes in the Development and Operations of the Greens Creek Mine*. This assessment gave a decision notice and finding of no significant impact. Major changes were the approval of a dry tailing impoundment and the placing of significant amounts of tails underground. Kennecott completed the construction of the surface facilities and began operations in February 1989.

During the spring of 1991, the USFS was notified of the need for the expansion of the waste rock disposal capacity at the Greens Creek Mine. The USFS concluded that an environmental assessment would be required to assess potential wate rock sites. As a result of this the *Geotechnical Investigations at Potential Waste Rock Sites - Kennecott Greens Creek Mine* was prepared by Steffen Robertson & Kirsten in February 1992 (SRK 1992).

In April, 1993, the *Environmental Assessment for Improvements to Greens Creek Mine Telecommunications System - Admiralty Island National Monument, Alaska* was conducted assessing the impact of proposed expansions to the mine's telecommunications system, resulting in the selection of a site for a microwave tower. (USFS, April 1993).

1.3 1989 Summary of Key Milestones

- Initial ore production created stockpiles in February. Achievement of this objective provided a 6,000 ton stockpile available for mill processing.

- February 1 was the planned completion date for construction of all facilities. Although plant startup occurred on February 6, construction personnel remained on site through the end of April performing equipment modifications.

- Shipments of concentrate were planned by April 30 for lead and bulk concentrate and June 30 for zinc concentrate. On April 10, lead concentrate was loaded on a southbound barge for Seattle. On May 16 zinc and bulk concentrate destined for European smelters departed Hawk Inlet.

- One thousand (1,000) TPD of mill throughput was planned by June 1, 1989. Actual throughput of 1,000 TPD was not achieved until September.

- Concentrator achievement of designed metallurgical recoveries was planned for August 1, 1989. Several plant problems kept this objective from being met.

1.4 1990

- By 1990, the production problems were solved and environmental problems with mill effluent were corrected. Additional reclamation work was conducted and the 1350 Campsite was reclaimed. The removal of two sediment ponds constructed as part of the development work was a part of that reclamation.

- Began tailings impoundment study to characterize the tailings impoundment. Extensive sampling began to determine if stratification of pond water was occurring.

- Began tests to further characterize the "leachate" from water that may percolate through the dry tailings system.

- Began constructing retention ponds prior to the main water impoundment. The retention ponds were to help correct and adjust for uncontrollable weather conditions which affected effluent quality.

1.5 1991

- Concluded the tailings characterization study. The study indicated no pond stratification.
- Added more retention ponds to the tailings system.
- Conducted pilot plant studies to determine if physical treatment of pond effluent would be required and which method would work best.
- Paving was initiated at mine site to reduce sediment production.
- KGCMC placed a rock berm in the area where the toe of the tailings pile will extend, and constructed several more settling ponds to add flocculents and increase settling time.

1.6 1992

- Completion of the Environmental Assessment for additional waste rock disposal capacity.
- Completion of a truck washing facility at the Hawk Inlet complex. Facility is used to wash down equipment associated with concentrate handling.
- A pre-settlement basin was constructed upstream of Pond "A" influent. Basin was constructed to reduce sediment loading and maintenance of Pond "A".

1.7 1993

- Completed construction of polishing filter plant of the secondary treatment of tailings impoundment waste waters.

- Significant drainage changes at the Hawk Inlet facility directing all storm water drainages to a sediment pond for pumping to the tailings impoundment facility.

- Initial logging for waste site 23 waste was conducted.

- Telecommunication Environmental Assessment completed.

- Operations were curtailed in March. Mine site begins care and maintenance mode of operations with a major reduction in the work force.

2 MINING OPERATIONS

2.1 Method of Mining

Underground mining methods employ rubber-tired diesel equipment. Access to the mining areas is by means of ramps or other suitable underground workings such as waste rock and tailings which form working foundations for subsequent mining. Because of the size and shape of the orebody, there is a physical limit to the amount of ore which can be removed. On reaching full production, mining methods will include some type of sub-level open stoping, and cut-and-fill mining.

2.1.1 Cut-and-Fill Mining

The ore in each work area or stope is mined in successive cuts and trammed or scraped to an ore pass.

Raises from the main haulage level provides access to the stopes. As each cut is taken, the manway and ore pass are raised and the mined-out vein is backfilled.

2.1.2 Backfill

The ore mined in the stopes is being replaced with classified tailings or other waste rock material. All classification, sand storage and cement addition is accomplished at the mill. Approximately 500 tons per day of tailings is taken back underground while waste rock is being stored underground on a space available basis.

2.1.3 Materials Handling

The 920 level is the main haulage level while the mine is in operation. The ore and waste are removed from the mine at this level. All levels are connected with a main ore pass and a main waste pass. The stope chutes are pulled as required on the individual levels and this material is then dumped into the main ore pass system.

Supplies are brought into the mine on the 920 level. Large equipment and materials are also brought in through the 920 portal, and supply areas are provided on each level in the mine.
Approximately 90,000 pounds of explosives are used per month, all of which is stored underground. Underground storage facilities meet all Mine Safety and Health Administration Magazine specifications. Explosives consists of ANFO, dynamite, other blasting agents and blasting caps.

2.1.4 Mine Services

Compressed air is being distributed to the various levels through a piping network. The ultimate compressed air plant size is capable of supplying 14,000 CFM.

Mine water is brought to a sump on the 1350 level from where it is distributed to the 920 level. Mine discharge water is pumped to the mill site sedimentation pond (Pond "A").

2.1.5 Shops

Underground shops are provided for routine maintenance and repair, along with underground space for warehousing of small tools and supplies.

2.1.6 Ventilation

The mine ventilation system takes advantage of the waste heat generated at the compressor-generator building thereby heating the 920 level through the main intake.

Ventilation air is distributed to the levels from the portal and up into the stopes and out onto the level above. The main exhaust level is the 1350 sublevel.

Underground diesel equipment in the mine includes trucks and loaders. Estimated ventilation requirements of 100,000 CFM are sufficient to maintain low diesel exhaust levels and to remove blast fumes.

2.2 Mine Service Area (Mill Site)

At present, access to the underground workings for the mine service area is provided by a bridge across Greens Creek. The mine service area consists of equipment, maintenance and repair facilities, mine backfill plant, ore concentrator, power plant, fuel storage tanks, locker and shower rooms, ore and waste rock storage, a warehouse, office space, maintenance/electrical shop, and a truck scale.

An extensive sediment control program has been developed for the mine service area. Pond "A" in conjunction with a system of collection ditches, paving, sediment traps, and storm drains collect all surface runoff from disturbed surface areas. A pre-sediment basin installed upstream of Pond A receives mine drainage and some surface runoff. The pre-sediment basin, paving, and sediment traps were designed to reduce sediment loading in Pond "A". All are part of the mine sediment control system. Maintenance of the paved areas and traps are in the Pond A Operation and Maintenance Plan (Appendix 10). Waters from Pond A are routed to the tailings impoundment via a pipeline for ultimate disposal to the marine environment through a National Pollution Discharge Elimination System (NPDES) permitted site.

Surface runoff that would normally enter the disturbed area is intercepted and diverted around the mill area by means of a berm and trench diversion system located up slope of the mine area. Clean water intercept "B" Pond was developed to channel all uncontaminated water, from the diversion ditch, into Greens Creek.

Underground catchment (water collection) and settling systems were developed as part of minimizing underground road damage and reducing tracking drainage onto surface environment.

A sump at the batch plant was installed to catch spillage from the backfill and return that material to the tailings thickeners.

3 MILLING OPERATIONS

3.1 Method of Milling

The milling method uses a selective flotation milling process to concentrate valuable minerals. The flotation process consists of three major steps: size reduction, mineral concentration, and moisture reduction of the concentrate.

Size reduction involves reducing ore from the mine in a SAG mill and a grinding mill to produce a slurry.

The ore slurry is then transported in pipes or launders to flotation cells or tanks, where valuable minerals are separated from waste materials in a froth flotation process. The ore minerals in this case are sulfides of lead, zinc, silver, and uncombined gold. Waste includes various silicate, carbonate, and sulfide minerals. The valuable minerals adhere to air bubbles that rise to the surface of the tank and are removed. To make the process work efficiently it is necessary to add air and various reagents to the tanks. This allows the bubbling or frothing action to float different ore minerals selectively, so that metal concentrates can be produced. No reduction of sulfides to base metals or other change in the chemical composition of ore minerals takes place in the concentrator or at the project site.

3.1.1 Concentrate Hauling

Concentrates are hauled from the mine to the marine terminal in end dump tractor trailers requiring approximately 10 trips per day.

Concentrates transported to the marine terminal, at Hawk Inlet, are placed in covered storage until they can be transported off site. Ocean going ships are loaded by a shipload and conveyor belt system. Drainage from the rock-fill portion of the ramp is directed to a settling pond within the marine terminal area. Water is transferred from the settling pond to the tailings basin via a pipeline for finial discharge through a permitted NPDES site.

3.1.2 Reagents in Concentrator

Approximate reagent consumptions and points of addition are outlined below.

TABLE 1

Reagent Addition Points and Addition Rate (lbs per ton)

MIBC	
- SAG Mill Discharge Box	.08
- Cyclone Underflow	.009
Sodium Cyanide	
- Lead Rougher Con Pump Box	.08
Copper Sulphate	
- Zinc Conditioner #1	1.05
Aero 3477	
- Cyclone Underflow	.017
- Column Cell Feed	.0001
Sodium Sulphite	
- Ball Mill Feed	.4
- Lead Rougher #1	.2
Potassium Amyl Xanthate	
- Lead Rougher #1	.028
- Lead Rougher #2	.032
- Zinc Conditioner #2	.02
- Zinc Rougher #1	.02

- Zinc Rougher #2	.0212
- Zinc Scavenger	.0212
- Bulk Conditioner	.004
Aerophine 3418A	
- Lead Rougher #1	.065
- Lead Rougher #2	.065
Percol 351	
- Lead Conditioner Thickener	.008
- Zinc Conditioner Thickener	.01
- Bulk Conditioner Thickener	.01
- Final Tails Thickener	.04
Lime	
- Zinc Feed Pump Box	.33
- Zinc Cleaner #1	.25
- Zinc Cleaner #2	.30
- Bulk Conditioner	.30
Sulfuric Acid	
- Ball Mill Discharge Pump Box	1.83
Hydrogen Peroxide	
- Water Treatment Plant	.252
Nalco 8130	
- Water Treatment Plant	.46

NOTE: All addition rates in pounds per short ton of dry feed ore.

Two weeks of dry reagent storage is provided for at the mill and all mixing is carried out in an isolated area of the mill. Holding tanks maintain three days storage of mixed reagent. Unlike other reagents, lime is pumped in a continuous loop from a holding tank, through the points of addition areas and returned to the holding tanks. Reagent is removed from the loop at its point of addition and controlled by a timer-actuated solenoid valve. All other reagents are pumped from their holding tanks by positive displacement pumps.

Greens Creek has prepared a hazardous materials control plan, which specifies precautions to be used in the transport, storage and use of these materials. (See Appendix 5.)

3.1.3 Materials Handling

3.1.3.1 Concentrates and Supplies

Lead, zinc and bulk concentrates are transported from mill storage to the cannery storage site on a daily basis, seven days per week. Bulk transfer is achieved with three semi-tractors, each pulling a 40-ton capacity end dump trailer. During periods of adverse road conditions, the trailers are not used and two shifts are required to transport concentrates. Truck drivers load their own trailers with a front end loader, under shelter and the trucks are covered prior to transport to the Hawk Inlet marine terminal. After loading, trucks proceed through a freshwater wheel-wash to reduce tracking of ore concentrates.

A 10-ton flatbed truck is used to transfer supplies from storage at the Hawk Inlet facility to the mine/mill area. Conex or Seavan style containers are used for material containment and shipping, and are loaded onto 40 or 80 foot flatbed trailers by forklift. Milling reagents comprise about 50 percent of the supplies transferred in this fashion.

Cement for backfill preparation is moved from cannery storage to mine storage by a 35-ton capacity blower-equipped tank truck.

Major supplies of reagents are stored in warehouses at the millsite. Two months of dry reagent storage is provided and all mixing is carried out in an isolated area at the millsite. For details, see Appendix 5.

3.1.3.2 Tailings Transport

A nominal 1,300 tons of ore is being mined each day and processed to produce approximately 265 tons per day (tpd) and 735 tpd of concentrate and tailings, respectively. Approximately 500 tpd of tailings are used as underground mine backfill with the remaining 235 tpd being placed in the tailings disposal area.

Dewatered tailings are produced using pressure filters and have a moisture content of 9 to 11 percent. Dewatered tailings are placed in a stockpile at the millsite, loaded, under shelter, using front-end loaders into covered trucks of approximately 40-ton capacity, and transported to the tailings basin. In 1990, the actual daily round trips for tailings haul trucks was 12.5.

During the first year of operation, monitoring of the road surface conditions was implemented to establish sediment production as outlined in the Road Sediment

Monitoring Section of Appendix 8. The purpose of the monitoring was to determine if additional mitigation measures were needed. Sediment sources were evaluated within 200 feet of natural stream courses for several road segments along the entire length of the mine road. Evaluation criteria included:

- Evidence of excessive road surface wear as indicated by rutting during heavy rains;
- Loss of road ditch capacity;
- Sediment plugging cross drain inlets and building up behind ditch blocks;
- Sediment build-up in vegetation filter strip adjacent to steam crossings.

This monitoring was the joint responsibility of KGCMC and the Forest Service (see Appendix 8). The monitoring program continued through 1993, and results of the study are summarized in Appendix 8.

If sediment production from road traffic becomes a problem, mitigating measures such as upgrading the road surface or using different transport technology (e.g., low pressure tires) would be applied on an as-needed, site specific basis.

3.1.3.3 Wastewater Transport

An eight inch diameter single-walled, high-density polyethylene pipeline carries mine and mill wastewater from the millsite (including water generated from a 24-hour, 10-year storm) to the tailings impoundment. The wastewater line has been placed on a pipe bench within the road corridor, adjacent to the drainage ditch and then covered to help provide protection from physical damage. Installation of larger diameter piping for a portion of the pipeline is planned for 1995.

The pipe has either been bedded with granular material, or is supported from bridges using prefabricated pipe supports located outside the guardrail.

The wastewater pipeline carries wastewater that has had the majority of sediments removed by filter press or pond settling. The water contains some turbidity. Residual flocculation chemicals from the milling process helps to precipitate sediments, metals, and other particulates upon release from the pipeline into the tailings sedimentation ponds.

A flow monitoring system was included in the pipeline design to detect a failure or significant leakage. Automated recording devices and alarm systems at the mill allow for rapid shutdown of the wastewater pipeline until repairs can be made. If pipe breakage occurs, the mill will be shut down until repairs can be made.

Greens Creek Mining Company has developed and implemented a program for monitoring the quality of mill effluent to determine discharge/water quality during operations. Monitoring is performed at a minimum of once a month and is in accordance to a plan submitted and approved by the Forest Service. If the actual water quality exceeds toxic levels for agents of concern and if risk of line break or leakage is determined to be of concern, additional protection measures

will be implemented to reduce the risk of a mill effluent spill into the environment (See Appendix 3).

3.1.3.4 Tailings Disposal

Disposal Method

Dewatered tailings are mechanically placed, spread and compacted in lifts within the dry tailings facility.

Site Conditions and Design Criteria

Site selection criteria for the tailings included sufficient volume, expansion potential, proximity to roads, gravity flow for effluent from the mill, proximity to the Hawk Inlet outfall point, avoidance of low and high spots in the wastewater pipeline, and pond spillway discharge to Hawk Inlet.

Factors considered for the dry tailings basin include:

- A relatively level site, to allow the placing and compaction of the tailings in lifts;
- Accessibility for truck traffic and equipment;
- Adequate area to build a tailings effluent sedimentation pond below the tailings pile.

This site was selected to take advantage of the natural embankments for the impoundment. The saddle embankment is less than five feet in height over most of its length, being constructed on a low ridge which forms the western side of the Tributary Creek valley.

Approximately 235 tons per day of dry tailings are placed in the dry tailings facility. Total area of the site is approximately 29 acres which includes a 3.5 acre tailings effluent sedimentation pond with a total volume, including sediment and water storage, of 58-acre feet. Information on site criteria is available in the tailings pond operating manual (See Appendix 3).

Most of the length of the saddle embankment was constructed on a few feet of peat over consolidated clay or sand till. Parts of the saddle embankment were constructed over a muskeg area with pockets of peat up to 17 feet thick.

3.1.3.5 Tailings Dam

The tailings dam has been constructed of earth and rock, and designed essentially as a water-retaining structure. Mill tailings will not be utilized in this dam structure. (See the Operations and Maintenance of the Tailing Dam, Appendix 3.)

3.1.3.6 Seepage

Embankment design includes a relatively impervious clay core in the main and saddle embankments to control seepage losses from the tailings impoundment sediment pond. A seepage cut-off wall was constructed through the highly-permeable peat immediately beneath the embankments. Seepage is expected to be on the order of 1-2 gpm. The amount of vertical seepage losses would be minimized due to the low permeability soils and are estimated to range from 4-6 gpm.

At the main embankment, water depths of from 8 to 12 feet are expected to be retained under normal operating conditions. Based on an average head of 10 feet, the approximate quantity of seepage through the main embankments is expected to be less than one gallon per minute. The spillway was established at the 147.5 foot elevation and designed to pass the one in 100-year flood.

Estimate seepage losses from the dry tailings effluent sedimentation pond during its operating life is expected to be approximately 8 gpm (SRK October, 1987, p.19). However, no seepage has been observed.

A seepage return structure is located downstream of the sediment pond to intercept any seepage from the core of the main embankment. Water in the seepage return structure is being monitored and, if the water quality does not meet state and federal discharge requirements, it is pumped to the tailing effluent sedimentation pond. Permitting for the structure is in accordance with the Federal Clean Water Act.

3.1.3.7 Tailings Outflow

The Alaska Department of Environmental Conservation (ADEC) has established receiving water quality standards pertinent to discharge of wastewater from the tailings pond into the marine waters of Hawk Inlet (See Appendix 2). Under the NPDES permit, 3.60 mgd are permitted with a 1.66 mgd 30-day average requirement. Discharged water from the treatment basin can not exceed, at the boundary of the mixing zone, the standards set by ADEC. The mixing zone is an area around the diffuser measuring 300 feet by 1,000 feet. The table on the following outlines water quality criteria of interest to the mine that have been incorporated into the ADEC water quality standards as set in the NPDES permit for Greens Creek Mine.

TABLE 2 - ADEC WATER QUALITY STANDARDS - Greens Creek Mine NPDES

Parameter	Water Quality Standards	
	24-hr. Average (mg/l)	Daily Maximum (mg/l)
Arsenic (As)	0.005	0.005
Copper (Cu)	0.004	0.023
Chromium (Cr)	0.018	1.26
Lead (Pb)	0.007	0.007
Mercury (Hg)	0.000025	0.0037
Nickel (Ni)	0.007	0.140
Selenium (Se)	0.010	0.010
Silver (Ag)	0.0023	0.0023
Zinc (Zn)	0.058	0.170
Cadmium (Cd)	0.010	0.010
Free Cyanide (CN)	0.0003	0.0003

The U.S. Environmental Protection Agency (EPA) has established effluent limitations for all discharges from the tailings basin to marine waters. These limits are "end of pipe" standards. That is, the discharge from the tailings basin must be in compliance with the standards before the effluent is discharged into Hawk Inlet. A listing of EPA effluent limitations and monitoring requirements are listed in the following table.

TABLE 3 - EPA EFFLUENT LIMITATIONS/MONITORING REQUIREMENTS

Effluent Characteristics		Effluent Limitations* (Total)		Monitoring Required	
Daily	30-Day	Maximum	Average	Frequency	Sample Type
Flow (mgd)		3.60	1.66	Continuous	Recorded
Copper (mg/l)		0.3	0.15	Weekly	Grab
Zinc (mg/l)		1.0	0.5	Weekly	Grab
Lead (mg/l)		0.6	0.3	Weekly	Grab
Cadmium (mg/l)		0.10	0.05	Weekly	Grab
Mercury (mg/l)		0.002	0.001	Weekly	Grab

Free Cyanide**(ug/l)	5.30	2.65	Weekly	Grab
Arsenic (mg/l)	N/A	N/A	Weekly	Grab
Chromium (mg/l)	N/A	N/A	Weekly	Grab
Nickel (mg/l)	N/A	N/A	Weekly	Grab
Selenium (mg/l)	N/A	N/A	Weekly	Grab
Silver (mg/l)	N/A	N/A	Weekly	Grab
Suspended solids (mg/l)	30.0	20.0	Weekly	Grab
pH (pH units)	(see para. 2 below)		Daily	Grab
Temperature (^{o}C)	N/A	N/A	Daily	Grab
Manganese (mg/l)	N/A	N/A	Weekly	Grab
Chloride (mg/l)	N/A	N/A	Weekly	Grab
Turbidity (NTU)	N/A	N/A	Continuous	Recorded

* Effluent concentrations were derived from EPA ambient water quality criteria using a safety factor of 100 and a dilution factor of 265:1.

** Effluent samples are monitored at a location representative of the tailings impoundment wastewater without dilution from any outside sources.

Other conditions outlined in the NPDES permit that affect monitoring are:

· There shall be no discharge of floating solids or oily wastes which produce a sheen on the surface of the receiving water.

· The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.

· All discharges shall comply with Alaska Water Quality Standards (18 AAC70).

· Treatment impoundment must be designed (free board provision), constructed and maintained to include the volume of water that would result from a 10-year, 24-hour precipitation event.

· The diffuser outfall shall have an average depth of minus 40 feet mean lower low water. An as-built survey of the pipeline and marine outfall diffuser shall be submitted.

The ADEC and EPA discharge limitations were formalized in a National Pollution Discharge Elimination System permit (NPDES) which was coordinated with involved agencies, opened to public review, and issued in 1987.

Treated water is discharged from the tailings impoundment into a pipeline and through a diffuser into Hawk Inlet. The diffuser at the end of the pipeline aids in the dilution of the effluent with marine waters. The average design discharge to Hawk Inlet normally range

from 600-900 gallons per minute. However, actual average discharges will vary on a daily basis in response to rain fall, temperatures, and runoff. The NPDES discharge permit issued in 1987 limits the 30-day average discharge to 1,150 gpm with a peak daily discharge rate of up to 2,500 gpm.

The tailings impoundment has been designed to retain the 10-year/24-hour recurrence flood without use of the spillway. Runoff that exceeded the design storm would cause water to be released from the pond, through the spillway and into marine waters.

Under this approved design, the cannery muskeg tailings pond would overflow into the lower portion of Hawk Inlet during extreme rainfall events. Water quality of overflows would be similar to normal tailing pond discharge. The overflow would enter Hawk Inlet through a designed spillway as a point source between the cannery and the Greens Creek delta. The overflow would be of short duration (up to 6 hours), and localized water quality degradation could occur during the overflow. ADEC standards could also be exceeded during the overflow. Mathematical modeling indicates that flushing of such an isolated, short duration incident would be at least 95 percent complete within 60 hours. Localized dilution would proceed more rapidly. The impact of such an event will be insignificant due to the short duration and dilution from runoff waters.

A formal sampling program for fresh water including NPDES permit streams and wells has been developed. Detailed data regarding the outflow sampling is found in the Greens Creek Water Monitoring program. (See Appendix 1.)

3.2 Tailings Dam Operation

The dry tailings pile contains centerline and finger drains under the tailings, crossroads for access from the main haul road, and a rockfill embankment at the toe of the tailings pile. The tailings pile will eventually reach a maximum height of approximately 80 feet.

The dry tailings pile is constructed in sections (panels) and raised and compacted in 2-4 foot layers. When tailings reach the southern-most panel, a rock embankment at the south toe of the tailings pile will be constructed. As the size of the tailings pile increases to the south, the chances of the sediment pond periodically rising above the downstream toe of the tailings pile increases, therefore, the addition of the rock embankment as slope protection was developed. In addition, it also functions as a toe drain for the dry tailings pile. Water level over the rock toe will be approximately one foot as the final stages of the mine life. (See Appendix 3.)

The water level of the impoundment will operate between an elevation of 142 feet and 145 feet. Sediment storage will be maintained between 130 feet and 142 feet. The

elevation from 145 feet to 146.5 feet will be reserved as free board, to contain the 10-year/24-hour storm event.

4 DOCK FACILITIES

4.1 Marine Terminal (Cannery)

Offloading and storage of supplies and storage and shiploading of concentrates are provided at the terminal complex near the old cannery site in Hawk Inlet. The major portion of the supplies and concentrates are stored at this facility.

Containerized supplies are transported to Hawk Inlet by barge, unloaded by a forklift, and transported to either the 960 warehouse or the Hawk Inlet warehouse by flatbed truck. Fuel oil is received in bulk by special barges and is pumped to its respective storage tanks on shore. Supplies, such as lime and cement are received in bulk in specialized seavan containers, which are used to transport and transfer the product to their appropriate silos at the mill site.

Supplies received in containers or on pallets are stored in a warehouse which can hold 60 days storage for consumable supplies such as mill reagents. All supplies are transported to the mine/millsite by truck as needed. A minimum of two weeks storage of all supplies is kept at the mine/millsite. This reduces the impact unsafe road conditions might have on supply availability and limits the potential for environmentally hazardous spills.

A sedimentation pond was constructed at Hawk Inlet to collect surface runoff from the entire Hawk Inlet facility. Water from the sediment pond is pumped via a pipeline to the tailings impoundment for finial discharge through an existing NPDES permit.

A telescoping boom conveyor is used to transport concentrates from the shore storage area directly into the holds of the ships. Concentrate spilled from the conveyor belt will be collected at the bottom of the enclosure and returned to shore for reloading.

Existing bunkhouse facilities have been upgraded for emergency housing for those times when employees cannot be removed from the Island. Under such conditions, a maximum of 160 workers might remain at the cannery site for two to three days. There will be no

employees permanently housed within the project area, however during special periods employees may be temporarily housed on a rotating basis. KGCMC has implemented a "no guns or traps" restriction for anyone traveling to and from the project area by company boat, thus eliminating increased hunting and trapping pressure by project personnel, including contractors and subcontractors.

4.2 Young Bay Dock

The Young Bay dock is primarily a pedestrian dock. Only those small quantities of supplies which may be carried on the personnel boat such as parts, hand tools, and small items of general supply are unloaded. All heavy equipment and major supplies are landed at the Hawk Inlet Marine terminal.

5 ROADS

The established road network consists of 4.85 miles of 14-foot wide road between the marine terminal (old cannery site) and Young Bay plus 8.5 miles of 16-foot wide road between the marine terminal and the mine/mill plant site. There is an additional mile of 14-foot road connecting the existing support portal with the plant site. The 8.5 mile portion of the road between the mill and tailings dam also serves as the right-of-way for the mill waste water line.

The road was constructed in the manner of a logging road following normal Southeast Alaska practices. The road was pioneered with a large backhoe and overlaid with shot rock fill. Filter fabrics were used in muskeg areas to provide better stability and reduce required fill quantities. Special attention was paid to road drainage due to very sensitive environmental considerations related to water quality. Stream crossings were made with culverts, CMP arches or prefabricated bridges. Road grades are less than 8 percent, except for a very small portion of 18 percent. Turnouts are provided for passing.

5.1 Snow Removal

Road maintenance equipment specifically for snow removal includes a motor grader, plow trucks, and sand trucks. Snow removal and sanding are conducted on existing roads only. Plowing and sanding of the "B" road extension are not done because of a 18 percent grade in the lower extension could create extremely hazardous conditions. Greens Creek limits the use of the "B" extension road from December to March. If the "B" extension road cannot be maintained, then snowmobiles are used to access the 1350 level.

To augment plowing, and sanding, moderate uses of salt, and low-toxicity ice melting compounds are used. Salt and low toxicity ice melting compounds may be mixed on a ratio basis with sand to assure safe travelways for men and equipment.

Snow which must be stored until it can melt is "stored" at the mill site. (See Appendix 8.)

5.2 Slides

Slides which occur are cleaned up to allow road traffic as soon as possible. Trees are cut and placed along the roadside. Other materials are placed at Waste Site E, or appropriate areas designated by the US Forest Service.

6 BUILDINGS AND SHOPS (MINE/MILL LOCATIONS)

Three buildings accommodate all shops, warehousing, milling, assay laboratory, and all dry and office facilities. A generator/compressor building is located on the west end of the mill building.

Maintenance, shops and the dry room are located on the ground floor of the main service building. Frequently used items and materials are stored in the 960 warehouse. Supplies handling and distribution are accomplished through use of a forklift. Maintenance of surface and some underground equipment is carried out in a common shop area, which is capable of servicing rubber-tired equipment. Additional underground shop facilities are located in the mine. During periods of heavy underground shop use, equipment is sent to the surface shop to be serviced. Specialty shops, such as welding, electrical, machining and carpentry, are contained in the main service building. The assay laboratory is located in the mill building, remote from dust and vibration, and provides sample preparation and analyses for geology, ore control, mill and environmental water samples. The first-aid station is located on the ground floor of the main service building near the employee loading and unloading area.

Offices are located on the top floor of the main service building. Offices for minesite salaried employees, except those directly associated with the mill, are located on this floor.

A small electrical and construction shop building (860 shop) is located at the waste site "C", mine waste storage area. Four trailers are used as offices for additional personnel. Two trailers are located next to the main office dry. These trailers house safety and training functions. The remaining two trailers are located adjacent to the powerhouse and mill facilities. A pump house next to Greens Creek contains fresh water pumps for plant and domestic needs and a switchgear building is also located in this area.

One building remains at the 1350 level. An emergency housing unit to be used in the event of a cold weather mine evacuation from the 1350 level. The building will be removed for final reclamation of the 1350 waste area.

The cannery buildings are maintained to accommodate miners, mill operators, and salaried personnel in the event travel back to Juneau is unsafe. It is anticipated that travel will be restricted about nine days a year.

7 POWER DISTRIBUTION

Three GEC Ruston-type 12-RKC turbocharged and intercooled, heavy duty diesel engines, and a Cat 3516 generator were installed at the mine/millsite. The three units will produce a combined rated capacity of 4,400 kilowatts while the fourth generator will serve as a standby unit. Although the projected maximum and average loads are somewhat less than the rated capacity, emissions are calculated based on the rated capacities of the engines.

The electric power requirement at the ship terminal for lights, heat, communications equipment and shiploading is satisfied with three existing diesel generators at the cannery. Two of the existing units are rated at 275 kilowatts and the third is rated at 300 kilowatts.

The mine/millsite and ship terminal are considered as separate facilities. The only air contaminant subject to BACT review is NO_x at the mine/millsite. Diesel generators account for almost all of the total NO_x emissions at the mine/millsite, as well as emissions of SO_2, CO, and HC.

A small generator at Young Bay is used to light the walkway during docking and crew changes.

7.1 Emissions

7.1.1 Oxides of Nitrogen

Emissions of NO_x are minimized by selecting engines with inherently low emission rates, matching engine performance characteristics with the power and torque characteristics for each application and through proper maintenance. Retarding the fuel injection timing

and selective catalytic reduction are alternative NO_x control techniques which were rejected because of maintenance and cost considerations.

Retarding the fuel injection timing in an internal combustion engine reduces NO_x emission rates by causing more combustion to occur during the expansion stroke. This effectively lowers the peak combustion temperatures and pressures and reduces NO_x formation. However, retarding the injection timing can have negative affects on fuel consumption,power output and engine life. Exhaust temperatures are higher and fuel consumption is increased because less of the energy input is converted to work. Higher exhaust temperatures can result in damage to the exhaust valves and turbocharger turbine.

The NO_x emission rates for the Ruston engines are less than or equal to those for the average diesel engine.

New Source Performance Standards (NSPS) for stationary internal combustion engines, including diesel engines, were proposed in 1979 but have not been promulgated. The proposed standard is aimed at reducing NO_x emissions and limits the NO_x concentration in diesel exhaust to 600 ppm corrected for the presence of 15 percent oxygen on a dry basis. This is more stringent than can be met by many currently available engines. The diesels used at the Greens Creek project meets the emission limit of 975 ppmvd at 15 percent oxygen. Selection of the Ruston RKS turbocharged diesel engines satisfies BACT requirements for this project.

7.1.2 Sulfur Dioxide

Sulfur dioxide emissions from diesel engines result from burning of sulfur in the fuel. Greens Creek will burn No. 2 diesel fuel or a mix of No. 1 and No. 2 fuels, with reduced sulfur content.

7.1.3 Carbon Monoxide, Hydrocarbon and Particulate

7.1.3.1 Emissions

The Prevention of Significant Deterioration (PSD) applicability threshold for particulate matter was changed on July 21, 1991. Now, the threshold is 25 tons per year of particulate matter or 15 tons per year of particulate matter smaller than 10 microns in diameter (PM-10). Most particulate emissions from a diesel would be PM-10. If

emission of any regulated air contaminant exceeds thresholds listed in 18 AAC 50.330(a)(6)(C), a BACT analysis and ambient impact analysis will need to be prepared as part of a permit application.

8 SOLID WASTE DISPOSAL

8.1 Cannery Facilities

To minimize wildlife attraction, solid combustible wastes, including food residues, are collected on a daily basis at each major activity area and taken to an incinerator at Hawk Inlet where the waste is burned. The incinerator is a commercial oil-fired facility sized to handle the maximum projected wasteload. The incinerator meets air pollution standards for particulate emissions. Residues from the incinerator are disposed of in the tailings impoundment during operation. Residues are buried with dry tailings and only in that part of the impoundment away from standing water.

The incinerator is a single-chamber, industrial/commercial incinerator and is used primarily to dispose of domestic refuse including cannery refuse when the kitchen is open. The incinerator is a Consummate C32P and is located at the cannery.

Emissions from the incinerator must comply with the State standard limiting opacity to 20 percent for no more than three minutes per hour (18 AAC 5.40(a)(1)). The incinerator is exempt from the State particulate emission standards in 18 AAC 50.040(b) because its rated charging capacity is much less than 1,000 pounds per hour. Federal New Source Performance Standards apply only to incinerators with charging rate greater than 50 tons per day. (See Appendix 9.)

8.2 Mine/Mill Site

Waste is collected and segregated at the mine site into three waste streams, burnable, inert, and ferrous metal. All burnable wastes are taken to a industrial compactor at Hawk Inlet. When the compactor is full it is shipped to Juneau, and incinerated. Inert wastes are collected until quantities merit a shipment to Juneau, where the waste is sent to an

incinerator and a landfill. Such wastes would include items which are not suitable for burning in an incinerator or recyclable as steel. Ferrous metal is collected and stored at Hawk Inlet, until sufficient quantities are obtained, and sent to a recycler. Those waste which should be classified as hazardous are either recycled or sent to a licensed disposal facility.

9 FUEL STORAGE AND HANDLING

Bulk fuel is shipped via barge or tanker from Juneau by bulk oil vendors. Normal bulk fuel delivered includes No. 1 diesel, No. 2 diesel, and limited quantities of unleaded gasoline.

Fuel can be delivered by the mainline fuel barge directly to the fuel farm. Fuel is transported from storage tanks at the Cannery to storage tanks at the mine by a 5,000-gallon tanker truck. An average of three round trips per shift, five shifts per week of diesel fuel is necessary to support a full capacity mining and milling rate.

An alternate means of transporting No. 1 or No. 2 diesel fuel is being considered. This would be by ISO containers which are 20 feet long and hold 5,000 gallons.

All fuel is stored above ground, away from major stream courses and water bodies, in diked or double lined steel tanks. In the event of a ruptured tank, the contents of the tanks will be contained by dikes constructed in compliance with Federal oil pollution prevention regulations (40 CFR 112). Bulk storage tanks at the cannery hold a 40-day supply of fuel (approximately 200,000 gallons of fuel). An additional 60,000 gallons of fuel is stored at the mine service area. (See Appendix 6.)

Less than 1,000 gallons of gasoline will be stored at each site. Lubricating oils are stored in 55-gallon drums or in reusable 300 gallon flow totes in warehouses at both sites.

Federal requirements cover any facility storing over 1,260 gallons above ground and 42,000 gallons below ground. Therefore, a federal contingency plan has been developed for the facilities. (See SPCC Plan.)

10 FIRE PROTECTION

The fire protection system was designed to meet applicable fire codes and the requirements of KGCMC's insurance underwriter. In general, each site has an underground water distribution network, with fire hydrants at the required distance from buildings and other structures. The design criteria for water service call for a 4-hour rate of 500 gpm for fire, and a pressure range of 37 psi. A diesel booster pump is part of the system.

The "Operations Manual" for the Hawk Inlet marine facility, required by the U.S. Coast Guard, includes a description of fire safety equipment and procedures for use.

The USFS requires a fire plan which is in effect from April 1 to October 31 of each year. The plan will be implemented by KGCMC and managed according to the provisions set out in the fire plan (see Appendix 13).

11 SPILL PREVENTION (SPCC)

The Spill Containment and Control Plan, required by the U.S. Environmental Protection Agency, lists equipment on hand at the facility, and includes instructions for use by KGCMC personnel during a spill or clean-up operation. (See Appendix 6). KGCMC is also required to have a contingency plan in accordance with the Oil Pollution Act of 1990.

12 RECLAMATION

12.1 General Reclamation Plan

The purpose of reclamation is to return as much as possible of the disturbed areas in the monument to pre-project conditions and to reclaim non-monument areas as required to ensure protection of resources.

Reclamation practices that have been developed in other mining areas are expected to work successfully at the Greens Creek mine. However, some revegetation experiments will be conducted during the mining operations to determine optimum soil preparation, plant species, planting practices, and fertilizers for the range of soils, slopes, and microclimates present in the disturbed project area. Field test plots will be established and evaluated prior to reclamation (See Appendix 14).

A survey of soil types has been completed on all areas affected by the project, to determine reclamation suitability. There are no known metal or salt substances that would be deleterious to plant growth. Plant nutrients are low, indicating that fertilizers may be required to facilitate revegetation.

The general sequence of the reclamation process includes but is not limited to:

- Removal and stockpiling of topsoil (where possible) during construction.
- Removal of buildings, pavement, bridges, and culverts at end of project.
- Regrading, to the extent feasible, to blend with natural contours and original drainage systems.
- Topsoil replacement with soil amendments, as required.
- Reseeding with appropriate grass and forest species.
- Mulch and fertilizer application as required.
- Maintenance of erosion controls, such as sedimentation ponds, until grass cover develops.
- Maintenance and repair of reseeded areas until vegetation is established.

Yearly reclamation occurs as slides and areas disturbed after the previous growing season. See Appendix 14 for the detailed Reclamation Plan.

12.2 Tailings Pond Reclamation

Tailings pond reclamation include removal of free water from the tailings. The area is then revegetated using suitable grasses and trees, such as red fescue, hemlock, Sitka spruce, and alder. If required for plant growth, additional soil or rock materials would be deposited on the surface of the tailings.

The surface of the tailings pond is sloped slightly to direct runoff away from exiting streams. The dam crest is left at least three feet above the tailings to prevent any possibility of runoff over the dam.

12.3 Upper Portal Area

Areas at this site will be reclaimed during the first years of operation to test the suitability of proposed reclamation methods.

The upper portal (1350) was hydro seeded in 1990 with the approved Forest Service seed mix. The small dams used to hold sediment created by exploration were pulled. Prior to pulling the dams the sediment was pumped back to the larger retention dam and held. The log dams, and the plastic liners were pulled, and removed. The entire area was then reseeded, after the waste pile and the site was "graded". The area then had bare rooted red alder plants planted. Additional hydroseeding was conducted in subsequent years (1991,92, and, 93).

Germination was extensive, and both grasses and clover are beginning to establish as ground cover.

KGCMC has established several reclamation plots in conjunction with the Alaska Plant and Material Center to determine which endemic grass species would be best for long term reclamation projects. The plots are evaluated each year and the more appropriate species will be identified.

13 ENVIRONMENTAL MANAGEMENT

The goal of KGCMC, the U.S. Forest Service, and other state and federal agencies, is to use management practices and methods which limit impacts to the air, water, land and disturbances to wildlife.

This Plan of Operations includes environmental requirements from the EIS, EAS, USFS, ADEC and other agencies and permits.

13.1 Forest Service Authorities

The legal authority for mining in Admiralty Island National Monument is found in Section 503(f)(2)(A) of ANILCA. ANILCA's emphasis on environmental protection underscores the importance of a systematic review of all significant direct and indirect environmental impacts associated with development of the proposed mine. Specific actions required of the Forest Service are:

- Issuance of permits or leases as appropriate for all surface development on National Forest Land.
- Issuance of a special use permit for roads and other facilities located on National Forest (including Monument) land.
- Issuance of a lease for lands to be used for milling purposes on National Monument Land.
- Approval of this General Plan of Operations.
- Approval of Annual Work Plans covering specific work to be done for a given calendar year.

13.2 Other State/Federal Requirements

Before operation of the Greens Creek Project could begin KGCMC obtained necessary permits. The major permits or review actions are:

State of Alaska, Department of Natural Resources (ADNR):

- Tidelands permit and lease
- Water rights permit

State of Alaska, Department of Environmental Conservation (ADEC):

- Solid waste disposal permit
- Certification of compliance with Alaska water quality standards
- Air Quality Control Permit
- Prevention of Significant Deterioration Permit (PSD).

State of Alaska, Department of Fish and Game (ADF&G):

- Specification of stream crossing structures for all fish streams under AS 16.05.840.
- Review and approve, alter, or reject all activities which may affect anadromous fish streams under AS 16.05.870.
- Review and approve, alter or reject all activities which may affect passage of native fisheries.

U.S. Environmental Protection Agency (EPA):

- National Pollution Discharge Elimination System Permit (NPDES) (as required for sediment pond, domestic waste, storm water, and tailings pond discharges).
- Spill Prevention Control and Countermeasure Plan (SPCC).

U.S. Army Corps of Engineers:

- Approval of the discharge of dredged or fill materials into waters under Section 404 of the Clean Water Act.
- Approval of the construction of structures or work in navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899. This includes fisheries barrier modification projects.
  Coast Guard approval (permit) also had to be secured to place tailings base structures (fill) on wetlands.

U.S. Coast Guard:

- Operations Manual (for fuel transfer facilities)
- Contingency Plan (Oil Pollution Act of 1990)

13.3 Monitoring Plans

13.3.1 Fisheries Mitigation

To offset long term, unavoidable production losses to the anadromous fishery of the project area, GCMC agreed to the following mitigation program (see Appendix 4) to replace lost habitat through (1) a modification of the waterfall barrier at road marker 5.0 on the "B" Road, and (2) creation of at least five jump pools to allow adult migrating salmon to pass the barrier. This action made available approximately two miles of habitat which contain at least one acre of usable habitat not previously utilized by anadromous fish for spawning or rearing.

Mitigation measures were monitored by KGCMC for three years. A determination on completion of the mitigation is still being reviewed by the US Forest Service and KGCMC. Proper functioning of the fish pass will be assured through semi-annual maintenance checks and carrying out any necessary repairs for the life of mine.

13.3.2 Fisheries Monitoring - Spawning Gravel

The spawning gravel monitoring program was designed to verify the predicted effects of sediment additions, the efficient operation of the settling pond system, and the recovery period for any short term unavoidable fine sediment additions to Zinc Creek and Greens Creek during the construction phase. Results from current research on fine sediment accumulation in spawning gravel beds is conclusive as to the exact degree of impact on anadromous salmonid production. The project design has addressed these impacts in a number of ways: Construction timing, settling ponds, and well-designed road run-off systems. However, it will not be clear that these items are working as planned unless they are verified through monitoring.

TABLE 4 - Spawning Gravel Sites Monitored Through 1991

Site No.	Location
201	Zinc Creek Above Tributary
202	Tributary Creek
203	Zinc Creek Below Tributary
204	Lower Greens Creek above cable
205	Lower Greens Creek below cable
206	Head of Greens Creek Delta

In 1991 a review of all data indicated no impact to spawning gravel and the program was scaled back to monitoring sites 203 and 206 once per year. In 1994 the spawning gravel program was concluded. The monitoring program provided the information required by the EIS and associated study plan. The study plan identified that a 25% increase in sediment would be the level at which some action would be taken. All sites, with the exception of one site that is well downstream of the mine and waste rock sites (Site 205), was below the 25 percent level. At site 205 there was some local natural streambank disturbances that may have resulted in the increased levels of sediment. Appendix 4, Section 4 discusses the spawning gravel program in detail.

13.3.3 Wildlife Monitoring

A monitoring plan for bald eagles and brown bears was developed by KGCMC and approved by the Forest Service and ADF&G. Monitoring of these species was conducted for four years during operation. Detailed monitoring plans for eagles and brown bears are included (see Appendix 4). Annual operating plans were adopted to provide protection for these species.

Bald eagle nest sites were monitored to insure compliance with the Bald Eagle Protection Act. Nests sighted in Hawk Inlet and Young Bay were checked in April to determine nesting activity and in July to determine nesting success. Eagle monitoring was conducted by the U.S. Fish and Wildlife Service, with assistance from KGCMC.

Brown bears were monitored to ensure EIS compliance with ANILCA, to document and verify the effects on the brown bear population, and to provide basic information that can be used during operations to identify sources of possible impacts and subsequent mitigation measures. Bear monitoring was conducted by ADF&G, with assistance from KGCMC.

Since information was not available to establish a baseline from which to predict possible effects on the bear population, the Company and ADF&G initiated a cost-share study in Greens Creek in 1981. The purpose of this effort was to establish baseline information on bear densities, movements, and habitat utilization. In addition, the effects of project implementation on those parameters are to be measured. While information is just now becoming available, the full benefits of this information will not be derived until project development and operation has begun.

13.3.4 Freshwater Quality Monitoring - Surface Water

Water quality monitoring plans are reviewed by EPA, ADEC, Forest Service, and other interested agencies annually through the Annual Work Plan.

Effectiveness of specific monitoring plans, including sites to be monitored, parameters to be measured, and sample frequency, will be reviewed and evaluated.

Monthly flow monitoring is conducted in upper Greens Creek, upper Zinc Creek, the mine service area sedimentation pond discharge (see Appendix 1), and continuous monitoring at the tailings pond marine discharge (see Appendix 2). Monitoring during reclamation will be necessary only on Greens Creek, Zinc Creek, and Tributary Creek, if no other water quality problems have been detected.

Additional stations were monitored through the construction phase of the project to access the effectiveness of sediment control measures. These stations include all settling ponds and major stream systems along the road corridor.

13.3.5 Groundwater Quality Monitoring

Seven water quality monitoring wells have been drilled downslope and one upslope from the tailings impoundment.

Downslope locations were chosen to detect potential seepage. The EA stipulates these wells will be monitored monthly the first year of operation, semi-annually through the remainder of operations and the first three years of reclamation, and annually for two additional years.

TABLE 5 - Well Locations

Site No.	Deep	Shallow
25		X
26	X	
27		X
28	X	
29		X
30	X	
31		X
32		X

13.3.6 Freshwater Aquatic Biota Monitoring - (NPDES)

Heavy metal tissue burden analysis is measured annually for fish species in freshwater. This analysis is conducted in conjunction with the analysis of heavy metals in the water column. The program will continue for the life of the mining operation (see Appendix 2).

A summary of freshwater monitoring requirements include:

1. Monitoring will continue for the life of the mining operation.
2. The NPDES permit and the ADEC water quality certification include standards for both the effluent discharge and receiving water, and comply with all aspects of the Clean Water Act.
3. Specific monitoring schedules will be included in the Annual Work Plans.

13.3.7 Marine Water Quality Monitoring - (NPDES)

A marine water quality monitoring plan is required as part of the discharge permit process and subject to approval by EPA. The monitoring plan includes five marine water quality monitoring locations (the neck of Hawk Inlet, near the cannery dock, outside Greens Creek delta, Chatham Strait off Hawk Point, and the discharge point of the tailings outfall line) to be sampled quarterly during operational phases of the project. Water quality monitoring parameters will be for total metals.

Monitoring requirements are designed to insure compliance with applicable standards.

TABLE 6 - Marine Sampling Locations

Site No.	Location
104	Neck of Hawk Inlet
105	Hawk Inlet off Greens Creek
106	Chatham Strait off Hawk Inlet
107	Mid Hawk Inlet off Cannery
108	Outfall Sampling Point

13.3.8 Marine Aquatic Biota Monitoring - (NPDES)

Representative samples of indicator species of mussels, clams, and crabs will be taken semi-annually during operations near the cannery dock, near the Greens Creek delta and within the tailings impoundment pond discharge mixing zone. Shellfish tissues will be analyzed for metals. Benthic communities will also be sampled semi-annually during operations in five intertidal locations; the head of Hawk Inlet, near the cannery, Greens Creek delta, outside Hawk Inlet, and the tailings pond discharge site (see Appendix 3).

A summary of marine aquatic biota monitoring requirements include:

1. Monitoring will be conducted by GCMC and the results analyzed by ADEC.
2. The data from each monitoring will be reported in chart form.
3. Sampling will occur semi-annually.
4. Monitoring will continue for the life of the mining operations.
5. The NPDES permit and the ADEC water quality certification including standards for both the effluent discharge and receiving water quality. The permits' monitoring requirements include procedures to be followed if tissue analysis indicates a build-up of heavy metals in the marine environment.

14 LAND USE AUTHORIZATIONS REQUIRED

The U.S. Forest Service is responsible for the issuance of leases, special use permits, timber sales, and other authorizations for activities identified by GCMC as part of the General Plan of Operations and any subsequent Supplemental Plans of Operations. All plans must meet NEPA requirements and approved prior to implementation.

KGCMC will submit plans and information sufficient to describe land needs, uses to be made of land, including schematic drawings showing area, facilities, clearing limits and other essential details.

The Forest Service will review information submitted, and will prepare the appropriate permit or authorization, including appropriate requirements and conditions. Upon acceptance by KGCMC, and submittal of any fees required, the approved permit or authorization will be issued by the Forest Service.

The following authorizations are required:

1. Annual Work Plans - These plans set forth work to be conducted during the upcoming year in greater detail operations covered by the General Plan of Operations. The Annual Plans cover overall project activity, mitigation, monitoring, specific activities on valid claims, including development of the storage areas, activities, and exploration on unperfected claims and valid claims. These plans are approved by the USFS and undergo a review by the State Department of Governmental Coordination.

2. Special Use Permits - A special use permit has been issued to authorize construction and maintenance of the road for the life of the mine.

3. Leases - Leases are required for the milling and mining-related use of lands that are not authorized on such lands under other provisions. Such lease shall provide for

refund of any lease fees during the period of adjudication if the claims are determined to be valid.

4. Minerals Materials Contracts - Minerals materials contracts are required to authorize use of quarry material for construction and maintenance purposes. Quarry No. 7 has been designated to serve as the rock source for the life of the mine.

5. Timber Disposal Sales - Timber disposal sales contracts or permits will be required preceding clearing operations for any additional clearing. Timber removal will be authorized subsequent to approval of plans for various other facilities.

14.1 Waste Rock Disposal

Waste rock has been placed in waste sites C, D, and E, and is planned to occur at site 23A. Much of the waste rock produced was kept underground and placed in mined-out stopes or used for backfill. In 1990, the Company began discussions with the Forest Service concerning additional waste sites. Through the NEPA process an Environmental Assessment (EA) for additional waste rock disposal capacity was initiated. Completion of the EA was in November 1992 and resulted in the approval of waste site 23A.

Waste Site E has an approved operating plan which is found in Appendix 11. Waste Sites C and D were phased out in 1991 and the majority of waste rock has been disposed of in Waste Site E. Some waste rock has been used in hard surfacing the tailing slopes, construction of settling ponds, and ramps in the tailings area.

14.2 General Conditions

The Forest Supervisor will be notified at least one week prior to the start of operations and at least one week prior to operations ceasing.

During operations, Forest Service representatives will be notified prior to undertaking any surface disturbance not described in the operating plan. Forest officers will inspect the site periodically to assure compliance with the operating plan.

In accordance with 36 CFR 228.8, "all operations shall be conducted so as, where feasible, to minimize adverse environmental impact on National Forest surface

resources". All requirements for environmental protection contained in 36 CFR 228.8 will apply.

In addition, all applicable requirements of 36 CFR 252.9. 252.10, and 252.11 pertaining to maintenance during operations, public safety, removal of structures and equipment, and fire prevention and control shall be met.

Use and storage of explosives will be conducted in accordance with applicable state and federal laws.

If, during the initial survey or during any subsequent ground altering activities, any cultural or paleontological remains are encountered, work in that area will stop and the Forest Service will be notified immediately. An immediate determination as to the significance of the remains will be made by the Forest Service archaeologist. Mitigating measures will be enacted to ensure the protection of these resources and may include relocation of the drill site, or excavation of the remains.

No seismic activity will be conducted during August without prior approval of the Admiralty Monument Manager.

Approval of the use of water from National Forest lands during drill operations does not in any manner constituted certification of water rights.

Discharge of any petroleum products into any aquatic upland ecosystem is prohibited. Any accidental spills of petroleum products shall be reported to the US Coast Guard immediately. Petroleum product spills in other than saltwater shall be reported to the Alaska Department of Environmental Conservation immediately. A contingency plan for clean-up of any petroleum product spills has been prepared (see Appendix 6). The plan includes materials and methods of spill clean-up as approved by the U.S. Coast Guard and Alaska Department of Environmental Conservation.

Greens Creek Mining Company will not allow hunting or trapping in the project area by Greens Creek personnel or by contractors working in the area. Guns will be allowed only for the protection of life and property as state law allows. Greens Creek will also post the roadways from Young Bay to the cannery and from the cannery to the 920 portal, which will prohibit non-Greens Creek personnel from using the roadway to access hunting and trapping areas.

The harassment of wildlife by low flying aircraft is prohibited.

The baiting or feeding of any wildlife species is prohibited.

14.3 Brown Bears

In 1981, a baseline monitoring program was initiated by the Alaska Department of Fish and Game, with financial support from GCMC to collar and track brown bears, identify home ranges, migration patterns, and denning sites. Initial reports from this effort identify bears in the project area by age, sex and tag characteristics.

The major effort by KGCMC will be to prevent bears from being attracted to the site in order to prevent the risk of a nuisance problem occurring.

GCMC will continue to use the oil fired incinerator installed in 1985 at the marine terminal. All wet garbage from the 920 mine/millsite, and the marine terminal will be incinerated.

GCMC's policy is as follows: "No person may intentionally feed bears, wolves, foxes, or wolverine, or intentionally leave food or garbage in such a manner that it attracts these animals."

14.4 Bald Eagles

Management of the bald eagle is provided for under the Federal Bald Eagle Protection Act (BEPA). In addition to other requirements, the act prohibits the disturbance of bald eagles.

Disturbance to nesting eagles may result from construction and exploration activities (including blasting) and helicopter overflights. The period of March 1 to June 15 is most critical, as the eagles choose nesting sites at this time. July 20 through August 15 is also a critical period as the feathered young are learning to fly and may be frightened into a premature departure from the nest.

Mitigation measures may include timing of construction, reducing the level of construction activity in close proximity to nests, providing topographic and vegetative screening, and/or reducing the noise level.

Helicopters are to fly so as to minimize disturbance to wildlife, maintaining an elevation of 500 feet above ground level and 0.5 mile distance from beaches and estuaries; this will be adequate to minimize disturbance to bears, eagles, and waterfowl.

14.5 Blasting in Proximity of Streams

To avoid damage to fish from blasting in the proximity of streams, the following charge-distance table shall be used as a guide:

TABLE 7 - Blasting Charge Distance Table

Distance Ft.	Charge Wt. per Delay (8ms) Lbs.
20	2.4
40	9.6
60	21.5
80	38.4
100	60.4
120	86.4

15 CAMP OPERATIONS

The construction camp location at the Hawk Inlet marine terminal continued in operation until early 1989. Although the mine crews were commuting from Juneau, the construction crews were housed at Hawk Inlet until construction ceased. Some contractor personnel commuted if their home base operation was in Juneau.

16 SECURITY

It appears there are some local attitudes that the facilities on Admiralty Island are available for public use. KGCMC has had several instances of local hunters using the "A" Road and stating they had "rights" to use any mining facilities. Because of this, the Company will begin talking to the appropriate agencies to prevent these types of occurrences.

17 STATE HISTORICAL CULTURAL SITE

During the development of Greens Creek Mine, cultural sites were discovered. Those sites were examined by qualified people, as they were discovered, to determine the extent of their specific cultural significance. Those sites which were determined to be "culturally significant" were mapped identified to the State Historic Preservation Office (SHPO). Sites identified as having enough cultural value to warrant listing on the State Historic Preservations National Registry will be inspected on a monthly basis to assure they are not disturbed. The sites are not identified here, however, anyone wishing to know their location can contact the U.S. Forest Service.

18 ANNUAL WORK PLAN

Annually, the Company submits to the USFS and ADEC a proposed Work Plan for the following year. This Plan is reviewed to determine if NEPA documents need to be developed. The Plan also acts as a "pre-notification" to the various agencies of work which will require new or amended permits.

Annual Work Plans are filed at the mine site and are a dynamic document which requires updating on a consistent basis.

The Annual Work Plan will be prepared by the Company for each calendar year and submitted to the Forest Service for their review and approval. The Forest Service will coordinate with other State and Federal agencies who have an interest in the project. This will be an informational review, and not a State Consistency review, and will be coordinated by the USFS and the Division of Governmental Coordination (DGC). The Annual Work Plan will outline proposed activities for a specific year. The purpose of the plan is to provide an information exchange between the Company and the agencies. Information provided in the plan will be relatively general in nature; more specific information will be provided for each individual project. This latter information may be in the form of a formal permit application or construction plans. Each of the Annual Work Plans will be consistent with the overall General Plan of Operations.

If projects or activities proposed in the Annual Work Plan are outside of the scope of the EIS or subsequent NEPA documents, General Plan of Operations, or existing permits, those projects or activities will undergo additional reviews such as NEPA analysis and Alaska Coastal Zone Management Consistency review, depending on the circumstances.

19 REFERENCES

Steffen Robertson & Kirsten, Inc. 1992. Geotechnical Investigations at Potential Waste Rock Sites Kennecott Greens Creek Mine.

USFS. 1983. Final Environmental Impact Statement, Greens Creek Mine, Admiralty Island, Alaska.

USFS. 1988. Environmental Assessment of Proposed Changes to the General Plan of Operations for the Development and Operation of the Greens Creek Mine, Admiralty Island, Alaska.

USFS. 1993. Environmental Assessment for Improvements to Greens Creek Mine Telecommunications System, Admiralty Island National Monument, Alaska.